TECHNOLOGY in TIMES of TRANSITION

41st ICOHTEC Symposium, 2014
Brasov, Romania
EDITURA UNIVERSITĂȚII TRANSILVANIA DIN BRAȘOV

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Editură acreditată de CNCSIS
Adresa nr.1615 din 29 mai 2002

Editori: Elena Helerea, Marina Cionca, Mircea Ivănoiu
Traducători: Luminița Husac, Monica Cotfas, Viviana Moldovan, Virgil Borcan
Copertă: Antónia Czika, Biborka Bartha
Tehnoredactare: Roxana Ciobanu

Descrierea CIP a Bibliotecii Naționale a României
ICOHTEC. Simpozion internațional (41 ; 2014 ; Brașov)
Technology in times of transition : the 41st ICOHTEC
Symposium, 2014 : Brașov, România / coord.: Elena Helerea,
Marina Cionca, Mircea Ivănoiu. - Brașov : Editura
Universității "Transilvania", 2014
I. Helerea, Elena (coord.)
II. Cionca, Marina (coord.)
III. Ivănoiu, Mircea (coord.)
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FOREWORD

The organisers of the 41st ICOHTEC Symposium which takes place in Brasov, Romania, between July 29 and August 3, wish to offer the participants the opportunity to see their full-text papers published in a printed volume. The scientific contributions that the reader is going to find in this volume with the title „Technology in Times of Transition” represent a substantial part of the papers presented at the ICOHTEC Symposium, papers of a high scientific level that have been safely uploaded with respect to the template and deadline specified on the Symposium website. The editors have received 52 papers in English and French that were grouped in five thematic chapters and prepared for publishing.

The volume opens with the French version of the traditional Kranzberg Lecture, presented this year by the distinguished professor Alexandre Herlea, a member of ICOHTEC since many years, former president of this prestigious international scientific association. The presentation of Professor Herlea makes a concise analyse of the relation between technical development and European integration along several historic ages, it highlights the de facto unity of Europe at the level of technical and technological development, the fractures of the good functioning of communication during the ideologised political regimes, the ancient origin and persistence of the idea of European unity. At the end of his presentation the author remarks the necessity to introduce morals in personal and collective gestures, in historic analyses and in the education of the creators of material goods, in order to reduce risks and avoid multiple mutilating social side-slips, as well as to consolidate human solidarity.

The authors’ group is absolutely international: Finland, Germany, Russia, Poland, Bulgaria, Hungary, Italy, Romania, France, Ukraine, Portugal, Austria, USA, Croatia...

The five thematic chapters that give structure to the book are:

**The social, political and economic medium as framework of the technical evolution**
This chapter contains scientific contributions regarding the impact of the political atmosphere and social events of the past century upon the European technology, the impact of the East-West relations, oral history, problems of technology transfer, etc.

**Built human environment**
Contains papers regarding architecture, historical buildings with innovative solutions, the experience of fast urbanisation and industrialisation, the social impact of built solutions in dwellings and workplaces.

**Materials, Energy and Engineering**
The majority of the scientific contributions deals with a review of the general and local evolution of informatics, telecommunication, electrical and magnetical applications under the conditions of WWII, postwar development of medical electrical instruments, etc.

**Personalities of science, education and culture**
These papers present portraits of personalities of a certain notoriety, either of world-wide or local prestige, problems of the specific professional and technical education, of technical and scientific documentation as well as the impact of technical novelties on art. Part of the papers presented in this volume shaped a starting point in the Round Table discussions focussing on the theme of
technical education, on the field of the history of technology, on the idea exchange at academic level and on the personalities involved in this domain.

The readers will realise that in fact this is a bilingual volume, meaning that there are papers written in both English and French. This is explained by the fact that this opportunity was used to bring back French as an official language of ICOHTEC here in Romania, a country whose educational background is traditionally French. We highlight once more the role of Professor Herlea in introducing French for a group of participants and in creating French sections in the Brasov 2014 Symposium. Simultaneously this approach was morally and materially supported by the Agence Universitaire de la Francophonie (AUF) which made possible the participation of several French speaking researchers, whose papers you can read in the next pages.

The editors wish to thank all those who had a contribution at the publishing of this volume (for the lay-out, cover, sponsoring, language check, translations...). They also thank the publishing house that worked under pressure for printing the book in time. Special thanks are dedicated to Professor Timo Myllyntaus, Professor Sławomir Łotysz and Professor Alexandre Herlea, who all along the Symposium organisational and editorial work had the best interventions and the most appreciated suggestions. Last but not least the editors wish to highlight the decisive role of the material support given to the 41st ICOHTEC Symposium and implicitly to the material achievement of this volume: The Brasov County Council, the AUF (Agence Universitaire de la Francophonie), ANCS (The National Authority for Research at the Ministry of Education, Bucharest). To all of them we owe a debt of gratitude for the sensibility with which they recognised, reacted to and supported this significant event.

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Kranzberg Lecture

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Abstract — This conference about the History of Technology and the European unity opens the ICOHTEC symposium, whose general theme is: “Technology in Transition Periods.” It sets into parallel lines the birth and the evolution, in Europe, of a discipline—the History of Technology—and that of an idea which leads to the construction of the European Union. This presentation is chronologically divided in five parts: the Middle Age; the Renaissance period; the 18th century and the first half of the 19th century; from the middle of the 19th century to the Second World War; after the Second World War until the Treaty for the EU in 1992. It shows the dependence of the History of Technology and of the idea of European unity on human thought, on cultural and spiritual contexts. At the same time highlights a wide range of chronological similarities, of a similar rhythm of evolution, maturation, and implementation. In the Middles Ages, Europe was united by the Christian faith and monasteries played an important role in the preservation of technological memory. During the Renaissance period, the first projects dealing with the European political unification appear at the same time as the first technical publications: the “Theatrum Machinarum”. In the second half of the nineteenth century, a debate emerges on the legal form of a united Europe and the evolution of technology ceases to be solely regarded as a genealogy of technology and is integrated in economic, social, historical analyses. Between the two world wars, Aristide Briand’s project for a federal Europe, in which the syntagma “European Union” is used for the first time, and Lucien Febvre’s manifesto for the creation of a new branch of history, the History of Technology, were both launched. After the Second World War, the idea of European unity came to be implemented, the European Union to be established, and the History of Technology to reach maturity and to be fully recognized as an academic discipline.

Today the EU is integrating into its plans (see the Lisbon and Europe 2000 strategies) the evolution of techno-science, and History of Technology is expected to play its role at the technological assessment and technological forecasting levels. In a rapid changing world burdened by crises, morality must dominate efficiency.

Keywords — idea of European unity, history of technology, economic social historical analyses, technological memory, chronological similarities
1. INTRODUCTION

C’est un honneur et un grand privilège de présenter la Kranzberg Lecture, qui ouvre depuis 17 ans les symposia de l’ICOHTEC (the International Committee for the History of Technology).


Il y a 40 ans disparaissait Maurice Daumas, mon professeur et maître en histoire des techniques ; je dédie cette conférence à sa mémoire.


La technique et son histoire, tout comme l’idée d’unité de l’Europe et sa mise en œuvre, font partie intégrante de la même culture et civilisation. Ces dernières se sont développées à partir de deux racines : le naturalisme et le rationalisme grec d’un coté et la spiritualité judéo-chrétienne de l’autre. C’est en Grèce qu’apparaît l’histoire définie comme enquête portant sur le passé et c’est le christianisme qui fait de l’homme, doté par Dieu de la liberté, un être responsable qui peut et doit agir.

2. LE MOYEN AGE

L’idée de l’existence d’une Europe fondée sur la Chrétienté et la possibilité de la réalisation de son unité politique apparait déjà au Moyen-âge. Elle est partiellement réalisée par Charlemagne dont les frontières de l’empire sont aussi celle de l’Eglise romaine. Au cours des siècles suivants, l’Europe garde une unité culturelle due à la religion et à la langue latine. Le réseau des monastères cisterciens (l’un d’eux se trouve dans le village de Carta, à 80 km de Brasov) jouent un rôle de
A. HERLEA: Kranzberg Lecture

premier plan. Au niveau de la technique, ils sont des endroits d’innovation, d’accélération du changement technique, considéré par certains comme une vraie révolution technique au Moyen Âge. L’Huges de Saint Victor, le grand scolastique du 12ème siècle, écrit que : « la raison humaine brille par l’invention de toutes les choses qu’elle fait ». Mais celles-ci sont pour la technique également l’endroit de préservation du savoir et la conservation de la mémoire technique dans les monastères européens constitue une forme primaire d’histoire des techniques. C’est la religion et ses institutions qui assurent, au Moyen Âge, à l’Europe une certaine unité et à la mémoire technique son existence.

3. LA RENAISSANCE

Au 15ème siècle, la Réforme et l’apparition d’Etats structurés mettent un terme au rêve d’une Europe unie par la religion. Mais l’unité culturelle de l’Europe perdure grâce aux intellectuels qui gardent et développent des contacts soutenus et se déplacent souvent d’un pays à l’autre. Tel est le cas de l’évêque Johannes Honterus (1498–1549) de Brasov qui a introduit la Réforme et l’imprimerie en Transylvanie (1535), après avoir séjourné à Bâle, où il a dû côtoyer Erasme et qui est l’auteur de « Rudimenta Cosmografica » publié, à partir de 1542, en 39 éditions dans plusieurs grandes villes d’Europe. Ou le cas du cardinal Nicolaus Olahus (1493-1568), le premier humaniste d’origine roumaine, né à Sibiu, qui séjourne beaucoup aux Pays Bas, est primat de Hongrie et entretient une correspondance soutenue avec plusieurs érudits de son temps, dont Erasme de Rotterdam.


L’époque de la Renaissance est aussi celle du retour à la vision naturaliste-rationaliste des grecs qui renait de ses cendres. Ceci entraîne la séparation entre la Philosophie et la Théologie pour qu’ensuite la Science se sépare de la Philosophie. C’est la naissance, à la fin du 16ème siècle de la science dite galiléenne, appelée ainsi d’après le nom de l’un de ses pionniers, Galileo Galilée. Elle se définit comme connaissance par concept, donc structurée logiquement et validée soit par des procédures expérimentales soit par des procédures formelles (mathématiques). C’est Francis Bacon qui précise les règles de la méthode expérimentale dans son « Novum Organum », publié en 1624 et attire l’attention sur l’application technique du savoir. A partir de cette date de nouveaux courants de pensée apparaissent (mécanisme, empirisme, positivisme) et de nouveaux rapports commencent
à s’établir entre science et techniques. Le grand Leonardo da Vinci les avait prévus et affirma : « Je cherche la lumière de la science et ses bienfaits ».

Tout ceci est lié à de profonds bouleversements au niveau des valeurs. L’utile devient critère de vrai et l’expérimentation permet de l’atteindre. La science qui recherche la vérité s’accommode de la technique qui est une ruse (tekne en grec signifie ruser) et dont la principale valeur est l’efficacité. Celle-ci commence à écraser les autres notamment la morale et la déontologie. Un siècle auparavant Nicolas Machiavel avait déjà écrit son « Il Principe » où le pragmatisme et le cynisme de l’efficacité sont propulsés sur le devant de la scène. Heureusement l’éthique de l’Humanisme apparaît aussi.

Désormais, l’innovation sera aussi provoquée par les opportunités créées par le progrès de la science et pour les promouvoir, on envisage la création d’établissements spécifiques. C’est Francis Bacon qui décrit dans son pays idéal « The New Atlantis » les maisons de Salomon, où habitent et travaillent les scientifiques et un peu plus tard, en 1648, René Descartes plaide, en France, pour la mise en place de vastes salles d’expositions où seront présentés des objets et procédés techniques. À la même époque, apparaissent en Angleterre (1660) et en France (1666) les Académies des sciences et les systèmes de brevets. L’obtention d’un brevet exige désormais une nouveauté, donc une recherche d’antériorité qui se rapporte à l’histoire des techniques. En Angleterre, le premier système juridique de brevets (« le statut des monopoles ») date de 1623 et en France, on octroie, en 1699, à l’Académie des Sciences le rôle d’examiner les nouveautés techniques.

Le 15ème siècle est aussi celui de la réalisation d’une invention technique d’une portée sans précédent : l’imprimerie qui donnera naissance à ce qu’on appelle « la galaxie Gutenberg ». Elle permettra au siècle suivant l’apparition des premiers ouvrages imprimés consacrés à la technique : les célèbres « Theatrum Machinarum ». Ces livres succèdent aux « carnets d’ingénieurs » qui rassemblent des informations sur différents métiers, voire professions ; les carnets de Léonard de Vinci en sont un exemple bien connu. Parmi les théâtres de machines, je mentionne « De Re Metalica » de Georgius Agricola publié en 1556 et le « Theatrum Machinarum » de Jacob Leopold, 9 volumes publiés à Leipzig entre 1724 et 34, dernier ouvrage paru sous ce nom.

4. LE 18ÈME SIECLE ET LA PREMIERE MOITIE DU 19ÈME SIECLE

Au 18ème siècle, à l’époque des lumières, l’idée d’Europe va continuer de se trouver dans l’attention des grands intellectuels, d’être analysée et débattue par eux. Tel est le cas de Jean Jacques Rousseau qui plaide pour l’existence d’une société européenne fondée sur une opinion publique consciente d’avoir une histoire commune, de partager les mêmes valeurs et donc d’appartenir à une communauté culturelle. L’un des projets les plus connus de cette époque est celui de l’abbé de Saint-Pierre, de 1713 intitulé : « Projet pour rendre la paix perpétuelle en Europe » et son abrégé de 1728. Il prévoit une alliance entre des souverains soumis aux décisions d’un « Sénat Européen » dotés de pouvoirs législatifs et judiciaires.
Dans la première moitié du 19ème siècle, l’essor de l’idée d’union européenne continue son chemin. Napoléon la tente par la conquête, qui donnera naissance à une réaction vive : La Sainte Alliance de 1815 entre l’Autriche, la Russie et la Prusse et la politique des congrès qui lui a succédé sous l’œil attentif de Klemens von Metternich.


La mémoire technique commence à être sauvegardée aussi à travers les objets. Une première collection de machines est constituée à l’Académie des Sciences peu d’années après sa création ; elle est présentée à la première exposition d’objets techniques organisée au Louvre en 1699. Le pouvoir politique accorde d’ailleurs une grande attention au développement technique. Jean-Baptiste Colbert, ministre de Louis XIV, l’érige en politique nationale et lance un appel aux scientifiques pour contribuer à son développement. Des collections d’objets techniques, les cabinets, vont se créer, au 18ème siècle, dans les grands pays d’Europe. Il s’agit parfois des modèles réduits de machines dont une première collection significative est réalisée par l’ingénieur suédois des mines Christopher Polhem au début du siècle.

Apparaîtront également des établissements spécifiquement dédiés à la technique, dont le but n’est pas seulement l’amélioration des techniques existantes mais aussi la conservation de la mémoire technique. C’est le cas de l’Hôtel de Mortagne créé, à Paris en 1750, par Jacques
Vaucanson, le célèbre inventeur français, inspecteur des manufactures royales. Cet établissement se trouve à l’origine du Conservatoire des Arts et Métiers qui date de 1794 et qui, comme lui, doit remplir trois tâches : le perfectionnement des machines, l’enseignement de leur utilisation et leur conservation.


Au début du 19ème siècle la technique, en particulier les machines et la mécanique, bénéficie d’une attention particulière, souvent en rapport avec la législation et les offices des brevets. Ils se créent sur l’exemple anglais et français dans la plupart des pays européens : en Prusse (1815), au Pays-Bas (1817), dans l’Empire autrichien (1820), en Suède (1834), au Portugal (1837). La majorité des législations prévoit l’examen préalable d’antériorité, lié à l’Histoire des Techniques.

5. DE LA DEUXIEME MOITIE DU 19EME SIECLE A LA DEUXIEME GUERRE MONDIALE


d’être promue par quelques intellectuels, les opinions publiques s’en éloignent, proies d’un nationalism romanesque.


Depuis la seconde moitié du 19ème siècle jusqu’à la Deuxième Guerre Mondiale, la route vers l’établissement, en Europe, d’une nouvelle discipline : l’histoire des techniques est moins accidentée que celle de l’idée d’Europe unie. C’est l’époque où elle s’affirme de plus en plus clairement et se manifeste dans plusieurs cadres.


Mais une véritable percée vers la création d’une histoire des techniques, tel qu’elle est définie aujourd’hui, se produit avec la prise en compte de la technique et de son évolution dans les analyses historiques, économiques, sociologiques, politiques, philosophiques. La technique est ainsi intégrée dans l’histoire. L’histoire des techniques nous le rappelle bien. Cette dernière n’est autre chose que l’histoire tout court, enchaînée par le monde matériel, formule utilisée par Bertrand Gilles un des pères fondateurs de la discipline en France.

Les grandes synthèses philosophiques du 19ème siècle basées sur l’histoire de la Raison (Hegel, Marx, Comte) concernent et marquent de leur sceau aussi l’histoire des techniques. Les places occupées et les rôles joués par le positivisme et le marxisme pour l’évolution de celle-ci ont été déterminants.


C’est un des élèves d’Auguste Comte: le sociologue Alfred Victor Espinas qui publie à Paris en 1897 le livre « Les origines de la Technologie » dans lequel il insiste sur le rôle de l’histoire des techniques dans l’analyse historique et sociologique.


Ces deux approches sont promues dans le cadre des sociétés savantes qui voient le jour dans plusieurs pays d’Europe. En Allemagne en 1901 est créée la « Gesellschaft für Geschichte des Medizine, Naturwissenschaft und Technick » (Société pour l’histoire de la Médecine, sciences naturelles et technique) suivie en 1926 de la « Georg Agricola Gesellschaft », société d’histoire des sciences et des techniques et en 1930 la société des ingénieurs allemands, la VDI, établit dans son cadre, une section spécialement dédiée à l’histoire des techniques. Entre temps en Angleterre a vu le jour, en 1920, la plus ancienne société qui s’intéresse uniquement à l’histoire des techniques, la « Newcomen Society »

Si en Allemagne ceux qui s’intéressent à l’histoire des techniques sont souvent des ingénieurs, en France ce sont plutôt les historiens et sociologues regroupés autour de la revue « Annales d’histoire économique et sociale » créée par Marcel Bloch et Lucien Febvre à Paris en 1929. L’Ecole des Annales, orientée politiquement à gauche, milite pour une histoire engagée dans le présent, d’où son intérêt pour l’histoire des techniques.

C’est dans un numéro spécial de la revue de l’Ecole des Annales que Lucien Febvre lance, en 1935, un manifeste pour la création d’une nouvelle branche de l’histoire – l’histoire des techniques. Il considère qu’il y a trois étapes qui doivent être franchies pour cela : l’élaboration d’une histoire technique des techniques, œuvre des ingénieurs qui ont les connaissances nécessaires pour rentrer dans la boîte noire de la technique ; une histoire des relations science-technique qui doit être, également et pour les mêmes raisons, l’œuvre des ingénieurs et des scientifiques et enfin l’intégration de ces deux histoires dans une histoire globale dans laquelle l’histoire économique, l’histoire sociale, l’histoire politique doivent être présentes.

Dans les années 1930, la création en Europe d’une histoire des techniques est stimulée aussi par son développement aux États-Unis. Le livre de Lewis Mumford « Technics and Civilizations », paru en 1932, connaît un grand succès sur le vieux continent. Il met en avant deux techniques dominantes : l’énergie et les matériaux en fonction desquels un découpage de l’histoire en trois périodes (eo, paleo et neo technique) est proposé. Il s’agit de la mise en place d’une nouvelle périodisation en fonction des techniques qui sera développée après la Guerre.

Les philosophes de la première moitié du 20ème siècle sont eux aussi, comme leurs homologues des siècles précédents, concernés par la technique et son évolution. L’allemand Oswald Spengler publie en 1931 « Der Mensch und die Technik » (L’homme et la technique) livre dans lequel la technique, vue comme expression de la volonté faustienne de puissance propre à la culture occidentale, est suivie dans son évolution. Dans le stade du développement dans lequel elle est arrivée, elle transforme l’homme en esclave de la machine et est cause du désastre écologique.

6. APRES LA DEUXIEME GUERRE MONDIALE, JUSQU’AU TRAITE SUR L’UNION EUROPEENNE (1992)
C’est dans le climat de guerre froide qui s’installe immédiatement après la Deuxième Guerre Mondiale, que l’idée d’unité européenne cesse d’être une affaire d’intellectuels ou de quelques rares


Jusqu’au traité de Maastricht qui marque l’aboutissement d’une évolution et en même temps le début d’une nouvelle phase de progrès de la construction européenne, quelques grandes dates jalonnent celle-ci, telles: Le Traité de Rome (1957) qui donne naissance à la CEE (Communauté Economique Européenne) et à l’Euratom (CEEA - Communauté Européenne de l’Energie Atomique); le Traité de fusion des trois exécutifs : CECA, CEE, CEEA (1965); l’entrée en vigueur de l’union douanière et du tarif extérieur commun (1968); le sommet de La Haye qui accepte le premier élargissement (1969); la première élection du Parlement européen au suffrage universel (1979); l’Acte unique européen (1985) qui établit les objectifs du marché unique et codifie la coopération politique européenne.

Pendant les deux premières décennies, l’accent a été mis sur l’approfondissement de la construction européenne et à partir de la fin des années 1960 l’élargissement de celle-ci sera son autre facette. Après la chute du mur de Berlin, la perspective de l’élargissement à l’Est a été à l’origine d’un large débat sur la définition de l’UE et de ses frontières qui a statué que : a la vocation d’être membre de l’UE tout Etat qui appartient géographiquement à l’Europe et dont les politiques et actions sont fondées sur les valeurs sur lesquelles l’Europe s’est engagée, évoquées plus haut.

Mais je ne vais pas m’arrêter sur l’histoire de la construction européenne qui a fait couler tellement d’encre, je vais consacrer le temps qui me reste à l’histoire des techniques en Europe après la Deuxième Guerre Mondiale quand elle s’affirme académiquement.

Le nouveau statut que l’histoire des techniques acquiert en Europe est du aux universitaires et chercheurs européens et à la collaboration avec leurs collègues des États-Unis. Ces derniers jouent désormais un rôle majeur dans le développement de la discipline. Ils se trouvent sur la première ligne du progrès dans le domaine, comme le prouvent le périodique “Technology and Culture” et la société américaine d’histoire des techniques, American Society for History of Technology – SHOT.


Mentionnons aussi le fort développement de la muséologie technique, après la Deuxième Guerre Mondiale. Un nombre relativement important de musées des techniques spécialisés dans diverses branches des techniques (automobile, aviation, mines, etc.), se créent, à côté des grands musées existants, dans les pays d’Europe occidentale. Des écomusées, sur le modèle de ceux développés aux Etats-Unis, voient également le jour à partir des années 1970. Tout ceci dans le cadre d’une action pour la promotion de la culture scientifique et technique.

Les problèmes débattus après la Deuxième Guerre Mondiale concernent :

- la définition, l’identité de l’histoire des techniques, notamment histoire interne (histoire technique des techniques) ou externe (histoire sociale, politique, économique des techniques).
- les aspects conceptuels : système technique (complexe, modèle), changement technique (rupture ou continuité, révolution industrielle), périodisation en histoire des techniques, méthodologie (structuralisme),
- les relations de la technique au cours de l’histoire avec les sciences, l’économie, la société, la politique (la guerre), l’environnement, la philosophie, les croyances et les idéologies,
l'histoire des techniques dans la culture, la recherche, l'enseignement et son organisation institutionnelle.

Je m'arrête très brièvement seulement sur quelques aspects des problèmes mentionnés. Je donne la priorité aux aspects qui ont trait à l’identité de la discipline.

Le débat histoire externe - histoire interne des techniques a reçu, jusqu'à la chute du mur de Berlin, des réponses très différentes en Europe de l'Ouest et en celle de l'Est. Dans les pays d'Europe occidentale la question histoire externe - histoire interne des techniques ne se pose plus, après Guerre, en termes de l'une ou l'autre, à l'unanimité on considère désormais qu'il s'agit de l'une et de l'autre, étroitement imbriquées. La question qui perdure porte sur la profondeur à laquelle la boîte noire de la technique doit être explorée quand on étudie son histoire. La réponse est d’adapter l’analyse de la boîte noire aux besoins de l’histoire à étudier. Dans les pays d’Europe de l’Est c’est une histoire interne qui a apporté souvent une contribution importante au développement de la discipline, mais elle était sectaire, sortie du contexte. Certains vestiges sont encore là. C’est le cas de la Roumanie où l’histoire des techniques ne fait pas partie de la liste des disciplines dans lesquelles on peut s’inscrire en thèse. Les travaux sont toujours considérés comme appartenant aux différents domaines d’ingénierie ou des sciences durées dont ils étudient l’histoire et dans le cadre desquels ils doivent être soutenus. Ceci pénalise gravement le développement de l’histoire des techniques en Roumanie.

Remarquons aussi que l’histoire des techniques est mieux implantée dans les pays de culture anglo-saxonne que dans ceux de culture latine. Ceci s’explique par le fait que dans ces derniers pays la technique a été et continue d’être considérée moins prestigieuse et intellectuellement valorisante que les lettres ou les sciences. C’est en l’Allemagne et en Angleterre que la discipline jouit de la meilleure place et cela depuis le 19ème siècle. Au début des années 90 en Allemagne il y a environ 20 chaires dans les universités. Une synthèse sur l’état de l’enseignement de l’histoire des sciences et des techniques a été publiée suite à la conférence « History of Science and Technology in Education and Training in Europe » qui a eu lieu à Strasbourg en 1998, sponsorisée par la Commission Européenne.

En ce qui concerne la conceptualisation et la méthodologie, on note l’utilisation du structuralisme, théorie qui statue que les éléments (les structures) n’ont aucune existence séparée et ne prennent sens que dans leurs relations aux autres éléments existants dans le cadre d’un système. Très en vogue en économie, au début des années 1970, Bertrand Gille propose son utilisation en histoire des techniques. Il affirme que le structuralisme « est le seul moyen que la science ait trouvé jusqu’ici pour jeter un pont entre les deux ordres de recherches, trop souvent séparés : la recherche historique et l’analyse théorique ». C’est une contribution importante de l’historiographie européenne des techniques au développement de la discipline. La notion de système technique,
défini comme l’ensemble des structures, simples et complexes, et des filières techniques, cohérentes et compatibles les unes avec les autres est une notion centrale en histoire des techniques.

Cette notion mène aussi à celle de périodisation en histoire. Le découpage classique est souvent gardé et on décrit et analyse alors le système technique de l’une ou l’autre des périodes, solution choisie par Bertrand Gilles et la plupart des historiens des techniques en Europe. Mais la définition d’une nouvelle périodisation qui tient compte des techniques, notamment des techniques dominantes, est également promue. Le choix des techniques dominantes varie, pourtant l’énergie, les matériaux, l’information et les relations avec le vivant sont celles généralement utilisées.

Maurice Daumas met en évidence, tout au long de l’histoire, cinq systèmes techniques, complexes techniques, comme il les appelle et met l’accent sur les interdépendances, les cohérences qui existent entre les structures et filières qui forment le système technique à la recherche incessante d’équilibre. Il considère que le changement technique se produit sans ruptures (révolutions) et son accélération tout au long de l’histoire, s’effectue suivant une courbe qui après le Néolithique, n’a connu qu’un seul point d’inflexion au moment de la Révolution Industrielle. Ce point de vue est contesté par un grand nombre d’historiens (surtout historiens de l’économie mais aussi historiens des techniques) qui considèrent qu’il y a plusieurs points d’inflexion, sinon de rupture, tel celui de la fin du 19ème siècle et celui que nous vivons aujourd’hui lié aux technologies de l’information.

L’évolution, tout au long de l’histoire, des relations entre les techniques et les sciences, l’économie, la société, la politique et les guerres, l’environnement, la philosophie, les croyances et les idéologies, est abordée ou reçoit de nouveaux éclairages après la Deuxième Guerre Mondiale. Ces champs d’investigation se trouvent élargis à un rythme de plus en plus accéléré compte tenu des changements que notre monde connaît. Je m’arrête très brièvement, à titre d’exemple, sur quelques-uns, en commençant par les relations des techniques avec les sciences et l’économie qui occupent des places privilégiées et qui ont connu des changements importants.

Ainsi l’histoire des relations science-technique, est revue. La technique n’est plus considérée, comme science appliquée. On met en évidence que jusqu’à la fin du 19ème siècle, à quelques exceptions près, la technique a précédé la science. Que même si à partir du début du 20ème siècle les deux sont intimement liées, si les techniques sont de plus en plus tributaires de la science et de l’esprit scientifique, elles sont loin d’être seulement science appliquée. Le domaine des relations science-technique s’enrichit et devient de plus en plus complexe au fur et à mesure que les nouvelles technologies apparaissent dans les divers domaines tel : l’information et la communication, l’énergie, les matériaux, les biotechnologies. Le suivi de la problématique est désormais plus difficile. Dans le dernier numéro de « ICON », périodique de l’ICOHTEC, est publiée une étude sur la contribution de notre association à ce débat.

Les relations entre technique et économie sont tout aussi riches et substantielles que celles entre science et technique et ont continué de bénéficier de la même place privilégiée qu’elles occupaient déjà depuis le milieu du 19ème siècle. L’étude du processus recherche - invention – innovation – développement, lie fortement l’histoire des techniques et l’histoire économique. L’économiste Joseph Schumpeter, l’auteur de « Business Cycles », publié à New York en 1939, y joue un rôle important, comme d’autres chercheurs américains, après Guerre. On met en évidence que
l’accélération du changement technique est fonction de l’accroissement des investissements. François Caron, professeur d’histoire économique à l’Université de Paris IV – Sorbonne, considère qu’il est impossible d’analyser séparément le système technique et le système économique et propose la notion de « modèle » qui regroupe dans un seul ensemble ces deux systèmes. Il souligne que le disfonctionnement technique est source d’innovation et que plusieurs concepts utilisés en histoire des techniques et en histoire économique sont convergents tel ceux de « goulot d’étranglement » et de « demande d’invention ». L’histoire économique joue un rôle de locomotive pour l’histoire des techniques, en prenant en quelque sorte la place que l’histoire sociale, l’histoire du travail, jouait dans la première moitié du 20ème siècle.

Après guerre, les recherches sur les relations technique – société se renforcent également. La technique est vue comme une construction sociale ; les choix la concernant sont orientés par des choix de société, façonnés eux-mêmes de plus en plus par les techniques. Les axes de recherches sont consistent et nombreux, surtout ceux concernant les relations technique société après la Seconde Guerre. Tel est le cas, du processus de rationalisation du travail qui entraîne la disparition des industries traditionnelles, la concentration des entreprises, le remplacement accéléré des techniques. A partir des années 1990, le passage de la société industrielle à la société d’information, société en réseaux, dans l’établissement de laquelle la technique a eu un rôle déterminant, forme un autre grand sujet, qui dépasse les limites chronologiques qu’on s’est fixées.

Entre technique et politique existe également et depuis toujours des liens étroits, notamment dans le domaine militaire, mais aussi dans celui du civil. La France qui depuis la fin du 17ème siècle, est le pays le plus centralisé d’Europe occidentale, en est un très bon exemple. Après la Deuxième Guerre, le rôle de l’État est capital quand il s’agit de la défense ou des grands projets de recherche. Les frontières entre le privé et le publique s’estompent face aux industries d’intérêt stratégique notamment l’énergie nucléaire ou l’informatique. La guerre qu’elle soit chaude ou froide a fortement contribué à l’accélération du changement technique. L’environnement et le réchauffement climatique commencent aujourd’hui à la concurrencer sur ce plan. Espérons que bientôt ils joueront le premier rôle, au niveau des politiques industrielles.

7. CONCLUSION

En guise de conclusion je souhaite rappeler, qu’aussi bien l’histoire des techniques que l’idée d’unité européenne a, à titre différent, des rapports avec les évolutions de notre monde qui se déroulent dans un rythme de plus en plus accéléré et compte tenu de la mondialisation, dans une interdépendance accrue. Le passage, ces dernières décennies, de la société industrielle à la société d’information en est un des aspects. Les crises que nous traversons, crises financières, économiques, énergétiques, d’environnement ne sont que le prélude et les composantes d’une crise de système avec une dimension morale importante.


L’histoire des techniques joue un rôle au niveau de l’évaluation et de la prévision technologique. Elle rappelle fort utilement que l’approche exploratoire utilisée dans la prospective ne peut pas être réduite à une simple extrapolation des tendances antérieures. Cette approche doit prendre en considération les multiples interactions qui existent entre diverses techniques à l’intérieur du système technique et entre celui-ci et tous les autres systèmes. Elle rappelle aussi que l’accélération continue du changement fait que celui-ci devient une variable essentielle de l’évolution technologique et qu’en conséquence il est difficile de savoir ce qui est cause et ce qui est effet.

Mais en dehors de son implication au niveau de la technologie et de l’économie l’UE doit veiller aussi au respect des valeurs, qu’elle affirme promouvoir (liberté, démocratie, justice, solidarité), au niveau politique et social. Ici aussi elle a enregistré des succès, mais aussi quelques échecs. Tel a été le cas pour certains aspects concernant l’intégration des pays PECO. La stratégie (les critères de Copenhague), arrêtée n’a eu en vue que l’efficacité, sans tenir compte suffisamment de l’histoire d’après la Deuxième Guerre Mondiale de ces pays. Ainsi dans plusieurs d’entre eux, le pouvoir réel est resté entre les mains de ceux qui le détenaient à l’époque communiste. Ceci, en dehors de l’aspect moral inacceptable, compte tenu du caractère criminel du communisme, est une cause principale de la corruption et du mauvais fonctionnement de certaines institutions, dont la justice.

Ainsi qu’il s’agisse des choix technologiques, économiques, financiers, sociaux, politiques, je suis convaincu, que la seule voie pour éviter ou dépasser l’impasse est celle du respect des valeurs ; c’est le retour aux fondamentaux qui s’impose. L’histoire par l’éclairage qu’elle jette sur le passé se trouve dans une position privilégiée et l’UE doit veiller à ce que toutes les valeurs qu’elle affirme défendre soient rigoureusement prises en compte. L’efficacité doit cesser de dominer la moralité.
BIBLIOGRAPHIE SOMMAIRE

I. THE SOCIAL, POLITICAL, ECONOMIC MEDIUM AS FRAMEWORK OF THE TECHNICAL EVOLUTION

TECHNOLOGY IN TIMES OF TRANSITION
THE 41ST ICOHTEC SYMPOSIUM, BRASOV, 2014
60 YEARS OF TECHNOLOGY TRANSFER

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Abstract — This paper describes the history of ICPE since its founding in 1950 until today in inorganic materials research for electrical industry. As important milestones in this evolution are presented creation and separation of ICPE of some research and production groups, of some materials whose technology was previously established in our laboratory, approved and with technology transfer in three major stages after their maturation: in the first two decades 1950-1970 after the establishment and then transfer of products during 1970-1990, and the last transfers made under conditions much changed between 1990-2010. Therefore, are analyzed and presented the results of five major areas of R&D on metallic pseudoalloys with imposed electrical properties, carbon materials (electrical brushes, resistances, composites), structural and functional ceramic materials, magnetic and superconducting materials. The paper presents also the conditions for technology transfer and economic effects of last transfers to Electromagnetica Bucharest, Elba Timisoara, Electroaparat Bucharest, IPRS Baneasa, Electroceramica Turda, trading companies from Odorheiu Secuiesc and not the last part, the establishment of a new plant for carbon materials - especially brushes for electric cars - to Ferite Urzici, which after the transfer, became Rofep. A special chapter is dedicated to technology transfer of electrical contacts and permanent magnets, sintered and bounded, to Sinterom Cluj-Napoca with the establishment here of specialized production departments. It must to mentioned that all these technologic transfers were performed outside ICPE and those direct from the research team to pilot stations, are not considered in this paper. Those who are going through this paper will be little surprised when will finds that technology transfers which are presented, are not only for electrical engineering products, but for all branches of economy, starting from agriculture and ended with the equipment for aviation.

Keywords — electrical industry, technology transfer, materials, electrical engineering products

1. INTRODUCTION

Starting from a real need for electrification of the country, in 1950, within the Ministry of the Economy were established the Electrical Engineering Research Institute. The new institute has brought an important contribution to solving technical problems, particularly difficult for the period in question, at the same time has been leading the way in research in Romania, both in their creative fields and in related sectors.

In 1950 was founded the Research Institute for Electrical Engineering by HCM 868/1950 and in 1954 it was changed in the Institute for Research and Design for Electrical Engineering (ICPE) according to the HCM 357/1954.
The year 1956 marks the transfer of the technology for Se rectifier plates from ICPE to Electromagnetica Bucharest. In 1957 the Department for Designing Electrical Engineering Factories spin out from ICPE and was transformed in to the Institute of Technology for Machine Construction (ITCM). The detachment of the ICPE’s Automation Department takes place in 1963 and as a result a new institute is born, the Design Institute for Automation, Bucharest (IPA).

In 1963, is transferred from the ICPE to IPRS Baneasa, the semiconductor group, which subsequently will develop the Research Institute for Electronic Components (ICCE). In the same year, by splitting the Department for Design Investments in the field of Electrical Engineering from ICPE, it will be created the Electrouzinproject Enterprise.

ICPE release in 1966 the Departments of Electronic Measurement Devices and Department for Non-electric Measuring Devices thus creating, Electronic Research Institute (ICE) and in 1974 by the Decision 259/1974 ICPE enters in the category of large institutes.

After 1990, in 1992 start splitting from ICPE of some commercial companies, for this year they are a total of 8 independent companies. In 2001, emerges from ICPE our Institute as ICPE-Advanced Research (ICPE-CA) which in 2004 is turned into National Institute for Research and Development in Electrical Engineering – Advanced Research (INCDIE ICPE-CA).

2. RESEARCHED AND PRODUCED MATERIALS

Among the many achievements of researchers of our Institute, we have selected the most representative scientific and technical achievements on decennial periods, which we present below:

- **1950-1960**: technology to achieve sintered magnets, barium ferrite, single silicon crystals and developing the first Si single crystal (Fig. 1) diodes for current intensities of up to 200 A (Fig. 2), ceramic capacitors, ceramic insulators, silicon tempered glass insulating material and materials used;

![Fig. 1. Si single crystal](image1)
![Fig. 2. Silicon diode for 200A](image2)

- **1961-1970**: silicon rectifier diodes 8-25-50-200 A (Fig. 2), new types of sintered contacts with tungsten, magneto-strictive materials, AlNiCo and MnAl magnets, technology for vacuum deposition of Silicon monoxide on reflectors, Ag-CdO contacts, magnetic ring cores as memory elements for digital computing (Fig. 3), piezoceramic materials (Fig. 4);

![Fig. 3. Hard and soft ferrites](image3)
![Fig. 4. Piezoceramics](image4)

- **1961-1970**: silicon rectifier diodes 8-25-50-200 A (Fig. 2), new types of sintered contacts with tungsten, magneto-strictive materials, AlNiCo and MnAl magnets, technology for vacuum deposition of Silicon monoxide on reflectors, Ag-CdO contacts, magnetic ring cores as memory elements for digital computing (Fig. 3), piezoceramic materials (Fig. 4);

![Fig. 5. Fe-Co precipitates in an high energy Alnico PM(x30k)](image5)
![Fig. 6. AgNi electrical contacts](image6)
- *1971-1980*: high-energy Alnico permanent magnets (PM) (Fig. 5), different contact materials (Fig. 6), functional ceramic based on stabilised ZrO₂ (Fig. 7), carbonic materials for electrical brushes (Fig. 8);

- *1981-1992*: eddy current brakes, magnetic materials, control technologies in the field of metal contact materials, magnetic defectoscopy, rare earth-transition metal PM (Fig. 9), magnetic and carbonic materials for defense industry.

- After 1992 our policy was changed: we try to include our materials as components in finished products, which are sold directly to the customers.

All developed products and technologies were transferred to existing or new established factories or in our own pilot plants and here produced for Romanian and foreign customers.

### 2.1. Carbon Materials

The first carbon materials developed by our institute were carbon-based electric brushes. Metal-graphite type brushes are heavy or very heavy brushes with very low friction and low voltage drop at brush-collector contact. With good electrical conductivity these support the operation at high current density. These dominant characteristics make them suitable for use in slow rotating d.c. motors, with low or very low voltage, for electrical sliding contacts on brass or steel rings from low and medium speed synchronous motors, as well as for car starters and alternators.

Copper-graphite electrical brushes, MGR-type, show an apparent density in the range of \((2.4 \pm 7.2)\) g/cm³, Rockwell hardnesses (HRB10/60) in the range of \((45 \pm 120)\) and an electrical resistivity ranging from 0.035 to 13 \(\mu\Omega\)m.

Silver-graphite electrical brushes, AGR-type, show an apparent density in the range of \((2.3 \pm 3.8)\) g/cm³, Rockwell hardnesses (HRB10/60) in the range of \((60 \pm 110)\) and an electrical resistivity of max. 8 \(\mu\Omega\)m. Nominal current density for both electric brushes ranges from 11.5 to 20 A/cm². Hard carbon electrical brushes are appropriate for universal car collectors and distributors of electrical ignition in automobiles. The main technical characteristics of hard carbon materials indicate an apparent density of 1.55 up to 1.72 g/cm³, Rockwell hardnesses (HRB10/60) in the range of \((80 \pm 130)\) and an electrical resistivity in the range of \((25 \pm 400)\) \(\mu\Omega\)m. Operating characteristics by conventional shorted collector shows current density of \((6 \pm 8)\) A/cm². Electrographite electrical brushes are fitted in all modern electrical machines, stationary devices or traction, having low, medium or high voltage in constant or variable load and characterized by an operating mode with little losses. The main technical characteristics of electrographitic materials are: bulk density in the range of \((1.50 \pm 1.80)\) g/cm³, Rockwell Hardnesses (HR10/60) in the range of \((60 \pm 130)\), the electrical resistivity the range of \((12 \pm 62)\) \(\mu\Omega\)m and a current density in the range of \((8 \div 12)\) A/cm².
2.2. METALLIC MATERIALS

Contact materials made of silver-metallic oxide, with a content of oxides of (2÷20) % wt are largely used in low and medium voltage devices. By including the metallic oxides in silver, the welding force and silver contacts burning can be diminished. Contact materials based on silver-cadmium oxide due to the total insolubility for the two components can be elaborated only by powder metallurgy.

Our institute has established a technology to obtain silver-cadmium oxide materials with a content of (6÷15) wt % CdO by chemical co-precipitation. The main physical, mechanical and electrical characteristic of silver-cadmium oxide contacts obtained by sintering from powders prepared in our institute: for Ag-CdO we have densities between 9.9 to 10.2 g/cm³, hardness HB 80 to 100 kgf/mm² and electrical resistivity of 2.0 to 2.2 Ω·cm.

Among the contact materials, the most frequently used is the Ag-Ni for low voltage electric equipment. The Ag – Ni pseudo-alloys have a constant and reduced contact resistance to the material transfer under direct current, whatever leads to their using as silver or silver alloys substitute with diminished resistance to wear. The main technical characteristics of the sintered Ag-Ni electrical contacts, for different technologies are (in the same sequence): 9.5 to 10.8 g/cm³, 78.5 to 110 HB and 2 to 3.75 Ω·cm.

The electrical contact with the simplest form is the solid rivet contact. Contact materials used in the manufacture of rivets current contacts are: fine silver, alloys Ag-Cu, Ag-Mn, Ag-Cd and Ag-C composite material, Ag-Ni.

The electrical contacts in the form of rivets are used in automotive and traction electrical equipment and in switchgears for telecommunication, Table 1.

<table>
<thead>
<tr>
<th>Type</th>
<th>Ag Content wt %</th>
<th>Density g/cm³</th>
<th>Electrical resistivity 10⁻⁶ Ωcm</th>
<th>Microhardness HV</th>
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<td>1.62</td>
<td>60</td>
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<td>10.0</td>
<td>2.00</td>
<td>130</td>
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<tr>
<td>Ag-Mn</td>
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<td>Ag-C</td>
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</tbody>
</table>

Most electrical switching contact request for contact spare a material which should provide resistance to oxidation and a lifespan as long as possible. The W-Ag pseudo-alloys, containing Ag, (10÷50) wt % and being arc-resistant as well as resistant to oxidation of contact surfaces can be, depending on the content of Ag, a contact part that work at 500 A, when silver content is of (35 ÷50) wt %, or as only breaking contact at high currents, when the content of tungsten is in the range of (65÷90) wt %. Some properties of W-Ag contact materials are (in the same sequence): 13 to 16 g/cm³, 120 to 250 HB and 16 to 32 Ω·cm.
The coated materials for electric contacts are usually obtained by applying a precious metal on a common metal support. By this combination the materials obtained, meet the good mechanical qualities of common metals with the excellent electric contact properties of the noble metals. Depending on the mechanic properties – elasticity, rigidity, density – necessary for the electric contact – an adequate support material can be used. The support materials usually employed are copper and bronze. As contact materials, silver, silver-nickel can be used. Tungsten has the highest density of all common engineering materials – 19.3 g/cm$^3$, but besides being difficult to manufacture machine parts from it, is also difficult to machine, due to its high hardness and relatively low ductility. Materials of high strength and ductility may be obtained by addition of small amounts of alloying elements such as nickel, copper and iron. These materials are economically manufactured by powder metallurgy techniques. The remarkable properties of these heavy alloys make them suitable for various applications. The main properties of heavy alloys developed in our Institute are presented in Table 2.

<table>
<thead>
<tr>
<th>Tungsten content</th>
<th>87-95 % mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>16.5 – 18 g/cm$^3$</td>
</tr>
<tr>
<td>Electrical resistivity</td>
<td>14 – 12 $\mu$Ω·cm</td>
</tr>
<tr>
<td>Modulus of elasticity</td>
<td>28000 – 35000 kgf/mm$^2$</td>
</tr>
<tr>
<td>tensile strength</td>
<td>50 – 65 kgf/mm$^2$</td>
</tr>
<tr>
<td>Hardness</td>
<td>280 – 350 HB</td>
</tr>
</tbody>
</table>

The decrease of Ag consumption by replacing silver contacts with silver alloy contacts, done by the activity of our own pilot plant, in which we transferred and tested our established technologies was in 1980, 40,000 kg Ag. The customers were Electroaparataj, IAEI Titu, IAEA Sfantu Gheorghe, Electrocentrala Botosani, Buzau, Medias.

2.3. Ceramic Materials and Products

In our Institute have been developed technologies for preparation of ceramic materials based on:

- magnesium silicate (ceramic insulating for high frequency);
- alkaline earth silicate (ceramic arc resistance and thermal shock);
- barium titanate and lead titanate (piezoelectric ceramic);
- zinc oxide (ceramic semiconductor);
- stabilized zirconia (high-temperature electroconductive ceramic).

These were used to achieve landmarks, components or products as following:

- elements and piezoelectric transducers (Frequency = 20 kHz ... 2.5 MHz);
- insulations and insulating parts for high frequency (up to 90 MHz);
- plates for extinguishing chamber and parts resistant to electric arc and thermal shock (T = 2000°C);
- nonlinear ceramic rezistors for low voltage surge ($U_n = 2$ kV);
- oxygen sensors for control pollutant emissions (output voltage at 600 °C: 1 ... 300 mV);
- electrical feedtrough at pressure for acoustic logging (p=140 MPa and T=175°C);
- varistors for telecommunications ($U_{nc}=170$ V$_{ef}$).
2.4. MAGNETIC MATERIALS

Discovered in 1932, the AlNiCo magnets have been, for many years, the most wide spread metallic magnets. This is mainly due to their remarkable qualities: very high remanent flux density (up to 14000 Gs), maximum coercive force of 2000 Oe, specific magnetic energies up to 10 MGsOe, all combined with particular stability to temperature: they can be used from the lowest temperatures to maximum temperatures of 500 °C, the decrease of induction with temperature-rising being, in average, of only 0.02%/°C. The Curie points are all above 700 °C. The magnets are resistant to corrodning agents and they stand high mechanical efforts.

AlNiCo permanent magnets investigated in ICPE-CA can be isotropic and anisotropic, obtained by sintering, casting or by bonding (the latter being only crystalline and magnetically isotropic).

Magnetic properties of technical interest of AlNiCo permanent magnets obtained by casting, which are crystalline and magnetically isotropic, have a remanent induction, $B_r$, between 6 and 9 kGs corresponding to coercive fields between 150 and 1200 Oe, an energy density $(BH)_{max}$ ranging from 0.5 to 3 MGOe and the Curie points are in the range from 720 to 870 °C; they are used in electric motors, measuring instruments as well as mounting magnets.

PM obtained by ICPE-CA by casting and which are anisotropic crystalline and magnetically anisotropic, they have a remanent induction, $B_r$, ranging from 12.5 to 13.5 kG, with specific magnetic energies of 5.5 up to 8 MGsOe when they do not have in composition Ti and a Co content of 24 wt %, shows a coercive fields of 600 to 800 Oe, are especially used where technical qualities such as: maintain structural stability, maximum working temperature up to 550 °C and Curie temperatures approaching to 900 °C - have a greater importance than the price. For permanent magnets containing Ti about 5 wt % and Co about 34 wt %, with large coactive fields from 1400 up to 1600 Oe, they show specific energies ranging in the area of $(4÷10)$ MGsOe with a remanent induction, $B_r$, ranging in the area of $(4 ÷ 9)$ kGs. These alloys have the highest Curie point of about 880 °C.

Isotropic bonded AlNiCo PM, obtained by sintering and used in tachometers has technical characteristics: $B_r = 3$ kG; $H_c = 1000$ Oe and $(BH)_{max} = 0.9$ MGOe. Sintered AlNiCo permanent magnets are used where the advantages of these magnets, e.g. tensile strength (35 to 45 against 2 to 16 daN/mm², are required magnets having magnetic characteristics similar to those of casted AlNiCo PM.

Some NdFeB developed in ICPE-CA and industrial transferred to other industrial companies, are presented in the Table 3.

<table>
<thead>
<tr>
<th>Grade</th>
<th>$B_r$ (G)</th>
<th>$H_{cj}$ (kOe)</th>
<th>$(BH)_{max}$ (MGOe)</th>
<th>$\alpha(B_r)$ (%K⁻¹)</th>
<th>$\alpha(H_{cj})$ (%K⁻¹)</th>
<th>Work. temp. (°C)</th>
<th>$\rho$ (g/cm³)</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sintered NdFeB</td>
<td>min. 10</td>
<td>min. 22</td>
<td>min. 30</td>
<td>-0.1</td>
<td>-0.55</td>
<td>max 180</td>
<td>7.5</td>
<td>actuators, sensors, VCM, MEMS, servomotors, generators, couplings</td>
</tr>
<tr>
<td>Bonded NdFeB</td>
<td>min. 6</td>
<td>min. 13</td>
<td>min. 8</td>
<td>-0.13</td>
<td>-0.40</td>
<td>max 150</td>
<td>5.8</td>
<td>actuators, sensors, small VCM, MEMS</td>
</tr>
</tbody>
</table>
2.5. MAGNETIC POWDER FOR NON-DESTRUCTIVE DEFECTOSCOPIC CONTROL

Magnetic powders for non-destructive defectoscopic control of ferromagnetic materials – cunsumables, developed in our Institute are done in Table 4.

Table 4. Magnetic powders for non-destructive defectoscopic control

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Contrast magnetic powder PDMUC-x</th>
<th>Fluorescent magnetic powder PDMUF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour Contrast:</td>
<td>blue, red</td>
<td>fluorescent</td>
</tr>
<tr>
<td>Color in ultraviolet, (UV)</td>
<td>-</td>
<td>yellow-green</td>
</tr>
<tr>
<td>Grain size:</td>
<td>60...150µm</td>
<td>40...300 µm</td>
</tr>
<tr>
<td>Apparent density:</td>
<td>1.8...3.7 g/cm³</td>
<td>1.8...3.7 g/cm³</td>
</tr>
<tr>
<td>Magnetization at saturation:</td>
<td>217 Gs.cm³/g</td>
<td>217 Gs.cm³/g</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WET PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescent magnetic powder ROMVA 1.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Colour: - in ultraviolet (UV)</th>
<th>- the visible (VIS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain size:</td>
<td>&lt; 30 µm</td>
<td>max. 40 Oe.cm³/g</td>
</tr>
<tr>
<td>Mass magnetization:</td>
<td></td>
<td>1.5 – 2.0 g/l suspension</td>
</tr>
<tr>
<td>Technological consumption:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.6. ELECTROPHOTOGRAPHIC SUPPLIES (TONER AND DEVELOPER) FOR Duplicator DevicEs

Table 5. Toner and Developer for duplicator devices, developed in ICPE-CA

<table>
<thead>
<tr>
<th>Developing System</th>
<th>Type of Duplicator Devices</th>
<th>Developer type</th>
<th>Toner type</th>
</tr>
</thead>
<tbody>
<tr>
<td>magnetic bi-</td>
<td>Rank Xerox 1020;</td>
<td>PDM-112</td>
<td>PTM-112</td>
</tr>
<tr>
<td>component</td>
<td>Rank Xerox 1045;</td>
<td>Grain size: 60-200 µm, Virtual density: 1.0 – 1.2 g/cm³; Hₘₐₓ 50-80 Oe; Bₘₐₓ 300 – 600 Gs; Hₑ 0.5 – 3 Oe; Electrostatic loading:+200 ue.</td>
<td>Grain size: max.30 µm Triloelectric loading value in contact with Developer DPM-112: min. 6x10⁻⁶ C/g; Electrostatic loading: - 80 ue.</td>
</tr>
<tr>
<td></td>
<td>Rank Xerox 3100.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>magnetic monocomponent</td>
<td>Canon P200</td>
<td>-</td>
<td>TM-01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Grain size: &lt; 15 µm; Tt : 135 – 150⁰C ; Rₑ: 10¹³ - 10¹⁵Ω.cm.</td>
</tr>
</tbody>
</table>

3. TECHNOLOGICAL TRANSFERS

During over the 60 years of research and development of inorganic materials and components have been transferred manufacturing technologies for products, designed and developed in our institute. Thus, in 1956 it was transferred to Electromagnetica Bucuresti, the technology for tile selenium rectifiers manufacturing. In 1963 it was transferred to the IPRS Baneasa the technology to obtain single crystals of silicon as well as the manufacturing process for rectifier diodes obtained with these single crystals. In the 80’s were transferred to Electromagnetica Bucuresti the manufacturing technologies of high energy AlNiCo PM. In the same period, were transferred to
Sinterom Cluj-Napoca the manufacturing technologies for Alnico PM (high energy casted Alnico and isotropic bonded Alnico PM and W-Ag, W-Ni electrical contacts and, to Rofep Urziceni, the manufacturing technologies for virtually all types of electric brushes developed until then by the Institute. In the decade 1960 ÷ 1970 there were transferred to Electroceramica Turda the manufacturing technology of ceramic electric insulators and electrical insulators based on ZrO₂ for thermal shock resistances. Also, to IPEE Arges, has been started the manufacturing of ceramic resistors and capacitors based on technology developed in our Institute. In the decade 1970÷1980, at Electroceramica Turda, our technologies, ceramic zirconium for extinguishing rooms, steatite formed by injection pressure, have been approved and at Izolatori Electrici Botosani has been started the manufacturing of glass insulators.

During 1980 ÷ 1990, there were transferred to Steaua Electrica Fieni metal-glass feedtroghts for compressors of refrigerators and at Electro Covasna Targu Secuiesc, the manufacturing technologies for ceramic insulators CER 2020 and electric fuse ceramic tubes obtained by isostatic pressing, also based on the technologies developed in our Institute. Also, it was transferred to Electroaparataj Bucharest the technology of producing fine silver powder by electro-galvanic methods. Other transfers that have to remember, refers to technology of aluminizing the auto headlight at ELBA Timisoara, the machines for balancing in one plane and two planes at the heat engine factories and to railway equipment repairing companies, the equipment used to test wagon shock absorbers to Grivita Company ant at the same company the equipment for crack detection in railway wheel rims.

Also some technological transfers take place in the field of active corrosion protection like: method and equipment for the active corrosion protection of underground metallic pipelines, method and device for electroprotection of metallic structures - Patent RO 113778, complex system for electro-security and protection against the corrosion destructive actions of stray currents of reinforced concrete structures from Bucharest METRO, efficient anode for cathodic protection in modular construction Patent RO 120717 and intelligent and preventive diagnostic procedures of medium voltage underground cables. Figure 10 shows a device for electroprotection of metallic structures developed and produced in ICPE-CA.

![Fig.10. Hybrid solid-state device for electroprotection and underground corrosion control accelerating by stray currents in DC and AC](image1)

![Fig.11. Magnetic coupling for pumps](image2)

Also, in the last 10 years, we managed some spectacular technological transfers of our products to the industry. So, we managed to develop and to transfer knowledge and skills on the size of
magnetic coupling, (Fig.11) to SC Roseal SA Odorheiu Secuiesc. To the same company we transferred technology to obtain carbon/ceramic volume resistors, manufacturing method for bipolar carbon plates used in PEM fuel cell, process of obtaining of MENER-5kW product - Integrated power module with power of 5 kW based PEM fuel cell (Fig. 12); to Rofep Urziceni we transfer also wind turbines between 0.8 and 3.5 kW (Fig.13); a biogas plant for rural area of 4 cubic meters for individual households was transferred (Fig.14).

ICPE - CA has a rich experience in the production and characterization of carbon materials, the Laboratory of Carbon Materials having a tradition of over 60 years of research in the field. This allowed that in recent years the research has to be oriented towards achieving carbon materials with outstanding performances from classical materials, the proper products and technologies being transferred to the corresponding industrial environment, SC Rofep SA Urziceni.

Since 1986, the factory has expanded the manufacturing area with a second profile, namely the production of carbon brushes for electric motors and other carbon materials with technology transferred from our Institute; until 1990, were transferred the technologies for carbon materials from four main groups BGR, CDR, EGR and MGR materials. The technologies have allowed gradually introduction into the production to SC Rofep SA of numerous grades of electrical brushes for electrical motors with industrial uses or in the household appliances and automotive sector, Table 6.

Table 6. Marks carbon materials transferred to SC Rofep SA Urziceni

<table>
<thead>
<tr>
<th>Name of Grade group</th>
<th>Grade</th>
<th>The main fields of application/use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrographite EG</td>
<td>EGR – 8-23 (11 grades)</td>
<td>Welding inverters, auxiliary engines of electric locomotives, amplifier, traction motors from electric locomotives, industrial electrical machinery, generators for automotive equipment, special motors, servomotors with disc rotor, drive motors for rolling mills, industrial power electrical engine from metallurgy.</td>
</tr>
<tr>
<td>Metal-graphite MG</td>
<td>MGR – 10-26 (13 grades)</td>
<td>DC motors for low voltage starters for cars, tractors and trucks, generator excitation, auxiliary electrical equipment, car heaters, lifting machines.</td>
</tr>
</tbody>
</table>
After 1990 there was rolled out a technology transfer contract on the modernization of the manufacturing process of the carbon materials at SC Rofep SA. (2003-2007). The main objective of the contract was the modernization of the obtaining process for electrographite materials and replacement of lead in metal-graphite materials.

4. CONCLUSIONS

The tenth of technology transfers managed by ICPE-CA—here we presented only a given selection of that transfers—demonstrate that the high applicative research potential of our Institute was well used to establish technologies which were of interest of the commercial societies which were customers of our works. In the same time we can conclude that the same transfers demonstrate the quality of the developed products with applicable technologies in the named companies. The technology transfers described in our presentation is a solid basement for the future of our Institute.

The same technology transfers give an answer on the question: there is an industry in Romania which needs technologies?

ACKNOWLEDGEMENTS

The authors of these presentation ask to express of these way their deep recognition not only to those which has had a direct or a no direct contribution in preparing these presentation, but in a special way to all those which has had a contribution to design, to develop and to establish the technologies and to manufacture the above described products.

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DE L'HISTOIRE DE L'I.A.R - BRASOV

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Résumé — Après un bref examen de la contribution de la Roumanie par Traian Vuia, Henri Coanda et Aurel Vlaicu à la naissance de l'aviation, la communication présente des aspects de l'industrie de l'aviation à Brasov, depuis sa création en 1924 jusqu'aujourd'hui. La société IAR (Industrie Aéronautique Roumain) a été fondée le 25 Juin 1925. Un tiers du capital appartenait à l'État roumain, un tiers du capital aux entreprises françaises Lorraine-Dietrich et Blériot Spad et le reste des capitaux roumains provenaient de la société Astra Arad et de certaines banques roumaines. Pendant cette période, compte tenu du contexte politique et économique spécifique du pays, on peut mettre en évidence quatre étapes: - 1924-1945, une première phase de développement, qui se termine à la fin de la Seconde Guerre mondiale.

C'est la plus grande réalisation et elle souligne le rôle des ingénieurs roumains dans la conception et la construction de plus de 1000 avions dont 8 types de licences et 16 à concept roumain.


Une phase caractérisée par l'économie et la privatisation de l'IAR Brasov Roumanie c'est le rétablissement 1989-2014, l'introduction de capitaux étrangers et la création en 2002 de SC Eurocopter Roumanie S. A. Brasov - Roumanie dans le contexte de la transition du communisme vers la démocratie et l'économie de marché. Cet article présente ces étapes complexes de transition qui ont eu une influence majeure sur le développement de l'industrie de l'aviation en Roumanie et la vie de ceux qui ont travaillé et travaillent dans cette industrie.

Mots-clés — aéronautique, ingénieurs, avions, aviation

1. INTRODUCTION

L'aéronautique est la zone qui peut illustrer très bien comment les gens ont contribué au progrès technique du début du XXe siècle, et maintenant le XXIe siècle et la Roumanie a joué un rôle important, surtout au début par la priorité de Trajan Vuia qui a accompli le 18 Mars 1906 à Montesson, près de Paris, le premier vol du monde d'un aéronef dans le décollage avec son propre conseil. Le 16 décembre 1910 à Paris la réalisation par l'ingénieur roumain Henri Coandă du
Technologie in Times of Transition

Premier vol dans le monde d'un avion avec un moteur à réaction était l'aube du jet de l'aviation. L'ingénieur roumain Aurel Vlaicu, le 17 Juin 1910 à Bucarest, en Roumanie, sur le terrain Cotroceni mène son premier vol avec un avion conçu et construit dans le pays. Les ingénieurs de la Roumanie ont contribué depuis le lancement de l'aéronautique dans la première moitié du XXe siècle au développement de ce domaine. Henri Coandă était le fils du général Constantin Coandă, premier ministre de la Roumanie en 1918 et le premier président du conseil d'administration de l'IAR-Brasov établi en 1925.

2. 1924-1945 -LA PERIODE DE DEVELOPPEMENT S'ACHEVE AVEC LA FIN DE LA SECONDE GUERRE MONDIALE

Après les étapes du Conseil consultatif sur l'aéronautique, le gouvernement roumain a accordé au début de 1924, un crédit important pour la mise en place de l'usine d'avions à Brasov. La société IAR Brașov" (Industrie Aéronautique Roumaine) a été fondée le 25 Juin 1925 avec la promulgation par le roi Ferdinand de la "loi sur les entreprises industrielles liées à la défense nationale". L'article 1 prévoit la création de l'industrie aéronautique roumaine à "fabriquer des avions." À l'art. 2 il est prévu: L'état participe au capital garanti (troisième) et s'engage à fournir les commandes d'usine d'avions pour une période de 10 ans. Environ un tiers du capital a été investi à IAR par deux sociétés françaises - Lorraine-Dietrich-Blériot Spad et le dernier tiers de l'obligation de capital par Astra Arad et des banques de Roumanie. IAR devenir "la première usine d'aviation roumaine," comme il est écrit dans l'acte d'ouverture du 11 Octobre, 1927. L'usine est située à IAR Brasov, dans la zone près de la route Brasov - Sânpetru, ayant une superficie de 2.233.800 m² et disposant d'un terrain d'aviation d'environ 1800 m. de long qui a fonctionné jusqu'en 1961 comme l'aéroport de Brasov.

![Fig. 2. Vues de l'usine IAR-Brasov en 1932](image)

Dès 1928 on passe à la conception et la mise en œuvre de l'IAR-CV-11, le premier avion conçu et fabriqué à IAR Brasov par sa propre conception après un projet de l'ingénieur roumain Elie Carafoli et l'ingénieur français L. Virmoux avec une équipe qui comprenait les ingénieurs roumains Ion Grosu, St. Urziceanu, D. Barbieri, V. Timochenko, I. Ciobanu, I. Cosereanu. Après les succès des essais statiques, le prototype d'avion IAR-CV-11 exécute des vols d'essai, mais le 9 Décembre 1931 un défaut du moteur a causé l'accident qui a tué le pilote capitaine Romeo Popescu.
En 1930, par ses caractéristiques et sa performance, l'avion IAR-CV-11 était parmi les premiers avions dans le monde, le moteur de 600 ch Lorraine type 12 cylindres Courlis 48-5 avec hélice bipale, permettant une puissance spécifique de 30 CP/m² et une montée à 5000 m dans 8 min 30 sec. Cet avion de combat a été l'un des premiers au monde avec l'aile vers le bas et le premier de ce type d'avion construit à IAR Brasov. Les données techniques et la performance sont présentées dans la circulaire AIRCRAFT. n° 144 mai 1931 à Washington, publiée par le Comité consultatif national pour l'aéronautique (NACA).

Fig.5. L'ingénieur Ion Grosu, les avions de chasse IAR-80 et le chasseur/bombardier IAR-81.


Tableau. 1. Les données principales, caractéristiques et performances de l'avion IAR pendant 1930-1941

<table>
<thead>
<tr>
<th>Type</th>
<th>Puissance</th>
<th>Plafond</th>
<th>Poids</th>
<th>Envergure</th>
<th>Longueur</th>
<th>Hauteur</th>
<th>V. max.</th>
<th>Année</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CP</td>
<td>m</td>
<td>kg.</td>
<td>m</td>
<td>m</td>
<td>m</td>
<td>km/h</td>
<td></td>
</tr>
<tr>
<td>IAR 11</td>
<td>600</td>
<td>9.000</td>
<td>1.510</td>
<td>11,50</td>
<td>6,98</td>
<td>2,46</td>
<td>329</td>
<td>1930</td>
</tr>
<tr>
<td>IAR 12</td>
<td>450</td>
<td>7.500</td>
<td>1.540</td>
<td>11,70</td>
<td>7,32</td>
<td>2,50</td>
<td>294</td>
<td>1932</td>
</tr>
<tr>
<td>IAR 13</td>
<td>450</td>
<td>7.500</td>
<td>1.540</td>
<td>11,70</td>
<td>7,32</td>
<td>2,50</td>
<td>294</td>
<td>1932</td>
</tr>
<tr>
<td>IAR 14</td>
<td>450</td>
<td>7.500</td>
<td>1.540</td>
<td>11,70</td>
<td>7,32</td>
<td>2,50</td>
<td>294</td>
<td>1933</td>
</tr>
<tr>
<td>IAR 15</td>
<td>600</td>
<td>10.000</td>
<td>1.707</td>
<td>11,80</td>
<td>7,29</td>
<td>2,70</td>
<td>352</td>
<td>1933</td>
</tr>
<tr>
<td>IAR 16</td>
<td>500</td>
<td>10.000</td>
<td>1.650</td>
<td>11,70</td>
<td>7,37</td>
<td>2,80</td>
<td>342</td>
<td>1934</td>
</tr>
<tr>
<td>IAR 21</td>
<td>120</td>
<td>5.500</td>
<td>850</td>
<td>12,70</td>
<td>7,00</td>
<td>2,50</td>
<td>190</td>
<td>1933</td>
</tr>
<tr>
<td>IAR 22</td>
<td>130</td>
<td>5.000</td>
<td>880</td>
<td>11,53</td>
<td>7,50</td>
<td>2,02</td>
<td>193</td>
<td>1934</td>
</tr>
<tr>
<td>IAR 23</td>
<td>340</td>
<td>4.100</td>
<td>1.920</td>
<td>12,00</td>
<td>8,35</td>
<td>2,70</td>
<td>245</td>
<td>1934</td>
</tr>
<tr>
<td>IAR 24</td>
<td>350</td>
<td>4.500</td>
<td>2.030</td>
<td>12,00</td>
<td>8,35</td>
<td>2,70</td>
<td>280</td>
<td>1935</td>
</tr>
<tr>
<td>IAR 27</td>
<td>180</td>
<td>5.000</td>
<td>948</td>
<td>9,10</td>
<td>7,41</td>
<td>2,40</td>
<td>180</td>
<td>1937</td>
</tr>
<tr>
<td>IAR 37</td>
<td>870</td>
<td>8.000</td>
<td>3.459</td>
<td>12,22</td>
<td>9,50</td>
<td>3,97</td>
<td>335</td>
<td>1937</td>
</tr>
<tr>
<td>IAR 38</td>
<td>700</td>
<td>7.000</td>
<td>3.100</td>
<td>13,20</td>
<td>9,56</td>
<td>3,80</td>
<td>220</td>
<td>1938</td>
</tr>
<tr>
<td>IAR 39</td>
<td>870</td>
<td>8.000</td>
<td>3.085</td>
<td>13,10</td>
<td>9,60</td>
<td>3,99</td>
<td>336</td>
<td>1939</td>
</tr>
<tr>
<td>IAR 80</td>
<td>1000</td>
<td>10.000</td>
<td>2.470</td>
<td>10,00</td>
<td>8,85</td>
<td>3,60</td>
<td>510</td>
<td>1939</td>
</tr>
<tr>
<td>IAR 81</td>
<td>1000</td>
<td>10.500</td>
<td>2.550</td>
<td>10,50</td>
<td>8,85</td>
<td>3,60</td>
<td>510</td>
<td>1941</td>
</tr>
</tbody>
</table>
3. LA PERIODE DE SURVIE 1945-1968 A PRIS FIN AVEC LA MISE EN PLACE DE L'ICA BRASOV


La tradition aéronautique à Brasov a été poursuivie par l'ingénieur Joseph Ţîlimon (22.07.1918-8.02.1981) qui a fait les planeurs, les motoplaneurs et l'avion type IS. Après avoir été diplômé en 1941 de la Polytechnique de Bucarest il s'engage comme ingénieur à IAR Brasov, en 1944 il est devenu le chef de la section de montage cellules et en parallèle il fabrique en 1949 à l'Aéroclub Sânpetru son premier planeur IS-2.


Fig. 8. Hélicoptère IAR 316B Alouette III, IAR 330 Puma et hélicoptère prototype IAR 317 Airfox.
Le 19/03/1984 a été signé la coopération de l'aviation entre les gouvernements roumain et soviétique. Elle prévoit la coopération pour un hélicoptère multi-rôle dérivé de Ka 26 avec le suivant partagé des activités:

- La société KAMOV - URSS avait été responsable de la conception et de la certification de l'hélicoptère,
- ICA Ghimbav était responsable de la conception technologique et la fabrication des hélicoptères. L'intégration de ce modèle a été fourni pour atteindre le but. Les Principaux sous-traitants d'ICA sont Turbomecanica Bucarest Roumanie, qui devait livrer le moteur TV100, Avions Bacau, qui devrait produire le réducteur VB126 et le train d'atterrissage. Le programme nécessite la réalisation de cadences de fabrication de 117 hélicoptères/an, dont 100 unités ont été prévus pour être livrés en URSS, 10 PCs dans le marché du CAEM, et 7 pièces étaient destinées au marché roumain. Une très grande expansion de l'usine de production s'est imposée par une salle de l'assemblée générale, une salle pour l'usinage, une salle pour la peinture finale et une salle pour la conservation et l'exportation des hélicoptères, une salle pour les bancs d'essais statiques et dynamiques de pâle et l'expansion des dépôts. En Décembre 1988, il a été fait le premier vol de l'hélicoptère Ka-126. Le deuxième hélicoptère Ka-126 a été fabriqué dans la première moitié de 1989 et a été remis, comme le premier en URSS. Les essais de deux appareils 001 et 002 ont été menés par des spécialistes soviétiques et roumains. Au total 11 pièces ont été produites, dont les sept premières ont été livrés à l'URSS. Les événements de 1989 en Roumanie et dans l'Union soviétique ont conduit à la cessation du programme, malgré la demande du marché de ce type d'hélicoptère.

5. LA PERIODE 1989-2014, LA TRANSITION EN ROUMANIE DE L'ECONOMIE CENTRALISEE A UNE ECONOMIE DE MARCHE

Grâce à la Convention de Vienne, la Roumanie a le droit de tenir un total de 120 hélicoptères d'attaque. Pour atteindre cet objectif, il a été décidé que l'existant IAR 330 Puma détenu par le Commandement de la Force aérienne atteigne un total de 25 pièces pour compléter un programme de modernisation de Opto-électronique et le système de recherche anti-tank et, en outre, de produire un total de 96 nouveaux hélicoptères. Le programme d'hélicoptères roumains d'attaque a commencé avec AH1W Cobra qui avait installé le système de SOCAT, réalisant ainsi l'hélicoptère AH1Ro Dracula. Le programme devait être réalisé grâce à la coopération avec la société américaine Bell Helicopters, qui, par ailleurs, participé à la privatisation de l' IAR, programme initié par l'Etat roumain. Le 21.05.1997 a été signé par le ministre de la Défense nationale le contrat pour acheter l'hélicoptère AH 96 l FR Dracula et le contrat de privatisation de la SC IAR SA avec la société Bell Helicopters. Les deux contrats n'ont jamais été en vigueur. En septembre 1995 l'IAR-S. A. Brasov a signé avec le ministère de la Défense nationale de la Roumanie un contrat pour moderniser le 25 IAR 330 Puma et équiper la version Armée de l'Air de IAR 330 Puma SOCAT, la principale entreprise partenaire de développement du système Elbit en Israël. Le prototype IAR 330 Puma SOCAT a été exposé statique au salon de Bourget 1997. Le 26 mai 1998, IAR 330 Puma SOCAT a mené le premier vol officiel et le 23.10.1999 a volé le second IAR-330 Puma SOCAT.

Fig. 10. Hélicoptère IAR 330 Puma choqué et avions légers IRA-46 S

Comme une solution optimale entre les motoplanes biplaces IS 28M2,l'avion IS -28MA et les avions légers, SC IAR-SA Brasov a développé les avions légers IAR-46 S qui ont obtenu le certificat de type roumain en novembre 25 1999 et le certificat de type américain en 2001, ainsi c'est le premier avion roumain dans sa catégorie certifié aux Etats-Unis.


SC IAR SA a acquis une expérience dans la modernisation d'hélicoptères avec d'approches réussies:

- Puma 330 SM programme, commencé en 2002, sous contrat avec les Emirats Arabes Unis, Forces armées GQG, la modernisation d'un certain nombre de 25 hélicoptères Puma version SM. La mise à niveau consiste en l'installation de nouveaux moteurs, Makila 1A1, puissant, haute performance, faible consommation, la conception modulaire d'un nouveau pilote automatique 4 axes, un système de surveillance et une système de communication - navigation avancé.

- L'IAR 330 programme PUMA de l'OTAN, a commencé en 2004, sous contrat avec le ministère de la Défense nationale de la Roumanie, de la modernisation des 16 hélicoptères existants au bénéficiaire, une partie des systèmes SOCAT (système moins armes) systèmes de communication de saut de fréquence, identification ami / ennemi (IFF). Un certain nombre de ces appareils ont été équipés comme sanitaires.


- L'IARR 330 PUMA VIP, développé pour différents clients dans le monde entier, y compris la Roumanie.

Fig. 11. L'évolution de fabrication I.C.A. Brasov 1968-1990 et I.A.R. - S.A. Brasov 1991-2007

6. CONCLUSIONS

Dans la période 1925-1945 à I.A.R. Braşov ont été fabriqués environ 1000 avions, mais l’activité de l’aviation à Brasov a continué après 1945 par la production de beaucoup plus que 1200 planeurs, motoplanes, avions et hélicoptères.

Pendant ces 89 années, à I.A.R. Braşov Roumanie Brasov l’industrie aéronautique a fait plus de 2.200 avions dont plus de la moitié étaient des avions conçus par l’Industrie Aéronautique Roumaine.

REFERENCES

Abstract — By the late-1950s, the Soviet Union had reacquired a strong position as a world oil exporter, thanks to a number of discoveries in the Ural-Volga area. In order to transport their oil to strategic locations within the Soviet Union and to Europe, the Soviets devised the project of a colossal pipeline system that would connect oilfields to Eastern Europe, as well as to the Black and the Baltic Seas. The work to the system started in 1960. Anxieties for the pipeline coupled with those arising from a spectacular oil export strategy directed to some major West European countries. The Soviet ‘s oil invasion of Europe’ was seen by countries with established positions in the international oil market as part of a larger economic offensive, aimed at generating dependence of European markets from cheap Soviet oil, and at destabilising the international market's price structure. The completion of the pipeline’s European branch, Druzhba, would thus help the Soviets accomplishing their putative mission. Both exports and pipelines were at the core of bitter and lengthy discussions staged between 1960 and 1962 within transnational organisations, where a difficult harmonisation of conflicting positions was attempted. In my paper, I have first shown that the debate on oil imports eventuated in very limited concrete results, due to the opposition of Italy and to its temporising tactics. I have then moved to the Druzhba question, and analysed how the US-formulated proposal of an embargo on pipes and pipeline technology met with firm British hostility. While the Americans tried to persuade their allies into accepting their proposal by advancing military security reasons, the British responded by stressing the economic inconvenience of a blockade. The NATO confrontation, which included the intervention of high-rank military and intelligence figures, also centred on a more technical aspect, namely the definition of ‘strategic equipment’. The latter, I argue/consider, was co-produced through a negotiation among the parties involved, and eventually steered the issue to a conclusion.

Keywords— oil, USSR, pipelines, NATO, embargo

1. INTRODUCTION

Between 1955 and 1965, Soviet oil production rose spectacularly from 71 to 243 million tons.1 Worried by such spectacular increase, in 1958 the CIA Director, Allen Dulles, warned the US

Cabinet, led by President Dwight Eisenhower, that “[t]he free world face[d] a quite dangerous situation in the Soviet capacity to dislocate established markets”.2 The new Soviet production had significant implications for Western security as well, as it meant a higher capability to boost production of USSR’s heavy industries and fuel its military machine. The Soviet Union also increased its exports. Over a period of ten years, the exports’ share of total Soviet production rose from 5.2% to 26.4%, and oil exported to non-Communist countries increased from 3.8 Mt in 1955 to a stunning 35.5 Mt in 1965.3 Not only could the Soviets produce a colossal amount of oil, they could also offer prices that international companies could not match.

2. BACKGROUND

Historians of technology have recognised the importance that social, political and economic factors play in shaping what a technological artefact is4. More recently, Paul Edwards and Gabrielle Hecht have further developed this analysis suggesting that political factors play a major role, too.5 In particular, introducing the notion of technopolitics, Hecht has proposed that we should think about the underlying political dimensions of technological networks and the interconnectedness of these networks in favouring the spreading of some technologies globally.

This paper enriches this analysis by showing, on the one hand, the absolutely crucial role that oil and oil pipes had in shaping international relations during the Cold War. On the other hand, it also highlights that the Cold War shaped the definition of what oil pipes are. In particular, the actual understanding of their size, methods of manufacturing and materials was negotiated in the set of responses that NATO implemented to face the Soviet threat.

This study also refines our understanding of the role of oil and oil pipelines in political history, which has been emphasised by historian Timothy Mitchell and more recently by geographer Andrew Barry. While Mitchell has highlighted, amongst other things, the importance of Middle Eastern pipelines and refineries as sites of intense political struggle, Barry, in his study of the Baku-Tbilisi-Ceyhan oil pipeline from the Caspian Sea to the Mediterranean, built in the second half of the 2000s, has demonstrated that pipelines as material artefacts are active agents of politics.6


3 Ebel (1970), 40, 44.


with Barry’s approach, I have demonstrated that pipes, as political devices, were the central element of the NATO debate on Soviet oil exports and technological capabilities, which was debated at NATO from the late 1950s.

Finally, my paper has also drawn on recent analyses highlighting the importance of science and technology in understanding the Cold War conflict, and thus helped overcoming the limitations of historiographical approaches focusing mainly on nuclear weapons.

3. ANALYSIS & RESULTS

The Soviet oil flood promised to upset the Western bloc militarily and economically. By the late 1950s, individual countries were about to sign agreements to import Soviet hydrocarbons and had also promised to sell the pipes needed to rapidly transfer it from central Russia to the western borders of the Iron Curtain. These oil exports were part of a larger offensive, in which barter agreements were employed as powerful economic and diplomatic weapons, in that they enabled beneficiary countries to find outlets for their productions. The US administration first, and the European Community and NATO afterwards, swiftly moved in to block these deals.

Reactions to the Soviet oil offensive varied from country to country. While, expectedly, the American government firmly refused to allow Soviet imports into the United States, the European positions were more varied, depending on each country's trading activity with the USSR. In particular the Italian public oil company, Ente nazionale idrocarburi (ENI) was deeply involved in trading with the USSR. In 1960, ENI signed a massive oil-for-technology supply contract with the Soviet Union. ENI's trading with the Soviets soon brought the Italian company to the attention of transnational organisations. In the EEC, France, wary to market 'its' new Algerian oil, reacted as strongly when faced with the perspective of allowing Italy to sell its Soviet oil on the Common Market.

In addition, the Soviet project of a giant pipeline connecting oilfields to the country's borders (Fig. 1) triggered frantic debate at NATO. By consequence of the imminent threat, Western technologies that made the construction of the pipeline possible were placed under strict surveillance by the Atlantic Alliance and the European Community alike. A long debate ensued at NATO over an American proposal of an embargo on large-diameter pipes and pipeline equipment exports to the USSR, probably prompted by US international oil companies. Unexpectedly if we think of the Anglo-American 'special relationship', US and UK administrations held conflicting points of view, which corresponded to two markedly different perceptions of the Soviet threat. The

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7 Archivio storico del Ministero degli affari esteri, Rome (ASMAE) – Telegrammi ordinari, Russia (Ambasciata Mosca), 1960, vol. 59 arrivo (Jul-Dec), n. 36288, Italian Embassy in Moscow (Italian Embassy Moscow, henceforth) (Pietromarchi) to Ministry of Foreign Affairs, ‘Contratto ENI-FINSIDER’, 3 October 1960; n. 37331, Italian Embassy Moscow (Pietromarchi) to Ministry of Foreign Affairs, ‘Importazione petrolio’, 11 October 1960. For the laborious negotiations preceding the agreement, mainly carried out by Giuseppe Ratti and under the auspices of Italian Ambassador Luca Pietromarchi, see: Archivio storico ENI (ASENI) – Fondo ENI, Presidenza Raffaele Girotti, b. 264, fd. 482E.

British opposed the embargo on economic grounds, while the Americans supported it on military grounds. The two governments fought their battle through industrial estimates, as well as through mobilising their military and intelligence agents. During and because of this debate, the nature of the ‘pipe’ artefact changed, its final status as technological artefact ultimately resulting from technopolitical negotiation. In late 1962 eventually, the embargo was approved by all NATO members bar the UK.

The construction of the pipeline system was indeed delayed: scheduled to be completed in late 1963, it was only completed a year later. However, the embargo was not able to stop Soviet oil exports to Western Europe, which continued to increase in the early 1960s.

4. CONCLUSIONS

Were the American and most West European diplomacies really acting in European security interests when trying to limit Soviet oil exports? Historian Geir Lundestad, disagrees, and maintains that the USA was more interested in perpetuating Europe’s dependence on the American national companies. His claim, I believe, can hardly be disproved. Strong economic interests were the elephant in the room at NATO and EEC discussions on restraining trade with the Soviets.

In analysing the debate that took place at the European Community and NATO, we have a clear indication of the fragmentary nature of these alliances. What is most interesting in the NATO discussion over the blockade, is the role played by technological artefacts in it. Beyond the Anglo-American security vs. economy debate, the discourse revolved around steel pipes.

For the Americans, an oil pipe was essentially any object that could carry oil regardless of its size or technical characteristics. Essentially, they adopted a prescriptive principle that stretched the definition of an oil pipe so as to include as many steel pipes as possible, and in order to reduce any potential risk. The British and Germans objected to such an all-encompassing definition and sought to distinguish. Oil could be carried only in certain kind of pipes, with well-defined technical specifications, and these pipes should not be lumped together with gas pipes. Vested interests prompted the adoption of either of these definitions.

Fig. 1 The Soviet pipeline system in late 1960s
ACKNOWLEDGEMENTS

This work was supported by the European Research Council under Grant nr. R111410. I would like to thank Dr. Simone Turchetti from CHSTM, who supervised my PhD; the members of the TEUS Project; Dr. Jeff Hughes (CHSTM, University of Manchester) and Prof. Ronald E. Doel (Florida State University) for their advice.

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L’IMPACT DES TRANSITIONS POLITIQUES DU XX-EME SIECLE DANS L’INDUSTRIE DE BRAȘOV, ROUMANIE, A TRAVERS LES RECITS DES ANCIENS EMPLOYES

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Résumé — Le contenu de cette communication se détache d’une série de conversations avec anciens employés industriels de la ville de Brașov, c’est-à-dire, il s’agit d’une approche par les instruments de l’histoire orale. La période choisie, d’ailleurs la seule accessible par cette démarche (celle de l’histoire orale), contient 50-60 années d’industrie communiste et postcommuniste, à la fin du XXème siècle.

Les récits commencent pratiquement avec le moment de la nationalisation et ils surprennent aussi le retour à un système de production capitaliste, après 1990. Les personnes interrogées occupaient de différentes positions dans la hiérarchie de l’entreprise et cela explique les points de vue différents par rapport aux événements sociaux, à la technologie et au management, par rapport à la politique des cadres et à la stratégie de développement de l’industrie, etc.

Une partie des interlocuteurs détient une bonne information sur les réalités contemporaines dans le milieu industriel, même après leur retraite officielle.

Brașov et ses alentours (Râșnov, Zârnești, Codlea, Sâcele,...) est depuis plus de 150 ans la région avec la plus grande concentration industrielle de Roumanie, une région avec une riche tradition de l’industrie (surtout les constructions de machines et industrie lourde).

La collecte du matériel (les interviews) s’est déroulée d’après les règles les plus strictes de l’histoire orale, le point de départ commun est représenté par un paquet de questions d’intérêt pour le thème, mais, pour protéger le style coulant (la fluidité) du récit, on a laissé à l’interlocuteur la liberté de développer ses idées préférées autour de la question. Les questions centrales de la collection de récits regardent (envisagent) : les produits en usinage, les bénéficiaires les plus connus de l’entreprise, le progrès technologique et la dotation instrumentale, le management spécifique, les nouveautés industrielles, la qualité des produits, ..., l’impact des relations interpersonnelles et professionnelles dans le climat de l’entreprise.

Finalement, on détache les éléments communs des histoires vécues et on essaye l’interprétation des témoignages par rapport à l’histoire officielle et par l’évolution économique nationale, régionale, voire européenne.

Mots-clé — industrie roumaine, histoire orale, formation industrielle, l’impact politique, histoire des produits industriels
1. INTRODUCTION


L’approche du sujet dans le présent article se fait à travers la technique de l’histoire orale. En fait, dans les pages suivantes seront analysées seulement 5 interviews [1], [5], [6], [7], [8] représentant le point de départ d’un projet d’histoire orale de plus grandes dimensions, concernant la culture technique et industrielle du Pays de Bârsa (Brasov et ses alentours).3,4,5,6,7

Malheureusement, pour la période de passage au socialisme, c’est-à-dire à l’économie planifiée, les témoins deviennent de plus en plus rares, car il s’agit de personnes qui devraient dépasser 80 ou 85 ans. Les dialogues avec nos interlocuteurs se sont déroulés sur un questionnaire unique, mais ayant la liberté d’ouvrir des sujets collatéraux ou agrées, partant de la question en cause. Pour le contenu de cet article, on a retenu les directions suivantes :

- éducation, à tous niveaux, pour former et augmenter le nombre des spécialistes techniques dans l’industrie ;
- les produits en exécution, niveau de technicité, exemples ;
- relations à l’intérieur et à l’extérieur des entreprises socialistes, l’implication de la décision politique (management, déficience,...) ;
- les directions vers lesquelles se dirige l’industrie locale de succès, exemples de passage par-dessus le choc du retour au système du marché libre.

2. CADRE HISTORIQUE


1944-1948, la dégradation économique et industrielle due à la guerre, de même qu’aux dettes de guerre.

1948-1960, sur le fond social dominé par la famine, épuration politique et idéologique, camps de travail forcé, déportations, s’installent les structures monopolistes de l’État et du pouvoir centralisé.

1963-1976, étape hésitante, avec tendance de libéralisation dans différents domaines économiques, haut niveau d’accumulation du revenu national, de même que le développement irrationnel, qui conduisent à l’augmentation sévère de la dette externe du pays.

1976-1989, étape de la crise profonde, manifestée par la concentration excessive du pouvoir et de la décision.

Dans n’importe quelle période ci-dessus, l’économie socialiste (communiste) a une évolution paradoxale. Comme de nos jours, la société reste extrêmement résistante au changement, par
conséquent, elle perpétue, par inertie, à long terme, des éléments „historiques” propres aux époques apparentemment dépassées.

Le système communiste roumain a trois mérites (succès), presque unanimement reconnus: l’industrialisation, l’urbanisation et l’éducation de masse.

Apparemment, tous ces trois facteurs, synergétiquement, devraient conduire aux résultats matériels et sociaux positifs dans la société. L’absence des effets attendus sur le plan économique et social a toute une série d’explications, qui nécessite une discussion plus large, mais, on peut faire, dans une première approximation, les remarques suivantes:
- l’industrialisation a été faite sur des critères démonstratifs, sans aucune efficience, avec investissements disproportionnés irresponsables, sur le fond d’une incompétence progressive (par la politisation de la décision technique) et par la mistification des conséquences;
- l’urbanisation a été partiellement une réussite au niveau des premières générations, mais subminée plus tard par sa vitesse excessive, qui n’a plus permis aux nouveaux citoyens l’assimilation correcte d’une civilisation urbaine réelle;
- l’éducation de masse est en souffrance, peut-être toujours à cause de la vitesse et de ses larges proportions, de l’implication du politique dans l’école et de l’abandon de la composante morale de l’éducation, apparemment dans la faveur de la composante professionnelle, oubliant le fait que l’une sans l’autre ne peut pas exister.

Fig. 1. Produits de la même entreprise, à gauche dans les années 40 (Frères Schiel) et à droite, turbosoufflante pour les moteurs Diesel dans les années 70 (Hidromecanica Brasov)

3. L’ENSEIGNEMENT PROFESSIONNEL TECHNIQUE

La qualité du corpus des travailleurs est évidemment une conséquence du trajet de formation et de l’expérience accumulées le long des années.
Les premières entreprises socialistes ont continué l’activité des entreprises nationalisées, et bonne partie du personnel est restée dans l’entreprise, travaillant avec la même habileté et attachement qu’il l’avait fait pendant des dizaines d’années pour le patron.

Tous les interlocuteurs, sans aucune exception, confirment le haut professionnalisme de ces anciens travailleurs. Dans la situation du manque de cadres d’après la guerre et de la nationalisation, bonne partie de ces travailleurs ont été installés sur des positions de contremaître (chef d’équipe), mais ça ne signifie pas toujours qu’un tel choix était adéquate. Il n’était pas évident que le meilleur travailleur soit en même temps un bon contremaître ou chef d’équipe. [7]

Sur le tracé de formation personne ne formule des verdicts défavorables, mais il est important que dans le système de formation se trouve des gens qui ont travaillé directement et ont été parmi les meilleurs dans leur métier. Dans ce sens, après la constitution de l’entreprise Tractorul, quand le besoin de travailleurs qualifiés était très important, l’école professionnelle a fait son devoir, la majorité des contremaîtres-formateurs, venaient directement de la production. Ils savaient très bien diriger la formation professionnelle des jeunes, étant, en même temps, des exemples de moralité. [6], [1]

Dans toutes les entreprises de Brasov on peut trouver des situations où le métier et la fidélité envers l’entreprise étaient transmis de père en fils, même sur trois générations. [5], [1], [8]

De même façon, on remarque chez trois de nos interlocuteurs, qu’il y a une grosse différence entre les travailleurs des années 40, 50, voire 60 et ceux qui appartiennent à la dernière période. Les premiers étaient préparés et ils réussissaient à faire face à une large palette de situations dans le montage et la technologie mécanique. Les dernières générations sont affectées par la monotone des opérations propres au travail des grandes séries et par le fait que le management est établi dans le moindre détail, au niveau le plus élevé, ne permettant une initiative personnelle et l’expression de la propre personnalité professionnelle, avec toute une série de conséquences malheureuses (le manque de motivation, par exemple) [5, [7], [1]

**4. PRODUITS INDUSTRIELS RENOMMES DES ENTREPRISES DE BRASOV**

Les interviewés ont travaillé sur différentes positions tout le long de leur vie active dans l’une ou l’autre des entreprises dont il s’agit dans cette étude.

*Hidromecanica* (ainsi dénommée après 1961), au moment de la nationalisation s’appelait Strungul et avant 1948 elle portait le nom de Frații Schiel (Frères Schiel). Dans la période entre les deux guerres et la première moitié du XXème siècle elle a été une entreprise mécanique d’exception, avec une activité diversifiée, la catégorie d’entreprise qui ne refuse jamais une commande. On y construisait en série assez courtes : autobus urbains, tours semi-automatiques, installations de pompage à chaîne pour l’exploitation du pétrole, moteurs semi-diesel sur une plate-forme mobile, waggonnets, concasseurs, constructions métalliques, même deux aéroplanes y ont été construits. Après la nationalisation, l’entreprise a suivi la même ligne (production diversifiée), concentrant pourtant la production sur les tours, les ouillages pour les constructions, l’industrie chimique et les chemins de fer. (Fig.1)
La production après 1958-1960 s’est beaucoup concentrée, suite à une longue collaboration (Fig.2) avec une entreprise d’installations de forage de Ploiesti, sur les convertisseurs hydrauliques de couple à aubes fixes (CHC-420-1A, CHC-650-2, -2L, CHC-650-5A, CHC-750-2) dans un intervalle de puissance 165-890 CV et avec des aubes réglables (CHC-420-P, CHC-650-P.1) dans un intervalle de puissance 136-680 CV.

Après 1964 on a assimilé une licence Voith pour les transmissions hydrauliques pour les locomotives : TH1 (TH1-AR) TH2, dans les domaines de puissance 1160-1300 CV, TH8 à inversion hydraulique 4 convertisseurs de couple et réducteurs avec deux régimes de travail, pour les locomotives de manœuvre rapide.

Parallèlement s’y est développé un atelier pour la production des turbosoufflantes : TS1-pour les tracteurs dans les domaines de puissance 130-180 CV, TS4 pour les moteurs de 2100 CV, la famille VTR200, 250 licence Brown Boweri et la famille ALCO, TS5, TS6 pour des moteurs beaucoup plus grands. [9]

Après l’année 1978 l’entreprise a acheté la licence américaine pour les transmissions hydromécaniques power-shift Clark, pour lesquelles a été prévue une longue série de fabrication, et une nouvelle location de production a été ouverte dans la ville, dans le voisinage de la plate-forme Tractorul, espace équipé avec des outillages d’usinage de dernière génération, conformément à la technologie imposée par le fabricant américain.[5]

L’entreprise de poids-lourds ROMAN S.A., ancien Steagul Rosu (Drapeau Rouge), développée sur la plate-forme de sud-est où, pendant la guerre, fonctionnait l’usine ASTRA, productrice d’armement (canons). Par une décision politique on a décidé d’y bâtir une usine de poids-lourds, produits importants sur le marché roumain (chantiers, armée, etc..) et, plus tard, sur le marché.
international. Après la nationalisation (étatisation communiste), le premier poids-lourd construit ici faisait partie de la famille ZIL (modèle soviétique). La production est continuée dans les années 60 avec deux marques très souvent rencontrées sur les routes du pays, Carpati et Bucegi, copiées, pièce à pièce d’après des produits FORD (USA), c’est-à-dire sans avoir la technologie originale et sans connaître les justifications constructives et technologiques du fabricant américain.

La plus importante licence acquise a été MAN, même dans ce cas, les choses ont été faites à moitié, parce que le moteur a été procuré d’autre part, et le résultat a été un hybride qui, dès le début, a nécessité un effort supplémentaire de design et il a inclus des risques accrus dans les essais et les homologations.

Les bureaux d’étude de l’usine ont fait tous les efforts d’adaptation du produit aux demandes des bénéficiaires intérieurs et extérieurs (parmi les plus constants bénéficiaires a toujours été l’armée). Une entreprise avec les dimensions de Roman S.A. ne pouvait pas survivre en attendant seulement les demandes internes. A cause de cela, l’une des préoccupations permanentes a été de trouver en même temps bénéficiaires et marchés, les plus stables possibles. [7]

Vers la fin, dans les années 80-90, une bonne partie des ingénieurs et des techniciens qualifiés ont travaillé pour la documentation, la technologie et les accessoires technologiques spécialisées d’une série de poids-lourds (25, 50, 100 tonnes) dont les plus grands (1500 pièces prévues), on a supposé d’être achetés par la Chine. L’intention était d’acheter les moteurs des États-Unis, mais, le partenaire américain a remarqué à cette occasion que 1500 poids-lourds de ce tonnage dépassaient le nécessaire du monde entier. Le projet était loin de la réalité, presque mégalomane, et il a consommé ressources financières, moyens techniques, énergie et intelligence sans le moindre résultat. [8]

ICA Ghimbav est une entreprise de constructions aéronautiques qui, en fait, reprend la tradition des usines d’avant la dernière guerre, IAR Brasov. Cette fois elle ne pouvait pas débuter avec des appareils destinés aux vols motorisés et, elle a dû ouvrir une autre location, la location initiale était déjà occupée par l’entreprise Tractorul. Un collectif restreint d’ingénieurs s’est agrégé dans un bureau d’études qui, dans le temps, a reçu des investissements pour ériger les halles de Ghimbav, situées à 5 km de Brasov. L’âme de l’équipe était l’ingénieur Iosif Silimon, diplômé en mécanique, spécialité aéronef et appareillages de bord. Il a récupéré un certain nombre d’ingénieurs enthousiastes qui voulaient à tout prix travailler en aviation, mais aussi une partie du personnel technique de l’ancien IAR.

La production initiale consistait en planeurs et moto planeurs (IS) qui ont gagné une certaine notoriété en Europe et même dans le monde. Malheureusement l’ingénieur Silimon est mort dans un accident d’automobile en 1981 et la production de planeurs s’était restreinte peu à peu.

A ce moment-là, une collaboration signée avec la France lance la production d’hélicoptères Puma, et plus tard, Alouette. [5]

Dans les années 1984-1985, profitant de l’expérience gagnée dans la construction d’hélicoptères français, surgit l’opportunité d’une production de grande série (1000 pièces) d’une licence soviétique, K-126, constructeur l’ingénieur Kamov, hélicoptère qui possédait un système ingénieux
d’orientation avec deux hélices sur l’axe vertical, en contre sens. En principe, on estimait qu’il devrait devenir un hélicoptère utilitaire très recherché.

![Image](image1.png)

Fig. 3. Délégation soviétique (à gauche) et les ingénieurs roumains d’ICA Ghimbav, en face de K-126, le premier et le seul hélicoptère réalisé d’après le projet soviétique (ing. Kamov), début de l’année 1989 (archive personnelle, Dan Pavalache)

Excepté le moteur et la transmission qui venaient de l’Union Soviétique, tout allait se faire à ICA Ghimbav et en Roumanie. Toute la production allait être achetée par le partenaire, c’est-à- dire, on travaillait pour l’Union Soviétique. Jusqu’en 1989 un collectif assez large d’ingénieurs de spécialité et de technologues ont travaillé seulement sur les dessins, sans avoir sous la main un seul exemplaire de ce K-126. Finalement, quand la fabrication pour la grande série a été complètement préparée et un exemplaire a été réalisé à ICA, une délégation soviétique y est arrivée pour les premiers essais, avec leur propre pilote. Les essais simples de vol de Ghimbav ont confirmé, la délégation soviétique est rentrée chez elle pour des essais supplémentaires avec celui qui a fait le projet et si tout marchait bien et les paramètres prévus étaient atteints, la production pourrait démarrer. Les événements qui ont ravagé l’Est européen ont laissé sans réponse la continuation de la collaboration. Ceux qui ont travaillé avec dévouement et passion 4 à 5 ans à la construction de l’appareil sont restés avec un sentiment de frustration.

L’entreprise **Tractorul S.A.** de Brasov était placée sur le territoire de IAR Brasov, dont elle devient l’héritier du patrimoine, de la célèbre entreprise d’appareils de chasse : IAR 80, 81 et Messerschmitt ME 109-G. Par la convention d’armistice et le traité de paix d’après la deuxième guerre mondiale, la production d’appareils de vol de Roumanie est interdite et l’entreprise doit se reconvertir pour une production de paix (civile).
KD-35 est un tracteur à chenilles, réalisé d’après une documentation soviétique.

MTZ-2 est toujours un tracteur soviétique, produit longtemps après, en Biélorussie.

Vers 1960 l’entreprise produit ses premiers tracteurs avec un certain succès à l’exportation, UTOS-26, 27 nom qui s’explique par le fait que dans cette période-là, la ville de Brasov avait été baptisée *Orașul Stalin*, c’est à dire la Ville Staline, et, par conséquent, l’entreprise productrice s’appelait *Uzina de Tractoare Orașul Stalin*. Fig.4

Après la disparition des entreprises mixtes de type SovRom, les ingénieurs roumains interviennent en remplaçant le moteur et exécutant d’autres modifications essentielles aux tracteurs.

Le nouveau produit s’appelle Universul 650, 650 M, un tracteur 100% roumain, peut-être le plus important concurrent sur la marché international de John Deer.

Les tracteurs UTOS et ensuite Universal, sont exportés en grand nombre en Hollande, France et Inde (en très grand nombre) à roues et à chenilles, et, dans l’étape suivante, au Brésil, en Egypte, en Iran (le plus important client depuis toujours). L’utilité, l’adaptabilité, la qualité et le très bon rapport qualité-prix permettraient, même aujourd’hui, de trouver des clients dans le monde entier. [1]

Après l’année 1970 a été assimilée une licence FIAT[1], avec une documentation technologique complète. La plus grande partie des sous-ensembles ont été fabriqués dans le pays, bien sûr, sous licence, c’est-à-dire, il y avait plusieurs industries horizontales qui travaillaient dans la production de grande série.

Un grand succès est enregistré aux États-Unis, où est installée une ligne de montage sous la marque Long, et plus de 60.000 tracteurs y ont été assemblés et vendus. Fig.4
L’entreprise a produit des tracteurs beaucoup plus puissants à chenilles S-1500 et S-1800, exportés en Pologne et en Allemagne de l’Est, le premier (S-1500) a été demandé en Union Soviétique pour des travaux dans les régions arctiques.\(^3\)

Le dernier grand tracteur industriel a été A-3600, utilisé tout au long des travaux lourds à la construction du canal Dunare-Marea Neagra (Danube-Mer Noire). Il est le résultat d’une collaboration moderne avec des producteurs de sommet (turbosoufflantes Clark, moteurs Scania). Après 2007 l’entreprise a fait faillit et la plupart de la surface occupée a été libérée de tous les outillages et les bâtiments industriels.

5. CONCLUSIONS

Les conversations enregistrées et les notes écrites des personnes interviewées mènent à une série de conclusions en bonne concordance avec les livres et les publications, en économie et activités industrielles.

La nationalisation (étatation) et le passage à l’économie socialiste (communiste) centralisée ont déterminé une fracture majeure dans la production industrielle de la Roumanie.

Les facteurs de décision locaux et centraux n’avaient pas, pour la plupart des situations, de compétences dans l’ingénierie, management et économie. Ils ne font que suivre de strictes objectifs politiques, pour la plupart non réalistes, utopiques jusqu’à la fin, dans la compétition mondiale industrielle.

L’évolution de la force de travail, dès 1930-1940 jusqu’à présent prend des aspects paradoxaux. La qualité de la force de travail déterminée par l’adaptabilité, l’initiative, la rationalité, l’implication, baisse au fur et à mesure que hausse la technicité du procès industriel, la complexité logistique du lieu de travail et l’activité spécifique dans le cadre d’une production de grande et très grande série.

La formation professionnelle d’un travailleur apprécié dans les années 1930-1970 assurait des connaissances fondamentales solides (fondation de l’adaptabilité personnelle), un sentiment élevé de responsabilité, la compréhension des phénomènes physiques et techniques, ce qui pourrait lui permettre l’exploitation innovatrice de la machine-outils ou des instruments, leur exploitation dans un esprit d’économie de moyens et de ressources.

Un travailleur dans la production de grande série est moins créatif, plus obéissant mais beaucoup moins attaché à son lieu de travail.

En essence, les nouvelles formes d’organisation de la production utilisent le travailleur comme un exécutant non-impliqué, et, apparemment cette attitude est agréé par le management global de l’entreprise.

Au niveau personnel il y a une inertie positive, trompant, (1950-1970) propre aux générations formées dans l’industrie capitaliste roumaine en expansion (entre les deux guerres), une inertie du système d’enseignement et de formation, qui continue l’éducation professionnelle et morale sur les principes indispensables d’une production de qualité.

Il est remarquable le fait de trouver dans la mémoire collective des anciens ouvriers et ingénieurs, quelques esprits tutélaires, personnalités accablantes, qui offraient le meilleur exemple
professionnel et morale, contournaienbient les obstacles politiques du moment, protégeaien
la valeur là où elle était évidente. Dans cette catégorie on retrouve dans tous les récits les noms de
l’ingénieur Iosif Silimon pour ICA Ghimbav [5] et de l’ingénieur Gorun Kassargian à Tractorul
[1]. Fig. 4

En ce qui concerne la rémunération, son effet stimulant est presque nul, le revenu salarial à
l’intérieur de l’entreprise se trouve dans un rapport de 1:3, sans tenir compte de la responsabilité,
implication, l’initiative, la compétence et, finalement, de l’utilité de chacun pour l’institution.

L’attachement et la récompense des salariés se réalisent par des systèmes collatéraux, quelques fois
avec l’implication et l’avis politique : liste en ordre prioritaire pour obtenir un logement, déplacement à
l’étranger, recommandations ou avis pour l’obtention de biens (déficitaires) domestiques, etc.

Entre les années 1980-1990 la production industrielle entre dans un déclin qualitatif parce qu’il y
avait une soif de devise forte. Cette pression a imposé l’assimilation de plusieurs repères et sous-
ensembles dans le pays, bien sûr, tout devait être fait en grande vitesse, ce qui a provoqué la chute
qualitative et la perte de plusieurs marchés importants.

Après 1990 et même après 2000 plusieurs grandes entreprises font faillite au moment où elles
sont confrontées avec l’alternative de renoncer à la production excessivement intégrée et en plus,
affaiblie par des lois financières inconnues (par exemple, l’inflation galopante de la première
décennie). Le monopole de l’État sur le contrôle de la devise forte a sous miné les affaires des
entreprises.

Dans la même période baisse la qualité professionnelle du corps technique, premièrement par le
laxisme et le manque d’adéquation du processus d’enseignement à tous les niveaux : ingénieurs et
formation de travailleurs industriels. En parallèle, la liberté de circulation permet à un grand nombre
de gens, avec une bonne qualification professionnelle, de quitter le pays et de travailler ailleurs.

Après 1990 et surtout après 1995 et 2000 on constate une timide reconstruction industrielle, mais
seulement un nombre restreint d’entreprises continuent leur production antérieure.

En général partout s’installent de petites entreprises, au niveau de quelques centaines de salariés,
partant de zéro, qui s’occupent de la production d’accessoires et de petits sous-ensembles des
grandes firmes européennes et mondiales. Ce sont de nouvelles implantations avec des employés
jeunes et le personnel instruit par leur propre service d’enseignement-formation.

NOTES
1. L’œuvre citée du Dr Ion Dumitrașcu représente une thèse doctorale élaborée à l’Université de Bucarest,
   coordonnée par le professeur Bogdan Murgescu.
2. On fait une référence à l’étude : Constantin Ionete, Criza de sistem a economiei de comandă și etapa ei
3. B.I.C. né le 9 décembre 1946, ingénieur à l’entreprise Tractorul de Brasov depuis 1968, une bonne
   période directeur technique de l’entreprise, à présent retraité actif, c’est à dire, il travaille en qualité
d’ingénieur consultant et ingénieur d’études dans d’autres entreprises de la ville. Interview enregistrée le
   19 juin 2014.


6. D.P. né le 6 octobre 1945, ingénieur diplômé de la Faculté de Technologie de la Construction de Machines de l’Université de Brasov. Il a été embauché par ICA (Entreprise de Constructions Aéronautique de Ghimbav) où il a travaillé jusqu’à la fin de sa carrière professionnelle en qualité d’ingénieur spécialisé dans la technologie mécanique. Interview enregistrée le 3 et le 10 juin 2014.


10. L’achat de la licence a été doublé par une subtile ingénierie financière de l’état roumain. Parallèlement, on a été initiée une importation massive de voitures Fiat, vendues ultérieurement vers la population avec de prix légèrement plus élevés. De cette manière, on peut dire que ce sont les possesseurs des voitures italiennes qui ont payé le cout de la licence, sans rien savoir.

BIBLIOGRAPHIE


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Abstract – After the Stalin’s death relations between the capitalist and the socialist camps had improved, but it didn’t led to the end of the "cold war." In this period the Soviet Union could not exist without interaction with the capitalist countries, and between the two camps had been launched economic, scientific and cultural exchanges. Official soviet propaganda continued to impose conceptualization of "moribund capitalism." However ideologues had to face many difficulties in explaining why Americans and Europeans were living better than soviet people. Soviet citizens began to travel outside the Soviet Union. Western art was extremely important, because it was the main promoter of Western civilization in the USSR. Favorite authors in the USSR were E. Remarque and E. Hemingway. Hemingway's influence on soviet intelligentsia was great. Modern trends in Western painting were interested most educated part of soviet society, in spite of all the efforts of soviet propagandists. Heroes of Western films became idols of soviet youth.

Besides legal ways of obtaining information about the West, soviet people used illegal sources: samizdat, tamizdat and so-called "Voices."

In general, Soviet society borrowed a lot of things from "the capitalist world." This was most clearly expressed in the informal youth movements such as stiliagi (like hipsters) and hippies. Jazz was really popular. A circle of people, who dreamed about their own businesses, gradually formed. America seemed to be an ideal place to live for them. There were people who tried to make money from the illegal distribution of western goods which quality were better than soviet. Despite the fact that the ideologues tried to deal with the penetration of Western fashion in the USSR, it gradually entered into an everyday life. In the middle of 1960-s, after the appearance of the human rights movement, political system of the capitalist world also received its supporters in the Soviet Union.

However, not only soviet society borrowed everyday life practices from the West. Soviet leadership inculcated ideas that the Western world was an ideal. The main soviet aim was “catch up with and pass the West.” Thus, America became the sample of a successful life.

Keywords – Thaw period in the USSR, Soviet yours, Dissidents in the USSR, Soviet mentality.

After the I.V. Stalin's death “iron curtain” that separated the Soviet Union from the rest of the world was crack opened. Information about life outside the socialist camp began to penetrate in the USSR through different channels. It was fragmentary data and they repeatedly corrupted in people's minds because of a well-functioning system of Soviet propaganda. Nevertheless, the idea of the Western countries started to form not only under the influence of official sources, such as speeches
of party and government officials, newspapers, news broadcasts, movies, school curriculum, but also through new channels of information. Study of archival sources shows that the real soviet people’s attitude to the capitalist world was multifaceted, ambiguous, although many people didn’t aware of this fact. Willingly or not, citizens of the Soviet Union changed their way of living and thinking, when faced with an alternative system, borrowing from Western neighbors some practices of everyday life, ideals, attitudes and material values.

The purpose of this article is to analyze the degree of capitalist camp’s influence on everyday life in the Soviet Union. It is necessary to examine the sources of data about the West in the USSR and to analyze ideas about the capitalist world in Soviet society, the way of transfer technologies in everyday life, as well as the Soviet leader’s reaction to all these processes.

Different aspects of this problem are clued in literature. Researchers pay special attention to informal youth movements in the Soviet Union, some of which were focused on the "American" way of life, or were a carbon-copy of Western prototype. There are also researches about the Western fashion in the Soviet daily.

In a separate group can be distinguished investigations, which tell about the ways of penetration of west information in the Soviet Union. It includes the study of samizdat and other "illegal" sources, Soviet citizen’s tourist trips, international exhibitions, etc.

The sociologists’ conclusions about the mentality of the Soviet man, made on public-opinion poll data, are of great importance.

Despite all this researches, the problem of focus in the soviet way of life on the western model is not disclosed. Existing studies are dedicated to a narrow topic, or are based on a very limited range of sources.

Soviet leadership tried to get a monopoly on information about the capitalist world. They tried to form “right” image of an alternative system in soviet society. Ideologists painted clear pictures of “moribund capitalism” and tell, how badly is outside the socialist camp. But Soviet citizens knew that the standard of living in Western Europe and the United States were higher than in the USSR. It was the main soft spot in the brainwashing. Ideologists tried to impress that only a minority that is making its wealth through exploitation of other members of society are able to buy fine goods in America. The capitalist world was declared a center of universal hatred, rivalry and greed. Soviet propagandists also stressed that there is no unemployment in the socialist camp in contrast to capitalist countries.

In the second half of the 1950-s citizens of the USSR had alternative sources of information about the West. Existence of some of them went with thaw in relations between socialist camp and capitalist camp. Other existed thanks underground activity of dissidents in the USSR.

Large flow of information about the capitalist world was going through soviet tourists who visited capitalist countries. Historian A.N. Chistikov looks into this topic.

At the same time sharply increased flow of tourists in the USSR. According to KGB data over a period of 5 years (1958 – 1963) about 250,000 foreigners from capitalist states visited Leningrad. Although contacts with foreigners were not encouraged, and foreigners themselves were under the control of their guides, individuals still found a way to communicate with them. Moreover, the soviet people, without installing direct contact with visitors from Western countries could draw
certain conclusions from their appearance: quality clothing, behaviors, technical equipment. Some students of soviet universities had a chance to learn side by side with students from capitalist countries. For example, 41 foreigners-capitalists studied in Leningrad universities in 1964.10

In 1959 the American National Exhibition was opened in Moscow. It was submitted to the ordinary life of an American family. Despite all the attempts of soviet propaganda to deflect attention away from this show, it was visited by 2 million people.11 Foreign-made products also contributed to the formation of ideas about life in the West. In the USSR only goods of poor quality were made.12 Fine goods from capitalist camp governed the attitude toward the West.

On the one hand all that led to the fact that the idea of the West as a world of well-being and prosperity was the main. On the other hand the official propaganda described America as a center of lack of spirituality, where the main purpose is to get a lot of money. Under conditions of total frustration, universal hypocrisy, mismanagement, lack of opportunities for free development there were people who began to imitate the West model (how they imagined it). Running your own business was prohibited by USSR laws. Black market in the 1950s wasn’t yet developed, but already appeared enterprising soviet citizens who were trying to earn money using the shortcomings of soviet industry. For example, Shamil Armas gathered a group of 25 people and organized a small production of nylon blouses. He was sentenced to 1 year imprisoned with probation and he asked to let him go to the West, where he could open his own business.13 Soviet propaganda named these people "speculators." The name farzovshik (black-marketeers) was given to those who engaged in buying imported things from foreigners for own use or resale.14

However western arts, literature and cinema were the main promoters of Western civilization in the 1950s - 1970s. In the USSR in this period foreign journals appeared, exhibitions of Western art were organized, theaters, orchestras and individual musicians came on tour.15

Despite the negative attitude of the soviet ideologues to non-classical painting, attempts of exchange in this area were made. In 1956, at the Hermitage the Picasso exhibition was organized for the first time in the USSR. During exhibition "individual visitors, mostly students, showed uncritical attitude to a formalist works of foreign art, considering Picasso as the highest achievement of the contemporary art world."16

Soviet youth were interested in western literature. Youth cafe "East" conducted a public-opinion poll on the theme "10 authors whose books you would take into space." E.M. Remarque headed the list.17 Besides the idol of the young generation in the USSR was Ernest Hemingway.18 He was imitated in style and behavior. In fashion came thick sweater combined with jeans, a beard and a pipe. Men tried to be terse and sparing of emotions and named friends "old man."19 Hemingway became an American ideal for soviet youth: he had simple desires (good food, alcohol and women) as well as "high" quality, such as courage, self-esteem. Hemingway’s language influenced Soviet literature.20

The western cinema dominated soviet society. Foreign films appeared in the Soviet Union after the WW2. "Stagecoach," "The Roaring Twenties," "The Thief of Bagdad," "Tarzan" can be called among the most popular films.21 Giulietta Masina, Brigitte Bardot, Alain Delon, Marlon Brando became idols.22 Soviet people as far as possible tried to wear hairdo like in the movie "Babette s’en va-t-en guerre," long coats, dark glasses.
Party and Komsomol have repeatedly raised the issue that foreign films are more popular than domestic ones. The head of the Leningrad Komsomol City Committee called "The Magnificent Seven" as the most popular film. 2 800 000 people saw it in Leningrad.\textsuperscript{23} Over a period of 9 months foreign films were visited by three times more viewers than domestic films in the cinema "Aurora."\textsuperscript{24} Secretary of the Leningrad Komsomol Regional Committee emphasized that "Komsomol already made remarks ... But bourgeois movies still dominate."\textsuperscript{25}

Constant cultural exchanges between the West and the USSR led to the fact that the myth of spiritlessness of the West was dethroned. Soviet citizens had the opportunity to learn the culture of Western civilization. Soviet intellectuals often drew inspiration from Western samples of literature, painting and music, and ordinary citizens in their daily life imitated western heroes, as they often were more attractive than the Soviet ones.

One of the most interesting reflections of Western culture in the minds of the soviet youth was the movement \textit{stiliagi} (smth. like hipsters). \textit{Stiliagi} - a youth subculture that emerged in the Soviet Union in the postwar period. Apogee of its popularity came in the 1950s. Participants of this subculture tried to emulate American youth’s appearance, style of behavior and outlook. Having a limited amount of information about life in the U.S., they actually developed their own world, far from the realities of America and Europe. Nevertheless, the fact of appealing to Western culture is interesting. Center of this subculture was the interest in jazz.\textsuperscript{26} However, not only informals preferred this style of music: soviet youth in general enjoyed listening jazz. Interest in jazz in the USSR was not welcome, and it can be heard only by using a semi-legal or illegal methods. Boogie-woogie and then rock-n-roll and twist became very popular thanks \textit{stiliagi}.\textsuperscript{27}

At the end of the 1950s this movement was abolished. But the elements of its fashion penetrated into popular culture. Soviet factories implemented some parts of the \textit{stiliagi’s} costume in daily life models.\textsuperscript{28}

Other informal youth movements changed \textit{stiliagi}. In the mid-1960s the first representatives of the hippies began to appear. This movement will be widespread in the 1970s - 1980s. Both ideology and behaviors of soviet hippies were identical to western ones.\textsuperscript{29} Besides legal ways of obtaining information about the West, the soviet people use alternative methods of extraction facts about Europe and USA. First of all, they were treated samizdat, tamizdat and "voices."

Not only political news, but also works of art, religious literature, etc. were distributed with samizdat. There was information about the West, its culture, important events, relationships with the Soviet Union.

Also tamizdat existed. This is a literature, which was published outside the Soviet Union and secretly delivered in the USSR. For example, in 1963 American tourists tried to bring in the Soviet Union booklets "How to become a U.S. citizen."\textsuperscript{30}

KGB considered that foreign radio stations broadcasting in the territory of the USSR were the main channel of "bourgeois ideology" in the Soviet Union.\textsuperscript{31} Soviet students explained listening radio "Voice of America," "Freedom," BBC by the fact that the soviet media did not tell the whole truth.\textsuperscript{32}
Political structure of the West hardly attracted the attention of soviet dissidents in this period. Analysis of the political ideas of soviet dissidents shows that only a few focused on rebuilding the USSR by the example of western model. Most of the dissidents believed that soviet socialism needed in reform, not destruction. They didn’t doubt Marxism superiority over all other political theories. However, in this case it is necessary to stipulate that Marxism itself had come to Russia from the West. Thus, people confessed Marxism in its original form, were influenced by the West.

Of course, we can’t ignore the fact that the West supported soviet dissidents. And it was reflected on their attitude to the capitalist world. However, supporters of the capitalist path of development used to dream about moving to Europe or the U.S. They considered impossible the reorganization of the USSR. Documents CPSU and the KGB fixed periodic attempts of illegal crossing the soviet border. In the USSR, also the movement of otkaznik (refuseniks) was originated: Jews, demanded to give them the opportunity to move to Israel.

But the exchanges of everyday life practices were not only through the rank and file members of soviet society. Soviet leadership itself has turned the capitalist world into a sample well-being. The speeches of soviet leaders, especially N.S. Khrushchev, were full of America. The main soviet aim was “catch up with and pass the West.” Thus, America became the sample of a successful life.

NOTES

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Abstract— West and East technology transfer played a remarkable, though ambiguous, role in the Finnish-Soviet trade during the Cold War. Throughout this period Finland and the Soviet Union had a bilateral trade relationship which was a political necessity, but also a economically profitable one, for both Finland and the USSR, a mean to ensure Finland’s dependability and to channel western technology??. The technological collaboration as a part of the bilateral trade was based on state-level agreements, but on the Finnish side the business was primarily run by private enterprises. This paper explores this intermingling of technology transfer, foreign affairs and private business in the Finnish-Soviet collaboration in shipbuilding. The paper has two cases: counter purchases demanded by the Soviet Union in conjunction with ship orders and an initiative of joint venture in ship design. I consider that the collaboration in Finnish-Soviet shipbuilding was multifaceted and delicate and the companies used technological transfer to promote their commercial interests. The study contributes to the discussion about the relationship between the political visions and the economic interest in the Finnish-Soviet technological collaboration during the last years of the Cold War period. The primary previously unexplored sources consist of Finnish archival material both from the public and private side (Finnish Ministry of Foreign Affairs and Central Archives for Finnish Business Records) and interviews with business and government representatives.

Keywords — Eastern trade, shipbuilding, scientific and technological collaboration, joint business

1. INTRODUCTION

During the Cold War period Finland and Soviet Union had a bilateral trade relationship in which the political, economic and technological dimensions were strongly intermingled. Previous studies have shown how many decisions related to the Finnish-Soviet bilateral trade were dominated by foreign affairs. This paper focuses on the role and motivation of privately owned Finnish companies in East-West technology transfer. It does this through studying cases of industrial cooperation, and joint production, from the perspective of the Eastern trade department of the biggest Finnish shipbuilding company at that time, Wärtsilä Marine (WM).
The bilateral trade was based on the clearing trade and payment system, in which export earnings from the counterpart are used to pay for the imports. The transfer of goods, products and services was coordinated by 5-year framework protocols and the implementation was monitored by the trade authorities from the two countries. However, from the perspective of a private enterprise the trade was not barter. The specific trade agreements were prepared, negotiated and accepted by Finnish enterprises with the Soviet foreign trade organizations (FTO). The Finnish shipyards got their payments in Finnish Marks which were freely convertible. The bilateral trade formed an essential complementary channel for export although the majority of the Finnish foreign trade remained multilateral and directed to the west. The share of Soviet export of the total production in Finnish shipyards varied between 48 and 90%.

Since 1950s the Finnish shipbuilders had dealt with steady and guaranteed Eastern trade. In the second half of the 1980s they faced the whirlwind of reforms of perestroika campaign that affected the established Eastern trade system, business networks and practices. In 1991 the share of Eastern trade was only 4.9% of Finnish total export.

The research literature of scientific, technical and industrial cooperation between Finland and the Soviet Union as a part of the economic relationship between the countries is mostly focused on the foreign affairs. Historical literature scrutinizing the turmoil in the last years of the Cold War, from the shipbuilding industry’s point of view, is still quite narrow, especially when concerning the research based on contemporary archival sources.

This paper also participates in the discussion of how “predicted surprise” the end of the era of the Eastern trade really was: how prepared were the Finnish companies for the disappearance of the bilateral trade and the privileged position of Finnish enterprises in Soviet markets?

Primary previously unexplored archival sources consisting of Finnish material both from the public and private side are utilized in this study (Finnish Ministry of Foreign Affairs and Central Archives for Finnish Business Records). The archival sources are complemented with retrospective material, memoirs and biographies. I have also conducted altogether 10 interviews with 11 interviewees as a part of my broader study about the transformation of Finnish shipbuilding industry.

2. VISIONS OF INDUSTRIAL COOPERATION AND JOINT PRODUCTION – JOINING UP COLD BUSINESS AND WARM FEELINGS

Characteristic for the Finnish-Soviet trade from the viewpoint of technology transfer, were that Finland exported mainly refined and processed goods and products, but imported almost only raw materials. In the Soviet Union during the 1970s, it started to gain straight a perception, that the structure of the super power’s foreign trade resembled colonial trade. Political pressures to diversify Soviet imports had an effect on shipbuilding business as the Soviet Union started to require counter purchases to be included in every ship delivery contract. Target share of Soviet products, material or components in a ship built in Finland and exported to Soviet Union was as high as 10-15%, but in reality remained between 5-7%.
In 1987, the discussion about increasing the share of counter purchases in ships to 25-30% rose in Moscow. Sudoimport, the main FTO for ships, announced that they were not allowed to sign the trade agreement without sufficient counter purchases. The increasing demands for counter purchases were problematic for Finnish shipyards, because there was no genuine demand for the products that were available to be imported from the Soviet Union. Increasing the export of machinery and equipment from the Soviet Union was also complicated by the fact that export should not be in competition with domestic production.

The claims to counter purchases increased at the same time as perestroika altered the operational principles of foreign trade in the Soviet Union, by intensifying domestic competition it diminished the marginal profits in Finnish shipbuilding, and the low oil price restricted the export quotas for Finnish industry. Shipyard managers, faced with the situation in which the Finnish authorities did not grant export licenses, required to export goods to the Soviet Union within clearing system. Simultaneously, the client organizations in the Soviet Union were unable to order ships to fill the export quota appointed to be exported to the Soviet Union.

The Soviet Union’s demand for counter purchases affected the maneuvers of Finnish shipyards, as they were desperately trying to maintain their advantageous position as an important channel for East-West technology transfer in the last years of the Cold War.

In the spring of 1988, Wärtsilä Marine made an initiative of a joint ship design office in the Soviet Union. The main argument in the discussions that followed was that the initiative would boost the image of the Wärtsilä conglomerate in the Soviet Union. As stated in a memorandum: “For the sake of our image we have to give [to the Soviets] something. We’ll play the role of an active partner.”

In principle, the proposition should have been everything that the Soviet Union desired. The urge to intensify cooperation between Finnish and Soviet enterprises had been frequently highlighted at the state level: The joint ventures and cooperation in the field of shipbuilding and ship design was specified as the first in the list of potential cooperation projects attached to the protocol of Scientific and technical cooperation that was just signed in 1988. The listed benefits for the Soviet partners included transfer of know-how from Finland to Soviet shipyards, training in the use of CAD, possibility to earn convertible currencies through export, increase in the export of Soviet components and machines as well as boosted imago of Soviet shipyards when collaborating with a western company.

During the summer 1988 the plan was shaped. The joint venture was to be founded in cooperation with Wärtsilä Marine, and the Ministry of Merchant Marines (Morflot) and Ministry of Shipbuilding (LRM) in the Soviet Union. The suggested shares of the shareholders were 30% for Wärtsilä Marine, 30% for Ministry of Shipbuilding and 40% for Morflot following that the majority was to be given to the Soviet partners.

In order to implement the idea, the shipyard company contacted the high political authorities on both sides. According to an internal memorandum, the reactions on the Soviet Union’s side of the table had been encouraging, at least enough to proceed with planning. During the summer 1988 the plan became more tangible and the focus of cooperation shifted from mere ships to cooperative
design and production of nuclear icebreakers in collaboration of shipyards of Wärtsilä Helsinki and Baltic shipyards in Leningrad. It seems that the joint venture initiative evolved from the indefinite imago-boosting campaign into a purposeful lobbying in order to get Soviet Union to order a third Taymyr-class nuclear icebreaker from Finland.

In the autumn 1988, WM continued negotiations with the Soviet actors. Although the attitude towards the joint venture presented by the politicians had been positive, the intended partners, Morflot and LRM did not value the benefits of the cooperation as high as the Finnish counterparts. Morflot, as a primary end user for the nuclear icebreakers was reluctant to partner in a joint venture that would sell icebreakers to third countries because it would not bring new ships to its use. The shipbuilding ministry was not interested in the joint venture without possibility to earn convertible currencies through exporting. On the other hand, WM refused to accept payments in rubles, and the Soviet partners lacked convertible currencies.

After December 1988, the third Taymyr disappeared from the Soviet list of ships to be ordered and the references to the joint design office disappeared from the archival notes. The next year 1989 Wärtsilä Marine was driven to bankruptcy and in two years Soviet Union had collapsed.

3. CONCLUSIONS

In the literature of the East-West technology relationships, the flow of technology from West to East tends to be emphasized. The scientific, technological and industrial cooperation has been presented as an alternative channel for technology transfer demanded by Soviet Union. The archival sources emphasized the efforts of the super power to get rid of colonial trade structure and the attempt of the Finnish company to avoid the restrictions caused by the bilateral trade system. Above all, the sources presented the Finnish shipbuilding company as a proactive player in the technology transfer, not just a passive pawn in the political game. It actively monitored changes in the Soviet Union and tried to adapt to them. Interestingly enough it tried to use the opening of the Soviet economy to create new ties to connect itself more closely to the Soviet economy instead of trying to get rid of the existing dependencies.

During the Cold War, the Finnish shipbuilding companies learned to use foreign politics to sell ships. They participated in the political game of technology transfer to earn profits, but they were also accustomed to using the political argumentation and channels to promote their interests. At the end of the Cold War, the game ended leaving the experienced players without a counterpart.

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As a statistical concept “Eastern trade” refers to the trade between Finland and socialist countries including CMEA countries, Albania, China and North Korea. Politically and economically most important was trade with Soviet Union that consisted 80-90% of the Eastern trade. In this study the term “Eastern trade” refer to the trade between Finland and Soviet Union.


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xvi All translations by the author.


xix I use the same abbreviation that is used in my archival sources, LRM, coming from the Finnish translation laivanrakennusministeriö.


DESIGNED AND ENGINEERED BY POLITICIANS?
THE IRON CURTAIN AS A FILTER OF
TECHNOLOGY TRANSFER

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Abstract—There are forms and channels of technology transfer which can be considered uncontrolled. Nevertheless, a great deal of technology transfer has always been and still is controlled but part of the control tends to fail. Naturally, companies supplying technology are most interested to control the transfer of their technology. In addition, many other stakeholders participate in the control of transfer. Recipient firms want to influence what kinds of technology are used in their premises as well as their economic environment. Furthermore, governments of the countries of both suppliers and recipients and even those of neighbouring countries sometimes attempt to use their power in selecting the transfer of technology. Because the transfer of technology tends to be under the surveillance of many stakeholders even in normal peacetime situations, this phenomenon was under a tight control in the exceptional circumstances of the Cold War. This paper focuses to study how the Iron Curtain operated as a filter of technology transfer. The applicability of the theoretical model is demonstrated and tested by examining some historical case studies of technology transfer between Finland and the Soviet Union. The paper argues that the Soviet Union did always not want to import the best available western technology but preferred products, which had primarily manufactured from Finnish raw materials and components. This policy forced Finland to invest in the production of some raw materials and components, which were not of the best quality or price competitive in the western markets. As the result, the trade with the Soviet Union on one hand diversified the composition of the Finnish industrial production. On the other hand, it made the structure of the industrial production more fixed. However, not all choices by the Soviet Union were politically motivated. Especially in the consumer sector some Finnish products fit Russian taste better than other. For example, for decades Finnish Viola soft cheese by Valio has been more popular in the eastern neighbour than in Finland. The political control of Russo-Finnish trade has considerably decreased but Viola still remains the most popular Finnish cheese in Russia.

The paper ends up to a conclusion that the transfer of technology in the Cold War period was a very complex issue. The choice of transferred technology did not depend only on political and economic factors; cultural and national preferences had also an impact on the assortments of product deliveries. Finnish exporters have always been aware that somewhat different products are preferred in the Russian market than in the western ones.

Keywords — transfer of technology, West-East trade, political steering, Cold War
1. INTRODUCTION

The Cold War period (1947 - 1989) was a transition from wartime constellations to low-tension ones. Circumstances during the Cold War were strained but without open military conflicts between the two big political blocks. Although these years have been described as a period of icy relations between East and West, the period, nevertheless, had another – cooperative – side. Under the epithet “peaceful co-existence”, various kinds of technology was exchanged across the “Iron Curtain.”

The transfer of technology tends to be the more complex and challenging process, the more different are political and economic systems and cultures between the supplier and the recipient. Therefore, circumstances of technology transfer between West and East during the Cold War were exceptionally difficult because politics was closely intervening in the business relations. Exporting and importing were controlled in West and East by both business enterprises and governments. One might wonder whether exchanged goods were chosen on political or commercial grounds. Classical examples were that in the 1960s and 1970s, the Soviet Union did not allow importing jeans or women’s tights from West, whereas western countries refused to export high tech, such as microchips and computers to the Soviet Union. In principle, the control to obey trade regulations was tight and even ordinary customers were demanded to follow the restrictions; for example, when I bought an Olivetti personal computer in 1985, the Finnish subsidiary of the manufacturer required me to sign a statement that I will not take my computer to any socialist country.

During the Cold War, socialist countries imported a considerable amount of western products emphasizing commodities what they lacked or supplemented the assortment of their domestic supply. These products often were somehow different from western companies shipped to other markets. This article aims to analyze how products were selected, engineered and designed for the West-East trade between 1947 and 1989. A research hypothesis is that the strained political relations – the Iron Curtain – modified the West-East trade as well as the transfer of technological change.

In general, the political frameworks of both supplier and recipient countries always influence on the trade relations and technology transfer, while cultural factors have some impact on them as well. These phenomena I have earlier examined by means of a theoretical model of technology transfer and especially by a cultural and societal filter, which I explain shortly in the following chapter.\footnote{27}

2. THE MODEL OF TECHNOLOGY TRANSFER

Countries seeking to industrialize generally can create only a tiny fraction of the up-to-date technology they need, so they are compelled to obtain foreign technology to modernize their economics. Those vehicles though which machinery and technological expertise are transferred from suppliers to recipients are called channels for technology transfer. Within specific limits, technology is a multidimensional phenomenon, and it can be transferred from one country to another in many forms and though various channels. Regarding economic and societal effects, it is significant in what form technology is transferred into a country and by whom. If it is obtained in
such a way that the recipient country is able to control neither the transfer nor utilization, then there is a risk that the recipient becomes dependent on the supplier of technology. Some types of technological expertise are also available easily without any obligation or at low cost from the world market. In that case, however, there is a danger that the recipient cannot exploit the acquisition of technology composed of separate, poorly compatible components, because the result may be an unworkable technological unit.

The channels that transmit innovations from industrial centres to the peripheries of the world can be classified in many ways. I consider the following eight channels, depicted in Table 1, the most significant.

Table 1. Channels for the inter-country transfer of technology

<table>
<thead>
<tr>
<th>Role of the recipient</th>
<th>Channels of transfer</th>
<th>Type of recipient</th>
</tr>
</thead>
<tbody>
<tr>
<td>P A S S I V E</td>
<td>1 Receiving direct foreign investments</td>
<td>Controlled</td>
</tr>
<tr>
<td></td>
<td>2 Importing foreign machinery and equipment</td>
<td>Controlled</td>
</tr>
<tr>
<td></td>
<td>3 Acquiring turn-key plants</td>
<td>Controlled</td>
</tr>
<tr>
<td></td>
<td>4 Acquiring foreign licenses and patents</td>
<td>Controlled</td>
</tr>
<tr>
<td></td>
<td>5 Setting up joint-ventures with foreign entrepreneurs or companies</td>
<td>Controlled</td>
</tr>
<tr>
<td>A C T I V E</td>
<td>6 Recruiting skilled workers, artisans, engineers, teachers and consultants from abroad or permitting mass immigration consisting of a large spectrum of people ranging from unskilled labour to various craftsmen and professionals</td>
<td>General</td>
</tr>
<tr>
<td></td>
<td>7 Encouraging and supporting nationals’ journey abroad for studying at foreign schools and universities, or training in factories, visiting international congresses and trade fairs, making contacts with foreign experts, etc.</td>
<td>General</td>
</tr>
<tr>
<td></td>
<td>8 Utilizing “natural diffusion” or the low-cost diffusion of easily accessible technology: the spread of know-how through trade and scientific publications, analyzing foreign products, etc.</td>
<td>General</td>
</tr>
</tbody>
</table>


**General vs. controlled channels.** From the viewpoint of a recipient economy, technology transfer may or may not include some sort of engagement or subordination. Technology transferred through general, unlimited channels is easily available and inexpensive. It is not, as a rule, bought from the original innovators but through intermediaries, or obtained from common accessible sources. In this case, the recipient makes the decisions on technology transfer; he chooses from
whom he buys and what. In the extreme case of the general transfer, the supplier gradually becomes an outsider, because he does not finally know where his technology spreads.2

In the controlled transfer of technology, there is always a supplier and recipient who both make decisions. In this case, the object of transfers is clearly defined and its price is generally fairly high. This type of technology cannot generally be purchased freely on the world market because it includes at least some secret or otherwise protected components of technological expertise. In the controlled transfer of technology, the supplier has the upper hand; ultimately, it is he who decides when and where his technology is transferred.

Active vs. passive recipients. The channels of technology transfer can also be classified according to which party is the most active in organizing and managing the transfer. In the case of controlled transfer, especially in direct foreign investments, the supplier is responsible and the most active party. In contrast, the general transfer of technology greatly depends on the activity of a
recipient country. It preserves the dominance of the recipient country in the transactions, and its autonomous efforts to gain technological self-sufficiency, although the hazards of dependence are involved in the case of supplier-controlled technology transfer to a passive recipient.

The channels of Table 1 have been utilized all over the world. If, however, an international comparison is made to determine to what extent various countries have used these channels, some clear differences in emphasis can be observed. Discrepancies can also be found in how the governments have favoured or discouraged the use of certain transfer channels. Many societal features of the recipient country – not only the government – have profound effects on the transfer of technology. As a result, it can be claimed that when a new technology is being transferred into a country, it should, in a way, be filtered through a “sieve” composed of various economic, political and cultural layers. This contextual filter affects the choice of technology as well as the channel through which it is transferred. The choice may essentially influence the pattern of adoption and its success. I have condensed my theory on the mechanism of technology transfer from the recipient’s viewpoint in Figure 1.

At least in theory, the assortment of potential channels for technology transfer is roughly the same for all countries, but the contextual filter is always unique and nationally defined. This filter is very polymorphous. It can selectively close one channel completely, obstruct the functions of another, give the third a free-hand, and overload the fourth. It does not generally remain stable over time but keeps shifting because of changes in government, foreign trade relations or the economic situation.

The societal and cultural filter of technology transfer is an ambiguous combination of various elements ranging from unconscious popular attitudes to strict laws. The societal and cultural filter compromises the autonomous mechanism that regulates the transfer and application of technology. The introduction of an innovation is successful only if the social environment of the recipient country is supportive of it. Therefore, technology transfer is not only a technical operation but also a societal maneuver. The crucial factor is whether there are effective and socially accepted methods carrying out the intercultural process. The technology itself and its transfer channels should be coordinated with the existing societal and cultural environment.

3. THE IMPACT OF THE IRON CURTAIN ON TECHNOLOGY TRANSFER

Strained political relations during 1947 – 1989 strongly affected trade relations of countries in general but in West-East trade in particularly. They created a dilemma of objectives: economies as a rule aimed to grow by increasing their exports but at the same time, they attempted to avoid exporting strategically significant and militarily useful technology to the rivaling political block. Furthermore, they often were reluctant to export their high-tech products or strategic natural resources to countries even in their own camp or neutral countries that might re-export them across the Iron Curtain. Foreign trade policy was contrasting, as well. Countries favoured close and liberal trade relations with those countries, which had similar political goals, whereas discriminated those, which had a different political system and dissimilar socio-cultural values.
The Iron Curtain had a great impact on the transfer of most modern, edge-cutting tool machines could be used to produce weapons, aircrafts, battleships, submarines and ammunition as well as such machines and components, which were primarily used in manufacturing products for civilian purposes but were possible to turn to producing military items.

As a result, products exported across the Iron Curtain were often without a military significance or they represented old-fashioned technology. Therefore, the division of the Gold War world hampered the exchange of the most modern and efficient technology between countries. This led to utilize the “natural diffusion” in technology transfer in an extensive scale. The products of the opposite block were frequently copied and imitated; afterwards the production lines of factories supplied clones for sale. East Germany was particularly active copying Western German technology and products as well as exporting its clones both to East and West. The patent agreements between East and West were not as binding as inside both blocks. At the same time, during the Gold War industrial espionage was more active than in any previous period. Therefore, in the tightly controlled and regulated world of 1947-1989, technology transfer was partly an uncontrolled activity.

Because of the political trade restrictions between blocks, the importance of neutral countries increased in West-East technology transfer and foreign trade compared to the pre-World War II period. It was easier for neutral countries operate as intermediaries in the exchange of technology and do business across the Iron Curtain. Part of this kind of exchange was not under the control of their governments. Capitals of some neutral countries, such as Vienna, Helsinki, Stockholm and Nikosia, were hotspots of political and industrial espionage and the embassies of both the US and USSR were unproportionally large compared to the size and population of these neutral countries. CIA and KGB collected information on technological achievements of the opposite block using legal and illegal sources, such as espionage and bribery. Siegfried Beer, historian and head of the Austrian Center for Intelligence, Propaganda and Security Studies (ACIPSS) has made an educated guess that still today 2,000 to 3,000 agents and informants work in Vienna. In the Cold War era, there were much more people working in this field. It is estimated that in Helsinki the amount of secret agents has returned to Cold War levels after a dip in the early 1990s. In 2005 there operated about 50 spies but no figure is available on informants.

The transfer of technology by espionage has always been under the political or other institutional control. The acquisition of technology through this channel has been steered above, and in these undercover activities, there is hardly anything spontaneous or “natural”. The information gathered through espionage was not always easy to benefit and apply in manufacturing. Therefore, it was a fairly expensive way to adopt new technology. Nevertheless, industrial espionage has brought a very strong element of political influence in the transfer of technology.
4. CONCLUDING REMARKS

The Iron Curtain had a role in technology transfer in the Cold War period. It increased the political and institutional steering of technology transfer and pushed aside normal business practices. In the regular West-East trade, raw materials, basic products and old-fashioned technology were in the centre, whereas a relatively small proportion of trade with high tech products slowed down the development of all countries but socialist countries especially. In the West, there was not much reliance on the eastern technology, which had various other obstacles to enter its markets. Eastern technology was transferred mainly to developing countries and neutral western countries. Countries, such as India and Finland, bought nuclear power technology from the Soviet Union, for example.

Differences in institutional and economic systems also hampered the West – East transfer of technology. For instance, Soviet trucks were found too small and inefficient, while electric systems of locomotives too clumsy and outdated for Finnish circumstances. On the other hand, the choice of transferred technology did not depend only on political and economic factors; cultural and national preferences had also an impact on the assortments of product deliveries. Finnish exporters have
always been aware that somewhat different products are preferred in the Russian market than in the western ones.

The Iron Curtain worked as a filter for technology transfer in both directions of West-East trade. However, it did not prevent the transfer and trade entirely. The Iron Curtain “leaked” in many ways, and technology was transferred between two political blocks. Nevertheless, economic impacts were harmful both West and East. Those detrimental impacts consist the price of the political conflict, which these blocks had to pay.

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Abstract — The discovery of oil and gas one hundred and fifty years ago, in Romania, United States and in further other states, has lead the way of human development towards a society based on hydrocarbons whereas the technical and technological competition between companies and states for the ultimate supremacy evolved and is still in progress.

In the past century, the two world wars and the most recent conflicts we were and are contemporary with (Falkland Islands war, Iraq, Libya, Syria etc.) began with and for energy resources which resulted in a fierce battle on the front of research and streamline of this field. The technical and technology transfer in many areas, including the oil and gas one, disregarded ideological barriers imposed by the “Cold War” so that, through legal methods (imported licenses) and “reverse engineering” (intelligence), it carried through.

Since the emergence of the “drilling method with rotary table”, discovered by the Romanian engineer Ioan Basgan which revolutionized the worldwide deep drilling technology and whose patent is still disputed by Romania and the United States, up to offshore drilling platforms, high pressure blowout preventers, drilling rigs for mining and transport for extreme weather conditions and to the controversial method of extracting shale gas, the transfer of science, engineering and technology knew and will know no boundaries.

Keywords — technique, technology, technologic transfer, „Reverse Engineering”, patents

1. INTRODUCTION

From ancient times until nowadays, the transfer of ideas, technique and technology has never encountered any borders and it will never do, the development of human society being the cause and the effect of scientific progress.

From the discovering of Greek fire, weal, gun powder, silk, all types of engines, vaccines, recipes and nuclear technology, etc., spreading methods remained the same: legal paths (purchase, exchange, donations) and illegal paths (theft by spying/reverse engineering or rape/direct theft). In
some cases, the inventors, researchers and scientists obtained, almost simultaneously, similar results.

Decisive factors which led to the spread of innovative ideas, civil or military, were information, society’s needs, and not few times, the desire for power of individuals or states. From the exceptional passage from the Bible, entitled the Exodus, where the brilliant way is revealed in which Moses led his people through desert by obtaining in advance information about the track that had to go through [1] and up to the famous Wikileaks telegrams and much recent Snowden case, it can be observed that only the methods have improved.

2. SHORT HISTORY OF SCIENCE, TECHNIQUE AND TECHNOLOGY TRANSFER

Coming back to the topic under discussion, without giving an exclusive Romanian nuance, I cannot help to quote the Romanian origins savant, the great inventor Henri Coandă, without whose exceptional world-class invention, the jet engine, the presence of many participants to ICOHTEC 2014, Brasov – Romania, would have been, if not impossible, extremely difficult: “What lucky would mankind be, if it would have more nations to bring it, proportionally with the number of inhabitants, at least as much as Romanian nation has brought in the past 120 years!” [2] I believe that our brilliant compatriot argued his statement by reviewing the most important of the exceptional achievements of some Romanians, which I will not enumerate here, the list being very long. I have thought to remind that Romanian inventors of all times have made their marks in almost all important domains of human society, among which:

- Conrad Haas[3], Hertman Oberth and Gheorghe Botezatu who have contributed to the initiations and development of American space programs;
- Petrache Poenaru, member of Romanian Academy and one the organizers of national education, invents in 1827, the predecessor of modern pen: “never-ending portable pen, which recharges itself with ink”;
- Alexandru Ciurcu, Traian Vuia, Aurel Vlaicu and Henri Coandă, the pioneers of engine aviation and jet engine;
- Victor Babeș, Gheorghe Marinescu, Ioan Cantacuzino, Nicolae Păulescu, Ana Aslan, I. C. Parhon, Ştefania Cory Calomfirescu, remarkable achievements in medicine;
- Founders of some new sciences as: Emil Racoviţă – biospeology, Gogu Constantinescu, sonicity. [4]

And the list can continue...

Obviously, Romanian achievements, as well as around the world, have not remained between national borders. Nor was it possible. Science, technology and technique, the spearhead of human society development, a living complex, dynamic, did not know along the time borders or hindrances studded the world as vegetation which pierces even the strongest barriers.

It would be impossible to make an inventory of technologic transfer between East and West, north and south or anywhere in the world, from technical point of view; in some cases even a shy attempt would mind a lot of people. But nobody can stop, for whatever reason, remembering some of the most famous examples from the last hundred years:
“clip” operation, through which the Americans, winners of the second world war, took the best of Nazis specialists, the constructors of the devastating rockets V1 – V2 which have terrified millions of London inhabitants, headed by Verner von Braun, and developed the space program, and also the nuclear arsenal [5]. The ex-USSR, was not far behind, took everything that could, as war prey, from Germany and Romania, including the assembling lines of aircrafts factory from Brasov or Malaxa car factory;

- obtaining by reverse engineering, by ex-USSR, the fabrication technology of atomic bomb;

- through same method Israel state, obtained the building plans of “Mirage” French fighter aircraft and built a modern air fleet, difficult to compete;

- bringing very discreetly in Romania, with the scope of copying, from an Arabic country, in the period of Cold War, of a modern tank of NATO forces endowment;

- through the method of “reverse engineering” or the exchange of specialists in the fields of oil, aviation, nuclear, chemistry and petrochemical, Romania benefited of an exceptional scientific, technical and technological input between the years 1970 – 1989, a few hundred patents from USA, Canada, England, France, Sweden, Italy, Japan, etc., being “revealed”/copied, improved, and the exported products in CAER member states (Czechoslovakia, Bulgaria, Poland, Hungary, Democrat Republic of Germany, ex-USSR, Moldavian Soviet Socialist Republic, etc.), but also in China, People's Republic of Korea, Cuba, Vietnam, Iraq, Iran, Jordan, Syria and many countries from Africa. On the other side, after 1990, many Romanian specialists have left the country and work in the above mentioned western states, but also in Spain, Netherlands, Belgium, Norway, Israel, etc. Very serious is the fact that many specialists from Romania work for companies and states from the democracy opposition camp;

- when leaving Romania, legal or illegal, before 1989, some specialists took with them exceptional scientific results and patented abroad top technologies. For example, the mediocre “Superglue”, sold on civil market, but with many applications in aviation, nuclear and military field, patented in many western countries, is actually the fruit of many years of research at a former famous inorganic chemistry research institute from Mediaș, Sibiu county. The Romanian product carried the name „cianofix”;

- a reality that we all live is that China, through its specialists managed to produce almost everything on the globe and should not be forgotten the episode a few years ago when China brought down a strategic USA aircraft and, after few month of study, the plane was returned to the owners, including the pilot, in perfect shape. Recently, on a visit to Bucharest, the American general Michael Hayden, 69 years old, former director of NSA (1999 - 2005) and CIA (2006 - 2009), currently counsellor of “Chertoff Group” consulting company in the field of security to which of the activities of intelligence agencies are being externalised, stated: “USA is stealing information to protect its citizens, and the Chinese to enrich them. No comment.”

- Israel and China cooperate in the field of collecting economical electronic information. At the World Economic Forum from Davos from January 2014, the Israeli Prime Minister Benjamin Netanyahu, met his Chinese homologous Wang Yi. Netanyahu declared that the meeting
constituted a reflection of the intense relations at the state level between Israel and China and his country desired further development of the bilateral cooperation in the field of technology (…). On his turn, Wang Yi specified that after the meeting due to the visit in Israel (December 2013), there were established five common commissions which have convened and that the addressed problems needed detailed discussions, especially for high-tech field. [6]

The examples could go on forever...

3. SCIENTIFIC, TECHNICAL AND TECHNOLOGICAL TRANSFER IN THE FIELD OF OIL – GAS, BOTH WAYS, EAST – WEST

I will not describe the Romanian or worldwide history of oil – gas industry evolution, but I will only emphasize some important moments.

It is a notoriety that in the year 1857 Romania was registered as the first country in the world with an oil production of 275 tonnes (mentioned in „The Science of Petroleum”). In 157 years of oil – gas industry, Romania has brought an undisputed scientific, technical and technological input, Romanian specialists being among the most appreciated in the field. [7]

An important technological bounce was the application of the inventor engineer Ion Șt. Basgan patents in the interbellic period and after that in the 1970’s, during the period of Cold War.

The first invention patent called “The method for efficiency improving and rotative drilling perfecting through percussive rotations and by depreciation of hydromechanical pressures” it is awarded to him in Romania for a period of 15 years by the Royal Decree n° 1579 from 1st of June 1934, published in the Official Monitor n° 142 from 23rd of June 1934, registered with number 22789 from 18th of May 1934.

The second invention patent is called “Rotative apparatus for drilling wells”, constituting the object of a request submitted to the USA Patents Bureau on 13th of August 1934 and on its bases, after a 3 years experimentation period (according to the American procedure), the Patent n° 2103137 is awarded to Ion St. Basgan and his heirs, on 21st of December 1937, for a period of 17 years.

In 1967, Basgan patented in France, USA, Portugal and United Arab Emirates the invention called “Rotative and percussive drilling system with sonic frequency, limitation of Archimedean pressure effect, and also the facility and the equipment in question”, through which it was overpassed the critical barrier of 8,000 m depth.

So, in 1970 he registers in USA another invention patent with n° 3507341entitled “Rotative drilling procedure and system with sonic vibration imposed on drilling fluid” which permits digging deep wells, e.g. up to 15,000 meters.

The importance of these patents of the Romanian inventor lies not just in the effects on economic plan of which the states of the world benefitted (shortening of drilling time, implicitly commissioning of wells, better security assuring of drilling process, etc.), but especially on the scientific point of view. The last patent registered in USA was used by Americans to overpass the impasse they faced in the competition of Ex-USSR specialists in the programs of piercing the earth crust (30-35 km.).
4. OIL GIANTS DISPUTE

In 1955, USA Sciences Academy savants started the “Mohole” scientific project, and in 1961, after more studies and researches, they started drilling near Guadelupa Island, near Mexico. Five year later, in 1966, the drillings were stopped because the financial costs of the project exceeded the allocated budget. The Americans drilled in granite only 180 m. They have restarted drilling near Maui Island, but they did not succeed even this time, to overpass 3,000m depth. At that time took place several mysterious phenomena, inexplicable shakes and heat waves which were regularly repeating. Even though these were not the reasons of drilling stop, but the fact that the drilling hoes proved to be too weak in the fight with granite, and the costs of the work were well beyond the financial resources.

After just few years, in 1965, after detailed studies, the Interdepartmental Scientific Council for the Study of Earth’s Interior and Deep Drilling (Межведомственный научный совет по проблемам изучения недр Земли сверхглубокого бурения) from USSR announces the head of the state and of CPSU that it is ready to pierce the Earth’ crust up to the depth of 25 kilometres, but it will take 30 years. Russians’ attempts of drilling and the search of the best place for piercing the crust started in 1967. The drilling point was chosen in the North – West of Russia, in Kola Peninsula, 10 km West from Zapoljarni city, near North Pole. The perimeter received the status of special area and it was surrounded with military guard.

In the spring of 1970, the drilling begins in force with the famous and complex drilling systems URALMAH 4E and URALMASH – 15,000. The width of the drilling well was set at 2.5 m. The drilling team was led by Ivan Vasilis, L. Batișev, I. Kuzņețov and C. Țericovski, considered some of the best engineer specialists in great depth drillings.

In 1974, the drilling hole got to the depth of 5 km. The temperature inside the drilling well was over 70° C, and this fact amazed the worldwide geology community which was not expecting such a high temperature on a depth of only 5 km. The amazement was even bigger when the depth of the drilling well touched 7 km and the temperature almost doubled up to 120° C.

In 1983, after 14 years of hard work, the Russian drilling hoes from Kola Peninsula reached 12 km depth. The last 6 km were traversed through the toughest basalt. The working methodology remained secret until nowadays and has given rise to various legends. Among them there are two very interesting. The first one says that from 10 km depth down, Russian technicians used a special system which was introducing melted metal in the drilling hole in order to soften the basalt.

The second legend says that from 10 km depth down, Russian technicians used small atomic controlled explosions with directed and local effect. In fact, none of these suppositions were confirmed. The drilling hoes used by Russian drillers had teeth of hard carbonate and had to be changed every eight hours. This way the drilling team reached in 1983 12 km depth. No one on the Earth had reached this performance before. One year later, in 1984, a technical accident occurred which led to the blocking in the drilling well of more than 5,000 m of tubular material. Unlocking took several years. In 1988 the drilling was started again. In 1989 it was reached the drilling depth of 12,262 metres, this being the greatest depth ever reached in stone of a drilling team.
The scientific results obtained through this great depth drill were really sensational and produced a real seism in geological sciences. In the first place, it was discovered that life on Earth started 1.6 billion years earlier than it was thought before. On depths where no one expected to find organic wastes were identified 14 species of fossil organisms in layers almost three billion years old. [8]

The drilling process was not spared of mysterious happenings. So, at 12 km depth, the sonar captured human screams, cries and groans of pain, like thousands of people would scream of pain from down the drilling well. Unconfirmed testimonials of some technicians say that at 12.262 m depth the drilling string reached a huge void with temperatures of almost one thousand degrees and that from that void screams and cry of pain of thousands of people could have been heard even more clear, but this fact has been officially infirmed. Symbolic, the workers from the drilling base named the drilling well from Kola “The way to Hell”.

Apart from these aspects it remains the reality. Russians were heading rapidly towards the greatest scientific performance: piercing the crust of Earth.

The drilling team reported that there existed all the premises that in 1993 the drilling hoes will reach 15 km depth or even 20 km, fact which would have practically meant the pierce of half of the Earth’s crust.

Already at 11 km depth under the layer of hard basalt, the drilling hoes had discovered an over one kilometre thick layer of tiles crumbs seated on a real ocean of water with more than one kilometre depth. This water could not go the surface because it was stopped by the impermeable layer of basalt. But its presence there it was an inexplicable and strange mystery. On the floor of this ocean it was a layer of boiling mud in liquefied hydrogen. In this mud the concentration of gold was 10 gr. of gold in a tone of mud. Such a concentration of gold can be found just in the best gold mines in the world. Generally, the concentration of gold per auriferous rock tone is 2 or 3 grams (rarely reaches 7 grams of fine gold per ore).

Digging deeper, the geologists discovered, to their great astonishment, at 12,2 km deposits of methane and even carbon. The Russian specialists were sure that the drilling hoes were approaching the hypothetic diamond layer of the Earth. If this had happened the order of the entire world would have been blown up. Removing to the surface few coaches of pure diamonds coal pieces sized, would have been blowing up world stocks.

The World Congress of Geology asked Russia to stop the drilling works. A delegation of the Congress went to Zapoliani to see the works. Some members of the delegation their fear regarding the fact that piercing the Earth’s crust could lead to an explosion of underground magma which once released under the pressure will spring out as a giga volcano triggering a cataclysm which could destroy the life on entire planet. It is therefore recommended to stop the works.

But USSR refused the suggestion. The works were being restarted. In 1989, it is reached the depth of 12,300 m, but a part of one of drilling well walls falls down and the hoes were being withdrawn at 12,262 metres, pursuing strengthening walls, to restart the drilling works. In 1991, due to political changes in Russia, the works from Kola Peninsula were stopped. Russia passed to a new way of thinking. Boris Elțin, the new Russian leader, declared that the communist ideology was a criminal ideology and that Russia had to take example from the states from Western Europe.
Therefore, in the new capitalist Russia the only type of works that could take place were the ones bringing cash income, financial profit and a lot of material wealth.

On the basis of this “advanced” way of thinking of Elțin president, the drilling works were stopped, the workers were fired, and the buildings of the centre, a part of the land and the equipment sold. It only remained the drilling hole from Zapoliarni, which is now under the administration of Grate Depth Geolaboratory of Russian Federation.

Immediately after Russia announced the stopping of the drilling works from Kola reasoning by the fact that in a capitalist state have to be carried only activities bringing cash income and material wealth, USA announced the start in force of three projects for piercing Earth’s crust: Marine Drilling Project, Oceanic Drilling Project and, recently, Integrated Project for Oceanic Drilling.

A closer analysis of the chronology of the scientific, technical and technological dispute between Soviet and American scientists, fully sustained by USSR and USA governments, emphasizes the not insignificant role of oil/gas specialists from Romania.

So:

– 1960 – In all fields of the industry of oil and gas, exploration, research, drilling, extraction, processing, commercialization of oil and petrochemical products, but also in the filed of oil – gas and mining equipment construction, it begins a new stage, with remarkable worldwide recognized achievements.

– 1964 – At the international Fait from Leipzig the drilling installation DH-250 “Made in Romania”, exceptional achievement of the specialists from “1 Mai Ploiești” Factory, obtains the GOLDEN MEDAL, surpassing similar American and Soviet products.

Fig. 1. Golden Medal at the international Fait from Leipzig the drilling installation DH-250

Fig. 2. Eruption preventers

– Two years later, in 1966, at the International Exhibition from Argentina, the homeland of South – American oil, Romanian drilling installations reach the depth record 5,300 m.

– 1967-1968 – Under the licence of “1 Mai” factory it is performed in premiere the eruption preventer and hydraulic command through the patents no. 53415 and 51810 of the Romanian inventors Teodor Toivici, Emilian Uleia and Petre Stroie.
Fig. 3. Depth drilling installations

Fig. 4. Marine platform for LEBĀDA deposit drilling

1968 – At the Expositional Fair from Ex – G.D.R., the drilling installations F – 40 and 4 – DH – 400, produced at “1 Mai” factory, register a new depth world record: **7,050 m.**

The visits in Romania made by USA presidents, Richard Nixon, Gerald Ford and Jimmy Carter opened the way for bilateral cooperation in many fields, including the oil – gas one. Americans were the one that, using satellite technology for geological investigations, made a friendship gesture and told to the leadership of that time of Socialist Republic of Romania (country which had the privilege of the most favoured nation), that in the Romanian continental plateau of Black Sea are big reservoirs of hydrocarbons.

1971 – With the support of the Americans, English and Canadians, the Romanian oilmen constructors together with researchers, specialists from sites and university professors, make “FOMAR” marine drilling installation which will be installed on “GLORIA” oil platform.

For the completion of this grate work of art contributed almost all socio-professional categories which constituted Romanian society of those times. From textile and leather workers, to metallurgists and electronists, power engineers, aviators, road workers, farmers, sailors, pharmacists and doctors, and especially oilmen, military and order forces, information and communication specialists, activists of the former communist party, journalists, servants of religions, but also ordinary people paid a high price materialized in effort and big renunciations, worked together to enrol Romania in the family of world super – oilmen.

**It is not too much if we consider that Romania’s effort to build the marine drilling platforms to conquer the underground of the continental platform of the Black Sea is equivalent with the effort of U.S.A. and Ex – U.S.S.R. to conquer the cosmic space.**

1974 – A national program to enhance the recovery from oil deposits is initiated.

1974 – The first deethanization station has been built to Piteşti.

1974-1975 – Brazi, Teleajen, Piteşti plants were modernized, there are being constructed modern petrochemical plants, with western technology and the final works for the opening of the Petrochemical Complex from “Midia” Năvodari are being accelerated.

1975 – The first marine drilling platform is fixed on the location on the Continental Platform of the Black Sea.

1979 – It is organized in Bucharest the 10th World Oil Congress.

Oil pipe network is developing rapidly, Romania having a modern standards network.
Grate depth drilling for research – exploration on sea and dry land was a prior objective of the last decade of 20th century. In the period December 1978 – January 1979, Romanian specialists in oil and gases confronted the second natural eruption from all times which took place at 5034 probe Mitrofani, Vâlcea county. At that time it was projected, constructed and used, for the first time a bell type preventor and also turbo fire extinguishers with Florex foam, which were using decommissioned MIG-21 plane engines. The ingenuity and courage of Romanian specialists amazed the entire world. In 1991, after Sadaam Husein’s army retired from Kuwait setting on fire hundreds of probes, Romanian oilmen, together with American oilmen and also from other countries, stood out by extinguishing the most difficult and destructive fires. Romanian oilmen from all times and especially the ones that extinguished fires, the cinematography immortalized their courage, professionalism and humanitarian spirit in the excellent movie “The salamanders’ nest”.

− 1984 – “7000 Băicoi” probe, Prahova county, reached 7.025 m depth. This fact wouldn’t have been possible if, apart from grate depth drilling installation, Romania would not have several high performance steel plants which were producing the tubing pipes and drill pipes, and also the famous hoes with diamond (the factory had been built with Swedish, soviet and American technology obtained through reverse engineering/industrial espionage), but especially without highly professional human capital. [9]

5. INSTEAD OF CONCLUSIONS

While U.S.A and U.S.S.R. were trying to pierce Earth’s crust, Romania was preoccupied to find oil and gas at greater depths and was trying to apply innovating technologies to contribute to the enhancement of hydrocarbons in the probe hole. According to some confidential statements made by the regretted Prof. PhD. Eng. George Iordache, my PhD supervisor from the Petroleum - Gas University of Ploiesti, one of the most famous specialists in the world in the field of marine drilling and large diameters drilling, Romania was preparing before 1989 a technology based on nuclear mini – explosions. This fact was surpassing the controversial shale gas exploitation through the method of hydraulic fracturing. Former leadership of the country, worried about disturbing the geological balance from Southern region of Romania (the map of geological faults from the South of the country looks like a zebra), postponed the application of these technologies, even more after the earthquake from March 1977.

During the period 1960-1968, the brilliant Romanian geologist Prof. PhD. Constantin Beca, together with the Russian professor I. Visotky, address in the paper “The geology of oil and gas deposits” the inorganic theory of hydrocarbons according to which these would be renewable, without excluding the old theory, the organic one, launched by Lomonosov savant. It is a paper that surprises the international scientific community, not agreed by western savants, even if the theory of the two professors proved to be supported by practical results by discovering in many areas of the world oil and gas deposits of inorganic origins (Vietnam, Siberia, U.S.A.) [10]. During last decades, the re-evaluation by American savants of this theory offered the possibility to develop shale gas exploitation technology by “hydraulic fracturing”, a technology at most advanced scientific frontier.
I do not know if this paper brings enough arguments regarding scientific, technical and technological transfer from different fields in various directions, but I am convinced that the presented examples can represent, for those interested, new investigation tracks of the complex phenomena of human knowledge spreading.

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[3] This information was collected from an old manuscript discovered by Prof. Doru Todericiu, in 1961, at Sibiu library. The list of the mentioned inventions in the manuscript contain: two storey rocket firing (1529); three storey rocket firing (1529), rocket battery (1529), flying house (1536), necessary combustion on multi-storey rocket principle experimentation (1555), stabilizing delta shape wings use (1555). „Fling house”, air powered by rocket, was nothing else but the anticipation of space cabin used by cosmonauts beginning with the 50’s! In the paper were also mentioned the powders of Ioan the Romanian (Hans Walah) from Alba Iulia.
FROM A CONTRACTOR TO RUSSIA TO A CONSTRUCTOR FOR THE SOVIET UNION 1900-1960: THE CASE OF FINNISH SHIPBUILDING

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Abstract — This paper examines the development of Finnish shipbuilding in the context of Russian and Soviet maritime needs. During the first half of the 20th century Finnish shipyards went from being fully dependent on Russian commissions to relying on limited domestic markets and developing technology with Germany via navy development programs. After the Second World War the industry underwent an unprecedented expansion. Throughout this period Finland was in a peculiar position between the Cold War lines. I will explore the scope and nature of Finnish ship exports to the Soviet Union and their connection to western technology in the context of the development of Finnish shipbuilding.

Keywords — shipbuilding, foreign relations, war reparations, technology

1. INTRODUCTION

Shipbuilding transformed from a limited domestic industry into an export powerhouse in Finland between 1944 and 1960. The role of Soviet trade in this transformation is fundamental. War reparations forced Finland to invest heavily in the industry and later the Soviet Union offered ample trade opportunities for Finnish shipyards until the 1980s. This story dominates present day discussion on industrial history in Finland so completely that earlier Finnish reliance on Russian markets has been forgotten. I argue that the technological development into a modern industry happened over the period from 1900 to 1960.

As an imperial grand duchy Finland had toll protection within Russian markets through the nineteenth century. After developing alongside Russia, Finnish shipbuilding industry was unprepared to compete on open markets when the connection was severed in 1917. Interwar modernisation was done in close naval cooperation with German specialists. After the Second World War, Finland had to pay war reparations to the Soviet Union, which necessitated a doubling of metal fabrication capacity between 1944 and 1952. Afterwards the industry had to find its niche between Cold War lines. Finnish shipbuilding gave the Russians a reliable route to outsource production, to test the limitations of U.S. led CoCom policy, and to tie Finland to the Soviet sphere of influence. In this paper I will therefore ask the following questions. First, in what way did Russian and Soviet demand shape Finnish shipbuilding? Second, how important was the German naval interlude in preparing the industry for the late 1940s expansion? And finally, how significant were these foreign connections to the emerging industry?
2. SOURCES & METHODOLOGY

My research is based on public and shipbuilding companies’ records. These include the war reparations bureau Soteva archives, and various ministry and military records in the Finnish National Archives. Most constructors’ surviving records and the industry central association archives are in the Central Archives for Business Records, Elka. Most of these collections are fairly extensive, and in some cases little researched and even poorly organised. Consequently I have limited my efforts to Finnish sources, while fully acknowledging that a more balanced view would be achieved by using Russian and German archives. I will therefore use a wide body of literature to provide context for the archival materials.

A key part of my research is to compile a ship construction database from various sources. While other researchers have collected the construction records of individual shipyards, no such database exists. Previous efforts have been published in company histories and can be described as ship lists. They have omitted information that would be useful for quantitative analysis. Using such methods I can identify trends and changes from the source material and select representative cases for further qualitative analysis. This database is an integral part of my ongoing doctoral thesis work, and subsequently these results are preliminary.

3. RESULTS

3.1. FINNISH SHIPBUILDING AT THE TURN OF THE TWENTIETH CENTURY

In the late 1800s Finland was by European standards an underdeveloped country in terms of metal industry and ship construction. Lack of capital, low employment costs and limited domestic demand hindered the development of industry. While unable to compete on Western markets, Finnish shipyards did well in providing the Russian state from the 1870s onwards, as Finland was one of the more developed areas in the empire. By the end of the century western countries were moving to steam-powered and steel-hulled ships. This led to an overabundance of second-hand tonnage in the markets and a slow-down in domestic demand. As a result Finnish shipyards focused on serving Russian government needs. A number of metal works and shipyards were founded in the Finnish capital Helsinki after the Crimean War. They largely relied on work from the Russian Baltic fleet. Between 1880 and 1917 Russian clients, mostly the government, ordered four out of every five ships built at the Crichton shipyard in Turku. The shipyard also founded a subsidiary in St. Petersburg that seems to have built little else than government vessels. The industry was slow to develop despite a short boom after the Russo-Japanese war and another in 1914-1917. Domestic liner traffic started to expand around the turn of the century but this was not enough to build a stable industry on.

3.2. RESTRUCTURING THE INDUSTRY

Through the 1920s, Finland suffered from a lack of investment. Forestry dominated the industrial field and was almost solely responsible for exports. By 1924 the shipyards’ books had emptied. The situation was made worse by a wave of cheap second-hand tonnage from abroad. Companies
started to merge in order to rationalise their operations. Smaller companies fell one by one to the hands of the Wärtsilä Consortium. By 1937 it had also bought both Crichton-Vulcan and Kone ja Siltarakennus to create a near monopoly in shipbuilding.9

Crichton-Vulcan took the first steps to restart Russian trade in 1932 by building a series of fifteen tugboats and a small river tanker. The boats continue an earlier tradition of riverboat construction in Finland. The first vessels had a steam engine, but this was changed in 1934 to diesel. The engines were similar to the ones the shipyard had recently installed in Finnish naval submarines. At this time international shipping markets were recovering and the few remaining shipyards received orders from various companies. The new ships were significantly larger than before and featured new technology and increased winter traffic capabilities.10 This change in shipbuilding had started with a recent navy program.

3.3. THE NAVY AND THE GERMAN CONNECTION

Before independence Finland had no military forces. The navy was founded on the few remaining ships the Russians hadn’t been able to evacuate in 1917. Like the Imperial Baltic Fleet it was both materially lacking and technologically dated.11 After immediate national needs were met the issue of developing the military was raised in the Parliament. Naval officers prepared numerous plans for the defence of Finland’s extensive coastline. They received advice from British specialists and younger officers were sent to study in Italy.12 The major shipyards observed these developments and at least Crichton developed plans for new naval vessels based on their existing knowledge on Russian naval construction.13 The naval rebuilding plan was approved in 1927. It was a compromise between grandiose ideas and fiscal realities. All possible construction was to be done domestically and the program was linked to the viability of shipbuilding in Finland.14

Finnish shipyards had thus far failed to convince officials of their capabilities.15 Therefore shipyards quickly aligned themselves with foreign specialists in preparation for the competition. The government hired a German submarine specialist to oversee the program. The submarines were almost completely designed by a Dutch company Ingenieurskantoor voor Scheepsbouw that had been set up by German submarine specialists following the Versailles Treaty.16 The navy plan heralded new production techniques such as welding and the use of diesel-electric systems in Finland.

3.4. THE WAR REPARATIONS AND A NEW DIRECTION FOR FINNISH INDUSTRY

The metal industry boomed during the Second World War due to wartime needs. New shipbuilding went on as the shipyards continued work on their pre-war orders. The navy repair dock in Helsinki was also transformed into a construction yard to meet wartime needs. On the western coast steps were taken to develop new repair and construction capacity.17 Wärtsilä showed initiative gain during the short interim peace by negotiating a new tugboat deal with the Soviet import authority Mashino import. While the boats were eventually sold to Germany after the war broke out again, this demonstrates the company’s tendency to look for potential markets.18
Finland started to look for a way out of the war in 1944. While both government and business leaders were expecting fiscally heavy terms, the Soviet demands still came as a surprise. The war-worn country needed machinery and ships. After longwinded negotiations with the British, Finland was told to pay reparations worth of 300 million US dollars in 1939 value to the Soviet Union, most in metal manufacturing products and ships. The government set up the Soteva war reparations bureau under the ministry of trade and industry to oversee the process. It had full authority to work with the Soviet bureau for reparations.\textsuperscript{19} The reparations included a great number of wood-composite vessels, for which there was little expertise. To get these done in time, new companies Laivateollisuus and Hollming were jump-started with significant government funding.\textsuperscript{20}

The first two years were fraught with difficulties as construction materials were hard to come by and knowledge of Soviet standards and methods was wanting.\textsuperscript{21} New companies relied on the expertise of Soteva and the most experienced constructors to make the plans. Quality issues still crept up as the yards were being built alongside the ships, and Soviet inspectors played by the book.\textsuperscript{22} By 1947 things started to get into a working system that was subsequently kept in use as the two countries migrated from reparations into bilateral trade.

### 3.5. Finnish Shipbuilding as a Cold War Go-Between

While there had been few technological innovations in the war reparations program, the first Finnish-Soviet trade agreement in 1949 brought new challenges for the shipyards. Evidently the Soviet Union could outsource its harbour and merchant marine needs to a foreign provider.\textsuperscript{23} New larger icebreakers were added to the plan. They would later become an important part of Finnish shipbuilding. Ship production began to diversify in the 1950s thanks in part to the Soviet trade. From the start different companies approached this in a variety of ways. There are indicators of an over-capacity in production, which in part led to continued demands of rationalisation in production. The companies’ different strategies also seem to be linked to this post-reparation situation. While the Soviet Union had an agenda in keeping Finland in its sphere of influence, it did pit shipbuilders against one another in competition for orders. If however, a single company clearly had a dominant product, there would be no competition but negotiations were handled directly.\textsuperscript{24}

### 4. Conclusions

Finnish shipbuilding in the twentieth century can’t be understood without the Russian and Soviet connection. While the industry has been prone to fluctuations, it has also actively sought opportunities in the East. The 1920s downturn was initially solved with a national building program that brought in German expertise. The war reparations provided a practical model for Finnish-Soviet trade that allowed inexperienced shipyards to continue developing their operations. The Finnish government acted as an intermediary throughout this period. All foreign trade was publicly controlled and official help was often needed to secure resources. More research is needed to understand this emerging national, industrial complex and its relationship with the Soviet Union.
ACKNOWLEDGEMENTS

I would like to thank Katariina Mauranen, Saara Matala and Michael Halila for commenting on the manuscript and providing much needed insight.

NOTES


Technology in Times of Transition

10. “Laivalistat 1-4,” (SMM); A good example is the Bore II that was later turned over as war reparations, see Luovutus- ja vastaanottopöytäkirjat, Ha:1, Ship department, Soteva, KA; Sipilä, “Laivanrakennusta itsenäisyyden alun vuosikymmeninä,” 61; Kari Teräs, “Turkulaiset telakat: sataman naapurit,” in Turun sataman historia, ed. Jussi T. Lappalainen (Turku: Turun satama, 1999), 322.


13. The information is based on Crichton-Vulcan Company documents held in Turku Regional Archives. Mikko Meronen to the author on 13.5.2014.


21. Muistiot, Hb:10 (Soteva).

22. This is based on an overall impression from Soteva and companies’ archives. See Neuvottelut, Hb:2, Ship department, Soteva, KA; Harki, Sotakorvausten aika,159-172.

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Memoirs


Official documents

Sopimus Suomen hallituksen ja Sosialististen neuvostatasavaltain liiton hallituksen kesken tavarantoomituksesta Suomen taholta niiden vahinkojen korvaamiseksi, jotka Suomi on sotatoimillaan ja alueen miehistyllään aiheuttanut Neuvostoliitolle. Helsinki: [s.n.], 1945.


Books and articles


Correspondence

Abstract — Technological gap in the development between both sides of iron curtain became obvious already during the 1950s. Along with the détente-era communists countries managed to import some vital technological solutions by purchasing production-lines or signing license-agreements with France, West Germany or Great Britain. However, real high-tech, especially in such branches as automatic control or power engineering, was either protected by private companies interested in maintaining its monopoly and export, or embargoed by western governments inspired by the USA.

My paper claims that, in order to evade various legal restrictions in international trade, the Soviet Union encouraged satellites-states to launch massive clandestine undertakings. Furthermore, Moscow’s intelligence service instructed and trained their colleagues from Warsaw, Prague or East Berlin in the area of scientific and technical espionage. KGB also organized this multilateral intelligence-relationships, by designing a complex system of information-exchange. After the collapse of the Soviet Union, in most former communist countries, documents of the intelligence service had been declassified and made available for historians. In Poland these files are stored and accessible in the Institute of National Remembrance (Instytut Pamięci Narodowej - IPN). Files of the scientific-technical intelligence covering years 1986-1990 are exceptionally well preserved and they allow detailed reconstruction of the Polish-Russian cooperation in the area of industrial espionage during the last five-years plan carried out by the countries of the Council for Mutual Economic Assistance (so called Comecon).

Analysis involved tasks-descriptions passed from KGB to Polish intelligence as well as Polish reports on debriefings with the representatives of the Russian partner. Insight in those files enables to estimate the profile and the quantity of smuggled and exchanged material as construction-documentation, chemical samples, components, entire devices etc. Moreover, we can point out targeted countries, state’s corporations or private companies. Both sides exchanged experience in recruiting, handling and paying agents, which will be also discussed in the paper. The emphasis is put on the Russian partner, because the activity of the scientific-technical arm within KGB in the late 1980s – comparing to the previous period – is still not enough examined by historians.

Basic conclusions are as follows: the amount of the information being shared was growing systematically during the second half of the eighties. The spectrum of Soviet interest in the area of science and technology was rather evenly distributed between the civil and military applications. Electronic and IT as well as biotechnology and chemistry dominated information-stream, making heavy industry and energetic a secondary field of activity.

Keywords — technology, intelligence, espionage, cold war, (Poland, Soviet Union)
1. INTRODUCTION

To begin with, I want to stress that until now there has been insufficient research on the topic of Soviet branch of Scientific Technical Intelligence (STI) of PGU (Pervoe Upravlenie – KGB’s department responsible for foreign intelligence) in the time of Perestroika. Obviously there were some chapters or scattered fragments devoted to this topic published in western countries as well as in Russian Federation, like for instance in Sergey’s Chertoprud’s book on Soviet industrial espionage\(^1\), or even in Kristie’s Macrakis’s study focused on East-Germans so called Sektor für Wissenschaft und Technik within Stasi’s intelligence service\(^2\). Soviet’s espionage-activity during the first three decades of the cold war has been revealed by Christopher Andrew thanks to the famous Mitrokhin-Archives\(^3\). Numerous PGU’s operations carried out in the beginnings of the 1980s, in turn, became known to the public as a result of betrayal of officer working for the PGU’s Scientific Technical Intelligence Vladimir Vetrov and subsequently so called “Farewell affair” in France in years 1981-1984\(^4\). However, what happened afterwards in the Soviet STI is still missing\(^5\).

How to fill this gap? The spectrum of interest of the PGU on the eve of the USSR’s collapse could be – I believe - reconstructed successfully through analyzing documents of the former KGB’s partners in East-Central Europe\(^6\). An excellent example make files of Polish intelligence stored and available for researchers in the Archive of Institute for National Remembrance (IPN). I decided to exploit this opportunity and browse correspondence between Polish and Soviet STI from the period of time between 1986 and 1990. Due to my present knowledge similar correspondence from the Seventies and first half of the 1980s was destroyed before 1990.

I examined documents focusing on such questions as: 1) qualitative-trends in the Soviet STI-gathering i.e. preferred areas of technology, 2) quantification of exchanged materials, 3) furthermore, I tried to discover the organizational rules of collaboration between these two asymmetric partners.

Probably the most significant thesis, which results from my hitherto studies, is that the spectrum of Soviet interest in area of science and technology had been more balanced, than it was assumed and presented in most works on KGB so far. I recon namely that the search for solutions applied in the civil economy was almost as important as the quest for military technology.

\(^1\) Sergei V. Chertoprud, Nauchno-technicheskaia razvedka ot Lenina do Gorbacheva (Olma Press: Moskva 2002).
\(^3\) Christopher Andrew and Vasili Mitrokhin, The Mitrokhin Archive. The KGB in Europe and the West (Gardners Books: London, 2000).
\(^4\) Éric Merlen and Frédéric Ploquin, Carnets intimes de la DST. 30 ans au coeur du contre-espionnage français (Fayard: [Paris], 2003).
\(^5\) For example there are only few references to science and technology in the recently published studies on English MI-5 and MI-6: Christopher Andrew, The defence of the Realm. The authorized history of MI 5 (Penguin Books: London, 2010); Gordon Corera, MI6: Life and Death in the British Secret Service (Phoenix: London 2012).
\(^6\) About individual special services along with intelligence-branches within the socialistic block see more: Krzysztof Persak and Lukasz Kamiński, eds., A Handbook of the Communist Security Apparatus in East Central Europe 1944–1989 (Warsaw: IPN, 2005).
2. BACKGROUND & ANALYSIS

The Soviet STI\(^7\) under command of general-major Leonid Sergeievich Zaitsev\(^8\), launched its industrial and scientific espionage-operations foreground against high developed countries as well as toward companies established in these countries, ignoring on the whole regions such as Sub-Saharan Africa, South America and with some exceptions China. However we can observe growing concern about rising economies in Middle East and India\(^9\), as well as in South-East Asia (Singapore, Taiwan or Malaysia). The later region was interesting for PGU because of its close ties to aviation companies from North America (as Being, McDonnell Douglas, Northrop etc.), Western Europe (Airbus, Aerospatiale, Marchetti/Agusta, Messerschmitt Bölkow-Blohm, British Aerospace) and Japan (Mitsubishi and many others)\(^10\).

Regarding technology as a point of view, there is a pretty good insight into the Soviet agenda in the beginning of the Gorbatschev-Era. In March 1986, Poland received from Moscow two lists with targeted technologies. I assume the date is not accidental, and the demands of the Soviet STI were in fact major requirements of the USSR’s five years plan, performing in years 1986-1990.

The First catalog came into existence almost for sure in the Military-Industrial Commission (Woienno-Promyslienna Komisiia) of the Council of Ministers of USSR\(^11\) and was covering in its complete version 52 or a bit more topics related to military technologies. However, in the memo passed on to Poland, there were only 26 topics (a half). Perhaps the reason was the operational limits of Polish STI or Soviet reluctance to share all its needs with the Polish government. It has to be emphasized that mentioned below enumerated topics are representing the priorities relevant for scientific and industrial progress of the USSR. Some of these technologies were already at that time in possession of Soviet Union and they only needed to be up to date. The others, however, were planned to be intercepted from the western countries, because USSR was unable to develop them using its own research-capabilities. Moreover, we have to take into account the fact, that some of the “wanted” military technologies presumably did not exist at all at that time, although they were believed by Moscow to be designed by the US Air Force in order to attack USSR\(^12\).

\(^7\) Its formal name was Directorate T of PGU KGB, while officers assigned to external operations in foreign countries were called representatives of “Line X”.


\(^9\) This country was particularly important as a rising consumer and producer of geneic modified products for agriculture and food-industry as well as a perspective so called silicon valley. See for example: Archive of the Institute of National Remembrance in Warsaw (AIPN Wa), vol. 37, Memo No 9117 from Ministry of Internal Affairs of PPR for KGB of USSR on progress in microelectronic in India, Warsaw, 18.11.1986, p. 60-62 (PDF-file).


Among 26 topics I distinguished four basic groups:

1. Weapons of mass destructions (fission and fusion bombs, chemical and biological weapons) including innovative solutions for the space war (American Strategic Defense Initiative – SDI\textsuperscript{13}), like laser, beam, plasma or electromagnetic weapons, furthermore geophysical weapons (able to disturb climate, generate fog or rain, activate Volcano, induce earthquake or tsunami). This group counts eight topics.

2. Conventional weapons based on the ground, sea, and in the air (vehicles, planes, ships and submarines including solution for the acoustical isolation of atom-reactors), also rocket-systems (like Submarine Launched Ballistic Missiles), stealth technology and remotely piloted unmanned vehicles. This part of the list contains seven topics.

3. The third group includes eight topics supporting both the first and the second group such as: command and control systems, radio-electronic warfare, anti-missiles defense systems (detecting, acquisition, tracking, targeting), weapon-guiding systems for ground and air forces, fifth-generation computers (12 billion operations per second), microwave- infrared- and UV- radiation.

4. In the fourth and last group I placed three remaining various topics: organization of the arms industry (increasing of products-durability), intelligence gathering and counterintelligence (equipment, methods, especially in the area of en- and decryption), as well as the most peculiar question – China's air and navy defense- and strike- capabilities (the only one state orientated topic)\textsuperscript{14}.

The second list passed on to Poland, probably prepared in the Committee for Science and Technique of the Presidium of Council of Ministries of USSR\textsuperscript{15}, counted 29 out of total 43 original topics (two-thirds) (related to civil technology). Also this time I distinguished four main areas of interests:

1. Chemistry and biotechnology covering among others organic synthesis (products of oil-, coal- and shales- processing and polymers), applications of genetic in human-medicine (antibiotics, vaccines), farming (steroids, feeds) and agronomy (herbicides, growth promoters) (10 topics).


\textsuperscript{14} AIPN Wa, sign. 02271/21, vol. 22, part 2, The list of priority issues of science and technology with military applications, [1986], p. 258-269 (PDF-file).

\textsuperscript{15} Although files of the PGU KGB are remaining classified, we can read some documents of the Committee. They are stored and accessible for the researchers in the Russian Federal Archives of Economy in Moscow (RGAE), Fond No 9480 (Gosudarstvennyi Komitet Soveta Ministrov po Nauke i Technike): http://opisi.rgae.ru:8099/scripts/uis/rgae_any.php?base=mysql:rgae&list=1627&sort=litnum&idObj=1520609 (access June 17th 2014)
3. Atomic- and conventional energy producing and providing, including technology applied in Pressured Water Reactors as well as superconductivity-phenomenon (7 topics).

4. Metallurgy as well as methods applied in searching, exploration and processing of various natural resources (especially coal- and oil- mining) (3 topics)¹⁶.

So far I did not found a similar complex list of topics delivered from Polish STI to the Soviet partner. However, there are a lot of short lists of demands passed on from Warsaw to Moscow by individual divisions of the Polish STI i.e. division V responsible for chemistry, biotechnology, food-industry and building-industry, division VI handling particularly topics related to IT, electronic and machine-industry, as well as ground- and air-transportation, or division VII dealing basically with heavy industry, shipbuilding and mining¹⁷.

Now I would like to tell a bit about organization of information-exchange between Poland and USSR. In the years 1986-1989 many tasks set out in 1986 were cancelled, while some new ones were added; others in turn were modified and updated. Those changes were made either through the memos exchanged by mail or were discussed during the bilateral meetings, which took place either on the level of individual STIs divisions (for example those responsible for microelectronic and programming)¹⁸, or on the level of STI-leaderships in Moscow and Warsaw. Soviet demands were usually expressed and described in details in so called Orientirovka (I found over a hundred of those documents)¹⁹. It was a kind of memo, which included analysis of ordered technology – its construction-specification, industrial applications, owners (states, companies), as well as the glossary, where the English (less often German) technical terminology was translated into Russian. There were also at least twelve meetings organized between December 1985 and December 1989 (some additional were planned to take place during 1990), among them three high-level conferences and nine working debriefings, three for each main areas of activities, mirrored in the organization of STI services in Poland and USSR: chemistry and biotechnology; electronic and IT; energy and heavy industry²⁰.

¹⁶ AIPN Wa, sign. 02271/21, vol. 22, part 2, The list of priority issues of science and technology with civil applications in economy, [1986], p. 246-257 (PDF-file)
¹⁷ During the second half of the 1980s Polish STI was initially guided by colonel Konrad Bicyzk, then by lieutenant colonel Henryk Jasik. More on structure, organization and operations: Miroslaw Sikora, „Firma. Służba wywiadu a postęp technologiczny w PRL” [The Firm. Intelligence service and technological progress in Polish People’s Republic], CzasyPismo, No 2 (2012), p. 142-151.
¹⁸ Detailed information on structure of STI PGU KGB see: Pawlikowicz, Aparat centralny [Central Apparatus], p.194-205.
¹⁹ AIPN Wa, sign. 02271/21, vol. 22, part 1-2 (concerning military affairs) and vol. 16 (concerning civil economy and military affairs).
²⁰ Compare: AIPN Wa, sign. 02271/21, vol. 37, Memo No 8939/PPR for KGB USSR and attachments No 1 and No 2, Warsaw, 19.04.1986, p. 431-441 (PDF-file); ibidem, vol. 31, Report on meeting with representatives of STI PGU KGB USSR and attachment No 2, July 1988, p. 54-69 (PDF-file); ibidem, vol. 21, Chief of the Division IV in Department I to Chief of the Division VII in Department I, Warsaw, 25.03.1986, p. 384-385 (PDF-file); ibidem, vol. 21, Chief of the Division IV in Department I to Chief of the Division VI in Department I, Warsaw, 25.03.1988, p. 386-388 (PDF-file); ibidem, Chief of the Division IV in Department I to Chief of the Division V in Department I, Warsaw, 25.03.1988, p. 389-390 (PDF-file); ibidem, vol. 31, Report on working-meetings with representatives of [special] services of USSR taking place
The mutual evaluation of exchanged intelligence-information proceeded with use of two main ways of communication mentioned above – assessments were delivered by each partner several times a year either per post or during meetings. The grading scale contained following five rates: 1. very valuable, 2. valuable, 3. interesting, 4. informative, 5. valueless. According to the well-known random Gaussian distribution of probability about 70-90% of exchanged portions of data were qualified as interesting or informative. Approximately half of captured data was finally applied in industry. For instance out of the material delivered from Poland to USSR in 1986 35% had been finally implemented, one year later it was 55%.

There were certainly many frictions between the partners. During the meeting in Warsaw, in spring 1988, Russians complained that the time-limits proposed by Poles for the execution of the task are often too short. In turn, on the conference devoted to IT-issues, organized in December 1989 in Moscow, Polish envoys pointed out that Soviet specialists do not deliver assessments of the material received from Poland timely. Standard time for evaluation was 3-6 months.

Apart from mainly technological information, both partners exchanged experiences in modus operandi especially regarding money transfers, material transport and various embargo countermeasures. For instance, in Polish memo written after the meeting in Moscow in December 1989, we read about the modern trends in PGU-operations, which Polish colleagues became familiar with: “If five years ago even 50% of topics were related to the acquirement of devices, then nowadays, devices make only 15-20% of submitted topics. [Russians] are now preferring to buy entire production-lines and design-documentation [instead of patterns of single devices – MS].”

From the same report we learn about tactics applied by Soviets in order to avoid detection of money-transfers from PGU for agents or other sources, enlisted in western countries. According to the knowledge of Russian experts, American intelligence services were able to detect and track each individual banking transfer exceeding over 1 million USD. That is why it was recommended to divide every bigger amount of money into smaller transfers. The other rule said, that only in exceptional situations and regarding solely the most trusted sources, payment on account was possible. However, such a prepaid should not exceed 10% of the total cost, while 80% was to be paid after the delivery and preliminary check of the illegally purchased device or technical documentation; the remaining 10% was transferred after the warranty time had expired.
In subsequent chapter I will limit results of my investigation to the quality and quantity of exchanged information on science and technology, because I did not yet elaborate proper methodological instruments to measure effects of Polish-Soviet discussion related to methods and means of spying on the one hand and avoiding of American surveillance on the other hand.

3. RESULTS

Let’s use statistical approach in order to measure the outcomes of the information-exchange. Graphs 1 and 2 below present quantity of exchanged so called portions of documentation. Definition of such a portion is very elusive. One time portion could mean for example manual guide for some innovative peripheral device applied in DEC-computers, or production-pattern along with construction-documentation of some crane, lathe, vehicle etc. Other time it was for instance complete documentation of streptomycin-production including proportions of individual components and technological requirements, sometimes also sample of chemical substance.

1. First of all we see the constant growth of the delivered material in both directions.
2. The second important observation is the domination of two sectors: electronic and IT on the one hand, biotechnology and chemistry on the other hand. This is evident especially in Soviet information-export to Poland. In the years 1985-86 information passed on in these two areas generated 76% of entire transfer; in the period of time 1987-88 this coefficient rose up to 87%, and even after significant fall in the years 1988-89 it still gave 63% of exported information.
3. Another relevant feature of information-exchange between Poland and the Soviet Union, that I want to point out, is the fact that the military technologies, at least regarding its quantity, played only a marginal role in mutual cooperation.
4. Finally, there is the question about the sudden stream of economic analysis and solutions provided to the USSR by Polish STI in the last documented period of collaboration. I cannot explain why there were no working meetings dedicated to the economic issues, and why economic topics were marginalized in both mentioned lists of topics from March 1986. Among the operations conducted by Poles, which were in interest of USSR, were those aimed at the World Bank and the International Monetary Fund, especially in purpose of capture the Revised Minimum Standard Model, used by World Bank-experts in order to assess the financial credibility and general economic capability of Eastern Block26.

26 AIPN Wa, sign. 02386/65, Files of the Operation Crypt. “Alter-Ego”, carried out in years 1986-1989 by the Division VIII of the STI (responsible for economy and natural resources).
Graph 1

Graph 2
Source: Own calculations based on figures from: AIPN Wa, sign. 02271/21 (see documents listed in footnote 20).
2. CONCLUSIONS

There is quite a promising insight into the Soviet agenda in the area of STI in the beginning of the Gorbachev-Era, in the documents stored in the IPN. Basically, the Soviet STI had a very wide interests regarding eligible technology, but at the same time it limited operations to the major capitalist countries like the USA, Japan, and the members of the European Community. The spectrum of Soviet interest in the area of science and technology was rather evenly distributed between the civil economy and military applications. Electronic and IT on the one hand, biotechnology and chemistry on the other hand, dominated the information-exchange with Poland (but not necessary with the other participants of Warsaw Pact or Comecon). Soviets shared – although perhaps not entirely - with Poles experiences in modus operandi regarding money transfers, clandestine transport of material and various embargo countermeasures.

Regarding the upcoming investigation it has to be already emphasized that there is for sure an asymmetry in the access to the former classified documents of both Polish and Soviet STI. However, the missing elements from within the KGB could be perhaps replaced by talking advantage of the documents produced by the other relevant Soviet institutions indirectly involved in the planning of the intelligence-targets. I mean the for instance Committee for Science and Technique\textsuperscript{27}, or War-industry Commission.

REFERENCES


\textsuperscript{27} We can find there for instance many analysis regarding Polish-Soviet official collaboration in the area of science and technology, at least for the 60s and 70s. Compare: RGAE, Fond 9480 (GKPSMpiNT), Opis 9, Delo 948 (Microfilm), Perechen’ tehnikheskoi dokumentatsii i obraztsov, peredawamych organizatsiammi Sowetskogo Soiuza Pol’skoi Narodnoi Respubliki w 1969-1970 gg, p. 6-9; ibidem, Perechen’ tehnikheskoi dokumentatsii i obraztsov, peredawamych organizatsiammi Pol’skoi Narodnoi Respubliki Sowetskому Soiuzu w 1969-1970 gg, p. 21-22.


TRADING WITH THE IDEOLOGICAL ENEMIES

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Abstract — Despite restrictions at various levels, exchange and cooperation between East and West existed, rendering the Iron Curtain, metaphorically speaking, permeable. In the 1960s and 1970s, the industrial need for Western innovations, machinery, and thus currency pushed the liberalization of trade policies with the rest of the European countries considered as capitalist - in opposition to the communist ideological and economic order. Bulgarians attempted to develop trade relations with non-communist countries, even though establishing contact with “ideological enemies” officially went against Cold War animosity and the government’s restrictions of free movement of people and goods. Bulgaria’s export and import policies, however, show that the state was less of a monolithic actor and operated on many levels. Civil servants working in the foreign trade area were entwined with Bulgarian embassies and state security agencies. The paper examines the promoting abroad of Bulgarian scientific and technical achievements in industrial yoghurt manufacturing in the 1970s. Bulgarian yoghurt was successfully promoted abroad in part because the Western yoghurt market was already well developed.

Keywords — iron curtain, export of technology, yoghurt, Bulgaria, communism, trade

1. INTRODUCTION

The paper is based on a research of Bulgarian yoghurt technology, starter cultures and know-how development in the 1960s, and their export from the 1970s on notwithstanding the limitations of the Cold War. On their part, by appropriating yoghurt which was considered a traditional Bulgarian product, dairy companies in industrializing countries like France, Germany, and Finland further reinforced the image. The appearance of Bulgarian type yoghurt on foreign markets changed the context of yoghurt consumption and adapted it to the specificity of the local markets. To trace these processes various sources have been used. The archival materials were a predominant source for studying the development of industrial dairy production and yoghurt export polices. The archival materials were a predominant source for studying the development of industrial dairy production and yoghurt export polices. Particularly the collections of Central State Archive in Sofia containing files on the state governed dairy plant Serdica (nowadays LB Bulgaricum Ltd), the major dairy producer in the Balkans from the 1970s until the 1990s. The researched documents on the negotiations and contracts between the Bulgarian state and foreign firms revealed that the export policies and appropriation of Bulgarian yoghurt abroad were located in the economic enterprise Rodopaimpex’s. The trade with yoghurt know-how and
Technology was both a process of identity manufacturing and export, but also an example of a state embarking on international trade politics. In that sense, the Central State Archives have not been sufficiently investigated either by Bulgarian or foreign scholars. The specific policies and the way trade organizations and companies functioned abroad have been insufficiently explored, with one exception. In a book published in 2009, *The Empire of the Communist Interventional Trade Companies* (Империятназадграничнитефирми), Bulgarian investigative journalist Hristo Hristov offers an analysis of communist trading companies based on archival research. Unfortunately, Hristov’s study is a general overview of Bulgarian trade organizations but does not go into details. His analysis concentrates on the smuggling of goods and weapons through case studies of internationally based Bulgarian trade organizations. His analysis aims to present the international trading organizations’ role in socialist Bulgaria, but only describes how these structures were used for illegal purposes. Concentrating mostly on the “dark side” of Bulgaria’s communist regime, Hristov does not discuss why the international trade enterprises (ITEs) not only had exclusive rights to represent Bulgarian firms abroad, but were also the sole form of official trade communication between Bulgaria and the non-communist world.

That article concentrates particularly on the role those organizations played in exporting technology and know-how for the production of Bulgarian type yoghurt. The organizations responsible for the international trade in dairy products acted as mediators between two different political and economic systems. In that sense, locating and researching “Rodopaimpex” files was crucial for my research. The dual character of the ITEs - functioning abroad and subordinated to the Party-state regime in Bulgaria - shaped the trade organization as a hybrid form that appropriated the characteristics of both systems. That specific feature of the ITEs enabled the transfer of goods, people and knowledge between the power blocs and thus re-connected them.

The major limitation of the above described sources is that they represent only the official discourse. The oral history methodology as well as the interviews with contemporaries were used as background source to make the story more vivid, but were also useful in a sense to verify my own material. All the interviews were conducted according to the methodology of the unstructured interview. Two interviewees, Maria Kondratenko and Todor Minkov, were “insiders” from the State Governed Dairy Plant Serdika and major actors in industrial yoghurt making, particularly in the creation of innovative technologies and starter cultures. The opportunity to talk to Todor Minkov, who worked in Bulgarian yoghurt export, was equally valuable. In the same years, I conducted two in-depth interviews with him.

2. **ANALYSIS**

The division of Europe into East (communist) and West (capitalist) after the Second World War influenced Bulgaria as part of the communist bloc. The struggles between the established power blocs resulted in a competition between the two systems, each one aiming to demonstrate its supremacy.
The communist project was the choice that post-war Bulgaria made. The state-and-party propaganda outlined a regulated state, with centrally planned economy, a state that made private ownership illegal and nationalized all existing business entrepreneurships. The Party line was toward industrialization of all production spheres; it enforced the establishment of large technological systems and the introduction of mechanization in the production process. Instead of the small private dairies that appeared in the biggest Bulgarian cities before the Second World War, Communist Party-State enforced the establishment of large dairy production complexes that were centralized and regulated by the state. Industrialization permanently changed the basic characteristics of Bulgarian yoghurt.

Scientists and dairy specialists at university and the established in 1963 Central Experimental and Production Laboratory for Pure Cultures (CEPLPC, a unit headed by the young and prominent microbiologist engineer Maria Kondratenko) sought how to adapt the yoghurt production technology to the industrial production and how to accomplish full automation of yoghurt production. In 1965, the scientist Tonyu Girginov developed a new technology for producing fully automated yogurt. The advantage of the technology was that it could be adapted easily according to the consumers’ preferences, but also to different yoghurt production cycles. That dual characteristic of the technology was crucial when exported later in the 1970s. Girginov’s invention became known as a New Technology for Production of Bulgarian Yoghurt. That naming of the technology shows that the industrialization of yoghurt production was not only a process of its mechanization but also a process of creating a national technology and national product. Further actions in that regard were conducted as an ambitious project that Central Laboratory started in 1968. By collecting, selecting and cultivating strains for producing the typical yoghurt Kondratenko’s team came to define what the typically Bulgarian yoghurt was. They defined in the scientific literature the symbiotic relationship *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (the two species crucial for making true Bulgarian yoghurt”) as a typical characteristic of a product named “Bulgarian yoghurt.” That symbiosis supported the mutual growth of the two types and each species benefits from that co-existence. The recreation and reproduction of that symbiosis in laboratory-selected starter cultures for industrial yoghurt production was the very process of manufacturing authenticity for an industrial product. Three years of research and thousands of experiments later, in 1972 the laboratory developed seven symbiotic blends of *Lb. bulgaricus* and *St. thermophilus*.

Further steps toward yoghurt “manufacturing” as a national product and technology were scientists’ efforts to prove the advantage of Bulgarian yoghurt over similar products. In the 1970s and 1980s many Bulgarian microbiologists, biochemists, and physicians collaborated with the researchers at the Central Laboratory in studying the health benefits of the strains of *Lb. bulgaricus* and *St. thermophilus* isolated in Bulgarian yoghurt samples. Evidence was provided in a few articles published also internationally. Thus science became an instrument for the authentication of Bulgarian yoghurt, while the scientists acted as promoters of its uniqueness. The scientific experiments helped to boost national pride and create an image of extraordinary Bulgarian yoghurt, but they also made good business sense for export. Reinforced by the national myth of origin and
superiority, people refused to believe that good yoghurt could be produced elsewhere - it could only originate in Bulgaria. This popular belief turned a blind eye to the export of cultures and know-how for yoghurt production. Export was perceived as further proof of the superiority of “our” yoghurt. Hence, science became a tool for nurturing the notion of Bulgaria as a unique sense of place, and was therefore the only place where the Bulgarian yoghurt was manufactured.

The Bulgarian state saw the economic potential of that innovation, not only for its dairy industry, but also for export to the international dairy markets. This explains why several years after its invention later, the Gerginov method of yoghurt and the starters were patented. Those patents might seem strange as communist regimes generally did not pursue such things, but in the 1970s, Bulgaria started intensifying trade exchange with the West, a policy aimed at reducing the state’s currency deficit. Reconsidering the economic effects of the patents, Bulgaria exported know-how and technology instead of selling a difficult to transport end product with a very short shelf-life. The fascination in respect of the scientific achievement affected not only the export politics but also the only understanding of what is Bulgarian yoghurt. Bulgaria’s culture and traditions remained in the background when Bulgarians promoted yoghurt abroad. This strategy was related to their urgent need for hard currency, forcing Bulgaria to focus on selling high priced technologies instead of direct commerce and product marketing.

At the end of 1960s the already well-established European and American yoghurt market seemed prominent, however, did not guarantee the quick success of Bulgarian yoghurt abroad. Yoghurt’s characteristics, Bulgaria’s centrally planned economy, export politics and commitment to the communist bloc all complicated the quick popularization internationally. The significant divergence between the market and a planned economy also hampered the exports. The activities in a planned economy were strictly divided into production and distribution spheres. As a result of this overall policy, the dairy industry was only passive actors in the distribution of their products, as well as in the export negotiations. Producers were absent in international trade activities, substituted by mediating organizations as the state-governed trade organizations named International Trade Enterprises (established in 1960s) that complicated the dialogue between producers and international partners. Only ITEs were allowed to carry out transactions, to lead negotiations and explore foreign and non-communist countries markets.

Only a limited number of people from the State Security Services, Ministries of Foreign Trade, and Food and Agriculture had access to information about foreign trade organizations and their representatives. The monopoly over information provided ample opportunity for manipulating and creating success stories of Bulgarian goods on foreign markets further reinforcing the nationalist propaganda and official discourse, celebrating the superiority of communist production over the capitalist economy. One such story created the image of the extraordinary success of Bulgarian yoghurt abroad. In practice, the yoghurt trade suffered many problems, however.

The main actors in the export of yoghurt technology and ferments were the “Dairy Industry” enterprise that governed the entire dairy sector (that had little control over the negotiation process and prices) and international trade agency Rodopaimpex department “Export of Dairy Products”
The first license agreement in 1967 was concluded between Rodopaimpex and French dairy producer Yoplait. The director of Dairy Industry Todor Minkov remembered that to prove the quality of the yoghurt, in that year he organized a tasting session at the Bulgarian Embassy in Paris, to which Yoplait representatives and diplomats were invited. He recalled preparing the Bulgarian yoghurt in a room at the embassy, using samples of starter cultures produced in Bulgaria. Minkov believes that the product’s superior quality presented at the embassy played a crucial role in convincing Yoplait. Although Yoplait’s marketing strategy never mentioned the transfer of Bulgarian know-how and technology, it did refer to Bulgaria and the Balkans by launching plain yoghurt branded “Balkan.” Yoplait employed the name of the Balkan mountain range in Bulgaria after which the Balkan Peninsula was named, even though the license agreement did not require the company to promote Bulgaria as trademark of the technology it was using. In retrospect, that was a glaring omission in the license agreement. At the time, the state did not value the potential income of products labeled as Bulgarian. Beside the international traders, the Bulgarian embassies as well as state and Dairy Industry representatives at major international trade fairs and specialist food exhibitions also promoted with fluctuating success the products and technologies that made Bulgarians proud. The stereotypes about yoghurt were re-produced at organized tastings to promote Bulgarian technologies and starters internationally.

Focused on exporting know-how and proud of the high quality of scientifically cultured lactic strains and the innovative technology of yoghurt production, all the influential actors from trade agents, dairy plant managers to the governmental elite, were initially not interested in the commercial opportunity that the West European market presented. Until the 1970s, these actors therefore supported copying the original and authentic product for commercial purposes, which they claimed the science produced. Bulgaria, although part of the Communist bloc, where national identities were frowned on and international socialism was celebrated as a matter of principle, actually shook off that ideological limitation when it sought to export yoghurt starters and technology as unique national products. The agency promoted Bulgarian yoghurt abroad as a national delicacy without attributing any socialist or communist connotation.

In 1972, Dairy Industry signed a contract with Meiji Dairies Co. for a period of 20 years, which was the first significant success for Bulgarian yoghurt abroad. That was followed by a 10 years agreement with one of the most influential Finish dairy companies Valio. In both cases the Bulgarian state did not have a strategy to promote its products, but the Japanese Meiji Dairies Co. and Valio created the entire advertising campaign for their new products based on its Bulgarian characteristics. Those foreigner companies created an image of Bulgaria as a country with beautiful nature and a healthy life-style.

Not all Bulgarian trade partners and foreigner dairy productions were exploiting the Bulgarian origin of the product correctly. Indeed, from the 1960s to the 1980s, the legal protection of the exported technologies, together with the cumber some export system were the stumbling blocks for Bulgaria’s foreign trade. Moreover, EEC policy on the so-called designation of origin was still in development, inviting abuse of unprotected geographical names of agricultural products and foodstuff like Bulgarian yoghurt.
What the Bulgarian specialists did not anticipate was that the claim of the product’s origin, which they had assumed was self-evident and therefore did not need any defense, might be questioned or even ignored. The “Bulgarian yoghurt” designation, claiming the origin of the product, was legally unprotected. The Bulgarian research and development community believed in the very construction of authenticity they had created, claiming that the real Bulgarian yoghurt was the one produced in Bulgaria or at least with the exported Bulgarian know-how, technology, and ferments. In exporting Bulgarian products like yoghurt, Bulgarian trade agents and politicians were forced to reconsider the need for intellectual property protection. That unfamiliarity and experience with trademarks affected Bulgarian yoghurt’s technology and ferments export: the country faced many hurdles and in the end lost many potential markets. Although the technology and the starters were legally protected, the phrases “Bulgarian Soured Milk” or “Bulgarian Yoghurt” were not. Some European companies took advantage of this hiatus: from 1963 the French firm Chambourcy was using the name Bulgaria to promote its products, claiming its yoghurt was the most Bulgarian of all the yoghurts with a Bulgarian taste (le goût le plus bulgare c’est Chambourcy). In France the term “au gout Bulgare,” referring to all kinds of plain natural yoghurts, was popular. The advertising played on that, claiming the superiority of the product. A Bulgarian trade partner since 1967, the French producer Yoplait had registered the trademark “Balkan” in 1972. Similar labels were used by Danone. In Portugal, producers were selling “farinhalactobulgara” and in the Netherlands, Dutch firm Menken had a product called “Bulgaarse yoghurt.”

3. CONCLUSION

Bulgarian politicians, neglecting the economic values of the geographical indications allowed international producers to exploit Bulgarian yoghurts. By investing in research, the country competed for a leading position among the international dairy producers. The Communist Party, encouraging technological competition with the West, succeeded in exporting know-how, starter cultures, and technology for yoghurt manufacturing, promoting the image of extraordinary Bulgarian yoghurt thanks to scientists’ innovations. Competing in science and technology not in commerce, meant Bulgaria did not control the use of the name, symbols, or interpretation of what Bulgarian yoghurt was. As for profit organizations, Western producers were more attuned to how exotic products could be made more appealing by creating an image of Bulgaria when advertising their products.

When state leaders realized that such politics were actually depriving Bulgaria of commercial profit, they enforced the legal protection of exports. Even then, it was hard to adhere to the principles of the free market when the state protected technologies and know-how but neglected the end product, as was the case with Bulgarian yoghurt. In the late 1970s, enforced state protection acts for Bulgarian yoghurt had dubious effects, partly because they came too late. Scientists and dairy producers, deprived of national and international markets could not alter state politics even if they contacted Western firms when offered licensee technical assistance to guarantee the efficiency of the patented technology.
NOTES and REFERENCES

1 The Serdica Sofia dairy plant’s official company documentation contained valuable information such as trade and sales statistics, technological processes, innovation activities, official and annual reports, and details of the export and import of technology and products.


4 Kondratenko is a leading figure in Bulgarian industrial microbiology, as Head of the Laboratory for Clear Cultures from its establishment in 1965 to 1992. She led the research to select specific cultures for Bulgarian yoghurt. Since then, she has been in charge of a private laboratory for yoghurt and dairy starters “Genesis.” From 2007 to 2009, I conducted six in-depth interviews with her.

5 Minkov first worked as an engineer in Milk Industry Sofia before becoming its director from 1970 till 1982. He was one of the main actors in the export of starter cultures and technology in the 1970s and 1980s. As representative of the Bulgarian Dairy Plant, he was involved in many negotiation processes relating to the export of Bulgarian starters and technology.


7 Zdravko Nikolov and Maria Stefanova – Kondratenko, "The Bulgarian Starters for Yogurt," in International Symposium on Original Bulgarian Yogurt (Sofia: "Dr. Stamen Grigoroff" Foundation, 2005), 2


11 Bulgarian microbiologists Kondratenko and Nikolov elucidate the specificity of the symbiosis between LB and ST, emphasizing that that it is not strictly a biological symbiosis “where the existence of one species determines the existence of another, but rather corresponds to terms such as “synergism” or “proto-cooperation,” when two organisms have mutual benefit, but the association is not obligatory and the two populations can grow separately.” In Nikolov and Kondratenko, "The Bulgarian Starters for Yogurt.

12 Nikolov and Kondratenko, "The Bulgarian Starters for Yogurt."
Representatives of the producers participated in some meetings but only for production and technology matters.

The ITEs established contact with ministries, trade organizations, and firms abroad to market Bulgarian products. They helped to introduce technological innovations from abroad and vice-versa.

Successful goods on the international markets were exploited by the official discourse about the superiority of the communist way of production over the capitalist economy.


The established in 1968 international trade agency Rodopaimpex (ВТО “Родопаимпекс”) was in charge of trading dairy products, animal products, and canned food as well as machinery and materials necessary for their production. See Булгарреклама, Стопански организации, фирми и предприятия в България. Справочник2том., част 2 (София: Булгарреклама, 1990), 1260; (Bulgarreclama, Business Organizations, Companies and Enterprises in Bulgaria, 2 vols., vol. 2 (Sofia: Bulgarreclama, 1990), 1260

Todor Minkov added that the famous Bulgarian actor Apostol Karamitev, who was receiving medical treatment in France and staying at the Embassy in Paris at the time, also participated in the tasting. Interview Todor Minkov, Sofia, June 16, 2009.

Trade organization Rodopaimpex produced a movie on Bulgarian yoghurt and its production techniques which was used particularly for presenting the product and its technology to foreign firms. The material is not available in the Rodopaimpex archives and its successor has changed the location of the main office several times, which it uses as excuse not to provide me with a copy. Information about the content of this advertising material was provided by one of the specialists who presented the technology, during an interview with Maria Kondratenko in Sofia, May 29, 2009.

That contract was prolonged for another 20 years.

CSA, registry 259, 44, file 44, 35.
MISSED TRANSFER CHANCE. EARLY OUTSOURCING OF TRUCK TRANSPORT IN EAST GERMANY IN THE 1950’S HAD NO FOLLOWERS IN THE WEST

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Abstract — In the 1950s the Soviet-Union and the German Democratic Republic (GDR) introduced an innovative concept of cargo transport by trucks: They pulled out the truck fleets that were operated by the enterprises of industry, construction and commerce and concentrated them into service companies (forwarders) that operated at the request of the enterprises. By bundling orders of different clients the capacity utilization of the loading space of the trucks could be increased and a macroeconomic utility were generated. I made some research to explore this innovation. For the case of Soviet-Union I relied on papers published in German in the GDR. The Western management did not pick up this concept but invented it a second time 30 years later in the 1980s under the name “outsourcing”. This concept was imported from the Japanese car industry (Toyota production system).[1] The Western management made no reference to the Eastern innovation as research in the archives of trade journals revealed. The Western management literature points out to outsource only those business processes that are not closely tied to core processes of the enterprise. This experience made also the Soviet-Union and the GDR. The outsourcing in the construction industry and in the wholesale enterprises, where transport was closely tied to core processes, was not successful. This paper could be a starting point for an international comparative research project. Scholars in the states of the former Eastern Bloc could evaluate the outsourcing policy in the 1950s and 1960s in their country.

Key words — truck, outsourcing, GDR, cargo transport

1. INTRODUCTION

For the contextualization, the GDR’s traffic policy will be outlined here. There were many similarities in traffic policy between communistic German Democratic Republic (GDR) and liberal West Germany in the 1950s and 1960s despite completely different institutional settings. As heirs of the Nazi era, the GDR had a dense autobahn network connecting important cities within the Saxonian industrial belt and with the capital of Berlin. The GDR expanded its autobahn network between Leipzig and Dresden in 1971 and between Berlin and Rostock in 1978.[1] As in the Western world, the GDR stepped-up its production division; partly because of the railway’s poor performance in freight transport – especially in the packaged goods sector[2]– it gave priority to truck transport on the autobahns.[3] Traffic policy concerning motorized vehicles was executed by the “Kraftverkehr” department within the transport ministry. The traffic policies with regard to truck transport differed in East and West Germany. While the transport ministry of West Germany fought against the forwarder truck enterprises leaving company fleets untouched[4], the transport ministry of the GDR fought against the company fleets and favored the forwarder truck enterprises.
2. OUTSOURCING IN THE GDR

To deliver merchandise to a customer, a company had – besides postal services – two choices: The first was to give a transport order to a forwarder or else to transport by one’s own trucks (transport “on own account”). If one compares only the cost of transportation, in many cases, the transport by a forwarder is cheaper than the transport by one’s own fleet because the forwarder can gain a higher utilization of truck capacity by bundling different orders to one truck, as also state socialist planners in the GDR transport ministry underscored in a long series of statements from 1958 to 1989. But there are other advantages of using one’s own fleet that countervail the cost argument, as demonstrated by the broad debate during the 1920s concerning the economic advantages a company can achieve using one’s own truck fleets.[5] Many of the advantages result in the close ties between production and transportation that applied over also to enterprises in state socialist countries. In addition, the companies do not only take the isolated cost of transport into account but also the gains of immediate delivery.

3. THE STRUGGLE ON OUTSOURCING

The paper explores the struggle of the GDR transport department against company truck fleets since 1957 and its attempt to transfer company fleets to state owned truck forwarder companies (VEB Transport). Interpreted with the modern terminology of management science, the state socialist planners did nothing else than to “outsource” transport services from the nationally-owned companies in industry, construction and commerce, but 30 years before Western management started outsourcing and more radically than its Western followers and without any theoretical insight into business processes. Rapid growth and high earnings during the years of the economic miracle 1950 to 1980 enabled the well-unionized work force of the automobile industry in the Western world to implement high company tariffs, management balanced high costs and affordable end products. The outsourcing of production and logistics into sectors and countries with lower wages served as a way out of the cost trap. The transfer of warehouse operations and production supply processes to low-wage employees of the logistics trade lowered costs. This was the starting point for the development of just-in-time-delivery and the outsourcing of parts production to low-wage countries in the 1980s. This was the starting point for the development of just-in-time-delivery and the outsourcing of parts production to low-wage countries in the 1980s. The outsourcing movement in Western management was only partial and not as radical as the state socialist outsourcing. Western Management acted very cautiously. Before a service was outsourced, business partners entered into long negotiations. Western management placed outsourcing contracts only with esteemed companies like IBM or Siemens and never would bargain with a low performance company. Management was eager to retain control over its core processes by outsourcing, so only activities not closely tied to core processes could be outsourced.[7] Applied to construction sites, this meant that excavation and delivery of pre-cast segments were under control of the construction company. Also in the commerce segment, shop delivery was to remain under control of wholesale companies. Western outsourcing applied in the context of an economy under competition. When a forwarder company did not operate to the satisfaction of its customer then the
customer could change the transport orders to another one. But this kind of reaction to bad service was not possible in a centrally organized economy where the local forwarder possesses a monopole. It is interesting that Western management did not really “follow” the Eastern example. The outsourcing experiments in the Eastern Bloc were not published in Western trade journals but ignored. Even the failures of the GDR outsourcing movement were not published in the West. So, Western management invented outsourcing a second time.

The transport ministry started, in the 1950s, to establish large scale, nationally-owned service companies for truck transport by extracting some trucks out of the nationally-owned enterprises and transferring them to the new nationally-owned truck companies. These companies were called VEB Guterkraftverkehr (nationally-owned companies for truck transport) or VEB Kraftverkehr (nationally-owned companies for motorized transport, including couches and taxis). The implementing rule of the 7-year-plan on 3 November 1959 clarified the details of the transfer. Evaluating the growth rates of the 7-year-plan Siegfried Nobis, an official of the transport ministry, estimated that the amount of 47,000 tons of truck capacity had to be transferred until 1965.\[8\]

In a long series of statements in the 1950s and 1960s in the transport journals of the “transpress” publisher in Berlin, the officials of the transport ministry promoted outsourcing. They hold the view of highly fragmented truck fleets and accused nationally-owned enterprises of not completely using their truck capacity and of wasting capacity. They reported on supposed economic advantages of large scale truck companies where capacity could be fully used.\[9\] The advantages of large scale transport companies were:

- High productivity. By bundling a large number of transport orders the truck capacity could be used better. Statistical data were published that for each truck in the VEB the transport performance (t\(^*\)km) was higher than for trucks in company fleets.
- Fewer kilometers driven with empty trucks.
- Central facilities for repair and maintenance that could operate in an industrial manner. Methods of the assembly line could be applied.
- Use of technical progress, for example punch card technology for administration.
- Simplified administration that applies standard methods to more trucks and drivers.

At the first glance this concept of large scale trucking companies seems to be convincing. But in the economy of shortage in the Eastern bloc the large scale trucking enterprises could not meet full operation conditions and only offer a bad service.

For Western management it was left in its discretion to what extent it employed trucking services. In the competition economies of the West enterprises could find transport service companies that offered a standard or even a high quality of delivery. But this was not the case in state socialist economics that were characterized by shortage and a low degree of labor division. Companies in the Eastern World could not use a reliable network of suppliers. So they developed internal supplier relations by vertical integration (“Kombinat”). As one element of vertical integration they also employed own truck fleets to evade the trap of bad service of the socialist trucking companies. In their statements the officials in the GDR transport department always spotted the high share that company fleets hold in the GDR truck transport. The transfer of truck
capacity the 7-year-plan demanded was difficult to realize because it met resistance of the branch ministries of commerce and of construction. The nationally-owned production companies did not want to bow to the idea of VEB truck companies and fought hard against the state socialist transport department to keep their trucks which they needed for their operations. The companies underscored the close ties between production and transportation and issued alerts that production must be reduced when trucks were unavailable just in time. Some of these objections were published in the trade journals.[10]

In 1960, the general crisis of the GDR economy and a transport crisis coincided. The VEB truck companies’ bad transport services caused a transport crisis in the construction sector in 1960. Construction sites in Berlin and Leipzig were idle because transport service failed. According to an analysis of VEB Guterverkehr Berlin, it could not attain the coordination of the transport of pre-cast segments with loading and unloading devices so that long, unproductive waiting times occurred. The same coordination problem arose in the transport of excavators with flat-bed trucks. In the first half of February 1960 more than 1700 hours of waiting time occurred.[11]

NOTES AND REFERENCES


INDUSTRY, ENVIRONMENT AND SOCIETY IN KAZAN’ PROVINCE AT THE INDUSTRIAL REVOLUTION ERA

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Abstract — Industrial revolution is a process that affected all spheres of public life and had an undeniable influence on society – environment interaction. Substitution of large industrial enterprises for artisanal industry is of particular interest from the environmental historical point of view. The impact on the environment exerted by handicraft production was less noticeable, but in its total led to serious ecological problems (such as water pollution, deforestation of wide areas, etc.). On the other hand, the environmental damage caused by a single factory was much more profound, though at the same time more localized in space.

Kazan’ province differed from other regions of the Russian Empire because industries that had been formed in the pre-industrial period continued to develop here in the industrial revolution era. Factory production inherited the main directions of the region’s pre-industrial economic development.

The study of local and state government documents, 19th century periodicals, legislative acts and records of Kazan’ enterprises’ inspections allow coming to some conclusions, given below. The healthcare and environmental conditions of artisanal enterprises were almost impossible to regulate, while environmental monitoring of factories and plants proved to be significantly easier. The environmental harm caused by a single factory was most profound at the early stages of its functioning. Subsequently, the harm caused a firm tendency to decrease due to the public influence, state coercion, development of social institutions and scientific knowledge aiming to preserve the environment and public health.

Keywords — Environmental history, Kazan’ province, 19th century, industry, environmental consciousness

1. INTRODUCTION

The industrial revolution, being a transition to new manufacturing processes, was one of the turning points in human history. Technological changes that had occurred as a result of the industrial revolution caused profound changes in demography, politics and culture as well as in the relationship between society and nature. It was during this period that global transformation processes in the environment began due to the influence of the industrial growth, which led to the emergence of complex environmental problems common to all industrialized regions.

Kazan’ province had been one of the most economically developed regions of Russia even before the industrial revolution. Due to the proximity of the largest rivers and its location between two
natural areas — forests and steppes — Kazan’ province traditionally held the output and resources stream necessary for the development of both handicraft production and large industrial enterprises. Already in late 18th – early 19th centuries there was formed a complex of industrial enterprises that had a significant impact on the environment and that determined the transition to large-scale production factories.

Studying the transition from artisanal to factory production in Russian regions from historical and environmental standpoints is of particular interest. In the process of production integration the provincial society was to develop specific ways to regulate plants’ and factories’ sanitary and ecological conditions that would take into account the specific features of the region. Due to the fact that historical and ecological approach in the national historiography has not been wide spread up to the present time, the problem has not received a thorough study. Its certain aspects are considered in the works of Aidar Kalimullin [1], Radik Salihov, Ramil Hajrutdinov, Inga Maslova, Nelli Ligenko [2], etc.

However, Kazan’ archive materials and province periodicals allow a comprehensive insight into the interaction between Kazan’s province industry and nature, in the era of the industrial revolution. A conclusion can be drawn that the second half of the 19th century was the period of sharp deterioration of Kazan’ province environmental quality. The more devastating was the impact on wildlife and public health, the more time and effort was required to determine scientific mechanisms of this effect and take reasonable steps for its reduction. The latter, however, was a natural and inevitable process, the evidence to which is the ecological history of the enterprises.

2. INDUSTRY

Leather, textile, soap, candle and chemical industries were the main ones throughout the 19th – early 20th centuries in the Kazan province. Small but numerous industrial enterprises (e.g., in 1815 only in Kazan’ there were about 100 tanneries [3]) were located near the main city of the province, mainly along the banks of the city water reservoirs that were widely used in the manufacturing process. Wood and chemical production factories manufacturing potash, wood ash, coal and tar were widespread in the counties of the Kazan province.

Handicraft enterprises and those of manufacturing types lost their positions with the adoption of capitalist relations, which had been clearly marked by the beginning of the 19th century. The first half of the century was accompanied by consolidation of production processes that led to the formation of large plants and factories (for example, only 15 tanneries continued to operate in Kazan’ in 1871).

Middle 19th century was the borderline in the development of industry: a number of plants were built in the province and adjacent territories, which marked the beginning of the industrial revolution. In 1850, the Kokshansky plant set up by Kapiton Ushkov began operating in Elabuga county of Vyatka province which turned into one of the world’s largest potassium dichromate producers [4]. Its appearance in the province was largely due to the numerous leather and soap enterprises which widely used chemicals in the production processes. In 1855 the Krestovnikov Bros. founded a stearic-and-soap works in Kazan’ [5]; in 1864 Ivan Alafuzov founded a tannery [6].
It is obvious that together with the processes of industrial integration the harm to the environment caused by separate enterprises increased immensely.

3. ENVIRONMENT

Environmental pollution was most acute and harmful in the vicinity of industrial enterprises; it resulted due to the lack of adequate waste treatment systems and waste safe disposal. [7] The industrial consolidation caused an increased pressure on nature that appeared to be even more complicated and complex.

Even in the 18th century numerous artisanal enterprises caused industrial pollution of water, soil and city reservoirs that were the only source of drinking water. A dynamic development of chemical industry in the province led to a new stage in the process of negative environmental impact. In chemical industry, unlike soap and leather producing industries, not only waste, but the finished product also had a great toxic effect. Thus, the urban and natural environment deteriorated sufficiently in just a few years after the opening proceedings around the Kazan’ plant of Chemical Plants Partnership “Ushkov & Co” — forests and fruit trees withered; birds and insects died; the increased hydrogen chloride and sulfuric acid vapors content in the atmosphere corroded iron roofs. [8]

Industrial production had a no less detrimental effect on people’s health — primarily on those workers who were involved in the production process. Most of the shops in large factory enterprises of Kazan’ province did not meet sanitary standards: an excessive number of people worked on a small labour area; the ventilation was inadequate; and business owners paid little attention to safety regulations and observation.

As a result, the workers developed various occupational diseases, many of which affected the respiratory system (due to the poor air quality in the factory premises), and skin (due to contact with corrosive substances) [9]. A kind of “anti-record” in the workers’ disease incidence was set by the Kokshansky chemical plant, where it reached 100%. The population of the adjacent territories was also affected by the chemicals: according to medical statistics, the incidence of eye diseases, diseases of the respiratory and digestive systems increased twice.

Undoubtedly, the negative changes in the environment attracted public and government attention, who sought to protect the citizens and preserve natural landscapes from the harmful industrial influence by all available means.

4. SOCIETY

The changes that occurred during the industrial revolution led to transformation of the urban population’s ecological consciousness. The traditional stereotypes about the inexhaustible natural resources and man’s inability to have a significant impact on the environment [10] were replaced by the understanding that it is necessary to develop a conservationist attitude to nature and regulate the anthropogenic load on the environment.
One of the most important directions of the city and provincial administration’s activities was now the attempt to solve the environmental problems. However, the environmental policy that they pursued faced a number of formidable obstacles, directly related to the level of the society’s environmental consciousness.

The industrialists and civil servants had a clear cut priority of economic interests over environmental values. Thus, the former did not comply with the existing environmental regulations being protected by the corrupt provincial authorities [11], for example, legal proceedings against the Chemical Plants Partnership “Ushkov & Co.” concerning air and water pollution were terminated several times in 1900 — 1910 by Kazan’ provincial government.

At the same time the urban inhabitants’ level of environmental consciousness remaining fairly low, they often demanded that the authorities should undertake vigorous measures to improve the sanitary environment, but did not contribute to those measures in any way. Finally, the natural and medical sciences in the region were not properly developed, which did not allow the healthcare authorities to control industrial enterprises’ environmental pollution effectively to prevent environmental crises.

5. RESULTS

Thus, in the period of the industrial revolution, the transition from handicraft to large-scale factory production became the reason for the changes in the nature of environmental problems in Kazan’ province. Large enterprises of the chemical, leather and soap industry aggravated pollution of atmosphere and hydrosphere, contributed to large-scale deforestation, adversely affected the health of the general population — the workers and residents of the surrounding areas. The ecological condition of such major productions was poorly amenable to regulation, for the owners of large enterprises had ample opportunity to assert their economic interests and were frequently supported by the provincial authorities.

6. CONCLUSIONS

Environmental history should be considered as an integration of economic and environmental factors and ecological consciousness inherent in society during a particular research period. These three components of the universal historical and ecological processes acquire undeniable specificity in every particular region due to the peculiarities of its development in prior periods. Thus, among the features of Kazan’ province we should state the new industrial enterprises’ predominantly negative impact on the environment, the technological processes having been insufficiently studied from an environmental standpoint. At the same time, due to the extensive experience in the industrial development of the region, Kazan municipal authorities and Kazan province citizens had the necessary potential to protect the population’s environmental rights, resulting in the long term in normalizing health and urban environment.
NOTES


[4] Due to the Kokshansky chemical plant the potassium dichromate import from abroad was discontinued in the second half of the 19th century and home produced potassium dichromate was exported to Western Europe. See for example: Sergei Kashin, *Est’ Na Kame Zavod* (Kazan’: Tatarskoe knizhnoe izdatel’stvo, 1965), 7.


[11] For example, when the Kazan’ City Duma was solving a question of moving slaughterhouses outside the city borders, Nikolai Krestovnikov (the stearic-and-soap plant owner) suggested not to move them, but move the city borders on the map. ‘Zasedanie Kazanskoi Gorodskoi Dumy’, *Volzhsky Vestnik*, no. 19 (1879): 7.

REFERENCES


II. BUILT HUMAN ENVIRONMENT

TECHNOLOGY IN TIMES OF TRANSITION
THE 41ST ICOHTEC SYMPOSIUM, BRASOV, 2014
THE EVOLUTION OF VERNACULAR CONSTRUCTION TYPOLOGIES IN TIMES OF TRANSITION – VILLAGES FROM VÂLCEA COUNTY, SOUTHERN ROMANIA

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Abstract — The purpose of this study is to embrace regionalism and the evolution of vernacular construction typologies in times of transition with the aim of creating a vital connection between vernacular concepts and new interior design. In this time of technological advancement, rapid urbanization which is not taking in consideration the traditional rural structure, local identity, cultural value, where the handicraft is under the constant pressure of mass production, there is still much to be learned from the knowledge of vernacular architecture. It can be seen very clearly that the architectural, functional, house position and veranda evolution regarding vernacular housing in the Romanian rural context has been directly influenced by the two world wars making these constructions more enclosed, reflecting the need of people for protection; after the Second World War the porch with railing or turret being replaced almost completely by the enclosed veranda.

The methods used in the study process are based on field trips, visiting villages from Vâlcea County, connecting with the community and determining the degree of presence of traditional wood structures and housing, the transition of vernacular construction typologies in the contemporary context. The most difficult part of this project consists mainly of raising the awareness of local authorities and the community of local identity, traditions, vernacular construction as a viable way of seeing contemporary design. The aim of the project is to create furniture with value and meaning as a symbolic, direct, clear reflection of the context which increases with time and through the use of local communities. The traditional Romanian vernacular characteristics can still be easily identified due to the limited acceptance of advanced technologies in villager’s way of living. The differences between the “vernacular” and “modern” design processes are very clear: in the case of vernacular, the production would be singular, crafted and local, whereas the contemporary modern production would be characterized by a serial, industrial, dislocated approach. In order to achieve the wanted result, we need to utilize and rely on the advantages of modern production, but should not forget that the design should reflect the profoundness of a local vernacular concept.

Keywords — Romanian vernacular, times of transition, rural context, local identity, wood
1. INTRODUCTION

The main subject of this research consists of rediscovering a series of traditional Romanian regional values lost in the rapid process of urbanisation, and redefining the concept of local identity by the improvement of specific Romanian vernacular characteristics concerning architecture and the way of life of village communities. The new design process has to be aware of the efficiency of vernacular architecture, being able to take in consideration the possibility of concept transfer between contemporary and vernacular planning and building methods. In the present, vernacular or traditional building methods are under a constant transition and adaptation phase, the legislative system being stricter concerning the quality of materials, stability and safety of building structures. Although contemporary architectural requirements are very strict, vernacular concepts can still be easily integrated in the design process without altering the demands of modern living.

In the conditions of rapid urbanisation which is not taking in consideration the traditional rural structure, a series of threats appeared concerning the preservation and protection of local identity and cultural value: the disappearing of traditional households, the growing density of the built environment, degradation of landscape, loss of traditional techniques and building materials (due to European standards or globalisation), abnegation of local traditions and cultural activities.

These transformations and transitions in the field of traditional architecture led to a series of reactions and research projects initiated by specialists, the main subject being the determination of the transition phases that the local traditional architecture or building methods in the rural context of Romania had been through in the last decade.

The vernacular and traditional buildings in a specific rural context are a product of the accumulated experience and practice of many centuries and can provide a continuous source of knowledge. The harmonisation with the local environment and climate [1], the use of local materials are some of the factors, which contribute to the distinct architectural identity of an area [2], cultural heritage being also one of the main factors that influence the vernacular architecture of a location [3].

In the future, specialists, designers and architects have to realise the importance of local tradition and building methods using local resources, as the possibility of rejuvenating local cultural identity.

2. BACKGROUND & ANALYSIS

The theoretical undertaking described earlier, meant observing a series of particular aspects referring to the presence of the hipped roof in the local architectural landscape (four slopes usually), the usage of wood as a basic building material and traditional techniques in log construction (specific construction details, beam joints, wooden pillars), the presence of the porch, the general composition and proportion concerning the facade of the building.

As a result of the field trip investigation in three villages situated in Vâlcea county Romania, it was possible to conclude that the local household’s primary building material is wood and has remained unchanged despite the transitions of the last decade; it is developed on a single level with a rectangular planimetric display, with a high hipped roof with four slopes covered by wooden tiles.
The house consists of two rooms (a guest room and main room for daily activities), a small entrance hall (called „tinda”) and a porch as shown in figure 1.

Wood as a primary building material is a clear reflection of the local community’s way of living [4]. Even though the communication of traditional building methods from one generation to the other has had a fragmented evolution, it has managed to adapt itself to the contemporary context due to the collective interest of local communities and their way of understanding life, living and the importance of traditional wood constructions.

The chaotic urban development was the result of a series of changes in the structure and life of local communities and made them witness a constant transition phase concerning their way of living: migration of the local village population, transition and deformation of specific values, the loss of
the role of the traditional household in the rural context as the key element in the village landscape. So, the need of identifying and proposing methods of improvement of local cultural and architectural potential has become a necessity.

The determination of the objectives is preceded by a research on a social level, connecting with the communities of the three villages Titesti, Boisoara, Bratovesti. “Today, rural architecture is undergoing a phase of acute change and loss of traditional values, through its physical disappearance, a natural and acceptable phenomenon up to a point, but also through its damage by the uncontrolled introduction of elements from other cultures” [5]. A series of dramatic changes had occurred concerning space perception and the way the user interacts with furniture which had become more flexible, modular, multi-purpose, and recyclable. The need of specific local values reappears in a globalised world and interest for traditional wood design increases: specific vs. uniform (the furniture is a direct reflection of a community’s cultural identity).

The next step was to determine the degree of presence of wooden traditional built environment and the level of preservation of these constructions. The debate of the research project mainly focused on two basic plans: the social aspect (connecting with the village community, discussions with the villagers) and the architectural aspect (construction methods, building materials and techniques, roof, walls, entrance, porch).

The first aspect of the analysis consisted of determining the attitude of locals towards wood as a construction material and if they maintained to use this type of material in the construction of a new household. The experience gained during the interviews showed that the majority of the locals were very firm in their options mainly consisting of other building materials like concrete or brick which have no compatibility with the traditional methods and local architectural expression. These new materials gain terrain against wood in the options of villagers, their main motivation being that they are cheaper than wood and easier to work with on the construction site.

The second aspect of the analysis refers to the general shape of the constructions. Contemporary interventions usually ignore the vernacular functional and spatial layout or the proportion of the façade and lack the porch from the front of the house resulting in a major impact upon the way of life of the inhabitants and their connection with the rest of the community (the porch being a place
to meet and spend time with neighbours and friends) and an altered connection with the natural context. The porch has a definitive role on a functional level and has a precise length between 80-90-120 cm [6]. Its existence is a clear response to the climate of Vâlcea County. The role of the porch can be extended to a social, aesthetic and symbolic layer also and in figure 3 above you can observe the evolution and the adaptation process of it in order to satisfy the inhabitant’s needs. It is important to mention that the porch, after the Second World War, was replaced by the enclosed veranda (the need of protection) and in the present it is being replaced by the balcony which has a different proportion (150-200 cm) and visual aspect.

One of the most important compositional and functional elements of any vernacular household is the roof. It has usually four very steep slopes: on the longitudinal direction of the house having a 60° angle, and on the transversal direction a 70° angle. The main structure of the roof consists of round wooden logs, and the structural elements (wooden pillars) are replaced by a series of angle braces and horizontal beams connecting the wooden eaves which support the layer of clapboard. Contemporary interventions tend to change the angle of the slope or the general chromatic of the roof, replacing the traditional wooden clapboard with ceramic or aluminium tiles the aesthetic integration in the landscape becoming impossible.

The transformations due to the lack of interest and awareness of the community of the local building methods, traditions and cultural values have a strong impact not only on a level concerning the general exterior aesthetic of the house (roof, walls) but on a smaller scale also as the carpentry. The walls are made of wooden logs with dimensions between 12-15 cm in length and 20-30 cm in height and the carpentry is mainly of wood painted in green or blue. In the present, the texture of the façade offered by the layers of the wooden logs is interrupted by a wood boarding which covers it up and has a dramatic visual impact.

3. RESULTS

The results obtained from the research process in Vâlcea County (villages Titești, Bratovești, Boișoara) were transferred in a more compact format in order to reflect visually the multitude of spatial and aesthetic organization typologies of traditional wooden housing in a Romanian rural context. The four axes of the graphic represent four of the main characteristics that define specific traditional architectural design: wood utilisation, hipped roof, porch, vernacular furniture. In the graphic below, we can see a comparison between the degree of presence of these fundamental characteristics at the beginning of the century and in the present.
By overlapping the individual graphic of each vernacular house, we were able to draw the general conclusions regarding the transition phase concerning vernacular architecture, furniture and the way of living of villagers in Vâlcea County.

In each of the three villages analysed it was possible to identify a series of parameters available for 80% of the built environment. The general characteristics according to figure 5 in the case of Titești are: a highest degree of utilisation of wood as a primary material in the construction process, the existence of the porch; in the case of Bratești: steep slopes with angles between 50-70°, 30% of the investigated village houses contained vernacular wood furniture; and Boișoaia was characterised by the presence of wood furniture in 25% of the analysed interior space. It can be generally concluded, that a gradual decrease of wood utilisation can be observed concerning the three analysed localities. Also, the wooden furniture has lost its local identity characteristics,
modern prefabricated furniture taking its place; the porch was also replaced by the balcony or terrace. The only aspect remaining unchanged in high percentage is the hipped roof, due to the specific climatic conditions.

The overlapping of an architectural analysis with a statistical research method can offer clear and precise conclusions concerning the metamorphosis of the contemporary design process in the Romanian rural context. This systematic reflection of data can avail an effortless interpretation and a multitude of possibilities for future investigations.

4. CONCLUSIONS

The research embraces regionalism and specific Romanian wood construction methods and defines a clear connection between vernacular concepts and new interior design process (Fig. 7) concerning Romanian villages and creates an overview of the transition of vernacular construction typologies in the contemporary context.

![Fig. 7. The process of transition concerning the vernacular and new design process](image)

Therefore, the use of more sustainable construction materials and techniques represents a major contribution to the eco-efficiency of the construction industry through a more sustainable development [7], the re-interpretation of contextual values [8] and traditional building or furnishing concepts in a contemporary key in order to assure a condition of visual comfort regarding external/internal spaces [9]. Vernacular architecture creates structures that are respectful to people and the environment, tradition being associated with the mass of cultural values [10] that can be a clear resource for restoring local cultural identity [11] and in the same time represent the main reasons for the success of any project.

The differences between the “vernacular” and “modern” design processes are very clear: in the case of vernacular, the production would be singular, crafted and local, whereas the contemporary modern production would be characterized by a serial, industrial, dislocated approach. In order to achieve the desired result, we need to utilize and rely on the advantages of modern production, but should not forget that the design should reflect the profoundness of a local vernacular concept.
ACKNOWLEDGEMENTS

This paper is supported by the Sector Operational Programme Human Resources Development (SOP HRD), ID134378 financed from the European Social Fund and by the Romanian Government.

REFERENCES

THE IMPACT OF TECHNOLOGY ON THE DEVELOPMENT OF TOURISM IN SOUTH CROATIA IN THE BEGINNING OF THE 20\textsuperscript{TH} CENTURY

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\textbf{Abstract} — This paper analyses, using archive records and relevant literature, the application of technological advances in transport and tourism in South Croatia in the period that preceded cruisers with thousands of passengers, mass air transport, as well as the usage of computers reservation systems and credit cards that are used in tourism industry nowadays. Technology was intensively involved in the tourism industry in the past. The impacts of technology could be seen on the connectivity by railway as well as sea, land and air traffic. In addition to the mentioned factors of communicative tourism, its receptive factors – hotel industry, catering, marketing, cultural institutions, public services etc became more dependent on technologies in the interwar period. The connection between the advances in technology and the new growing service sector of tourism in the Croatian south was a prerequisite of the coming development of mass tourism. Therefore, the human need for rest, recreation and adventure while abandoning their permanent residence achieved its purpose – enjoyment and relaxation. Peripheral parts of the Croatian south outgrew into world tourist destinations due to the progress of both transport and communication technology in the first half of the 20\textsuperscript{th} century.

\textbf{Keywords} — technology, tourism, South Croatia, 20\textsuperscript{th} century

1. \textbf{INTRODUCTION}

The Republic of Croatia is oriented towards tourism development, it is a recognized and popular destination with a clear development strategy and vision of its future in tourism. This orientation of Croatia’s regions to tourism has a long tradition; its beginnings were boosted by progress in steamship and railway travel, i.e. with the prosperity of faster and more comfortable transport connections. Travelling for pleasure, once feasible only for the elite, became more widely available with the industrial revolution. However, despite technological advances in transport in the early 20\textsuperscript{th} century, tourism had not become a mass phenomenon. This novelty remained a privilege of the wealthy in Croatian territories, then part of the Austro-Hungarian Empire.

Technology is crucial in all industries today, so it is in the largest and the most pervasive international industry – in tourism. Technological progress is the basis of virtually every study of the development of mass tourism, yet its influence in the earlier periods of individual tourism is not
sufficiently represented in historiography. The aim of this research is to analyse the beginnings of the rich tourist Croatian history through the advancement of technology in transport and communication.

This paper, after a preliminary review, explores the current researches of the impact of technology on the development of Croatian tourism; the orientation of the Croatian coast towards tourism up to the Second World War; as well as the impact of technological advances in traffic communications on the example of Dubrovnik as the tourist centre of South Croatia. The conclusion of the research is presented at the end of the paper.

2. RESEARCHES ON TECHNOLOGY IMPACT ON THE DEVELOPMENT OF CROATIA’S TOURISM IN THE PAST

The historical approach to the research of the phenomenon of tourism is a growing discipline whose history is marked by immense innovativeness. Innovation research in tourism gained popularity in the world by late 20th century and is incorporated into the plans and strategies of Croatia’s tourism today.¹ Little has been written about the impact of technology on the development of Croatian tourism in the past, while the history of tourism in Croatian areas is mainly researched in the frameworks of broader studies.² In addition, research on the history of tourism and technology in Europe has been disproportionately directed towards Western Europe, neglecting its peripheral parts. The economically most underdeveloped Austro-Hungarian provinces of the time, specially Dalmatia³ – had never been a part of the Grand Tour and become part of the European tourist scene relatively late. Influenced by the British, the popularity seaside resorts gained spread across 18th and 19th century Europe.⁴ It was in this period that Opatija and Dubrovnik built their elite status and become tourist summer capitals of the coast. At the turn of the 19th and 20th century British visitors witnessed the beginnings of cultural tourism in the Croatian region.⁵

³ The geographic boundaries of the province of Dalmatia were subject to change through history. Thus, for example, from 1816 to 1878 Dalmatia stretched from Rab to Budva, and after the Congress of Berlin (1878) from Rab to Bar. Frane Ivković, "Organizacija uprave u okrugu Split za vrijeme druge austrijske vladavine od 1814. do kraja druge austrijske uprave 1918. godine," in *Sources and contributions for the history of Dalmatia* 12, ed. N. Bajić-Žarko. (Split: Povijesni arhiv, 1996), 894.; Frane Ivković, "Ustroj uprave u Boki kotorskoj od francuske uprave 1807. do kraja druge austrijske uprave 1918. godine," *Radovi Zavoda za povijesne znanosti HAZU*, 53 (2011): 195.
Authentic and credible sources of the history of tourism were far less interpreted by historians compared to researchers from other fields of social sciences. The reason for the domination of sociologists, economists and geographers to research the history of tourism was the subsequent recognition of the potential of tourism as a historical discipline. Only in the 21st century does tourism became the subject of serious historical research in the fields of social history, the history of everyday life and history of leisure. Proceedings which publish papers at the international level include studies of tourism in Croatia from a limited territory (the former Austrian Littoral) or analyse the period of mass tourism in socialist Yugoslavia. Technology occupied a special place in the socialist ideology of the period after World War II, and there is an increasing prevalence of younger and middle generation researchers of humanistic orientation from the region who research the development of the consumer society in socialist Yugoslavia.

Due to the lack, fragmentation and poor availability of data, the history of Croatian tourism is less frequent than other theoretical works on tourism which often lack a historical dimension. Also, technological advances in transport and communication on Croatian territory in the past is studied as a subject of Traffic and Engineering studies at Croatian universities, without attaching importance to tourism development of this region in the past. The main reason for discrepancies in research intensity is a different intensity of tourist experiences as well as a different representation of historical sources in some parts of Croatia. Bearing in mind that the amount of collected material and reference literature shapes a research, a greater number of studies of individual smaller tourist micro-regions in the past is not surprising.

3. TRAFFIC COMMUNICATIONS IN DALMATIA

Technological advances in history are lengthy and complex processes which have their duration until they are replaced with new technology. In the development of technology in the past, the Industrial Revolution was a watershed period. A period of fast development occurred for the countries and nations with leading technologies, while the backward European periphery with the Croatian areas gradually and incompletely accepted progress in the last decades of the 19th century.

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The economic situation in Croatia at the beginning of the 20th century was extremely grave. While half the population of Austrians and Czechs lived off jobs in industry, crafts, trade and rail, river and maritime traffic; the Croatian areas ratio hardly exceeded 20%. In such circumstances, tourism – particularly in the Rivieras of Opatija and Dubrovnik under the Austrian government – recorded an unhindered development.

The arrival of the first tourists to the Croatian coastal area which was under Austrian rule was exquisitely illustrated in the exhibition The Austrian Riviera discovers the seaside which was held in Vienna from mid-November 2013 until the end of March 2014. Visitors to the Croatian coast arrived after revolutionary changes in traffic – travelling by steam trains and steamboats. Steam power, since it could be increased ad infinitum, changed the perspective of travelling and reduced the distances. Organized arrivals of tourists by steamships began after the establishment of regular steam shipping lines to Dubrovnik. Austrian Lloyd was founded in 1836 in Trieste as the first Austrian steamship company; only a year after its founding, it organised lines connecting Dubrovnik and Trieste. Lloyd’s luxury steamer liners were also the leading coastal steamers in the Mediterranean – Baron Gautsch, Prinz Hohenlohe and Baron Bruck brought the first visitors to Dubrovnik.

Since the tourists needed to rest during the long journey, Austrian Lloyd invested in constructing the hotel Imperial in Dubrovnik. The effect which technological advancement in transport connections had on the development of Dubrovnik tourism was evident from a fivefold increase in the number of accommodation units: from a total of six hotels and inns in the 1897 to thirty in 1910. Top Dubrovnik hotels (Grand Hotel Imperial, Hotel Odak, Hotel De la Ville, Hotel Gradac, Grand Hotel Lapad, Hotel Petka, Palace Hotel, Hotel Pension Dalmacija, Thermoterapija etc.) have contributed to the beginnings of congress tourism in this region. In the early days, these conferences were organised for business and entertainment. In the period before World War I, three congresses were organised: Austrian Railways representatives Annual Meeting (1897), Second Congress of Austrian balneologists (1900), and Third Congress of Slavic journalists from the Austro-Hungarian Empire (1901).

Visitors from the Austrian interior would reach Trieste by train where they would switch for steamships for transport to the Croatian south. Therefore, the railways Vienna-Trieste (1857) and Zagreb-Karlovac-Rijeka (1873) were primary tourist links to the Croatian south – the province of Dalmatia, since the purpose of the province's railway network that linked the hinterland to the coast was chiefly to exploit minerals. That was the case with the railway lines Šibenik-Knin and Split-
Knin (1877), and Knin-Siveri (1888) which linked coal mines with output ports on the Adriatic. Likewise, the long-awaited railway to Dubrovnik over the Bosnian-Herzegovinian hinterland (1901) was a military strategic objective linking the Bay of Kotor (today part of Montenegro) with the interior of the Dual Monarchy. Tourists loved visiting the hinterland of Dubrovnik by railway all until it was abolished in 1976. Its major drawback was its narrow gauge, yet for touristic purposes it did not matter.

Although the first airplane landed in Čilipi in 1936, and a regular air route from Sarajevo and Belgrade, which connected Dubrovnik during the summer months with many European cities (such as Bucharest, Vienna, etc.) was introduced two years later, air traffic was in its initial stage and didn’t have a big role in connecting Dubrovnik to the rest of the country or to the world. It should be emphasized that the runway at the time was a mowed lawn; Dubrovnik’s modern airport wasn’t built before 1962.  

Technical advances in the field of telecommunications (a total of 88km of underground and around 6,000km above ground cables were laid in the Croatian region), are evident after the First World War. Postage offices were opened in smaller towns surrounding Dubrovnik as early as 1930: Blato, Cavtat, Čilipi, Lapad, Govedari, Gruda, Janjina, Korčula, Kupari, Pločice, Slano, Ston, Šipanska Luka, Topolo, Trpanj and Vela Luka. Some of these little towns got post offices even before, like in Babino Polje on the island of Mljet, where the post office was opened as early as 1874 (with a working telephone from 1894). Those post offices were modestly equipped and would look very unattractive by current standards. Its few direct telephone lines were overloaded during the tourist season. Thus, in the summer it was very difficult to establish a telephone call to western European cities, even a direct call to Zagreb was a challenge. Some important tourist destinations, such as the nearby Lopud, were not included in the Dubrovnik telephone network. Even those humble connection were an advance in those times since even fifteen years later, telephone lines were available only in bigger cities (a total of 338.10km of lines in 1908).

4. ELECTRIFICATION OF DALMATIA AND THE ARRIVAL OF TRAM IN DUBROVNIK

The application of electricity in the Croatian region began in the late 19th century. The beginnings of electricity production in Croatia were modest and concentrated around Zagreb. Power plants were built randomly without a plan and with small financial means; when the new union the Kingdom of Serbs, Croats and Slovenes (1918) was formed, most of them were in the service of industrial plants and were foreign private property. These extremely small power plants emerged for  

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20 Ilustrovan zvanični almanah šematizam Zetske banovine (Sarajevo: Kraljevska banska uprava Zetske banovine na Cetinju, 1931), 435-440.  
22 Dubrovački turizam IV (Dubrovnik: Savez za unapređenje turizma, 1939), 17.  
23 Ivo Juras, Pregled gospodarstva i trgovine u Dalmaciji (Zadar: Narodni list, 1910), 46.
the purpose of illumination – especially in industry. In the Austrian province of Dalmatia, Zadar was illuminated in 1894 and Šibenik the following year.

In southern Croatia, unlike the rest of the country, Dubrovnik (where the first electric light bulb lit up in 1897) had very different conditions. While electricity illuminated manufactories and industrial sites in the north, in Dubrovnik it was used for illuminating streets and restaurants. Electricity was produced in a power plant (720hp) in Gruž (Batala) from June 1901. In its first four years of operation, it worked exclusively by night, the power plant started operating in daytime from 1905. It was damaged during World War I in 1918 by fire.

As a consequence of the damage was that it became unprofitable for the production of electricity. Expensive and poor quality electricity production was complicated by unresolved ownership rights of the plant. After 1918, the power plant remained under the administration of Austrian foreign concessionaires – Gesellschaft für elektrische Industrie Wien (ELIN) and was not repaired. Growing losses of the power plant were followed by increased dissatisfaction of its consumers. The price of electricity due to a high cost of production was constantly increased. Frequent interruptions of supply, the falling into disrepair of the plant and the infrastructure had a negative effect on service activities in Dubrovnik. It was not until 1930 that a reconstruction was undertaken, the power plant becoming the property of the city of Dubrovnik, when plant offices, mechanical workshops and a modernized plant were built. A dilapidated and dangerous urban electric network was then also reconstructed.

On the other hand, street lighting in Dubrovnik has a long tradition – from the times of the Dubrovnik Republic. However, the first electric bulb illuminated the newly opened Imperial hotel in Dubrovnik in 1897; electricity for the luxurious hotel was produced by a home power plant. The luxurious hotel Imperial – built with the capital of the Austrian Lloyd, was one of the first elite Croatian hotels in general. The hotel was equipped with modern steam heating and had the first electric lift in this region which was quite revolutionary in the late 19th century.

With the power plant in Gruž (Batala), there were 8 small home power plants in the vicinity of Dubrovnik. In order to increase the quality of tourism, electrical energy was used in smaller villages around the main destinations of Dubrovnik. For example, on the tiny Elaphites’ island Lopud the first petroleum power plant (3hp) was installed in 1927 to supply the hotel Pracat, and two years later the hotel Glavović. All the hotels on Lopud were owned by the islanders; upon opening the Grand Hotel Lopud its tourist peak was achieved in the eve of the Second World War. Grand Hotel on Lopud had a home power plant as did all major restaurants since electricity was a basic prerequisite for tourist industry. The island of Lopud in the Kingdom of Yugoslavia had a much greater number of accommodations than the number of its permanent residents.

24 It was powered by steam, its raw materials for the production were English coal and oil. Dalmacija spomen-knjiga izdana o kongresu Udruženja jugoslavenskih inženjera i arhitekata god. 1923. (Split: Udruženja jugoslavenskih inženjera i arhitekata, Sekcija Split, 1923), 244.


26 Boris Markovčić et al., Razvoj elektrifikacije Hrvatske (Zagreb: Institut za elektroprivredu, 1984), 191.
Few citizens of Dubrovnik used electricity in their homes, the major consumer of electricity was the Dubrovnik electric railway that was established with a capital of 500,000 kronen in 1910.\textsuperscript{27} Electric trams had become a popular means of public transportation as they were introduced into the capital cities of the Austro-Hungarian Empire Vienna and Budapest in the 1880s. With the town of Rijeka as the earliest (1899), peripheral Austro-Hungarian regions which form Croatia today introduced trams as transport in Pula, Opatija, Zagreb and Osijek in the early 20th century. The introduction of trams as a means of modern public transport to Dubrovnik was an extraordinary event in a period of economic stagnation and difficult living conditions of the majority of its 12,683 residents in 1910.\textsuperscript{28}

Dubrovnik tramway resisted the tough challenges of the time (the First and Second World War), difficulties and interruptions in the power supply (conflicts over the management of the power plant), frequent changes of government framework (the Austro-Hungarian Empire, the first monarchist Yugoslavia, the Independent State of Croatia, Yugoslavia – the so-called second Yugoslavia), various systems (early capitalist, fascist and socialist), severe traffic accidents (in 1922 and 1970) and despite remained in use the longest in the Croatian coastal area. The tramway had a significant role in the history of technology and tourism of Dubrovnik and Croatia. Although the citizens of the city loved to joke saying \textit{if you're in a hurry, go on foot}, the tram was also liked by those who didn’t use it. Despite the projects on the possible reintroduction of trams as a touristic attraction, Dubrovnik tram can only be seen today in the Technical Museum in Zagreb, while its trailer is on display at Tramway Museum Graz in Austria.

\textsuperscript{27} Pravilnik dioničkog društva Dubrovačke električne željeznice (Dubrovnik: Štamparija De Giulli i dr., 1912), 2.
\textsuperscript{28} Mirko Korenčić, Naselja i stanovništvo SR Hrvatske 1857-1971 (Zagreb, Jugoslavenska akademija znanosti i umjetnosti, 1979), 219.
5. CONCLUSION

The first studies in the late 1930s on the beginnings of tourism phenomenon in the Dubrovnik Republic had sought the connection with slave trade, pilgrimage, amusement, diplomacy as well as with the development of science and technology.\(^{29}\) The application of technology in transport – steam railways, steamships and aircrafts, with the development of telecommunications (post, telegraph, telephone) was the precondition for the development of service activities, especially tourism. Traditionally orientated towards the sea, the territories of the former Republic of Dubrovnik were connected by steamship lines as early as the 1830s, almost in step with modern trends of maritime transport. It should be emphasized that almost all the hotels in and around Dubrovnik in the late 19th and early 20th centuries maintained their accommodation function to this day and have been renovated to meet hotel design requirements of the 21st century.

Electricity changed the lives of the citizens of Dubrovnik. Contrary to other parts were electricity was introduced as a prerequisite for industrial development, electrification of Dubrovnik in southern Croatia was directly related to its tourism beginnings. The only tram in Dalmatia outgrew its original purpose – a means of integrating the urban territory, and has grown into a distinct symbol of Dubrovnik. Since opening to traffic in December 1910 to its complete abolition in the 1970s, Dubrovnik tram had a remarkable social and economic significance for the development of the city. Although only five tram vehicles (imported from the Czech factory František Křižík) ran on rails that were built for the purpose in only 48 days, the tram as an indicator of its contemporary technological advancement left a deep mark in the history of Dubrovnik and its history of tourism.

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\(^{29}\) Jorjo Tadić, Promet putnika u starom Dubrovniku. Dubrovnik, 1939.


Abstract – Some of the most important topics nowadays are housing, home improvement and the living conditions of inhabitants. This article is about to reveal the possibilities hidden in the interior of flats, closely related to the judgment of the housing estates. An overall rehabilitation is needed to prevent the emergence of the slums. Unfortunately there are housing estates where this process has irreversibly strengthened. In these cases it is not enough to plant trees, establish playgrounds, insulate buildings and renew flats, but such drastic solution as demolition would be necessary. Of course the aforesaid method cannot be applied on every housing estate or block of flats, but this option cannot be precluded. Every living area has its own problems. After the diagnosis, unique solutions become compulsory. Depending on the residential density, the composition of the population and the characteristics of the housing estate have to be established and the goals of the rehabilitation have to be worked out.

Keywords – panel, individual, rehabilitation

1. INTRODUCTION

In 2013 Hungary has reached a never seen nadir in housing, which can induce the deterioration of the quality in housing stock. If this process goes on with this pace, six hundred years will be needed for a complete rejuvenation [1]. Home improvement is a factor needed to be considered in the future, since supporting it leads to advance and creates ten thousand new jobs in the building industry. A long term strategy is needed in housing policy to get up-to-date solutions for the problems arising. Modernizing the energetics of the housing estates is a primary challenge in two important steps: updating the district-heating service and the appropriate renovation of the heat technology [2]. Fifty years after the construction of these buildings the previously mentioned actions inevitably need to take place. In order to have long term results and returns, the most recent solutions are necessary to be utilized. Location-specific and unique modernization is required, since mass production cannot be substituted with mass refurbishment if socially accepted solutions are desired [3].

2. METHODS

One of the research groups at the University of Pécs, which is led by Dr. Péter Gyenizse, has been examining the so called ‘panel’ districts of Pécs. According to their survey the most influential factors in living comfort are transportation, infrastructure, public institutions, green spaces, view, cleanliness of air, flat prices and the social structure. ‘Úránváros’ and ‘Kertváros’, the two major subject districts have both advantages and disadvantages. The judgment of these housing estates,
according to the deficiencies listed in the survey, could be improved with minor investments and ideas [4]. These slight changes vastly affect the emotional values of the environment thus boost its overall judgment as well (Figure 1.).

![Fig. 1. Pécs, 'Kertváros' (photo:wikipedia)](image1)

The ‘panel’ flats can be found sporadically in Pécs, for instance in the downtown, ‘Kertváros’, ‘Uránváros’, on the slopes of Mecsek and in ‘Budai’ district (Figure 2). The judgment and prestige of these flats depend on their location, environmental features, size and significantly the unique ownership (still perceivable), moreover the way of acquiring them. These aspects have to be considered throughout the rehabilitation.

![Fig. 2. Pécs, Google Earth map](image2)

3. RESULTS

The main square in one of the districts was renewed by means of the European Capital of Culture project. It resulted in a rather positive change, but it was not sufficient for the complete rejuvenation (Figure 3.). The renovation and the regular maintenance of the benches, green spaces, playgrounds (which meant the conceptual basis of ‘Uránváros’) and the spaces between buildings are necessary in order to regain the prestige once they used to have during the construction. The utilization of the so called ‘space waste’ also has to be handled, in order to find their function finally, which has been being searched for since they came into being.

In 1994 Pécs began a program in Gosztonyi Gyula Street (‘Uránváros’), which attempted to attach the public places between these buildings to the houses, so the inhabitants could have used them freely. The goal was a progressive experiment improving the living environment. The housing
estates in Berlin, Hufeisensiedlung, Onkel-Toms-Hütte and Weissensee can be considered the basic examples [5].

Their abiding state was due to the independent garden each flat possessed, furthermore their judgment was based on their human scale and useful interior. In Hungary this program was labeled as ‘too early’, but nowadays would be more successful, if the town offered the above mentioned possibility again. There would be an option to build public gardens, which is a popular form of strengthening the local community and improving our environment.

![Fig. 3. Pécs, the refurbishment of 'Uránváros' (photo: Uránváros Konzorcium)](image)

In general the bad reputation of the neighborhood is in connection with the fact that the public institutions of the housing estates have not been built yet due to the low investment budget and the lack of time. ‘Uránváros’ and ‘Kertváros’ are exceptions. Kindergartens, primary schools, educational centers, restaurants, supermarkets, pedestrian precincts and clubs were built at the foot of the ‘panel’ buildings [6]. The rhythm of the spaciousness and tension between the facades amongst these public spaces and houses is architecturally exciting (if the aesthetic desultoriness is not taken into account, which was meant to break monotonity).

The decreasing and aging population, unemployment and impoverishment led to the closure of almost every institution. A functional change should be initiated and establishments should be constructed such as the ones that are able to reflect on and adapt to the actual needs. The empty buildings and their surroundings should meet the demands and be able to become well-operating and maintainable functions. These problems induce the emergence of slums accompanied with further aesthetic deficiencies for instance, the improper placement and outlook of the trash rooms, or the inadequate amount of storage space, which cause the feeling of desultoriness and environmental amortization. The problem is intensified by the still existing social segregation, the high unemployment rate.

Architecture is only a tool in this program of rehabilitation; therefore social changes are definitely needed for the final solution. In the optimal case the residents and their communities are the ones who possess the appropriate financial background for the refurbishment, sustenance and maintenance. If it does not occur, despite the large scale investments, the problems will re-emerge.
over and over again. The architectural solution is not satisfactory, but is able to form communities and enhance the sense of comfort; however the complete alternative should be found elsewhere. In many cases, improvements with significant financial investments cannot be rationalized. It does not mean that cheap, fast, attractive and efficient ideas are not welcome in order to enhance the comfort of the living-spaces. Properly placing the trash containers, painting the parking slots, regulating the design of the shops and rethinking the empty buildings can provide an appropriate solution, in which the government should also be involved.

4. DISCUSSION

The district-heating service can be considered one of the most up-to-date and greenest heating technologies. In spite of this, its continuous modernization is a very important task. The reduction of heat loss is an important aspect of improvement. The former block heating centers would be replaced by individual heating-centers, which would be placed in the houses. Six block heating centers were moved in a competition, so their previous buildings remained empty.

The rethinking and reutilization of these establishments with new profitable functions would be a useful experiment on the rehabilitation of the environment requiring low amount of investment. It would be incorrect to think that only architects can rationalize these functional modifications, however such suggestions can be made by them, which have architectural aspects. Those functions can be considered important, which have ‘owners’ and are able to generate profit or have the potential to be tenderable.

Hungarian people have been socialized to reckon ‘everyone’s is no-one’s’, therefore they do not feel they possess the so called ‘common’, do not care about it appropriately and if there is no budget reserved, it is destined for decay. At choosing the function it is significant not to increase the physical extent of the available establishment. The successful foreign rehabilitations have found the solution in decreasing the population per square meter, using a human scale, creating more green spaces and comfort-enhancing investments.

A condominium has already been built on an abandoned heating center in ‘Kertváros’, but the goal is to form such a communal function, which is able to attract the inhabitants from the neighborhood (Figure 4.). The functions which are about to be built can replace the missing spaces of the flats with such grounds, which allow several free time activities: pet garden, daycare for elderly people and children, hub, garage, clothing swap, center for food allergy, community house, bio market, tutoring center, language school etc.

The requirement of the operability is to meet the environmental demands, since it is crucial that the rehabilitation has to be customized. After the precise analysis of the surroundings, the residential community, the available services and the arising needs, it is possible to make a right suggestion. A student competition would be able to give birth to the proposals for reutilization by architecturally visualized ideas. These concepts later can be judged by both the residential communities and the public opinion thus their raison d'être can be analyzed and the rehabilitation will be able to begin.
The emergence of the block heating centers can be labeled varied, which refers to the differences between space situations instead of unique space formations. It allows functional and architectural presence without standardized solutions, which means environmental valorization and in some cases the improvement of the visual value afterwards.

The question should be raised if the living environment needs to be changed or the judgment of the housing estates needs to be improved. The answer is yes from many perspectives, since we cannot do without the panel buildings. The general negative view about the housing estates, broken down to living spaces and living situations, does not necessarily show a negative picture.

Moreover some people prefer living in these flats, as they have an emotional bonding. The complete and economical refurbishment of the buildings and flats is very important for the building industry in the long term, since it creates jobs. These improvement possibilities significantly influence the comfort of the blocks of flats.

The ongoing and potential alternations have to be conveyed to people with such new communicational strategy, which shows the hidden possibilities in their homes as well (Figure 5.). Its goal is to be able to use the actually disliked stock of flats in an optimal environment. Besides the governmental solutions, an alternative concept can also be presented. The attention of the solvent social layer has to be raised with providing an opportunity for them to buy flats for reasonable prices. With proper interior design the well-known ‘panel-atmosphere’ can be overwritten and a home can be planned with contemporary ideology, in which comfort, expediency and multifunctionality are the most crucial factors.
6. CONCLUSION

The required actions of the suggested rehabilitation would be the following [7]:

- fresh sociological surveys (the survey of the customer needs), it allows the demographic effects and gives the possibility to create homes, which are child-centered
- favorable home loans
- management
- scheduling construction, professional education
- media engagement and responsibility
- preparation of political programs, since with the decay of this stock of buildings vast national wealth is depreciated

This concept has been confirmed by heading towards such an environmental rehabilitation, which can be rationalized quickly, with low capital or EU benefits and by not waiting for governmental or political decisions allowing these living-spaces to deteriorate. In the 90s, with bestowing the governmental flats, the solution of their problems were postponed by the state, that is why it is important to handle this issue with care.

REFERENCES

THE APPEARANCE OF TECHNIQUES DERIVED FROM AUTOMOBILE COACHWORK IN JEAN PROUVÉ’S INDUSTRIALIZED ARCHITECTURE

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Abstract — The development of the curtain wall in terms of a light, not loadbearing facade has been influenced by techniques and materials applied by the automotive industry. This can be shown in the oeuvre of Jean Prouvé who achieved an outstanding position among the protagonists of the modern movement as he undertook serious developments in terms of introducing methods of industrial fabrication in architecture. His innovative use of thin sheet-metal for architectural elements dates from the 1920s and led to architectural designs which differ from permanent or static architecture in a traditional sense. This architectural countenance joined the demands of society in the phase of reconstruction after 1944. At the same time, it made use of increased capacity in the production of aluminium as a result of warplane production.

Prouvé’s approach, to join façades or even whole buildings derived from a kit of parts is comparable to the principles established in car manufacturing, where the creation of different variants is based on transposition of a standardised set of compounds. Not only the method, but the techniques of construction find their analogy: The architectural elements were made predominantly by applying modern bending and welding techniques. In comparison to traditional construction-work, this meant a radical break.

A case study will analyze the prefabricated petrol stations of the 1950’s derived from Prouvé’s so-called "standard" system. This represents a highly inventive kit of elements which have been fabricated in his own workshop, a factory near Nancy, where Prouvé designed and produced many series of structural elements for buildings, facades and also furniture.

Key words — automobile coachwork, industrialized architecture, techniques, Jean Prouvé

1. INTRODUCTION
Jean Prouvé occupies a special place within Modernism. His creative work focussed on the industrialisation of the building process with the help of technologies that had led to major changes in a different area. In the 1920s he started to explore how a set of instruments that reflected the level of technologies in the 20th century could be used in architecture. His work marks a break with tradition and the transition to a new, technological but no less humane architecture.

Jean Prouvé, who was born in 1901 in Nancy, was the son of the painter Victor Prouvé, one of the protagonists of the École de Nancy. This association of representatives of Art Nouveau shaped the cultural life of the city around the turn of the century. Located in the centre of the industrial region in eastern France, Nancy had a long tradition of metal working. The young Prouvé trained as an artist blacksmith and opened his own studio where he initially worked with traditional methods.
But once he discovered modern semi-finished products, machines and jointing technology he soon abandoned traditional wrought iron. In his workshops he used a bending press to cold form thin sheet metal into structural sections which he welded together electrically. Using sheet steel profiles and later also stainless steel and aluminium, he produced building parts such as doors and windows as well as furniture. Although Prouvé did not have an academic education, in his collaboration with the leading architects of his time he was able to contribute his technical and design skills.

2. MODERN TOOLS

Working with the machine calls for a different way of thinking than handcraft: the individual adaptation of single pieces becomes a thing of the past, as the machine can quickly and precisely shape multiple identical parts of a type. In 1908 mass production at Ford led to the transformation of the automobile from a luxury good to a consumer product. With the introduction of the monocoque steel system by the Budd Company the degree of industrialisation in motor car factories was increased even further. From 1924 Citroen was the first European producer to use American tools and licences to launch the model B10 with its *tout Acier* construction. Instead of a timber frame the all-steel coachwork was built of hollow sections made from sheet steel, which, together with the external skin, produced a lightweight and rigid whole. The development of metal forming technology and suitable joining techniques made this possible. Both techniques, pressing and electrical welding, were used in the Ateliers Jean Prouvé. Investment in expensive equipment as used in the car industry with its high production figures made no economic sense in industrial building where relatively small amounts of parts were produced and therefore simpler tools were used. Instead of expensive deep-drawing presses, in the Jean Prouvé Ateliers a press brake was used. With this highly flexible tool a large variety of linear sections could be produced. Prouvé’s constructions, irrespective of their scale, are generally based on this system. His initial material was flat sheet metal. After gaining experience with his first building elements, in 1935-36, using folded sheet sections and panels, he erected the Flying Club Roland Garros. The building was completely prefabricated, including all the individual parts. The frame was made of hollow sections instead of the conventional, heavy, hot rolled steel sections.

2.1. Structural Analogies

Prouvé derived his inspiration from the world of technical objects, which he took apart in his mind – in some cases also physically – and subjected to close analysis. He was interested, for instance, in the profiling and joining of load-bearing coachwork parts. He sketched these as part of the preparations for one of his famous lectures at the Conservatoire National des Arts et Métiers in Paris\(^1\). Prouvé was a brilliant draughtsman and used this drawing to illustrate the unibody design of the front-wheel drive Citroen 7 from 1934. The sills, whose cross sections are detailed here, are integrated in the coachwork or body. This technical innovation – the replacement of the traditional frame and the integration of the upper parts of the coachwork – was emphasised by Citroen in their advertising. *Légèreté* (lightness) of the structure also became a typical characteristic of Prouvé’s
work. In 1935-39 the Ateliers Jean Prouvé together with the architects Lods and Beaudouin designed and built the much acclaimed Maison du Peuple in Clichy.

Architectural historian Bruno Reichl in has described this as an outstanding work of “synthetic” This refers to both the spatial flexibility of the architecture through the aid of mechanistic solutions and to the construction method. For that time the building’s adaptability was spectacular and still would be today: it had a sliding first floor slab and an opening glass roof with which the central internal courtyard used for the weekly market could be covered or closed. Movable partitions allowed the spaces to be divided up in different ways. All these solutions, together with the facades, came from the Ateliers Jean Prouvé. The facade is one of the first examples of a modern curtain wall to be built in France, a kind of facade that carries its own weight but none of the building load. The design of the facade panels is a fine example of the synthetic approach. An inner and an outer layer form a hollow box that is braced against wind forces by means of an upstand along the edge and is fixed without any additional substructure to the floor slabs. Built-in springs make the external skin belly outwards as a way of handling the expansion resulting from temperature changes.

Whereas sheet steel had been used earlier, after the war aluminium was the material of the time. Promoted by the French aluminium industry, it was adopted by various branches of construction including car manufacturing and the building industry. A small digression here to the method of building coachwork parts is most informative: in 1948 the Dyna X was launched as the first post-war Panhard model with an aluminium coachwork. The door with its integrated sliding window was made of two deep-drawn shells connected at the edge by a standing seam joint to create a continuous rigid hollow section, Fig 1.

Fig. 1. Panhard type Dyna X, 1946, front door made of aluminium sheet, (photo: a. buss)
The external skin was cambered and elastically supported to prevent it denting. The continuous window surround is characteristic: The rounded corners avoided tension fractures in the external skin and allowed the seal to be led continuously around the edge of the glass. In comparison to conventional details in building these solutions that are harmonised with each other required only minimum space.

2.2. **COQUE-TYPE**

From 1950 onwards Ateliers Jean Prouvé carried out numerous studies for what were called “nomadic” petrol filling stations. These could be erected wherever required and easily taken down again. The basis was the patented type standard – building system. In this perspective the open-roof car forms a subjective frame for the view of a transparent pavilion, whose construction in turn reflects that of the car. The dynamic lines and the detail of the rigid frame legs are characteristic of both. Only a few of these studies were actually carried out: this one has with the characteristic type standard panels with small porthole openings. The inclined roof is continued seamlessly to form the rear wall, which was made possible by the water-tight skin of aluminium sheeting. The roof illustrates Prouvé’s so-called type coque. Its basic element is a self-supporting box originally designed to roof industrial production sheds.

The light, prefabricated elements offered the advantage that they could be easily mounted using physical labour and were particularly suitable for smaller buildings, above all dwelling houses, as they could be laid out beside each other in rows. The soffit of the shell forms an impressive space into which light is reflected by the shiny aluminium skin. In case of the filling stations, the shell is carried by columns in the glass facade which are made from pressed hollow sections.

The coque – element makes use of techniques from the field of coachwork building. It’s welded ladder frame is made of folded C sections. By folding the sheeting around the flange of the C, the frame is made rigid. The curved, flowing transition between roof and wall is an important detail. This connection is bend-resistant. Like in the bodywork of a car or a train carriage the distinction between wall and roof disappears.

2.3. **CLOSED SYSTEMS AND CONSTRUCTION KITS**

Structure and construction techniques are aspects that refer to coachwork building, but for industrial building thinking in terms of systems, the relationship of the parts to the whole, is of equal importance. To create a coherent whole the elements must be geometrically harmonised with each other and connected.

Jean Prouvé liked to use examples from Citroën. They represented a spirit that employed unconventional methods to arrive at surprising constructions that also largely determined the formal appearance. Their simplicity was achieved by a high level of sophistication.

Perhaps the structure and coachwork of the Citroën delivery van resemble a building more than a vehicle. The popular transporter Type H is based on a concept from the 1940s and uses the drive train of the legendary front-wheel drive car from 1934. However the coachwork is different. Prouvé here examined the structure of the platform frame; the box-like coachwork connected to it is omitted. Together with the supporting frame it is a fine example of a modular construction made up of elements.
Citroën used flat panels stiffened by means of corrugations that could be easily produced with simple dies. The panels are not rolled semi-finished products like standard corrugated metal, instead each panel is separately pressed, allowing the corrugations to flatten out towards the edges. The box is made up of panels of different sizes, movable parts and hollow sections [Fig. 2].

The difference to a façade is only marginal: the metal walls are made of a single layer and are not insulated and therefore lighter. The simplicity of the design and the different heights and lengths available are the result of the modular construction system.

In the design of the delivery van alongside the fascinating structure the combination of different elements also plays an important role. This is a closed system which is to say: its standards are restricted to this one product and the producer. In industry this was the usual approach, in traditional building in contrast it is normal to use many different kinds of construction materials and parts. This, too, creates an entity but it becomes a whole only by adapting the individual parts to each other.

In contrast Prouvé promoted the use of the closed prefabrication method as it allowed the elements to be far more closely linked with each other in terms of their function than is possible in traditional building, while still allowing a range of variations to be offered by exchanging parts. The marketing was intended to reflect this. Prouvé hoped to offer prefabricated architecture in much the same way as car manufacturers produce types and series. Like a consumer product it suited the spirit of the times and it, too, had a limited lifespan. The differences between the elements in the construction kit system type Standard made it adaptable; it was not tailored to specific uses but could be employed universally. This resulted in the wide range of buildings of which the filling stations shown, dwelling houses or schools are just a few examples [Fig. 3].

The fact that in 1953 Prouvé separated himself from his business in Nancy and from then had to continue his career as a designer rather than a producer meant he no longer had his own production facility. But in the work of his later years, too, the idea of the closed system, the house as a construction kit, is still dominant, as is shown here.
3. WHAT OF PROUVÉ’S IDEAS HAS SURVIVED?

For the representatives of the automobile industry, with whom Prouvé would have liked to work, his architecture was too progressive. For instance the management at Citroen rejected a proposal for workers housing of the type Coque that he presented in 1951 with the explanation that it was “too modern”\(^2\). The industry shied away from the risk involved in using its progressive methods to explore the field of building construction. Among the few exceptions was Renault, which at the start of the 1970s attempted to enter the construction industry with a subsidiary company, however this attempt went no further than the test stage\(^3\). Following the decline of handcraft the French culture of building was dominated by industrialised concrete building methods, and it was only in the area of light facades that techniques derived from coachwork construction were able to establish a foothold. In this area Prouvé’s pioneering work remains exemplary today, but his plea for the building to be understood as a whole and for industrialisation down to the last detail has, by and large, been ignored.

NOTES
1 A collection of Jean Prouvé’s sketches referring to automobiles can be found in: Jean-François Archieri, Prouvé : Cours du CNAM 1957-1970 : essai de reconstitution du cours à partir des archives Jean Prouvé (Liège: Mardaga, 1990) 246-259.
RAPID INDUSTRIAL CHANGE AND URBAN EXPANSION: 
THE PANSIO SHIPYARDS IN TURKU, FINLAND

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Abstract – The paper discusses the close connection between the rapid post-war industrial change and the urban expansion in Finland. The Pansio-Perno area of Turku provides an outstanding example of post-war growth and shows its effects on the above mentioned city. In the aftermath of the Second World War, Finland was bound to pay reparations to the USSR. Among them there were hundreds of vessels, in which situation the shipbuilding industry had to be expanded. Two of the new shipyards were established in the Pansio area of Turku during the 1945–46. The need of labour force led to the gradual construction of several housing areas. One of them, designed by architect Erik Bryggman, pioneered in the use of industrially prefabricated units, and has been classified as national heritage. The formerly rural area thus gradually developed to a new socially diverse industrial community. Later/subsequent construction has further added to the industrial and urban layers of Pansio and its neighbouring area Perno, but the decline of shipbuilding industry has impaired current development. Currently, the area is one of the suburban revitalization targets of Turku. A key issue of the paper is how to understand the former industrial history and culture in the current situation. The timeline of development of the Pansio-Perno focuses on three key periods: the birth of the post-war industrial community, the realization of the industrially produced neighbourhoods of the 1970s, and the latest structural changes starting from the 1990s. This paper presents and discusses mainly the first one of these key periods, which lasted until the mid-1960s. The study is based on primary archival sources, former studies, and an empirical analysis of the layered historical development of the area. The paper demonstrates the complexity of industrial and urban development, and serves as a background for a general discussion on the potential of industrial culture in urban revitalization.

Keywords – history of technology, industrial heritage, urbanization
1. INTRODUCTION AND BACKGROUND

Pansio-Perno is a district of the city of Turku in south-western Finland, with around 5000 residents (year 2012 statistics). In the Finnish context, the known elements of the area are the commercial harbour areas, a naval base of the Finnish army, and a large shipyard. The area is also a location for smaller industries such as food manufacturing.

Typically the development of Finnish post-war suburbs, built from the 1950s onwards, has been based on comprehensive planning ideas and somewhat coherent realizations. The history of Pansio-Perno area presents another aspect of urban development: the area is fragmented in terms of urban form, and it has grown to its current state through several gradual phases. It is also worth mentioning that the identity of the area has, for a long time, relied on its character as an industrial community. As Pansio-Perno consists of relatively scattered fragments of urban development processes, it is not easy to define e.g. where its centre is located, nor what the hierarchy of its urban form is. Different scales and functions of urban development, industrial production, and logistics merge with the fragmentary remains of former countryside. Thus, Pansio-Perno represents in a small scale such aspects of new urbanity that have been discussed on a general level in connection to the concept “Zwischenstadt”, introduced by Thomas Sieverts. The challenges that city planners currently face when envisioning Pansio-Perno’s future are, therefore, slightly different from the challenges connected to more typical Finnish suburbs.

The southern (or south-eastern) part of Pansio-Perno is called Pansio. This is the area that first developed from a rural tract into an industrial area. This paper presents a brief summary of the first industrial change in Pansio, which started in 1930s and reached into the mid-1960s. The annexation of the Perno area took place later, in 1967. Our special interest is the period of rapid industrial growth after the Second World War, and the connection between the growth of the industries in Pansio and the development of the urban settlement during 1940s and 1950s. However, in the last section of the paper, it will also be briefly discussed the longer time span of Pansio-Perno.

Background of the industrial change before the Second World War

At the beginning of the 20th century, the area was totally rural and belonged to the neighbouring small municipality of Raisio, without even a direct road connection to Turku. The visible change in Pansio from rural to a more and more industrial area can be said to have started at the beginning of 1930s. The construction of an oil harbour in the area took place between 1930–1932. The planning of that harbour, nevertheless, had already started in 1918, when a group of entrepreneurs had purchased 930 hectares of land in Pansio for this purpose. However, their joint harbour company Transito-Satama Oy sold the purchased land to the City of Turku in 1922. Later on, in 1930, the whole Pansio area was annexed to Turku.

The development of the harbour functions in Pansio in the 1930s included not only the construction of an oil harbour, but also constructing storehouses for food exports, in a nationally notable scale. The investments meant in practice that the export of Finnish agricultural products was
gradually concentrated to Turku. The harbour functions, including an oil harbour, are continuously strongly present in Pansio even today.

The conditions were suitable for a harbour, and the location was seen strategically favourable. It is not surprising that also a military harbour, *Turun laivastoaema*, was established in Pansio at the end of 1930s. The planning of this naval base had already started at the end of the 1920s. The site became the principal base of the Finnish navy in December 1939, when the war between Finland and Soviet Union broke out. During the Second World War the naval base was further developed. The army carried out construction projects, such as subterranean store spaces for mines and a shipyard for reparations.

The long tradition of shipbuilding industries in Turku, which was manifested in many ways, would later become the foundation for the post-war growth of shipbuilding industries. During 1930s, *Ab Crichton-Vulcan Oy*, a shipbuilding and machinery company, was the biggest company of Turku. Before the war, in 1937, *Ab Chrichton-Vulcan Oy* opened a new shipyard in Turku.

In order to make the functioning of all the aforementioned functions possible in Pansio, it was necessary to improve road connections between Pansio and the central areas of the city of Turku. In addition to a road connection, also a railway connection was needed. The new road and the railway were constructed along the undulating shoreline. This would later result in a gradual transformation of the entire shoreline into an area reserved for industries and logistics, detached from the inner parts of Pansio.

One more factor in the transformation of Pansio from a peripheral and rural tract into a modern, more industrial area, was the construction of an airport in Artukainen, next to Pansio. The airport was inaugurated in 1935. This airport, serving the city of Turku, was the first in Finland and the northernest in the world at the time. During the war the airport served air traffic to Stockholm, which was the only city where connections could be maintained in the circumstances of war. The airport was in regular use until the 1950s.

2. THE BIRTH AND DECLINE OF AN INDUSTRIAL COMMUNITY

During the Second World War the naval base and its functions in Pansio were developed further, as was mentioned above. In addition to that, an iron mill was put in operation in 1943 in Pahaniemi, near Pansio, by a company called *Vuoksenniska Oy*, since military industry needed more crude iron than was available. The location was beneficial due to the availability of raw material in the proximity to harbours. The mill was operational until the 1970s.
In the aftermath of the Second World War, in 1944, Finland was bound to pay reparations to the USSR (300 Million US dollars altogether). The products of marine industry were well presented in the list of demands. For example, Finland was required to deliver 90 pieces of wooden schooners to the Soviet Union. In Pansio area, this resulted in the quick establishing of two shipyards immediately after the war. Pansio thus became an example of rapid transition from a basically rural area to an industrial community. The industry, in this case, was shipbuilding.\(^8\) (Fig. 1.)

One shipyard was transformed from the former repair shop of Turun Laivastoasema for the company *Valtion Metallitehtaat*. The company, also called VMT, was established in 1946, and was later known as *Valmet Oy*.\(^9\) The company that operated the other shipyard was called *Oy Laivateollisuus Ab*, or “LATE”. It was established in 1945 for the production of wooden ships. The first mentioned one was ready for launching in 1947.\(^10\)

The growth of industries resulted in housing needs. Housing in general was a problem to be solved in Finland of the 1940s. The population of Turku surged after year 1944 in just six years from less than 83,000 to 100,000 inhabitants. Two important growth factors were migration and increased natality. A great proportion of the increase converged on areas that had been recently annexed to Turku.\(^11\) In 1949 the population of Pansio grew to around 2000 people.\(^12\)

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**Fig. 1.** Pansio and Perno areas in 1946. The approximate locations of shipyards, harbour and the naval base are indicated. Source of the map: The National Library of Finland.
The industry was active in constructing apartments, to solve the acute housing shortage in Pansio. The first houses for shipyard workers were mainly simple shelters and log houses, built around years 1944–1946. Some brick buildings were also constructed. Since this was not enough, Oy Laivateollisuus Ab acquired a new piece of land for the purpose; this area was nicknamed “Lotinapelto”. It was also decided to build a whole new residential area. The new area was designed and constructed during 1946–1948. Architect Erik Bryggman, one of the most prominent early modernists in Finland, drew the town plan for the area. He also designed a small housing type for serial production. The area consisted of 42 wooden houses, which were placed along the height curves of the site. Prefabricated wooden elements, produced by A. Ahlström company, were used in their construction. The apartments had two rooms and a kitchen, either in units for single families or combinations for 2–4 families. In the middle of the area there was a community house. The layout of the area reflected the social hierarchy of the community. Closest to the shipyard, on the hill, there were the houses for the administration and engineers; lower ranks occupied perimeter areas.

There is also a story about the collective construction of single-family houses for a separate residential area. The idea was born in the summer of 1950 and was promoted by the local social democratic association. City administration accepted the project, and 47 lots were planned on unbuilt farmland. The idea was to construct the houses as a joint effort and, after that, assign the houses for each one participant by drawing lots. As one might suppose, things did not go quite smoothly, and 16 of the participants broke the deal and demanded some particular houses for them. The rest, however, proceeded as was originally decided.

Writers and interviewees have stressed the community spirit of Pansio after the war. People were busy at work, even if the work was hard. Families had small children, and as the housing problem had been solved within a period of some years after the war, the prospects of increasing wealth were positive.

The lifespan of Pansio shipyards was limited. After the reparations to the Soviet Union were returned, Oy Laivateollisuus Ab continued shipbuilding for special markets. A real innovation was the fabrication of glued laminated beams. It was a profitable business: over 50 per cent of the production could be exported. However, the beginning of the 1960s was already a difficult period. One reason was the transition from wooden to steel ships. The company avoided termination partly due the devaluation of the Finnish currency in 1967 (a recurring situation at the time), after which the prospects for export improved. In 1973 Valmet Oy bought the shares of the company, thus becoming owner of both shipyards of Pansio, and broadened the product scale.

Valmet Oy was also in difficulties: first in the beginning of the 1950s and then around ten years later, even if the company had especially invested into the development of the Pansio shipyard. The result of the year 1963 crisis was the establishment of Pansion tehdas factory, which began the fabrication of ventilation systems and steel structures for construction industry.

The next shipbuilding crisis begun in 1975, but could still be managed successfully. The final decline began in the 1980s. In the pressure of competition, the shipyards of Ab Wärtsilä Oy and
Valmet Oy were merged in 1986, after which the Pansio shipyards were closed. Also the operation of Laivateollisuus ended in 1988.21

Before the end of Pansio shipyards, Wärtsilä-yhtymä Oy had already decided to establish a new shipyard to Perno, only a few kilometres westwards of Pansio. The Perno shipyard was intended for the construction of large ships, often for special markets. Part of the employment of the Pansio shipyards could be transferred to the new site.22 This development also led to the abandonment of the older western and eastern shipyards of the company closer to the centre of Turku, at the mouth of Aurajoki river, except for repair tasks.23 The Perno area was annexed to Turku in 1967, and the shipyard was inaugurated in 1975.24 However, from the viewpoint of Wärtsilä-yhtymä Oy, this move was also temporary: The shipbuilding part of the company, Wärtsilä Marine, went bankrupt in 1989.25 The story of the Perno shipyard did not end, however, and its operation has since continued under various ownerships.

Thus, one can suggest that behind the few decades’ flourishing of the Pansio shipyards there is a longer span of the history of Wärtsilä-yhtymä Oy and shipbuilding in Turku. This becomes clear if we look at the former history of Wärtsilä. Before the year of 1938 the company was known as Ab Chrichton-Vulcan Oy, which had been founded in 1924 as a merger of two mutual competitors, Ab Crichton and Ab Vulcan. Both these earlier companies had their origins in the latter half of the 19th century.26

3. NOTES ON THE “ZWISCHENSTADT” DEVELOPMENT IN PANSIO SINCE THE 1960S AND CURRENT PLANNING QUESTIONS

The question concerning the ephemerality of Pansio shipbuilding industry is related to the questions concerning the gradualness of the development of Pansio’s urban structure. The original after-war industrial community in Pansio was relatively compact, and actually it represented well the general pattern of industrial community building before the war. This was an exceptional phenomenon in the immediate vicinity of Turku. The birth of the Pansio community in the pressure of changing industrial production, and the resilience of this community, may partly explain the current “Zwischenstadt” character of the surrounding urban development. After 1968, new planning ideas arrived at Pansio, and industrially produced detached apartment blocks were constructed around the old community. They broke the former compact nature of the area, but the new development did not largely wipe away the remains of the former development. However, the new development units seem to have been placed without a clear idea about an integrated urban structure, even if Pansio has been included in several general plans of Turku. At the same period, the scale of industrial development increased along with the introduction of the Perno shipyard and the extensions of the Turku harbour. (Fig. 2.)
Pansio-Perno is still, today, a relatively isolated from the downtown, and its urban structure is fragmentary and incoherent. On the other hand, the area also has many positive features. The fragmented discontinuity of urban structure is quite specific: there are historical layers, signs of the past, and beautiful natural spots in between. The multiplicity of scales, functions and historical layers can be seen both as a challenge and as a resource with regard to its developing.

One could suggest that Pansio-Perno has been a “colonization” area of Turku, with plenty of free space for production and auxiliary functions. This development is still going on – the allocation of large business and industrial units on the perimeters of the area takes place on its own pace. The planning of Pansio-Perno, thus, can be seen also as an attempt to allocate existing development forces in a beneficial way.

The logic of the urban structure of Pansio-Perno may appear somehow unclear if the area is observed from the point of view of (earlier) comprehensive planning ideals. The structure and the logic of the area become more understandable, however, if we regard the area as a collection of different historical layers, each of them having a character of their own. But with this new perspective in mind, the question is still: does the district need more shared elements, or connecting...
tissue, in order to make an interaction between the actors of different subareas possible? And if so, then what, where, and how? These are questions that planners face more and more when considering the future of the fragmented edge areas of current cities. Examining and considering the questions we face in Pansio-Perno, these can therefore lead to more general questions of city planning. Pansio-Perno can be an example a new phase in the development of suburban areas (also) in Finland. In the future there will be more and more demand for solutions for developing fragmentary districts in clever ways.

What sort of inspiration, then, could the awareness of the history of Pansio’s industrial community give to planning?

An important feature of Pansio of the 1940s and the 1950s was the mutual interdependency of the local people and actors. This mutual dependency was a basis for everyday community life – both ideological and material. Even though it is impossible to return to earlier modes of life, it is relevant to ask: what could be a positive content of the mutual interdependency of local actors and residents in our times? This question is strongly related to another key feature of the 1950s’ Pansio: a close connection between business (or industrial life) and housing. Is such a proximity and functional connection still possible (or worth pursuing), or does this type of connection belong to the past?

Pansio can have a specific urban character of its own, if it will be developed further on its own premises. For instance, the shoreline could be a valuable resource in case its accessibility and development for residents could be solved somehow. And when reflecting on potential changes on the shore, one should of course consider at the same time how to encourage community life inside the area. Can certain parts of the area be redeveloped in order to create an “urban spine” for Pansio?

The material marks from the different periods of industrial development in Pansio can be seen both locally and even nationally as a valuable industrial heritage. This raises additional questions for planners: what kind of potential does this heritage generate for the development, and what type of restrictions? From the point of view of the permanence of the heritage, the question can, in the end, be: what is the best and most natural way to encourage a close integration of the local everyday life and people’s awareness of the specific historic values of the area?

ACKNOWLEDGEMENTS

Our paper is a part of a more extensive research project about future potential of the Pansio-Perno area. The research is financed by the Housing Finance and Development Centre of Finland (ARA), which is a governmental agency to implement social housing policy, operating under the supervision of the Ministry of the Environment. We would also thank our colleague M.Soc.Sc. Jukka Hirvonen and the City of Turku for providing statistical background information.
NOTES

1 See e.g.: Terttu Pakarinen, “Metakkaa metaforista – Kaupunkikäsityksen muutos tiedollisena ongelmana [= Fuss about Metaphors – The Change in the Idea of the City as an Epistemological Problem],” Yhdyskuntasuunnittelu 45, no. 2 (n.d.): 30; Thomas Sieverts, Cities Without Cities: An Interpretation of the Zwischenstadt (Abingdon: Spon Press, 2003). [N.B. the Finnish titles have been translated into English by the authors.]


6 Varnila, Merellinen Pansio, 12–14.

7 “Imatra Steel Oy Ab 1915-,” n.d., Suomen elinkeinoelämän keskusarkisto.


9 Uusitalo, “Turku Suomen itsenäistymisestä vuoteen 1950,” 261; Björklund, Valmet, 63.


12 Varnila, Merellinen Pansio, 34.


15 Varnila, Merellinen Pansio, 29.

16 Ibid., 30.


19 Björklund, Valmet, 154–160.
Ibid., 210–214.


23 Knorring, *Aurajoen veistämöt ja telakat*, 137.


26 Ibid., 17–29, 81–82, 85–89.
EXPERIENCES ON THE TIMELINE OF ARCHITECTURE – PARALLEL CONTEMPORARY DESIGN BY THE MANIFESTO OF THE MODERNISM

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Abstract — Working with built architecture can provide a wide range of design experiences. The examination of the architectural concept helps to understand the unwritten rules, the local situation, the urban situation/plan, the landscape quality, the owner, etc. The design can be harmoniously based on the monitoring of the place. Sometimes it tells even more. I am going to integrate the 5 points of Le Corbusier to a contemporary design project. His own planning method did not come from the environment, it is his own creation, it depended on Corbusier’s genius. This points manifested in the ages of the heroic modernism - pilots, roof gardens on the top of the buildings, the free deigning of the ground plan, the free design of the façade without connection with the structure and the horizontal windows of the façade. one of the best example of this planning method is the Villa Savoy in France, dating from 1931, it became a built monument, an architectural basic element in Corbusier’s life. These 5 points could be an interaction between old and new, modern and contemporary. The specific expressive style generates a contemporary residential building as a “study case house” of nowadays – focusing of the changes of the functions, but staying close to the historical targets for form. (This research was supported by the European Union and the State of Hungary, co-financed by the European Social Fund in the framework of TÁMOP 4.2.4. A/2-11-1-2012-0001 ‘National Excellence Program’.)

Keywords — Architecture, Design, Residential Building

Let us speak about conceptual architecture!

Some architects try to find “standards” in architecture, that would be possible to follow, without being in danger of making mistakes.

There are two types of followers of these theories. One is the self-confident one with his own ideas. These ideas are defined at the beginning of the design project, maybe based on his own experiences, and the designer is carrying them out – because the ideas can work as a manifesto. It happened in the past, maybe in the middle of the modernism. Architects had the possibility to create in this age strong theories like the 5 points of Le Corbusier\(^1\).

This period offered lots of chances for getting experience or just looking for the right architecture. Corbusier researched the “always right” architecture and tried to define it in his 5 points. It was for the “new architecture”, his masterwork, that the Savoy Villa represents the basics of modern architecture, as the world knows this example of the “International Style\(^2\)”.

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\(^1\) Le Corbusier (Charles-Édouard Jeanneret-Gris) (06th of October 1887, La Chaux-de-Fonds, Switzerland – 27th of August 1965, Roquebrune-Cap-Martin, France)

\(^2\) The major architectural style is between the 20’s and 30’s. This is the formative decades of modern architecture.
Fig. 1. The five points of Corbusier (Villa Savoye, Poissy, 1928.)

The building was a country house, one of the most important architectural precedents. The building was known as a “mechanised entity”, working contextually as an industrial product – with the scale of the humanity inside.

From this point of view it is important to speak about the humanity, the scale of the building, the spaces inside it are bigger than what is normal today. It was not luxury or the device of luxury, just the ideal “normally” of the latest 20’s. After this period something changed. The economic crises (what a déjà vu!) and the Big Wars overtyped the norms, due to housing deficiencies.

Another situation, from this point of view: until nowadays these norms weren’t similar in Europe or in the US. The IKEA has to produce almost with one and half times bigger furniture for the costumers in US than for those in Europe. Even if a lot of architecture geniuses escaped to the US in the 40’s, they became more open for new experiences and created more generous conceptual projects while the others stayed in Europe.

Designers had to change their opinion about the manifestos, following the scale of humanity changes. The most important, on this procedure, were the first congresses of CIAM\(^4\) that focused on urbanism and the problems of living spaces after the determination “architecture as social art”. He members worked for the social cases,\(^5\) but had to earn money – by the orders taken from the rich people. This dilemma has led to the same questions, but their result motivated a lot of other experience and cases in the future. Groups of architects have tried to find the new scale of housing, the 5 points changed. The first point to disappeared was to be the “free floor plan”. The structure went back to the primer structures, it was more economical.

Maybe, as far as their work was concerned – not just for political reasons – there were some looking for the optimum and the absolutely economic structures, solutions in architecture by groups of architects in the early 50’s in Hungary. As the new “five points” in the architecture which were able to serve the changing popularity, can define the house of the miner and the teacher. It’s a conflict in ideology; in his concept, the flat of the deep layers has less total space and comfort quality as the layout of the intellectuals. The biggest work/activity/ was an opened architectural competition for designing the new residential building ordered by the communist government.

\(^4\) Congres International aux d’Architecture Moderne – the main international organization of modern architecture between 1928-1959.

\(^5\) The most of the members of CIAM agrees with social democratic ideologies, they had a lot of problems because of this in the changing Europe.
The new points of housing architecture in this case were:
- Productivity and economical aspects
- Modernity
- Quality
- Quantity, and building done by the government.

The result of this competition was a lot of contemporary structures, details (doors, windows, built-in furniture and kitchens), layouts for housing, and more prefabricating-able furniture. As a next step – in the near future - the plans of the first prefabricated buildings, the “house factory” were born. Some choice buildings were built – the prized plans, as case-study-housing estates.\(^8\)

The designers of these buildings were inspired by the results of the modernism – despite of the political atmosphere of Hungary in the 60’s. The flats were designed for the new kind of humanity with a high quality comfort, for the new dream of the (political) society. These buildings were strongly controlled – but they can bring a new aspect if we are looking for the main points of the new architecture. The manifesto of Corbusier was set out beside strong statements, and it was based on aspects of human \(??\). The new types of houses designed by the winners of the call in 1958 were created on quite contemporary way; everybody knows the built-in furniture or the kitchens of this flat.\(^9\)

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\(^6\) Die Wohnung für das Existenzminimum – collected the typo-plans for the „ideally flat“ published at 1929, after the second congress of CIAM.

\(^8\) In Öbuda, Hungary 1960

\(^9\) Witch looks sometimes more as similar to the “CUBEX” kitchens by Fabiansen in the late 50’s, was shown at the Danish Arts & Crafts Exhibition in Charlottenborg in Copenhagen, Denmark.
Today we (architects) enjoy the possibility of free creating. We are free, without main points, manifestos, or political aspects. We can find more and new conceptual contain such as: the social conventionalisms, ecological design aspect, or just money, plot, view, sunshine, etc. Every designer can create his own “five points”, and as an experience – why not – he will use it for housing to define the humankind of nowadays era.

Further on I am going to draw the conclusions. I wouldn’t say (as architect), I don’t think at the big manifestos of the modern creativity. To know the history of architecture is one of the most important achievements for an architect. On the other way – with the changing of humanity, architects have to change in order to produce high quality architecture. It can’t be without conceptual thinking.

ACKNOWLEDGEMENT

This research was supported by the European Union and the State of Hungary, co-financed by the European Social Fund in the framework of TÁMOP 4.2.4. A/2-11-1-2012-0001 ‘National Excellence Program’.

REFERENCES

EDIFICES PUBLICS – SYMBOLE: LA BANQUE NATIONALE ET L’ATHÉNÉE ROUMAIN, COLLABORATION DES ARCHITECTES ROUMAINS AVEC LES ARCHITECTES FRANÇAIS

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Résumé — Le règne du roi Carol I (1866-1914) a marqué pour la Roumanie le début de sa modernisation dans tous les domaines, parmi lesquels la construction des bâtiments publics a occupé une place de premier plan. Les travaux publics réalisés pendant les 48 ans de ce règne sont représentatifs du climat politique, de l’état de l’administration roumaine et des moyens techniques de l’époque, existant en Roumanie. Parmi les premiers édifices publics construits à Bucarest à la fin du 19ème siècle se trouvent la Banque Nationale et l’Athénée Roumain. Le 23 avril 1880 a été créée la Banque Nationale Roumaine et la première préoccupation de son CA a été de lui trouver un siège correspondant. La décision de la construction d’un nouveau bâtiment a été prise, le projet étant confié à deux architectes français: Cassieu Bernard et Albert Galleron qui ont remis leur projet en 1883. Le 18 juillet 1884, commence la construction qui dure jusqu’en 1890, réalisée par la Société Roumaine des Bâtiments. L’édifice réalisé avec des matériaux de grande qualité impressionne encore aujourd’hui par sa monumentalité et élégance.
Dans la même période a été construit l’Athénée Roumain conçu comme un temple de la culture. L’initiative a été prise par un groupe de roumains enthousiastes qui ont fait appel à la générosité du public ; le financement étant assuré par des donations. Le projet sera réalisé par la collaboration de l’architecte français Albert Galleron avec une commission d’architectes et ingénieurs roumains (Alexandru Orascu, Ion Mincu, Grigore Cerkez et Nicolae Cucu Starostescu), la construction étant réalisée entre 1886 et 1888 par l’entreprise roumaine de Dobre Nicolau.
Cette communication mettra en évidence le rôle que les architectes français ont joué en Roumanie et leur étroite collaboration avec les roumains. Elle présentera les éléments techniques concernant l’architecture, la stabilité et la résistance utilisés à l’époque dans un pays soumis à de forts tremblements de terre.

Mots-clés — edifices publics, la Banque Nationale, l’Athénée Roumain, architectes roumains, collaborations

1. INTRODUCTION
Le règne de Charles I fut pour la Roumanie le début de la modernisation dans tous les domaines, parmi lesquels, comme c’était naturel, les constructions occupèrent un lieu de choix. Les travaux publics érigés dans les 40 ans de règne fertile représentent non seulement un admirable effort matériel, moral et spirituel pour le climat politique et les moyens d’accomplissement de cette époque-la, mais surtout une fierté du passé, une leçon pour le présent et un stimulus pour l’avenir.
Parmi les premiers édifices publics élevés à la fin du XIXe siècle on compte aussi la Banque Nationale et l’Athénée Roumain.
2. LA BANQUE NATIONALE DE ROUMANIE

Pour la construction d’un système bancaire, le 23 avril 1880 on a fondé la Banque Nationale de Roumanie. Le premier gouverneur a été Ion Câmpineanu (1841-1889), qui était aussi à l’époque ministre des finances dans le gouvernement de Ion C. Brătianu. Mais le vrai fondateur de la Banque Nationale a été Eugeniu Carada (1836-1910), qui fut chargé en 1880 par Ion C. Brătianu d’élaborer le projet de loi pour l’organisation de la banque et qui ensuite est élu directeur général entre 1883-1910.


Les plans définitifs pour la BNR ont été délivrés par les architectes français en avril 1883. Une commission formée des ingénieurs Gheorghe Duca, Constantin Olănescu et Nicolae Cerkez a été chargée de l’analyse du projet.


Le 27 octobre 1883, Eugeniu Carada a proposé la note suivante en Conseil d’Administration, qui l’a approuvée: “La Construction de la Banque Nationale de Roumanie se fera directement par l’Administration de la banque, sous la direction d’un architecte roumain, pouvant livrer en entreprise les travaux partiels selon les spécialités. Monsieur Nicolae Cerkez est nommé architecte dirigeant de la construction, avec l’obligation de soumettre à l’avis de la Banque la délégation des adjoints dont il aura besoin”. Ensuite on a approuvé la proposition de N. Cerkez de prendre comme aide l’architecte Constantin Băicoianu. L’inauguration officielle des travaux de construction de la BNR e eu lieu le 12 juillet 1884, occasion à laquelle on a placé dans le fondement de l’édifice un document qui marquait l’événement.

Fig. 1. Médaille de l’inauguration de la Banque Nationale de la Roumanie
Les travaux principaux de la construction se sont terminés fin 1889 et les aménagements intérieurs, y compris l’ameublement, ont duré jusqu’en 1890.

L’exécution du bâtiment a été réalisée par la Société Roumaine de Constructions et Travaux Publics, avec laquelle on a signé un contrat le 3 octobre 1884.

Une part des travaux spéciaux a été contractée avec différentes firmes de Bucarest. Ainsi, les travaux de béchage et bétonnage ont été entrepris par Luigi Giuliani et Albert Lanetto, la ferronnerie par Andrei Rogalski et P. Georgescu, et le montage de la couverture en tôle par la firme de Teodor Georgesky. Cet entrepreneur exécutera aussi les couvertures en tôle de L’Ecole Nationale des Ponts et Chaussées (1885) et de l’Athénée Roumain (1887).

Il résulte des documents que bien des matériels ont été achetés à l’étranger. De la Roumanie on a utilisé la pierre de Rusciuc, dont on a plaqué la façade en entier (rue Lipscani). De la même pierre de Rusciuc on a exécuté toutes les sculptures extérieures du bâtiment. Le ciment a été acheté en France, chez les fabriques Lafarge, et la tôle en cuivre a été amenée d’une firme allemande. Le chauffage et la ventilation de l’édifice ont été réalisés par la firme Wasser-Leitungen de Vienne.

Au moment de la réalisation, tout comme aujourd’hui, le projet établi par Cassian Bernard a répondu aux caractéristiques de n’importe quelle construction bancaire. La forme générale est rectangulaire, 73 m de long (rue Lipscani) sur 52 m de large (rue Smârdan).

Au rez-de-chaussée il y a le vestibule des guichets et l’espace réservé aux relations avec le public. Il a environ 21 sur 12,5 m, l’hauteur maximale étant de 15 m. Le rez-de-chaussée est composé d’une succession de piliers massifs en briques, entre lesquels étaient fixés les guichets. Derrière chaque pilier on a monté un coffre-fort à la portée du fonctionnaire du guichet. Le vestibule est couvert de métal richement œuvré en stuc. L’illumination de la salle se fait par un grand illuminateur.

On peut considérer le premier étage comme le niveau noble de la banque, grâce aux fonctions de l’aile de la rue Lipscani: le hall d’honneur, la salle de conseil, le bureau du gouverneur, ainsi que quelques autres bureaux destinés à la direction de la banque. Les espaces de représentation du premier étage sont richement décorés. L’accès à l’étage se fait par deux échelles symétriquement posées face à l’axe principal de composition de l’édifice. Le point de départ des rampes est mis en évidence par des paires de sculptures, représentant des personnages féminins qui soutiennent chacun un corps illuminé au-dessus de la tête. La salle du Conseil d’Administration est...
fastueusement ornée, elle possède des meubles Louis XIV, des fauteuils en peau de Cordoue et des draperies en brocart rouge-pourpre. L’un des murs abrite une peinture remarquable, réalisée par Nicolae Grigorescu en 1894 et connue sous le nom "Rodica".

La façade principale (rue Lipscani) est décorée de six sculptures, dont deux sont placées en fronton et encadrent une horloge, tandis que les quatre autres se trouvent chacune dans une niche. Elles représentent l’allégorie de la Justice et de l’Agriculture, réalisées par le sculpteur Ion Grigorescu, le Commerce et l'Industrie, œuvres de Ştefan Ionescu Valbudea.

Assez vite, les espaces existants du palais se sont avérés insuffisants. Jusqu’à la réalisation de la solution optimale – la construction d’un nouveau corps – on a satisfait les nécessités par une série de transformations.

L’extension de la superficie déroulée du vieux palais bancaire a été réalisée par le sur-étagement des quatre ailes avec un deuxième niveau en dessus du rez-de-chaussée, destiné aux bureaux. Le plancher du premier étage, réalisé en profils métalliques, a été consolidé pour supporter les nouvelles charges et a été tourné en béton armé. Tous ces travaux ont été complétés par la refonte des installations, l’introduction des téléphones et d’une usine électrique.

Pour la plupart, les travaux ont été réalisés entre 1929-1930 par l’entreprise du distingué ingénieur Aurel Ioanovici.

Ce ne fut qu’en 1939 que les intérêts urbanistiques de la mairie se sont mis d’accord avec le désir de la BNR de bénéficier d’une nouvelle construction. Le nouveau Palais de la Banque Nationale sera construit entre 1939-1950 par l’entreprise de l’ingénieur Liviu Ciulley, étant la première construction de notre pays projetée et exécutée de façon à résister aux tremblements de terre.

### 3. L’ATHÉNÉE ROUMAIN

Dans cette même période on a érigé l’Athénée Roumain, temple de la culture, sur l’initiative de certains braves Roumains aidés par la générosité du public qui a répondu à l’appel lancé, "donnez une monnaie pour l’Athénée".
Puisque l’argent donné par l’homme de culture Scarlat Rosetti, 200.000 lei en or n’était par suffisant, pour obtenir des fonds supplémentaires de 500.000 lei on organise une loterie publique, autorisée par le gouvernement par la décision 5859/13 avril 1885.

L’extraction de la loterie a eu lieu le 22 mai 1886, dans le jardin Cișmigiu. Le gros lot valait 75.000 lei, étant signé par Nicolae Krețulescu et Constantin Esarcu.

Le rapport présenté par la commission susdite, le 16 mai 1886, soulignait le fait que l’on a envisagé, à l’étude de l’ante-projet, "de ne rien négliger pour assurer tant la bonne organisation des différents services, que toutes les garanties de confort et, surtout, de sûreté indispensables à n’importe quel édifice destiné à contenir non seulement une grande agglomération de personnes, mais aussi d’importantes collections de richesses littéraires ou artistiques; aussi, "de prévenir tout incendie on d’en annuler les effets", ainsi que "de lui rendre toute la solidité requise et de lui imprimer dans les moindres détails un haut caractère de sérieux, justesse et raison".

Retenons quelques-unes des observations et recommandations que l’on a faites. Pour réaliser les chambres de la bibliothèque destinée à abriter "des livres et manuscrits précieux" etc., on indiquait "qu’il faudra, par le choix des matériels de construction, prévenir les incendies".

On recommande que la lumière dans la bibliothèque et les musées soit naturelle, et qu’en dernier cas "elle vienne du nord pour épargner les objets exposés des reflets de lumière, très nuisibles surtout pour les tableaux".

Le fait est que, le 24 mai 1886, l’architecte Galleron s’engage à refaire son projet sur la base des recommandations avancées par la commission d’expertise roumaine.

La construction première fut exécutée par l’entrepreneur Dobre Nicolau de Bucarest, 116 rue Știrbei Voda qui avait offert "une déduction de 5 lei pour cent sous le devise" – avec lequel on signe le contrat le 1er juillet 1886.

Pour pouvoir entamer les travaux le 1er septembre 1886, Albert Galleron présente une part des compléments sollicités et un mémoire, on il montre que "pour conserver a l’édifice un aspect monumental on applique souvant et a grand succès les systèmes d’armature métallique dans la muraille", en soulignant par la suite "que cette armature constitue un ensemble très solide et indiqué particulièrement pour les pays soumis aux tremblements de terre". La mairie de la ville de Bucarest délivre l’autorisation de construction no.140 d’octobre 1886. En ces conditions, le 26 octobre 1886 a deux heures de l’après-midi on a posé la pierre fondamentale du palais de l’Athénée.

L’édifice de l’Athénée s’est réalisé en deux étapes, la première, située entre 1886-1889, pendant laquelle on a bâti la construction proprement-dite, le corps principal, au-dessus de laquelle on a érigé la coupole.

Au-dessus de la salle il y a un plafond suspendu par l’intermédiaire de tirants (barres en acier) de la charpente métallique de la coupole. La charpente de cette coupole, remarquable par sa forme et la
simplicité de sa construction, ainsi que par l’élégance et la légèreté, est exécutée en acier mou. Le diamètre intérieur de la coupole est de 29,16 m et l’hauteur de 13 m.

Le projet et la construction ont été réalisés par la firme Benchelt de Grunberg (Silesie) – spécialisée en ponts et constructions métalliques, avec laquelle on signe un contrat le 9 février 1887. Puisqu’on a supposé que le crépi avec la décoration du plafond pourrait se fendre par la dilatation de ces barres (tirants), on a effectué un calcul (en 1886!) compte tenu de l’influence de la température sur les déformations et les efforts produits dans ces barres. Le montage de la coupole commence en juin 1887 et se termine le mois de novembre. Sur ce montage s’exprimait de manière très plastique Al. Odobescu en 1888/14 février: "La toiture a été uniquement assemblée en fer et en zinc, très ingénieusement accordés pour que leur trame supporte le gel de l’hiver et la chaleur de l’été car, soit dit en passant, le jeune architecte dirigeant m’a communiqué la curieuse information qu’entre les 30 degrés de chaleur de juillet précédant, quand on a mis la couverture du dôme, et les moins 28 degrés d’il y a un mois, c’est-à-dire dans l’incroyable (chez nous) déplacement du mercure des thermomètres sur un espace de 58 degrés, la ferraille de l’Athénée ne s’est dilaté que 12 cm".

La coupole centrale, couverte de zinc, se termine par un couronnement ornemental d’où surgit le tripode qui rappelle un chef d’œuvre de l’architecture grecque – le monument choragique de Lysicrate (nommé aussi le lampadaire de Demosthènes). L’exécution des quatre escaliers en marbre de Carrara a été contractée avec le sculpteur C. Storck, auquel on a exigé quand même, qu’avant le commencement des travaux il dépose "une petite épreuve d’escalier toute faite". Les stucatures imitant le marbre dans les colonnes de la rotonde centrale sont l’œuvre des frères Axerio de Slănic Prahova.

Le 14 février 1888, à 8,30 du soir, le cycle de conférences annuelles est ouvert dans le nouveau local dans une petite salle du rez-de-chaussée, car la grande salle n’était pas achevée a l’intérieur.

En 1938 on a exécuté à l’intérieur la fresque qui représente l’histoire du pays en 14 tableaux. Elle a été faite par le peintre Costin Petrescu.
Fig. 11. Vue latérale de l’Athénée Roumain

Le monumental édifice a été grièvement endommagé lors des bombardements de l’aviation allemande en 1944. La reconstruction de l’édifice est due au grand ingénieur Emil Prager. On a consolidé la construction après le tremblement de terre de 1977.

BIBLIOGRAPHIE

Abstract — Rural vernacular architecture represents an important social-cultural and identity indicator mainly because due to its lack of an architect; its realisation according to the owner’s aesthetic feel/individuality; its reflection of the social status of the inhabitant; its protean nature, being able to adapt rapidly to the social context and mainly to the cultural progress / development but also to the needs of the owner, sometimes, becoming the creative source concerning parallel functional systems.

The study embraces the evolution of the rural homestead starting from the 30s in the 19th century (the first modern systematisation of Romanian villages) being followed by the 1880-1890 decade, when based on a holistic research on site the elaboration of the first urban law/order concerning rural areas was possible, leading to the structural reorganisation of the rural household until the Second World War. In the same time it highlights the architectural characteristics, but also the dependent functional systems of the household, representative for the communist and post-communist era, when important mutations appear caused especially by the dynamic of movement concerning the population (village-town; town-village; town-abroad-village). These are significantly reflected in the rural vernacular architecture of southern Romania, offering a large variety of information regarding the constructive capacity.

Keywords — vernacular architecture, transition period, systematisation, social context

1. INTRODUCTION

The way of living that vernacular architecture generates is respectful to its natural surroundings and its inhabitants; which create together a rich community with traditions and cultural values that can be a clear resource for restoring local cultural identity. "The farmer has a unique sense of space and fits his house just after his material and spiritual needs. Peasants adapt their home to climate and local materials. Farmers have solved the problem of their architecture." [1].

This subject has been in the center of the specialists’ interest in the last 5-10 years: a growing concern towards the environmental impact, sustainability, experiments with new prototypes and
ways of living adjusted to the more complex and diverse needs of modern society. The term vernacular architecture entered the Romanian specialized literature quite recently. It can be said that to a great extent, this subject was included into what is now called folk architecture. The first writings concerning vernacular architecture can be dated in the middle of the 20th century in 1964, when the Moravian-born American architect Bernard Rudofsky publishes his statement book entitled “Architecture without Architects”. This meant not only the introduction of a new term, but also a new vision and understanding of particular, local indigenous architectural forms: “Vernacular architecture does not go through fashion cycles. It is nearly immutable, since it serves its purpose to perfection. As a rule, the origin of indigenous building forms and construction methods is lost in the distant past.” [8].

The specific local building methods, materials and techniques used in each particular rural area turn vernacular architecture into an identity symbol and rich ethnographic evidence concerning rural technologies and ways of life in the countryside [2]. The traditional village house is a true fabric of space links [3] and the household, a place for daily rural activities.

The abandonment of vernacular building methods in the process of building production was first realized by using abundant concrete and reinforced concrete instead of stone and wood which were the vernacular structural materials [4]. We should be aware that vernacular architecture sets an example of harmony between dwellings and the natural landscape [18]. Therefore, the use of more sustainable construction materials and techniques represent a more sustainable development [5], the re-interpretation of contextual values [6] and traditional building or furnishing concepts in a contemporary key can assure a condition of visual comfort regarding external/internal spaces [9].

Rural vernacular architecture represents an important social-cultural and identity indicator mainly because due to its lack of an architect; its realisation according to the owner’s aesthetic feel/individuality; its reflection of the social status of the inhabitant; its protean nature, being able to adapt rapidly to the social context and mainly to the cultural progress / development but also to the needs of the owner, sometimes, becoming the creative source concerning parallel functional systems.

2. BACKGROUND & ANALYSIS

The traditional household, from the South Carpathian area of Romania, has witnessed many changes over time. Current form and structure have their origins in the early 19th century when a new organization of villages was ordered by "aligning the constructions". This meant placing the houses on a predefined fireplace by the local and central authorities.

Before aligning the households in the area, these were scattered and dispersed through meadows and forests, away from one another. Testimonies to this day are the toponyms: Galatia Clearing, Zafii, Hoaga Năndrăsoi, Pătru’s Peak and Pană’s Peak, Mălăiște, Hogioaia, Prunii Uții etc.

From a structural point of view this type of household was different from the one currently known. A striking difference is due to the lack of fences imposed, on the one hand, by the fact that the households do not require defense; in a clearing only one family placed its household and all its
space was for their disposal and delineation was done naturally. On the other hand, there were periods when fencing taxes were applied [10].

On the 20th of June, 1834, the village jury of Stroești - Argeș confirmed the receipt of a commandment to build the house counsel "after the form that we have, also for the other villagers to align their houses; after the command, we will truthfully follow" [11]. It seems that this "truthfully follow" has a relative content and residents resisted the aligning of the houses, forwarding complaints to local and central authorities. Also there was applied a continuous pressure on the villagers in the aim of achieving this systematization of villages [12].

Gradually the resistance of residents against the alignment was beaten, on September 6th, 1837 for the Plasa Arges (territorial and administrative subunit of the county), a list of all houses was established "that were aligned, measured from this territorial unit" [11]. This list shows that a total of 258 houses were moved from 24 villages. Comparing the Census from 1838 [13] for the village of Stroesti and Costești - Vâlșan (Ungureni and Pământeni) resulted that 22% and 15% of households were displaced due to the introduction of the alignment.

The displacement of the household brutally intervened in the human’s way of life, determining one to sought ways of defense: by building fences to protect its property and privacy; building the household in the most remote area far from the road, as a reminiscent of the need for protection / isolation of the inhabitants. The aligning of villages represented a first step in systematizing the rural areas but did not solve the problems of the inhabitants, especially of those who depended on large landowners [14].

Meanwhile, conditions and social relations have changed (land reform - Rural Act of 1864, gaining independence - in 1877, the establishment of the kingdom) in the period between 1887 - 1888, the General Direction of Health Services conducted a national analysis that found that "our villager’s house ... from a hygienic point of view leaves much to be desired." Therefore, the "Rules for aligning villages and construction of farmhouses – their hygiene and sanitation" were established. This regulation was accompanied by two model-plans concerning the construction of the house.

Regulation and related plans were approved in final form on September 6th, 1888 and then lithographed "in a sufficient number and on the expense of the ministry, to be distributed to all municipalities in the country." On March 1st, 1889 these were sent to the prefects with a circular which stated their immediate application. According to this regulation there were allowed three types of house constructions depending on the area: "in the plain, brick constructions and fence plastered with lime were allowed; in the hilly area, brick, wooden beams and fence plastered with lime were admitted; in the mountainous Rustic brick or stone and fence plastered with lime" (fig.1).

Although some measures were not applied fairly, in time it came to structuring the household after the classical scheme: the main house, small house (for servants and / or elderly people) and summer kitchen in the first court; haystack, winery, henhouse in the second yard (back yard - yard cattle); manure storage and the toilet in the garden. These functional models persisted and improved continuously.
In the first half of the 20th century the systematization of villages was based on the concept of Dimitrie Gusti and the school established by him. This included investigating the life and organization of rural society through modern techniques, applied by specialists in various fields, achieving a general radiography of the situation and proposing appropriate solutions thereof. This culminated in the systematic design and construction of model-villages [15].

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**Rules for aligning villages and construction of farmhouses – their hygiene and sanitation, 1888**

a) House should have windows facing south, east or west;
b) The main/side facade should be facing the street, not the back of the house;
c) A distance of at least 4 m should be preserved from the road ditches;
d) The width of the street should remain 10 meters respecting art. 7 of road law;
e) There should be plastered and whitewashed on the outside, plastering with earth not being allowed outside/inside/room floor;
f) The height of the house will be after the owner’s will; but the rooms will have a height of at least three meters;
g) Every room will have two windows of 1 m high, 20 centimeters wide by 80 centimeters; with mobile windows sash;
h) The room shall be paved with planks or well burnt brick, with stoves having doors inside and chimney that emerges above the ridge of the house with at least 30 cm;
i) The house will contain at least two rooms: one on the right and one on the left, a room in the middle, for the kitchen; the pantry will not be inside. One room and kitchen will be permitted only for families consisting of a men and a women;
j) The room space will be at least 20 square meters; the porch no less than 2 m wide;
k) The materials used for the roof of the house will be iron, tiles, shingles or cane, cobs not being allowed.

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Fig. 1. Rules for aligning villages and construction of farmhouses – their hygiene and sanitation, 1888

The Romanian rural world was marked at the end of World War II by a large and painful campaign of social engineering: the collectivization of agriculture. The stated aim of this campaign was to modernize Romanian agriculture to ensure higher efficiency and a higher standard of living. The real goal was the introduction of socialist structures and control, directly by the communist party of the peasantry (about 75% of the population). The transformation strategy of the communist authorities of the rural population was based on the division of social solidarity and the breaking of peasant communities by introducing the principle of class struggle [16, 17].

The preamble of collectivization was the introduction of forced and unavoidable food and feed collection, as laid down by the state according to social inclusion and paid underpriced, compared to the free market (5% of the free market price for potatoes and 6.6% for beans in 1950) during 1945-1949. The collectivization process took place from 1949 to 1962 being divided into several stages each with its specific character [16, 17].

The issue of rural systematization was approached in the National Conference on 6th- 8th of December 1967 and developed within the Xth edition of the Congress in 1969. Within the National
Conference in July 19\textsuperscript{th} – 21\textsuperscript{st}, 1972, resumes this problem with the assumption of achieving „300-350” after the systematization of villages. The Plenary of the Central Committee on 25\textsuperscript{th} – 26\textsuperscript{th} of March 1974, analyzed the systematization law of territory and localities adopted by the Grand National Assembly the same year on October 29\textsuperscript{th}. This predicted the construction of civic centers – placed in the center of each administrative village unit; established building perimeters of villages with development perspectives and demolished constructions outside of this perimeter; the disappearance of small villages, which involved the relocation of their residents in the preserved villages. The law prohibited the construction or repair of buildings in areas doomed to be demolished. A project of radical transformation of a large part of the country required a long period of training and resource mobilization. The earthquake on March 4\textsuperscript{th}, 1977 served as a catalyst for this project, becoming the subject of repeated interventions on the behalf of the Romanian Communist Party (PCR) leadership [16, 17].

In 1986, the Organizational Department report of PCR shows regarding the "systematization of localities based on standard dimensioning of land within the building perimeters" in which it was expected that of the 13 123 existing villages shall be maintained only 9192 the 3931 remaining being "proposed for decommissioning and removal in other localities with higher prospects of social - economic development". This measure affected all counties, but in a different manner: the most affected were, Alba with 264 villages proposed for demolition, than Arges with 252, Bacau with 237, Valcea with 222 and Prahova with 206; the lesser affected were Maramures with 15 villages, Braila with 19, Brasov, Bistrita - Nasaud with 20, Covasna with 23, Satu Mare and Sibiu with 25. This systematization sought to reduce the inhabitable perimeters of existing villages from 625 258 to 285 839 hectares occupied, thus recovering for agriculture 339 419 hectares of land. Basically, all villages were affected, while remaining outside the newly proposed inhabitable perimeters, 1,863,417 households having to be "displaced" [16, 17].

Fig. 2. House position in relation to the main road.
Based on documentation on site, in this research are considered important elements, which constitute important social-cultural and identity indicators: housing position in relation to the road; house typologies; main façade position in relation to the road and the cardinal points; the structure of the foundation, walls, ceiling and roof.

3. RESULTS

The placement of components in the household is based on functional units. The site selection for the house and its orientation regarding the main directions and cardinal axes north - south and east - west and facing south, denotes the spiritual archaic relationship after which the dwelling is considered *imago mundi* and also brings functional benefits (the house benefits of light and solar radiation energy in any season). This orientation was maintained even until the 50s, the 50-80s have sought a compromised solution, the need of the house's main facade facing the street but in the same time being oriented to south. In the 90s and beyond, the orientation of the main façade was exclusively towards the street, compromising natural solar lighting.

The positioning of the home in the space of the household denotes a collective mental development. In the first phase, after the alignment of constructions, the house sat in the furthest area of the plot and the main road, as reminiscent of the need for isolation / protection of residents from danger. In the 30s of the 20th century, houses were set close to the road, as result of the disappearance of the need for isolation / protection, the increasing population density and the need of displaying their economic status.

The situation was maintained after 1945, when the position of the houses in the households was predetermined by the authority, without regard to the will of the owner. This stage lasted until the late 90's, with a peak in the '70s. Currently the trend is placing the house further from the main access of the plot, as a defence against the intrusion of public space into the private one.
Fig. 4. Evolution of structure. Materials and techniques for foundation and walls
Regarding the structure and composition of houses until the 1930s, classic types of structure prevailed, developed, the porch and turret occupying a large proportion. In this period buildings are distinguished by narrow and high windows separated by narrow wall portions. The material for the wall structure mostly consists of solid wood plastered with mortar and for the foundations river stone was used. The roof is usually hipped and covered with wooden shingles.

In the late 1930s a transition to a more comprehensive housing scheme occurred, which abandons the classical structure by introducing a kitchen and a "back" entry. Also the dimension of the porch is reduced, whilst maintaining the shape and proportion of the windows. Also in this period we can witness a transition towards brick as a construction material for the walls. This sets the basis for the structuring of the early 50s -70s specific homes.

The 50s – 70s specific house has a stone foundation plastered with mortar, brick walls, hipped roof, with roof shingles - initially, then asbestos cement tiles, placed above the shingle structure. Regarding the composition, it was possible to observe an increase of the residential area, structures with three rooms being predominant, one used as a kitchen, a dormitory and a guest room and a pantry converted later (itself or through additions) in the bathroom. The open space of the front and back porch is reduced in proportion or even closed frequently.

In the 1980s, under the threat of general systematization of villages, demolishing or displacing of rural housing, especially in areas where collectivization has not occurred, the development of specific house typology was not possible although the previous model was somewhat outdated. This consideration combined with shortages of food, construction material and energy lead to sporadic constructions which repeat and improve the old models or set new directions.

In the 1990s characterized by transition and liberty, a more specific type of housing developed, with ground and first floor / attic. Composition of the ground floor comprises an open porch, central hall, bedroom, kitchen and bathroom and access ladder to the upper level. The floor or attic contains two or three bedrooms located on both sides of a hallway and a balcony or a terrace.
The predominant materials are reinforced concrete in combination with river stones for the foundation; bricks, concrete blocks, autoclaved concrete, alternating frequently; concrete ceiling and wooden roof structure and tile covering, asbestos cement board. Around 2000, a new specific typology appeared, the building area was enlarged, somewhat increased out of scale. The composition of the house becomes more complex, containing a basement, ground floor and even an attic. On the ground floor the kitchen, bathroom, living room are placed and the first floor contains bedrooms and a bathroom. The porch and / or balcony are opened and their proportion compared to the whole house is reduced. Currently, modern materials are used, which are fashionable and the trend is set by contemporary constructive solutions, or perhaps by the working system with specialized companies.

4. CONCLUSIONS

The house position in relation to the street, house typology, the main façade position in relation to the cardinal points and the street, the structure, materials and techniques used for building the foundation, walls, ceiling and roof, create strong socio-cultural and identity indicators generating the following holistic conclusions described below.

Placing the house in relation with the street denotes the human need of exposure or protection. Currently, the settlement of the house as far away from the road as possible, shows the tendency and need of isolation of modern man from the public space, which is gaining ground compared to the private space, a protection against pollution. In times of peace and socio-cultural and economic progress, the houses had open porches, both on the ground/first floor; the proportion of the porches surface area was significant in relation to the building. In troubled times, physical or ideological repression limited people and determined them to close the porch area, seeking solace inside the house.

The dynamics of the typological structuring of housing can be observed in the studied period, also an accelerated pace in terms of freedom of choice and the transition to a stable democracy compared to the "rigid" ideological statement of 50-70s period.

The boom in house construction after 1989, based on a new structural scheme (ground and first floor / attic, with central hall, bathroom downstairs, bedrooms upstairs / attic) denotes the ideological resistance of the population who waited for an appropriate moment to put their plans into effect, on the one hand and on the other hand, for the shift of the centralized planning phase in accordance with the needs / requirements / cultural development of the rural population.

In the period of 2000, due to contacts with Western Europe as well as temporary or permanent migration of Romanians to these countries (especially after joining the EU) cultural paradigm has changed and larger housing began to appear, with an updated structural scheme according to existent ones in Western Europe. In their construction new materials and techniques are used common on a European level (promoted by the major suppliers of building materials and systems), to the detriment of traditional materials and techniques. Thus, a gradual leveling of specific regional / national characteristics is taking place in the context of the current European Union.
ACKNOWLEDGEMENTS

This paper is supported by the Sectoral Operational Programme Human Resources Development (SOP HRD), ID134378 financed from the European Social Fund and by the Romanian Government.

REFERENCES

Abstract — In the given paper the development of lighthouses and their lights for the purpose of maritime sailing is presented on the basis of the analyses of Polish and German archive materials. The safety of vessels serving in the area of the Baltic Sea in the 19th and 20th century was very much depended on the navigational precision. One of the most important things concerning it, good quality lighthouses’ lights, was simply invaluable. Lighthouse network built in the given time period on the south of the Baltic Sea, the result of German engineers’ and government, levelled up the safety of the Baltic sailing routes. Along with the technical progress, lighthouses’ light systems were also changing. The evolution of the lighthouses’ light systems shows us the process of changes from the lights based on fire to oil, petroleum and gas lamps closed in glass lanterns, to, finally, electric ones. This process was concerning the majority of lighthouses around the world. Polish problems with technological development and the progress connected with the usage of better quality lights were nothing unusual and were concerning light systems all around the world, and their development increased maritime safety. A lot of modern lighthouses were put on sea routes to Gdańsk, a port with impressive goods overturn. Their job was to inform about danger and show the correct sea route; actions which, undoubtedly, helped to increase the safety of goods transport.

Keywords — lighthouses, sailing safety, navigational lights

1. INTRODUCTION

In the old days fires were lit along coasts with the aim of making navigation easier and safer within certain areas by helping the vessel triangulate its position or indicating dangerous regions. However, preserved archive documents and chronicles indicate that as early as during ancient Roman times fires were deliberately lit to deceive crews and make ships run aground, where they were looted by awaiting robbers1. In Europe this deceitful tactic lasted until as late as the 19th century. This is demonstrated by legal injunctions preserved in archives and libraries. A typical example is Louis XIV’s de la marine decree from 1681, ordering the death penalty for lords of fiefdoms along the coast and all those

1 Antoni Komorowski and Iwona Pietkiewicz and Adam Szulczewski, Marine Signposts of the Polish Coast. Gdańsk 2011.
coaxing pilots to deliberately cause ships to run aground, or lighting deceitful fires to lure vessels to dangerous zones to gain profits provided for in coastal laws\textsuperscript{2}.

This suggests that the issue of correct identification of navigational lights is as old as the lights themselves.

2. BACKGROUND & ANALYSIS

The analyses and research of the lighthouses’ light systems which were conducted, were based on archive sources indicated in the bibliography as well as books, essays and articles concerning the matter of the systems’ development. According to those measures it was settled which detailed solutions were to be applied and which ones became commonly used.

The first attempts at resolving this were made in the 15\textsuperscript{th} century Scandinavia in experiments with a mobile light source. Fire was lit in a basket suspended on a rope, known as a Vulcan pot. When a ship was approaching, the basked was raised 5-10m above the ground, then lowered again; this was repeated several times. Similar lighthouses – tipping cranes – were used in Anholt and Skagen along the Danish coast in 1560.

Another milestone along the way of distinguishing lighthouses from other coastal lights was the introduction of a clockwork-driven system of mirrors rotating around the light source, invented in the 18\textsuperscript{th} century in Sweden by Jonas Norberg. Norberg’s system was used in the lighthouse at the Carlsten fortress in Marstrand. It included three oil lamps with double reflectors driven by a weighted clockwork mechanism, and was the first to emit regular flashes of light\textsuperscript{3}. Since then engineers of all nationalities have been working on alternative mechanisms generating light with the desired characteristic. They were usually various versions of rotating mirrors or automatic shutters.

Another important factor in the identification of light emitted by a lighthouse is its intensity. Preserved documents show that increasing the range was achieved by working on two related platforms. The first used different raw materials to vary the light. The second was to do with the development of constructions used for burning those materials.

As the original fuels – wood and coal – turned out to be largely impractical in the long run, lighthouses started using lamps fuelled with candles and burning oil.

Thanks to the Swiss physicist Ami Argand\textsuperscript{4}, the 18\textsuperscript{th} century brought a solution to the problem of smoke emitted by oil lamps leaving a greasy, black deposit on their glass elements. His lamp design was fitted with a tubular wick, and the flame was surrounded with a glass cylinder enhancing airflow reaching right into the centre of the flame\textsuperscript{5}.

\textsuperscript{2} Komorowski and Pietkiewicz and Szulczewski, Marine, 54.
\textsuperscript{3} Ebbe Almqvist, \textit{Lighthouses of the World} (Gothenburg: Nordbok International, 1999), 53.
\textsuperscript{4} Francois Pierre Ami Argand (1750-1803) – Swiss physicist specialising in the field of alcohol distillation. In 1782 he devised an oil lamp with a novel tubular wick and an enhanced air flow (Argand lamp). The lamp emitted a light with ten- to twelve-fold greater intensity than candle light. Argand lamps, including several concentric wicks and supplemented with a reflector, were commonly used in lighthouses during the 19\textsuperscript{th} century. Author’s note.
\textsuperscript{5} Marian Czerner, \textit{Latarnie morskie polskiego wybrzeża}. Poznań 1986.
It is worth drawing attention to Augustin-Jean Fresnel, who devised the concept of dioptric lenses, laying down foundations for optics used in lighthouses until today. Fresnel also created the catadioptric system combining lenses with a variety of prisms. This system permits the construction of very powerful navigational lights until today.

Discussions of the evolution of lighting systems cannot omit the works of Gustaf Dalen, who was awarded the Nobel Prize in physics in 1912. Using gas as a lamp fuel required the construction of a safe device producing a flame with strictly defined characteristics. In 1906 Dalen made a cut-off valve allowing the lamp to emit short flashes of light of varying duration.

We could recall here many other design solutions improving lighting systems at lighthouses, but they also brought problems associated with excessive light range and shaping light characteristics.

Visibility and especially range of light depends on the intensity of its source and its height above sea level.

Another issue was the need for light sectors to overlap and create a chain of lighthouses along the coast, allowing vessels to triangulate their position accurately along the way.

An important technical difficulty was devising light characteristics that would differ among neighbouring lighthouses. Clockwork mechanisms rotating Argand lamps were used to distinguish between individual lighthouses as early as the 1820s. After the introduction of Fresnel optics, rotating shutters driven by a clockwork mechanism were used to obtain the required light characteristic. This method of forming flashes and intervals in lighting systems remains in use until today.

First attempts to use electrical lamps in lighthouses were made in the late 19th century. However, the experiments were largely unsuccessful, as the light bulbs gave a very weak light and burned out quickly. The new light source was small and didn’t fit in the existing optical systems. In addition the cost of such installations was very high, since each lighthouse required its own generator driven by a steam engine. The issue was finally resolved in the 20th century with expanding implementation of electrical power.

Initially lighthouses used a dual system with both electrical and gas systems in place, with an automatic switch between the two in the event of a power cut. The Dalen lamp mentioned earlier remained a back-up system in the majority of lighthouses. The switch from gas to electricity as the main source of power eventually took place after the Second World War.

3. RESULTS

Over the years all changes to the lighting systems and power systems described above took place at lighthouses in Germany as well as those taken over by the Polish authorities in the 20th century.

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6 Augustin-Jean Fresnel (1788-1827) – French physicist and engineer. Author’s note.
7 Czerner, Latarnie, 50-70.
8 Light intensity... HK
The analysis of source materials allows us to state that during that period each lighthouse had a different lighting system. Hel and Oksywie lighthouses were equipped with dated lighting systems including different oil Argand lamps. In Hel they were lamps with a single wick placed in front of a parabolic concave mirror, while the Oksywie lighthouse had a lamp with a multi-wick burner placed in a Fresnel prismatic lens\textsuperscript{10}. The Jastarnia-Bór lighting system included a Fresnel lens with a paraffin incandescent lamp, out of order at the time of handover\textsuperscript{11}. Only Rozewie had two 1500W electrical light bulbs, placed in a changer mounted between a concave mirror and annular lens. The electricity required to power the system was generated using a steam engine with a generator, located in an engine room adjacent to the lighthouse\textsuperscript{12}. At the time Rozewie was the most modern lighthouse along the Polish coast. Its lighting system remained unchanged until 1978, when a system manufactured by the Swedish company AGA was installed, comprising PRB-21 light panels.

In spite of many difficulties, including financial, the Maritime Authority overseeing the running of Poland’s lighthouses strived to modernise their lighting systems. The lighting system at the Hel lighthouse was upgraded by installing a paraffin light with an incandescent mantle, used to intensify the light in the Fresnel lens. In order to obtain the required light characteristic, the whole system was set on a turntable driven by a weighted clockwork mechanism. In 1938 the lighting system underwent another modernisation, which involved connecting it to the mains and mounting an incandescent light bulb with three 100W filaments in a prismatic lens\textsuperscript{13}.

Analysis of multiple source materials found in Polish and German archives shows that all lighting systems in Polish lighthouses during the interwar period originated from the German company Julius Pintsch\textsuperscript{14}, which manufactured the majority of lighting system and lanterns in German lighthouses along the Southern Baltic coast in the 18\textsuperscript{th}, 19\textsuperscript{th} and 20\textsuperscript{th} centuries\textsuperscript{15}.

Immediately after the end of the Second World War, Poland’s borders included 11 lighthouses: Świnoujście, Niechorze, Gąski, Darłowo, Jarosławiec, Ustka, Czołpino, Stilo, Rozewie, Hel and Gdańsk. As soon as the organisational period was over in 1946, works commenced on modernisation of the power and optical systems. In the first instance light ranges were relatively low, from 4-8 nautical miles (Jarosławiec and Darłowo) to 13Nm in Gdańsk and 17Nm in Hel, and 23Nm in Rozewie. The period saw numerous changes to the light characteristics by regular technical mainte-

\textsuperscript{10} APG sygn. 9.2/1518; 9.2/1520; GStA PK Berlin I HA, Rep. 93B. No. 4809.
\textsuperscript{11} Janusz Posińska, Optyczne i akustyczne oznakowanie nawiagacyjne. (Gdynia: wyd. AMW 2002), 26.
\textsuperscript{12} GStA PK Berlin I HA, Rep. 93B. Nr. 4808.; Apoloniusz Łysejko, Latarnie morskie w Rozewiu (Gdańsk: TPCM, 2008), 25.
\textsuperscript{13} Czerner, Latarnie , 82-83.
\textsuperscript{14} The Julius Pintsch company has been operating since 1843, today using the name Pintsch Bamag. The company is headquartered in the German city of Dinslaken. Nowadays it mainly manufactures equipment for railway signalling, and the navigational aid production is regarded as a sideline. Author’s note on the basis of www.berliner-lindenblatt.de, accessed on 15.12.2008.
\textsuperscript{15} LAGw Rep. 80. No. 1902-1911.
nance and increasing numbers of lighthouses along the coast\textsuperscript{16}. Between the end of the Second World War and the 1960s the Polish coast gained a further three lighthouses at Kołobrzeg, Krynica Morska and Kikut.

Another factor which had a strong influence on changing the lighting systems in Polish lighthouses was connecting mains electricity to lighthouses along the coast. As a result existing acetylene lights in the majority of lighthouses were upgraded to electrical systems, providing them with greater light ranges (e.g. Jarosławiec was increased to 19.5Nm) and various light characteristics\textsuperscript{17}.

By renovating and modernising lighthouses along the Polish coast, the post-war administration made a decision to replace the German Julius Pintsch equipment with Swedish equipment manufactured by AGA\textsuperscript{18}. Company representatives carried out an inspection of the lighting systems in Polish lighthouses at the turn of the 1950s. Specifications and drafts of equipment needed in the buildings were prepared in 1951 and handed over to the Ministry of Navigation in Warsaw\textsuperscript{19}. It resulted in an almost complete replacement of German equipment with Swedish before the 1990s. The systems were next upgraded in the mid-1990s, when two modernised lighthouses (Kikut and Darłowo) were fitted with a halogen system manufactured by Pharos Marine, which took over AGA at the turn of the 1990s. Kikut and Darłowo are fitted with a lighting system consisting of a six-positional changer with 100W halogen light bulbs. The only exception is Świnoujście, the only lighthouse which retains the Julius Pintsch lighting system until today.

4. CONCLUSIONS

Our studies have shown that no two of the 15 Polish lighthouses have the same lighting system. The oldest lighting systems, using incandescent light bulbs of varying strengths, are fitted in Świnoujście, Hel, Jastarnia and Krynica Morska lighthouses. The former three haven’t been upgraded since the Second World War. One exception is Krynica Morska, where the gas and electric system, including the main incandescent light bulb and the emergency acetylene light, was upgraded during the 1980s by replacing it with an electrical system with two incandescent light bulbs.

Another type of lighting system used in Polish lighthouses is a 1000W halogen light bulb system. It is used in Niechorze, Gąski, Ustka and Czolpino, which where modernised during the 1990s.

The final type of lighting system used in Polish lighthouses is the PRB-21 system manufactured by AGA. This system was first fitted in Jarosławiec in 1974. It was later installed at Śtilo (1975), Rozewie (1978), Kołobrzeg (1981), and Poland’s newest lighthouse in Gdańsk’s Port Północny (1984). It includes rotating light panels with 200W halogen reflectors manufactured in the USA\textsuperscript{20}.

\textsuperscript{17} Techman, “Służba hydrograficzna”, 31-32.
\textsuperscript{18} AGA – Swedish company supplying equipment to Polish lighthouses until the 1980s. In the late 1980s it was taken over by the British company Pharos Marine, supplying navigational aids to lighthouses around the world. Author’s note.
\textsuperscript{19} Archives of New Records in Warsaw (AAN) – 824 sygn. 14/34.
\textsuperscript{20} Accounts of lighthouse keepers from 2006.
The PRB-21 system is the most modern lighting system in use in Poland. It remains the most effective technical solution generating a light with the greatest intensity and range, such as Gdańsk’s Port Północny with 25Nm.

Currently all lighthouses are powered from city mains, but in the event of a power cut they automatically connect to generators installed at the lighthouses. The generators vary in terms of size and power, because they were produced at different times and in different places. Some are relatively “young”, although the majority are past their best.

The analysis of all lighting systems functioning in Polish lighthouses shows that relatively few lighthouses have similar lighting systems, which makes repairs and storage of spare parts and light bulbs difficult. There are 15 lighthouses between Świnoujście and Krynica Morska with five different lighting systems, as follows:

1. Halogen lighting systems – small 100W light bulbs: 2 (Kikut, Darłowo);
2. Halogen lighting systems – large oblong 1000W light bulbs: 3 (Gąski, Czołpino, Ustka);
3. Rotating lens and medium-sized 1000W halogen light bulbs (Niechorze);
4. Rotating PRB-21 halogen panels with 200W reflectors: 5 (Kołobrzeg, Jarosławiec, Stilo, Rozewie, Gdańsk Port Północny);

REFERENCES

INNOVATIVE OFFICE SPACES IN POST-WAR CONCRETE SKELETON STRUCTURES

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Abstract — The importance of alternative office spaces for more productivity and space efficiency are analysed: the way offices were used in the past decades and how new technologies and decreasing productivity in the tertiary and quaternary sector urge intervention in the traditional structures to attain top competitiveness. The history and functionality of the work environment led to the consideration of how existing office buildings could be used and reused in a more sustainable manner. In Hungary the trend was determined by demolishing instead of refurbishing, which led to the loss of substance and history on the one hand, but implied the possibility to create something new on the other. This process was considered normal – even for hundreds of years buildings had been in constant change, but analysed from the sustainability perspective, it resulted merely in the waste and recycling problems. As a partial demolition strains the urban and natural environment less, a smoother way of replacing a building was promoted: starting with refurbishment work until there were just few remains of the original. Trying to make the best of what is preserved and present, was meant to result in a competitive alternative of a new, even green design. The preservation of post-war concrete skeleton structures was considered sustainable, not only in terms of construction, but also in the work environment, resulting in the satisfaction and wellbeing of the users. Activity based design practices were approved leading to optimized space quality even in 30-40 years old office building stock – the main issue resulting in demolition seemed to be the image, the branding of architecture though.

Keywords — Office space, Sustainability, Preservation, Reuse

1. INTRODUCTION

Until the economic crisis in 2008 globalization was characterized by massive real-estate overproduction. In Hungary the trend was – and partly still is: demolishing instead of refurbishing. Though demolition is a loss of substance, it also implies the possibility to create something new. As even for several hundreds of years buildings had been in constant change, it can be considered a normal process, as a tool for regenerating old building stocks. Judging from the sustainability perspective it results in a considerable waste and recycling problem.

The life cycle of buildings with the introduction and spreading of mass construction - preferably using concrete structures, - was estimated around 50 years. Nowadays that building stock still seems to be constructional well preserved though, so they might get in another significant viewpoint: demolishing them is more like erasing the collective memory related to an era whose ideas and ideals are not appreciated anymore, not a real constructional necessity. There should also be a focus on the cultural and social consequences of continuity and discontinuity, considering regeneration in the larger, even urban context, because it is not just a technical or environmental problem. In the history of architecture there has been a smoother way to replace a building beginning with some refurbishment work until there are almost no remains of the original, or just the main structure. A
partial demolition like this strains the urban and natural environment less, as it takes place in small scale and almost organically, so the transformation of the building stock is not as shocking, as it is the case with the majority of projects at present. [1]

“Green” has become a way of life. Thinking green and sustainably also means trying to preserve what is given, what is present and trying to make the best of it. The land is a source which is limited and non-regenerative therefore only the use of it is changing. Inconsiderate and redundant building activities would lead to ecosystem damage resulting in the reduction of biodiversity [2].

2. BACKGROUND & ANALYSIS

The aim of the present research is to give alternative solutions for the reuse of office buildings built in the past 2 to 5 decades. Figure 1 and 2 show an office building built in 1971, demolished in 2004, which though the structure and even the spaces would have allowed an up-to-date, activity based office design.
The main dilemma is whether the better way would be to demolish or refurbish. Is it arguable that only newly built spaces can accommodate the workspaces of the future, or is it avoidable to build lots of new square metres so that the present building stock would moulder? In the research 14 different office buildings throughout Hungary were analysed, and the statements were:

- The depth of the floor plates is ecological – considering natural lighting conditions and ventilation.
- The building core with the stairs and washrooms is usually independent from the façade – which is rational and space efficient.
- The use of concrete skeleton structure was preferred – often prefabricated.
- Ceiling height is usually at the lower limit - in the case of prefabricated structures the beams are even visible
- The main problem is in the functionality of the building: in case of office buildings erected before 1989 the user was usually one corporation owned by the state – they were used as head offices, which means separation of smaller office units is challenging because of the mostly longitudinal arrangement of cellular offices along a corridor, common washrooms etc.

The first step was to prioritize the most significant characteristics of functional and efficient office buildings. This seemed to be as complex and challenging as the design of a new building. A ranking tool had to be developed and used to make the comparison of buildings possible. As the open office was not a prevalent option a couple of decades ago in Hungary, and also office cells used often the minimum of depth (around 4,50m, just a bit more than it is preferred in a space efficient combination office), the width of floor plates are in the range of 12m. The most space and cost efficient office buildings are preferably 13.50-15.00m in depth – above that the HVAC costs grow exponentially. Our building stock in the research is just a bit under the most favourable range, and with these conditions the operational costs can also be held at a low level.

The most problematic aspect is the flexibility of the buildings, which means that corporations demand variably scaled units in case of office spaces. In contemporary office design therefore more access points with user managed infrastructure are provided, which is a clear demerit in the analysed older building stock. As new and innovative office concepts prefer transparent spaces, where the combination of patterns for collaboration and concentration are provided, the abolition of the traditional structure is essential. The transparency of glass walls of closed enclaves towards central located facilities and communications areas in open spaces are all distinguished features of the layout.

By using the concept of an activity based office, no one is tied to a desk, and there are numerous opportunities for diverse work environments. One of the main aspects of the design is when individuals are seen in the lounge or kitchenette, they are still considered to be working, expanding their network or broaden their social capital - not just simply taking a coffee, meal, or relaxation break, because this kind of casual interaction will end up in unplanned discussions resulting in innovations. Traditional cellular offices offer privacy, but hinder spontaneous communication, as all commonly used facilities are in enclosed rooms - aligned along a middle corridor, what results in isolation, low transparency, and lack of communication. Fig. 3 shows the changing ratio of spaces for communication and workstations in successful and productive organisations.
The most obvious decision is to say that one floor functions as a rental unit, or if the access core is located in the middle, even two units are easy to develop. A quite unusual atrial building layout was found in a very dense urban situation, and it proved to be the most adaptable for even smaller units - as it is shown in Figure 4 and 5.

Fig. 3. Ratio of spaces for communication and workstations in offices

Fig. 4. Office building with cellular structure built in 1981
The development of innovative office spaces in old structures in the region of Southern Transdanubia is moderate, as decision makers did not notice the demand on the market yet. Investors and owners of such buildings still cannot feel the need for changes to gain on future competitiveness on the real estate market.

3. RESULTS

Most of the older office buildings are still state owned and host public administration or other governmental functions. As it is shown in Fig. 6, more than 50% of the state owned office buildings were erected before 1980. Looking at the energy consumption of the building stock and the recent actions towards more energy efficiency, it is clear that a huge potential of savings is still concealed.

Fig. 5. Reorganisation of an atrial building with the reduction of corridors into 4 rental units

Fig. 6. Breakdown of state owned office buildings on the basis of building period [3].
As a research of ENERGIAKLUB (Climate Policy Institute Applied Communications) has shown, the energy consumption could be reduced with up to 26% just by optimizing the building skin. [4] If we consider that an activity based concept can be 20% more space efficient than a traditional cellular office, and smaller territory results in smaller carbon footprint, the savings can achieve up to 40% on a yearly basis. As the state-owned office buildings are located central in the cities, the spaces saved by the substitution of innovative office concepts could be competitive on the real estate market and the rent could be a basis for the financing of the refurbishment costs.

4. CONCLUSIONS

It is argued that the preservation of post-war concrete skeleton structures is sustainable. Sustainability shouldn’t be considered only in terms of construction though, but in case of office buildings it should be complemented by the satisfaction and wellbeing of the users. It results not only in optimized space efficiency but also in a sustainable work environment, as additional energy savings and a definite reduction of carbon footprint can be achieved. The paper concludes that further research is required amongst post-war office buildings considering how to provide the most functional and efficient work environments depending on the current construction. Research is now continuing with numerous office buildings throughout Hungary.

ACKNOWLEDGEMENTS

This research was supported by the European Union and the State of Hungary, co-financed by the European Social Fund in the framework of TÁMOP-4.2.4.A/ 2-11/1-2012-0001 ‘National Excellence Program’.

REFERENCES

III. MATERIALS, ENERGY AND ENGINEERING

TECHNOLOGY IN TIMES OF TRANSITION
THE 41ST ICOHTEC SYMPOSIUM, BRASOV, 2014
AUTOMATIC FOCUSING - A ROMANIAN INVENTION

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Abstract — This paper presents the evolution of a technical idea concerning the automatic image focusing in photo cameras, TV cameras and camcorder-type recording cameras. The work aims to present both the evolution of the technical solutions, and the Romanian priority concerning the automatic focusing, reached by the technologies of the optical and electronic industries of image, on a period of only 15 years after the patterning in Romania of the most utilized principles, namely the dynamic analysis of image contrast, a principle used in commercialized cameras after the ‘80s.

Keywords — auto focus, contrast detection, international priority, patent

1. INTRODUCTION IN AUTOMATIC IMAGE FOCUSING

In order to obtain sharp images in the photo or video cameras, an operation called adjustment for definition or focusing is necessary. By this operation the image sharpness is adjusted up to a level perceived as correct by the operator (photographer). The notion of adjustment for definition or focusing is used in the instrumental optics to observe the images through field glass, lunette, telescope, microscope, laparoscope, proto cameras, and image projection on a screen. As for the eye, which is also considered as an optical instrument, the term eye accommodation is used, equivalent to the focusing notion for instrumental optics. The sight results from the analysis of the image formed on retina, an image that can be either clear or diffuse, depending on the accommodation. The mechanism of the eye is part of a chain of automatisms specific to living systems, in order that we obtain on the retina a clear image of the object on which our attention and sight are simultaneously concentrated.

The accommodation mechanism consists in the modification of crystalline lens convergence, so that the obtained image has sharp contours, with the highest contrast possible; the other images belonging to objects located in remote or close planes will have diffuse contours. The same phenomenon is noticed in the photo cameras that do not have an optical system consisting of lenses, namely in camera obscura without an objective (pinhole). There are situations when the image of the object on which our attention is directed is the result of a reflection in the mirror, window or any other reflecting surface.
The eye and the nervous system work together so that, irrespective of the distance, the accommodation is performed automatically, through a process whose mechanisms are very complex. This process analyzes the image projected on the retina and corrects the eye crystalline through the ciliary muscles to produce an image that is interpreted by the nervous system as having maximum sharpness. Certainly, the sight defects can also intervene, but the neuromuscular system interprets and establishes which image can be considered as “maximum-maximorum” sharp image, taking into account those defects. When introducing a correction (by means of lenses, for example), the image quality improves, the focusing - accommodation mechanism working in the same complex loop of neuromotor reaction of perception and ocular system.

A relatively simple focusing method is based on the following principle, a principle resulted from the laws of the geometric optics: the image of a point of a scene is correctly focused only for a sole objective-image plane distance; this distance is in direct relation with the focal length of the objective and the objective - scene distance. The optimum distance for a correct focusing can be determined for a certain objective aperture; accordingly, the higher frequencies the spectrum of the formed image will contain, the better the image is focused (sharper and with the highest contrast). As a rule, the optimum distance is found through repeated trials, the dichotomy being the fastest manner to find the optimum focusing. The method was presented and applied in certain patents, in some applications in robotics and television cameras.

There are several focusing methods for the photographic images, each one using specific physical principles, mechanisms and software:

- fix focusing;
- manual focusing;
- automatic focusing that can be of two types: active and passive;
- hybrid focusing that uses the active and passive methods together.

The automatic focusing makes use of a system called “autofocus”- “AF” or “mise au point automatique”. This system analyzes the quality of the image projected on an image analyzer prior to command the exposure of the photographic film or of the image sensor. There are several systems of image analysis, determined by the utilized principle. We can thus distinguish two methods: active focusing and passive focusing.

The active focusing refers to a system through which one measures the distance (using an active source of ultrasonic or IR energy) between the object situated in the main plane, and the photo camera, and depending on this distance, the objective focusing is modified either by shifting the entire objective, or one lens or group of lenses destined for focusing. The distance is measured using several principles: US or microwave radar system, active optical telemeter with IR radiations or another radiation from the visible range; another method concerns the optical telemeter (range finder) that transmits a complex image (matrix) consisting of several luminous points projected on the aimed object.

The autofocus passive systems are named like this since they do not make use of active principles (ultra-acoustic waves, infrared radiations, etc.) in order to obtain information concerning the object-camera distance. At the same time, these systems only use information that can be found in the image projected by an optical system on the sensitive element playing the role of analyzer, or
even on the sensitive element used to take the image. Even if it provides remarkable performances, there are situations when the passive AF system needs to be assisted by secondary sources when the image is not bright; this is the case of taking pictures in the dark using the flashes for focusing, or the image projection and analysis of a matrix on the aimed subject. The main AF passive systems use two principles: phase detection and image contrast detection (contrast analysis).

In some special applications (robotics) the hybrid autofocus systems are utilized that use simultaneously:
- active and passive methods;
- phase analysis and contrast analysis.

2. HISTORY OF THE TECHNICAL SOLUTIONS

The history of the development of the automatic focusing systems starts in 1932. The first mention of a system destined to automatic focusing of a photographic image is found in the US Patent [1] from 1932 belonging to an illustrious American inventor of Armenian origin named Luther Simijian, (1932). The patent is entitled: “Self-focusing camera”; the patent application was filed on the 16th of June 1931 and the patent was granted on the 12th of July 1932 with the number 1,866,581. Table 1 presents a synthesis of the main technical solutions and automatic focusing systems with applications in photography, television and cine-cameras, also specifying the year of patent granting.

<table>
<thead>
<tr>
<th>Filing year</th>
<th>Author</th>
<th>Patent no.</th>
<th>Title. Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>The system uses the fact that illumination depends in inverse proportion on the squared distance between the subject and the light source, and a photocell that measures the subject illumination</td>
</tr>
<tr>
<td>1946</td>
<td>G.L. Beers</td>
<td>US 2,403,628</td>
<td>Television pickup control system [2]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Measurement of incremental variation at different time intervals corresponding to a different optical focusing of the spectral component of the video signal frequency</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Three video-captor cameras with three identical optical systems are used, which provides three different focusing levels: focusing in front of the main surface, in the main surface and behind the main surface. The analysis of the level of the video-signals corresponding to the two extreme cameras determines the sense of simultaneous motion of the three objectives, the optimum focusing position of the central camera being thus obtained.</td>
</tr>
<tr>
<td>Year</td>
<td>Inventor</td>
<td>Country</td>
<td>Patent Number</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>1958</td>
<td>H.H. Salinger</td>
<td>US</td>
<td>2,838,600</td>
</tr>
<tr>
<td>1965</td>
<td>W.L. Steiner</td>
<td>US</td>
<td>3,211,831</td>
</tr>
<tr>
<td>1965</td>
<td>O. Baltag</td>
<td>RO</td>
<td>44,277 1966</td>
</tr>
<tr>
<td>1966</td>
<td>F. Biederman et al.</td>
<td>US</td>
<td>3,274,914</td>
</tr>
<tr>
<td>1969</td>
<td>A.B. Pagel</td>
<td>US</td>
<td>3,442,193</td>
</tr>
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</table>
The synthesis refers to the period 1932-1973, a period which also includes the year 1965, when at OSIM (State Office for Inventions and Trademarks) Romania has filled the patent application for the invention “Video-captor apparatus with automatic focusing”. There is no information concerning the utilization and application of the automatic focusing in the television transmissions, but some information from the 60’s mention the existence on some TV cameras of some analogue indicator instruments that supply information about the video signal spectrum component. From those indications the camera operator could draw a conclusion concerning the focusing quality, as the correct focusing means the presence of high frequencies in the video spectrum. The technological level of those years only permitted an analogue processing of the signal supplied by the optical sensors that integrally analyzed the image projected on sensors. The only patent referring to the analysis of an image segment is dated 1965 - Romania, which used the dynamic analysis of a part of the image, projected in a shooting camera, namely part of the exploration of a TV line.

After the ’70, until the moment when the AF systems appeared on the market and were used, several ingenious technical solutions were imagined and recorded, destined to both TV cameras and shooting and cine-cameras. These solutions were materialized in various prototypes presented at different photographic exhibitions. The evolution of optical and electronic technologies, the apparition of the integrated circuits and microactuators, permitted the application and integration in photographic cameras of new technical solutions, most of them proprietary. Starting from the end of 70’s, many manufacturers experimented the automatic focusing on various prototypes of compact cameras and SLR; this brought in the next decade the domination on the market of completely automated cameras, having also integrated the “AF” function of automatic focusing.

The first mention of the utilization and application of the automatic focusing in a photo camera appears in 1963, when Canon Inc. introduces at the Cologne fair the Photokina ’63, a prototype of photo camera having an automatic focusing system; the principle of operation is not known and, as far as we know, no demonstrations with this camera were made [12]. At the end of the ‘1975, the Hengniweir Company accomplishes and proclaims through Honeywell, USA, the first operational
AF device of automatic focusing that makes use of a double optical system, with telemetry through triangulation, known as “Visitronic System” or, in brief, VAF (Visitronic Auto Focus). It is delivered as an AF module to various manufacturers, who associate it with various components of external control and execution.

Fig. 1. Principle used by Visitronic, and the integrated circuit with optical sensor [13]

Figure 2 presents a synthesis of the main AF techniques. The human view is based on the contrast analysis of the image formed on retina.

Fig. 2. Synthesis of AF systems
No *Visitronic* photo camera was produced, but the *VAF* system remained. This is a system consisting of an integrated circuit with photo sensors, and a stereoscopic optical system with two paths for image transmission. Figure 1 presents schematically the utilized principle, gives a detail from the US Patent 4,002,899 (patent filed Oct. 1975) in which the solution of this telemetric system is described in details [14]. After these years, the evolution of the photo cameras turned toward their fitting with performing image processors, increasing the resolution, the focusing speed, the image storage capacity, the photo cameras also including macro-photographing option, shooting, operation in UV and IR ranges, complex image processing, etc. Table 2 present the evolution of all autofocus system produced and used in cameras.

Table 2. Evolution of the autofocus systems

<table>
<thead>
<tr>
<th>Year</th>
<th>Firm</th>
<th>Camera name</th>
<th>AF Principle</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963</td>
<td>Canon</td>
<td>Prototype (Photokina `63 Cologne)</td>
<td>UN prototype</td>
<td>prototype</td>
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<tr>
<td>1965</td>
<td>Baltag</td>
<td>No name, patent RO 44,277</td>
<td>CD patent</td>
<td></td>
</tr>
<tr>
<td>1971</td>
<td>Nikon</td>
<td>Prototype</td>
<td>UN prototype</td>
<td>prototype</td>
</tr>
<tr>
<td>1972</td>
<td>Nikon</td>
<td>Lens Nikkor 80 (Photokina `72)</td>
<td>UN prototype</td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td>Hengniweier</td>
<td>Dispositive AF</td>
<td>T, VAF mass production</td>
<td></td>
</tr>
<tr>
<td>1976</td>
<td>Leitz Camera</td>
<td>Correphot SLR CK1 AF unit</td>
<td>PDF prototype</td>
<td></td>
</tr>
<tr>
<td>1976</td>
<td>Pentax</td>
<td>K2 DMD</td>
<td>VAF prototype</td>
<td></td>
</tr>
<tr>
<td>1977</td>
<td>Konica</td>
<td>C35 AF</td>
<td>VAF mass production</td>
<td></td>
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<tr>
<td>1978</td>
<td>Honeywell</td>
<td>24 lens, telemetry</td>
<td>TCL mass production</td>
<td></td>
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<tr>
<td>1978</td>
<td>Honeywell</td>
<td>Patent US 4,247,762</td>
<td>CD patent</td>
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<tr>
<td>1978</td>
<td>Konica</td>
<td>UN</td>
<td>UN prototype</td>
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<tr>
<td>1978</td>
<td>Chinon</td>
<td>35 F-A</td>
<td>VAF mass production</td>
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<tr>
<td>1978</td>
<td>Chinon</td>
<td>35 F-MA Infrafocus</td>
<td>IR mass production</td>
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<tr>
<td>1978</td>
<td>Cosina</td>
<td>AF 35 Flashmatic EE</td>
<td>IR mass production</td>
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<tr>
<td>1978</td>
<td>Fujica</td>
<td>Flash Fujica Auto Focus</td>
<td>IR mass production</td>
<td></td>
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<tr>
<td>1978</td>
<td>Yashica</td>
<td>Auto Focus Motor</td>
<td>IR mass production</td>
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<td>1978</td>
<td>Polaroid</td>
<td>SLR One Step Sonar</td>
<td>US mass production</td>
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<tr>
<td>1978</td>
<td>Sankyo</td>
<td>ES-44XL Video Camera</td>
<td>VAF mass production</td>
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<td>1979</td>
<td>Canon</td>
<td>AF 35 M</td>
<td>IR mass production</td>
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<td>1980</td>
<td>Mamiya</td>
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<td>1980</td>
<td>Canon</td>
<td>Canon Visimon</td>
<td>VAF mass production</td>
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<td>1980</td>
<td>Konica</td>
<td>C35 AF 2</td>
<td>VAF mass production</td>
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<td>1980</td>
<td>Sankyo</td>
<td>XL-320 Video Camera</td>
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<td>Canon</td>
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<td>1981</td>
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<td>AF 35ML</td>
<td>SST, IR mass production</td>
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<td>Olympus</td>
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<td>Asahi</td>
<td>Pentax MF-F</td>
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3. DESCRIPTION OF THE PATENT “Videocaptor devices with automatic focusing” RO 44,277 / 1966

During the 60’s, the TV cameras were not fitted with autofocus systems. Some of them had an analogue instrument that indicated the high frequencies content corresponding to image sharpness. The technical solutions reported in the patent literature could not be applied, since they complicated the camera tube system. The application of the autofocus in photography was also impossible, given the technological level at that time. The solution of processing an image element, a segment of the TV signal line, permitted to interpret the video signal and to make decisions concerning the optic system control such that to produce a sharp image [6]. Therefore this system behaves like an extreme adjustment loop. We shall present, in the following, the description of the patent and the block diagram of the proprietary solution (see Figure 2).

![Block diagram of the invention, patent RO 44,277 /1966](image-url)
“The convergence of the video camera objective 1 is modified in a certain direction by a servomotor 2, which also implies the modification of the sharpness of the image formed in the camera; this image is explored and the obtained video signals are derived in a derivation circuit 3. The obtained derivatives pass through two level discriminators 4 and 5 that memorize the derivative negative and infinite values (of very high value, exceeding a prescribed level), the signals obtained at the output of the discriminator are stored in a memory 6; these signals belong to an image of a certain sharpness. After this first exploration of the image and video signal processing, another similar operation is performed, this time on an image of another sharpness, obtained by shifting the objective; the video signals corresponding to the same zone of the image obtained at the output of the discriminator 5 pass together with the corresponding signals from the memory 6 in another discriminator, where the derivative amplitudes are compared; the discriminator allows to pass only the derivatives with amplitudes higher than their correspondent (the derivatives will belong to either the first or the second image). The circuit 8 establishes the sense of modification of objective convergence or position with respect to the image plane that is situated on the front face of the video camera.”

Figure 3 presents the diagram corresponding to two raster images; the first image is out-of focus, and the second image is correctly focused. In the diagram one can see the shape of the corresponding video signal, together with its derivatives. One can notice the difference between the amplitudes of the derivatives of the two video signals [15].

![Fig. 3. Diagram of the video signals corresponding to the images](image1)

![Fig. 4. Patent RO No. 44,277/ 1966](image2)

The analyzed video signals are used to control, step by step, the servomotor so that after the first command and reanalyzing the video signal the shifting sense is established. This shift is performed gradually until reaching the maximum contrast of the video signal, which corresponds to maximum optic contrast. The system operates like a system of extreme automation and adjustment.
The advantage of the video signal analysis is that one can select for focusing the segment of the image which is of interest for the operator and the TV transmission. The analysis of the image contrast was used in the photographic and shooting cameras only after the 80’s, when the integrated image sensors of the digital cameras appeared.

This patent makes the first mention of the image contrast analysis by means of the corresponding video signal [16].

CONCLUSIONS

1. **In the first stage**, the evolution of the AF systems was accomplished starting from the telemetry and optical triangulation systems (in different versions), especially using photoelectric sensors and signal analogue interpretation. The telemetry with ultra-acoustic sonar was applied by Polaroid, but it was not generalized.

2. In television there have been various technical solutions based on the analysis of the frequency spectrum of two or more images coming from different camera tubes.

3. **The second stage** in the AF development was marked by the analysis of the image phase contrast using an auxiliary optic system and dedicated integrated photoelectric sensors with different resolutions; the number of photocells increased from 5 to 240 elements for each optical path.

4. **A third important stage** consisted in the utilization of the TCL technology by Honeywell, which permitted the utilization of SLR cameras.

5. **A fourth important stage** in AF was the utilization of image contrast. As in the case of the phase contrast, the electronic modules are dedicated, yet simpler from both, optic and electronic points of view.

6. The principles of telemetry and triangulation were used in two versions: passive and active.

7. Passive optic telemetry analyzes the scene images projected by two light beams on two photocells and analogue processing of the obtained electric signals.

8. Active optic telemetry developed at the moment when the infrared radiation sources and integrated optoelectronic elements appeared.

9. If at the beginning the optic and photoelectric modules of the AF systems represented a separate unit, distinctive from the camera, being produced as such (Honeywell, Visitronic, VAF), in time they were built in, at first in the camera body and then, as the electronic technology developed, they were built in, in the objective body.

10. The control elements (micromotors) of the objective shift with respect to the image plane where the photosensitive film is located evolved to miniaturization; at first, they were installed outside the camera together with the objective, telemetric blocks and a separated supply source. The technological process included them too in the camera body and then in objective body.

11. The objectives also evolved such that the focusing passed from the objective shift with respect to the image plane, to the shift of a lens group meant for focusing.

12. New technical solutions appeared some remaining in the project stage, other being applied; they permitted to perform the focusing by shifting the image plane (photographic film).
13. A technological progress concerning of the mechanical execution elements was made by using the piezoceramic micromotors. The first utilization of the piezoceramic micromotors was made by Contax. Contax had some other contributions in the mechanical construction by using the ceramic guides which provides a superior unprecedented mechanical precision and endurance.

14. The AF function set free the operator and was applied not only to photo cameras, but also to picture cameras and shooting cameras.

15. The utilization of the objective zoom function has as an effect the modification of the angle under which the image is seized, but not its sharpness; as the result, AF is also used in this application by some manufacturers.

16. In the beginnings, the analysis of the images projected on the photoelectric receivers and the servomotor control were done by means of the analogue circuits. The evolution of the digital electronics and the appearance of the microprocessors with firmware dedicated to specific applications had as an effect the utilization of new types of image analyzer photoelectric sensors, with a higher resolution, which resulted in higher response speeds of the AF system. Hereby appeared cameras that used several specialized microprocessors.

17. The minimum distance for taking photos with the AF function considerably diminished from 1.1 m to macro-photographing with supraunitary factors.

18. Some AF applications began to be used in microscopy, laparoscopy, telescopes, etc.

19. During the last years, both the optoelectric system for taking photos and the utilized software were perfected, the speed of taking and processing images, as well as the interpretation of the electronic image of the scene projected on the complex image sensor increased. This is a consequence of utilization of the hybrid AF systems that make simultaneously use of contrast and phase analysis.

20. The image contrast analysis has certain advantages, considering the simplification of objective optics, smaller errors is appreciating the optimum sharpness and smaller response time. These result from the fact that the inherent mechanical errors are removed due to the fact that the focusing decision is taken after analyzing the image projected on the image optoelectronic sensor. Another advantage is the fact that by selecting a segment of the image, the focusing can be done on the element of interest of the scene.

21. As for the analysis of the image contrast, a first mention of this method appears in the patent application “Videocaptor devices with automatic focusing” filed at OSIM (State Office for Inventions and Trademarks) Bucharest on the 7th of June 1965, 8th 15th, the patent was granted on the 9th of July 1966, with the number 44,277. The patent describes a solution which concerns a new method to obtain the image focusing in a camera tube using the dynamic analysis of the image contrast in a zone of the taken image selected by the operator.

22. The analysis of the image contrast does not appear in the consulted patent literature, this solution being present only after 80’s. The solutions utilized up to this date make references to the optical and electronic correlation of the video signals, focusing modulation and analysis of video signal spectrum, active and passive optical telemetry with infrared radiations, ultrasounds or microwaves.
REFERENCES

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MAGNETIC MEASURES AND COUNTERMEASURES IN COLD WAR ROMANIA

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Abstract — This paper presents the development and magnetometer techniques used in measure and countermeasure systems for naval and terrestrial equipment during the Cold War era (1970 -1989) and the beginning of transition in 1990s. Some applications of magnetometer means for naval magnetic fields control, magnetic characterization and detection of ship magnetic signature are presented. Also, there are examined some applications related to the magnetic characterization of ground combat equipment. In parallel, applications related to the development of naval and terrestrial defensive means are presented, that is naval and anti-tank mines.

Keywords — magnetic measures, countermeasures, degaussing, deperming

1. BRIEF HISTORY OF MAGNETIC MEASUREMENTS IN ROMANIA

The first measurements of the magnetic field in Romania were mentioned by Theodore Stamati (1812-1852), physics professor at Mihaielana Academy Iasi, and described in the first physics textbook [1]. The magnetic field value is not known, but there is mentioned: "La noi la Iasi la anul 1846 abaterea era 9°30 spre vest. La anul 1832 Mart 4, dupa Arago, abaterea magnetismului in Paris este de 22°3 spre est" (Figure 1). (Here in Iasi, in 1846, the deviation was 9°30 towards west. In March 4, 1832, according to Arago, the magnetic deviation in Paris is 22°3 towards east).

![Fig. 1. Quote from Theodor Stamati’s work - Elementary Physics (Fizica elementara)](image)

Fig. 1. Quote from Theodor Stamati’s work - Elementary Physics (Fizica elementara)

![Fig. 2. Theodolite used in Filaret meteorological station - Romania](image)

Fig. 2. Theodolite used in Filaret meteorological station - Romania
Later, another Romanian physicist - Stefan Hepites (1851-1922), together with Lt. St. Murat, achieved the first magnetic map of Romania. In 1896, he built a terrestrial magnetism station equipped with a theodolite (Figure 2), on Filaret hill, Bucharest, near a meteorological station [2]. Magnetometer investigations were continued by Stefan Procopius (1890-1972) who drew up important magnetic maps of Romania, during 1895 - 1954 [3]. He also stated that, since 1932 the Earth’s magnetic moment began to rise, after it had continuously decreased for over 100 years, thus solving a controversy lasting for decades. He determined the period of this variation: about 500 years. Researches on magnetic field variation were performed with conventional magnetic dipole magnetometers in a geodetic point located outside the city of Iasi. Carrying out teaching and research activities at the Iasi Faculty of Physics and Romanian Academy Technical Physics Center, he stimulated the researchers’ interest in magnetism and geomagnetic measurements until 1960s.

In the 70s, a group of researchers from the Centre for Technical Physics Iasi (IFT), under physicist Dr. Al. Moldovanu (1933-2013), initiated a series of research on the development of saturable core magnetometers. The purpose was to execute a triaxial saturable core magnetometer for equipping a Soviet satellite in the Intercosmos program. The magnetometer was destined to measure and transmit information on the circumterrestrial magnetic field [4]. Saturable core transducers of Vaquier type were made in several versions (Figure 3) and electronic modules were executed at the Institute of Atomic Physics in Magurele. Research on the development of magnetic transducers and electronic circuits meeting the specific requirements of space have stimulated the transition from basic research to technological research.

![Fig. 3. Saturable core in various execution stages](image)

Research on saturable core operation stimulated the development of a collective entitled "Magnetic Detection" coordinated by physicist Dr. Octavian Baltag, whose work focused on the magnetometer means and methods in detecting ferromagnetic bodies hidden or embedded in non-magnetic materials. Another area emerged as a result of military and industry demands was the control of ambient magnetic fields produced by magnetic masses or human activity. Regarding the documentation means, the lack of specialized magazines and books was replaced by the library of the State Office for Inventions and Trademarks - Bucharest, which had collections of patents in all areas and from all states.
On the Romanian contributions to the execution of fluxgate transducers and low strength field
magnetometers, the coordinated and systematic research conducted at the Center for Technical Physics
Iasi can be mentioned: Baltag O., A. Moldovanu with collaborators from: the National Institute of
Metrology Bucharest - Julier V., F. Cretu, U. Wiener, the Research Centre for Navy in Constanta - Nanu
D., Mateiiciuc I., Robu O., Balasa L., Ignat V., Institute of Atomic Physics Bucharest - Ciobanu M.

2. MAGNETOMETRY APPLICATIONS IN MEASURES AND COUNTERMEASURES

From military and strategic standpoint, measures are defined as the offensive and direct activities
undertaken by the armed forces, with (materially and psychologically) destructive effect on enemy
forces. On the other hand, countermeasures represent the entire defensive, direct or indirect, actions
performed by own forces to counter-attack or cancel enemy measures. Measures and
countermeasures involve precision, certainty, security and high reliability [5].

Regarding these very special applications for physicists, who had no training in the military area,
the military partners proved to be the perfect partner through the precise definition of problems to
be solved, and some original solutions. In general, this research has been focused on two directions:

1) naval applications in marine environment:
   - magnetic measures: magnetic field control, demagnetization, magnetic signature
   - magnetic countermeasures: naval mine with multi-parameter sensors

2) applications in defensive terrestrial military equipment:
   - magnetic measures: characterization of magnetic signature
   - magnetic countermeasures: antitank mine with multi-parameter sensor

2.1. MAGNETIC MEASURES

In 1951, the Romanian Navy received from the Soviet General Staff a degaussing station, among
other equipment [6]. At the 27th meeting of the Standing Committee for the defense industry CAER
(Czechoslovakia, 19-24 November 1973), the Romanian representatives required the specialization
in manufacturing the AG-9 grenade launcher (with carriage), anti-tank guided missile complex and
demagnetization ships [7]. In this context, there increased the interest in naval magnetometry
research, so that the Institute of Technical Physics was contacted by specialists of Navy Research
Center in Constanta, for cooperation in military magnetometry.

2.1.1. TRIAXIAL MAGNETOMETER FOR MINESWEEPERS SAD EQUIPMENT CONTROL

In 1976, the Magnetometry Laboratory received from the Ministry of Defence (Research Center
for Navy, Constanta), a request to perform a complex magnetometer system for controlling the
magnetic field of minesweepers [8]. This was the first research contract that led to a change in the
research team vision regarding the purpose of research projects, special metrological requirements,
issues raised by the marine environment: reliability, endurance, transport conditions, storage and
operation in unprotected environment, marine equipment specific supply, electromagnetic
compatibility, etc. Research was conducted in accordance with the topic requirements, norms and
standards were prepared for system testing and approval.
The system provides automatic control of current in the magnetic field compensation windings, depending on the latitude and ship magnetic heading. Equipment is divided into three identical channels, measuring the Earth magnetic field components: $X_T$, $Y_T$ and $Z_T$. Each channel consists of a fluxgate magnetometer measuring a field component. The transducers are arranged orthogonally and placed at the ship mast, in order to break-down the geomagnetic field after the vessel axes.

The measured signal on each channel is applied to the control winding of an amplidyne feeding into the compensation winding a current proportional to the signal amplitude (inductive component) superimposed onto the permanent component (defined in the degaussing process). The transducer is provided with compensation and calibration windings for periodic testing. The amplidyne functions in a negative feedback loop. Negative feedback signal collected through a shunt, forces the degaussing winding current to follow closely the field variations measured by the magnetometer. The installation is presented in Figure 4.a, and in Figures 4b, c, d there is presented old installation of Soviet construction.

![Fig. 4. SAD installation for ship antimagnetic protection](image)

2.1.2. THREE CHANNEL MAGNETOMETER FOR DEMAGNETIZATION CONTROL

The magnetometer is designed to equip a demagnetization ship and to measure the magnetic field vertical component. Romanian Navy was fitted with three demagnetization ships: *Automatica Energetica*, *Magnetica* and *Electronica* [9] (Figure 5). They were tasked with processing magnetic fields of Navy ships.

![Fig. 5. Demagnetization ships *Magnetica* and *Electronica* [9]](image)
Transducers are placed in sealed enclosures (Figure 7), properly ballasted and resistant to pressure corresponding to 40 meter depth in seawater. Magnetometer connection cable length is 70 meters. Weights are used to cancel transducers drift due to underwater currents. The magnetometer operates by a conventional electronic scheme, with excitation on the fundamental frequency and detection of the second harmonic. The three identical measurement channels are galvanically separated. Power supply is performed either through 220V/50Hz mains or from a 12V battery. Each channel is able to manually compensate for the transducer field vertical component, by means of a helical potentiometer and a switch to change the field polarity. The magnetometer can operate in both marine and land environment. The measuring range is ±800 mOe, resolution is 0.2 mOe. Magnetometer indications are measurement units known by the crew, and not in SI units.

2.1.3. NAVAL MAGNETIC RANGES

Measuring ships physical fields, including the magnetic field, has emerged as a necessity after the appearance of contactless naval mines. These fields needed be known and maintained below a certain threshold, set at ship design. Magnetic field measurement is carried in specially designed ranges, aimed at ship magnetic processing and periodic control of the ship magnetic field values. The magnetic processing range needs to comply with a sum of requirements [12].
The water velocity should not exceed 0.5 km in port waters. The area should be magnetically uniform, with no nearby ferromagnetic masses or electrical networks. The port waters depth should be at least 2 m higher than the measurement depth, and the sea bed should have uniform depth, without any vegetation. The range should be equipped with fixing means in four points, allowing the ship magnetic orientation on four main magnetic headings (Nm-Sm and Em-Wm) with an accuracy of ±2°.

The range for ship magnetic control is usually a fixed construction, and is placed on the ships fairway, at the port entry or nearby (Figure 9). The facility area should allow the placement of two sensors networks arranged on main magnetic directions Nm-Sm and Em-Wm, in order to ensure an effective magnetic control of the ship on four magnetic headings. Measuring and control equipment connected to sensors networks and power supply is housed in a nearby facility. The area is marked in order to avoid ships anchoring.

Ship ranges are usually constructed in a combined structure, to allow measurement of other physical fields: acoustic, hydrodynamic. As a result, those sea water areas must also meet the requirements of measuring these fields.

2.1.3.1. NAVAL RANGE WITH MULTICHANNEL MAGNETOMETER

In order to equip a naval range several multichannel magnetometers were constructed. These were designed to measure the Earth's magnetic field strength in several points remote from the magnetometer block. Applications were both naval and terrestrial. There were several versions produced, with 8 to 24 channels (Figure 10). The 8-channel magnetometer was used in a terrestrial range to determine the magnetic signature of military vehicles. The measurement channels are galvanically separated. The electronic scheme follows the magnetometer basic principles, but with some particularities, being made with hybrid integrated circuits.

The transducers are fluxgate type with saturable core made of Vacuumschmelzte supermaloi tape. Due to the large cable length, the excitation voltage supplied by excitation module is higher than for other magnetometers. Magnetometer output channels provide analog signals that are applied to a computer system type ECAROM 800, being the first computerized naval magnetic range. ECAROM was the first Romanian mini computer system manufactured since 1975 at
Automation Elements Enterprise using the 8080 microprocessor. It was equipped with an analog numeric converter EC 880-CAN representing the magnetometers interface.

The magnetometer system characteristics are [12]:
- measuring range: ± 20.000 nT, ± 2.000 nT
- geomagnetic field compensation range: ± 60.000 nT
- geomagnetic field compensation error: 5 nT
- calibration testing
- resolution: 1 nT
- transducer cable length: 200 m
- measurement error: 2%.

![Fig. 10. Multichannel magnetometer](image)

2.1.3.2. COMPUTERIZED MULTICHANNEL INSTALLATION

Due to modernization needs of both the magnetometer channels and information system, Terraflux Control Ltd. was asked to execute a complex magnetometer system with 128 channels (Figure 11) to establish an underwater measurement network, for ship magnetic field [11]. It provides data to a computerized analysis and computing remote system, situated ashore, on a nearby buoy, or on another vessel [12].

The system inputs data from the fluxgate transducers, and provides an output voltage proportional to the vertical component of the measured field. Electronic circuitry operates based on signals provided by the fluxgate transducers. Since magnetometers are used in a remote underwater network, transducers are provided with compensation - calibration windings remotely controlled. For remote compensation - calibration of the two winding functions are combined and represented by a single coil powered by a digitally controlled constant current supply. Compensation pulses are applied in a serial mode, with different length pulse trains for command and reset, in an 8 bit binary code. Pulses are applied by means of galvanic separation circuits made with optical isolators controlling the field increment steps through digital-analog conversion circuits.

The measuring system uses as primary elements of the acquisition, data acquisition modules 6B12 Analog Devices Series with 16-bit AD conversion, galvanic separation, and self-calibration and temperature compensation. The modules are used in a multipoint RS 485 serial communications network, with local power. This there is enabled the measurement data transmission to a computer system at 1200 m distance.
Calibrations commands are software performed and transmitted through the RS 485 network to each magnetometer, or to a single preselected magnetometer, by means of a digital card with 24 I/O ports type 6B50 Analog Devices. Each magnetometer is configured as an individual address corresponding to a number between 0 and 255. Transmission speed used on the serial line is 19200 baud.

Fig. 11. Computerized multichannel installation [12]

In the graphical representation there illustrated the magnetic field variation produced by the movement of an elongated shape ferromagnetic object, at different speeds and distances. Through the user interface to:
- configuration computer port through which the data transmission used on the RS485 communications bus - COM5;
- serial bus transfer rate: 19200 baud;
- measurement channel address selected for acquisition (maximum number of channels that can be addressed individually or all on a RS485 network is 256);
- magnetometer network scanning, indicating the maximum address number of the last channel;
- system map update and display of system active modules;
- transducer measuring range;
- measured value display in various formats;
- plotting measured values and storing data in a memory buffer of size is chosen by user;
- determining the number of acquired samples (if signal filtering is imposed);
- establishing the field steps for magnetometer calibration

The program first performs a network map of 6B modules, then monitors and controls any of the measurement network building blocks.

2.1.4. MAGNETIC ANOMALY DETECTION IN MARINE ENVIRONMENT

The existence of wrecks on the seabed, or searching lost bodies, anchors, anchor chains, buoys, torpedoes, etc., causes changes to the local magnetic map, but also represents a potential risk [13]. As a result, the Magnetic Detection Laboratory of the Institute of Technical Physics Iasi was asked in 1990 to conduct research related to the electromagnetic detection of these artifacts. The research was focused on two directions:
- delivery of a portable metal detector for divers, and
- delivery of large metallic objects detector, towed by a boat. The transducer operates on eddy currents, for this large application (2 x 3) m, and is shown in Figure 12.
In order to update the geomagnetic map of the Romanian littoral area after the 90s, the Navy Research Centre initiated a project involving aerial modern approach: a helicopter towing a nuclear precession magnetometer, optical communication of magnetometer information, accurate identification of magnetometer altitude etc. To increase resolution and reduce the measurement duration, Terraflux Control Ltd. chose to use the Overhauser effect [13]. Figure 13 illustrates the Overhauser effect magnetometer within a field application. The project was not completed.

**2.2. NAVAL MAGNETIC COUNTERMEASURES**

IFT Magnetometry Laboratory was approached alternately at 2-3 year intervals, with technical issues related to the implementation of specific countermeasures devices. Approach was delicate, as the same research team that had worked and conducted military installations intended for magnetic measurements was regularly approached for magnetic countermeasures, possibly combined with other systems: acoustic, electric, etc.

**2.2.1. MULTI-PARAMETER NAVAL MINE**

The Navy Research Center Constanta requested the IFT Magnetometry Laboratory to conduct a feasibility study of a naval mine with magnetic channel. Multi-parameter naval mine was equipped with several programmed acoustic, magnetic sensors that conditioned the time of the explosion. Magnetic channel was the most complex. It was composed of two blocks of triaxial magnetic field sensors are mounted on a base. One of the blocks provides magnetometer information about the
magnetic field components and applies to the other triaxial transducer corresponding compensation fields. Another three channel electronic block detects the second harmonic signals, resulting three voltages corresponding to magnetic field gradient components in the three directions [14].

![Fig. 14. Naval mine magnetic channel block scheme [14]](image)

### 2.3. Terrestrial Magnetic Measures

Terrestrial magnetic measurements came quite late in attention. As the only specialists in detecting and measuring magnetic fields were military scientists of the Navy Research Center, they were also asked to handle the organization and equipment of the terrestrial magnetic polygons. An interesting application was determining the magnetic signature of equipment.

#### 2.3.1. Terrestrial Magnetic Range

In 1980s magnetic field measurements were performed with several triaxial magnetometers, as well as with a multichannel magnetometer MM80-8. They were used in improvised or dedicated terrestrial ranges. Difficulties were determined by the fact that there is no particular location below ground level for magnetic field transducers. The vehicle speed was difficult to assess when passing above the magnetic sensors. Figure 16 presents the magnetic signature of various equipments. The vertical component was of interest, since it was not influenced by the magnetic sensor horizontal position. Magnetic disturbance was enough to trigger a firing circuit of magnetic mines.

![Fig. 15. Soviet tank](image)
2.3.2. POSTAL BOMB DETECTOR

The postal bomb detector was a portable metal detector, designed for antiterrorist control of postal mail (envelopes, small packages). In principle, it used to detect small metallic elements - wires, needles, which could have been part of an electrical circuit, electronic primer circuit or mechanical percussion device. It was useful in detecting the presence of banknotes by detecting their magnetic markers. It was also used by special services for the control of packages circulated with special post.

2.4. TERRRESTRIAL MAGNETIC COUNTERMEASURES

After performing measurements of equipment magnetic signature, the Magnetometry and Magnetic Detection Laboratory was asked to execute a magnetic transducer designed to work with a geophone in a magnetic anti-tank mine with cumulative effect.

2.4.1. ANTITANK MULTI-PARAMETRIC MINE

The parametric antitank mine was a sensitive issue, for several reasons. It had to be in magnetic and seismic standby mode for a few months. The existing accumulators were relatively large; the seismic and magnetic sensors had to have a very low consumption, and the metallic enclosure functioned as a magnetic screen and reduced the magnetic channel sensitivity.

After several stages of research, there were homologated: the geophone (ICPE Iasi), the magnetic transducer, the multiflux transducer, the electronic module [15] [16], the priming circuit and batteries. There was executed a zero series of sensors as well as multiple models (Figure 18), along with Electrotehnica enterprise. The project was stopped without completion.
3. ELECTRONIC COMPONENTS AND MAGNETIC SENSORS USED IN MILITARY EQUIPMENT

Research and technological development in magnetometry was particularly rich both in diversity and complexity of magnetometer installations, as well as in very special applications with great specificity, which is unusual for a group of researchers of the Romanian Academy. Precisely these applications and different requirements led the change in researchers’ optics and research approach. Thus, new electronic components were imagined, field transducers and sensors were created, new methods and means of measuring and detecting magnetic fields and disturbances were developed.

3.1. HYBRID INTEGRATED CIRCUITS USED IN MAGNETOMETERS

Naval and terrestrial ranges were equipped with multichannel magnetometers, which needed to have identical features, to be electrically isolated, to have a high reliability, and to be manufactured relatively quickly, with a minimum of electronic components. The solution was the design and development of special electronic components: hybrid integrated circuits for magnetometry. Therefore, Magnetometry and Magnetic Detection Laboratory designed, experimented, and built a series of thick film hybrid integrated circuits (Figure 19), in cooperation with Electroarges enterprise, having as section headed by engineer Dan Bizon.

IPRS Baneasa produced the military series of the active components- digital (TTL technology) and analog. These components were incorporated in transducer excitation circuits [17] and signal processing circuits. The passive components, the resistors were laser calibrated and the capacitors were multilayer type. Hybrid integrated circuits were made on thick film ceramic plates. Ceramic wafers were used on both faces. Some components were encapsulated, other were coated with quartz powder epoxy resin. These components fitted the 8 and 24 channel magnetometers series.

Fig. 18. Antitank mine with seismic and magnetic sensor [13]

Fig. 19. Hybrid integrated circuits used in magnetometry [13]
3.2. MULTIFLUX TRANSDUCER

Besides active electronics - hybrid circuits, there were designed and carried out a number of new types of magnetic field sensors of saturable core type [18]. In Figure 20 there is schematically shown the component of the multiflux transducer. It has equipped a number of magnetometers in 128 channels magnetic range, the magnetic channel of the anti-tank mine and several other laboratory magnetometers.

4. PROTECTION OF INTELECTUAL & INDUSTRIAL PROPERTY

Although it was a great and very special situation of research related to the military, it was also a rich period in filing patents at the national patent office. Patents were classified; usually the manufacturing and mining rights were assigned to the Ministry of Defense. The protection period was 15 years. After the 90s, the protection period was extended to 20 years.

Some products and services were protected by trademarks, trade and services, depending on the interests of the institution and preparation of intellectual and industrial property protection responsible. Figure 21 illustrates are some pictures of patent applications, as well as some trademarks, trade and services that were linked to special applications.
5. CONCLUSIONS

Scientific and technological research had a period of intense creativity in the use of magnetic field measurement and detection principles and techniques. Doctoral theses were supported in magnetic protection. Manufacturing technologies of magnetic sensors for measuring weak magnetic fields were developed. New technologies to conduct special electronic components, such as the first hybrid integrated circuits for magnetometry in the world were designed and implemented.

The multichannel magnetometers were the first magnetometers in the world equipped with hybrid integrated circuits. Several devices for military and special purpose defensive applications have been patented. The first complex ranges for determining the magnetic signature of marine and river vessels and land-based equipment have been constructed. A series of military magnetometry theses were presented, some of which were classified. One book on ships physical fields was reported (1990).

REFERENCES

POST-WAR MEDICAL USE OF INFRARED DEVICES IN THE USSR

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Abstracts — The first samples of Soviet infrared (IR) devices for night vision were developed in the late 1930s at the All-Union Electrotechnical institute (VEI, Moscow) and at the State Optical institute (GOI, Leningrad). With the beginning of the World War II the Soviet industry set about serial production of navigation devices Gamma VEI. The devices had been used then as a means of steering ships in darkness on the Black Sea. Many ships with wounded soldiers and civilians aboard were saved thanks to that in the days of the Sevastopol Defense. Also the VEI and GOI were the first institutions in the USSR to create the IR imagers at the end of the 1950-s. The first imagers were intended for military purposes. And in several years a research group, headed by Piotr Timofeyev and Mikhail Miroshnikov, achieved results that allowed to organize production of the thermal imagers as a means of diagnostics in oncology and other fields of medicine. Nowadays the IRTIS firm is a producer of medical IR imagers in Russia.

Keywords — Infrared devices, thermovision diagnostics, Soviet photoelectronics

1. INTRODUCTION

The history of the development of IR devices in the USSR has not been described in scientific literature before. Here authors elucidate some main facts of that history.

In the 1930s and after the beginning of the World War II, the Soviet scientists and engineers carried out various researches in radio and electronics aimed at military purposes. Many results of these investigations were used after the War for peaceful goals [1]. An example of such works is the development of IR devices.
2. BACKGROUND AND ANALYSIS

In the middle of 1930s, research groups at VEI, headed by P. V. Timofeyev and V. I. Arkhangelsky, as well as at GOI (leader V. I. Krasovskiy) began the development of electron optical converters (EOC). By this time the Moscow research group successfully completed works in the field of sound cinema and the optical and mechanical television. It contributed to the development of various photo cells, photocathodes, luminescent screens and their application in new devices [2].

The Moscow research group developed electro-optical converters with plane-parallel electrodes. A big number of the converters were produced during the years of World War II. The devices had translucent caesium-coated photocathodes developed under the leadership of Piotr Timofeyev.

The results of VEI and GOI works were used for steering ships of the Black Sea Fleet. Admiral L.M. Galler, a big enthusiast of new electronic equipment, headed the work on installation of invisible navigation fires in that region. In June - November 1941, the ships of the Black Sea Fleet were equipped with more than 30 IR – direction finders for steering by these fires. The entrance of the main fleet base – Sevastopol was equipped with invisible IR-fires. It helped saving many ships from German artillery bombardment during the defense of Sevastopol.

In addition to the radar location, the VEI developed sea heat direction finders. The finder detected ships by their thermal radiation. The newly developed receivers of thermal radiation gave an opportunity to make a step from heat direction finding and pyrometry to the development of thermal imagers.

In the 1950s, Professor Timofeyev and his laboratory investigated the possibility to detect infrared radiation with the help of semiconductor receivers. Since the beginning of 1960s, they have proceeded to use intermetallic connections (InSb, InAs) sensitive in IR-area as receivers.

A group of researchers, headed by V. I. Arkhangelsky, developed at that time the thermovision devices with InSb photodetectors that corresponded to the best foreign achievements by sensitivity, resolution, speed and mass-dimensional characteristics. The devices then served as a base for manufacturing equipment for military and for humane application [3].

Piotr Timofeyev (paid attention to) focused on the development of medical thermal imagers. In the late sixties the VEI thermal imager of his design (fig. 1) was recommended by Ministry of Health for mass production.

Doctor Yury Bogin became one of the first in the USSR to work out medical principles of the VEI thermal imager application. The Central hospital of the Ministry of Railways established for this purpose the Biolocation Laboratory. Achievements of doctor Bogin are widely known in medical circles. They played a big role in the development of diagnostics of oncological and other diseases. Doctor Yury Bogin also was one of first in the world to combine the methods of thermovision and ultrasonic analysis (ultrasonography). About that time the Leningrad school of medical thermovision was successfully developing (fig. 2).

It is known that the “Russian American” Dr. Vladimir Zvorykin, who is often called “a father of television”, dealt for many years with electronics for medical purposes. Both Zvorykin and Timofeev came across with similar scientific and technical problems. They happened to meet in
Moscow, though a possibility of close scientific contacts was not discussed. Zvorykin is also well-known for his development of the night vision devices for the US Army. One of the results of this important work in the War-time was that he could not visit after that Russia for fifteen years [4].

On 30th July, 2013, there was the 125 years anniversary of V.K. Zvorykin’s birth. In 2013, there was also the 115 years anniversary of V. I. Arkhangelsky’s birth. P. V. Timofeyev’s 110 birth anniversary was in 2012.

3. RESULTS

Now the State VEI Institute carries on researches and developments in the field of thermovision devices and methods of their application [5]. The GOI develops various types of specialized thermal imagers aimed at the solution of ecological problems. The further development of medical thermovision is now a mission of the Russian firm "IRTIS". This firm manufactures thermal imagers – thermographs of different function which are now widely known both in Russia, and abroad. The authors of this paper think that the history of the development of photoelectronics in Russia will also be one of the directions of our investigations.

4. CONCLUSIONS

Russian scientific school on photoelectronics and IR-technologies has achieved a certain progress in previous years. The results of the work in this field contribute to the development of the scientific and technical potential, raising not only the country power, but also the quality of life for the people.

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Fig. 2. Cover of the atlas of thermograms of GOI. 1976
NEW MATERIALS FOR PROMOTING NEW LIFE STYLES

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Abstract — New materials such as synthetic polymers are considered a ‘symbol of technological progress and growing industry’ and have rapidly become widespread consumer products. Nowadays, there is practically no field where they cannot be applied. These materials have even contributed to major changes in consumption patterns and in corporation's lifestyles.

In 2007, the international plastics industry celebrated its centennial. Given the lack of feedback from the Portuguese general public to this anniversary, we intend to study how the press assesses the relationship between the plastics entrepreneurs and the defense of their industrial sector. How the representatives of Portuguese Plastics Industry, every significant sector of the national economy, have been advertising and promoting the plastics objects since 1930’s when this industry was implemented in Portugal it is another goal of this paper. The consumption and production of everyday synthetic objects often is influenced by its aesthetic component. To what extent a number of artists and designers choose plastics as the material for their creations?

Based on a multidisciplinary approach, this paper intended to analyze the relationship between the plastic Portuguese industry discourse and its consumers. Special attention was devoted to some key players in the Portuguese context society.

Keywords — synthetic polymers, Portuguese plastics industry, promoting plastics, artists and designers

1. INTRODUCTION

The development of plastics up to today is a successful chapter in the history of modern chemistry [1]. Starting in the first half of the nineteenth century, the plastics revolution was most significant around 1960-70. The large development of chemical industry during the two World Wars along with the economic growth between 1950s and 1960s, has resulted in a historical period known by the emergence of a ‘consumption logic’ and the predominance of a ‘principle of pleasure’. These factors led to a revolution in the use of plastics, in everyday life and in art [2]. Along with granite and wood, plastics like polyethylene, polyester, polypropylene, polyvinyl chloride and polyurethane (among other plastics) started to appear in the galleries and art fairs [1]. Due to many plastics advantages, many industrialists, designers and artists have considered these materials as a revolution in the production of their own creations. Plastics gave the possibility to materialize the
new culture and lifestyle of the sixties, and enabled the rejection of conventional methods of manufacture [1].

In Portugal there are few studies concerning the history of plastics industry, and its recognition as an important achievement of the country was unknown to the general public[3,4]. In order to fill this gap, we try to show how the industry and consumers have valued plastic items. Also, we intend to point out the main changes resulting from the introduction of plastics in the context of national Portuguese industry and their impact on the general public.

2. BACKGROUND & ANALYSIS

Following an inter- and multidisciplinary approach, this research brought together different methodologies from different fields of science. This work aims at building a bridge between the history and the technology, the industry and the object, as well as, between the product and the consumer, in order to contribute in understanding the Portuguese history of plastics industry.

For the production of this documentation about the Portuguese plastics industry and its impact on the consumer’s daily-life, it was crucial to access the libraries’ archives, as well as to collect oral and/or written testimonies of former and current employees from the synthetic polymer sector in Portugal, especially those of textile, furniture and objects industries. For that some interviews to former employees and private entities were carried out.

3. RESULTS

The introduction of new materials in the Portuguese industry was closely related to the urgency of the country to get closer to what was happening abroad, as well as to the need of its industrial sector renovation. Synthetic materials, such as plastics and synthetic fibers, constituted a "solution in search of a problem", due to their development for a wide variety of applications.

After the World War II, the Portuguese plastics industry found a favorable environment for their development due to the global situation and the diversity of applications that plastics allowed.

Moved by the novelty and success of the industry as well as by the government incentives (low commodity prices in the domestic market, fiscal and financial benefits and ease of access to bank credit), some entrepreneurs explored and developed this area. As examples of the government incentives, Portugal has created the Lei de Fomento e Reorganização Industrial (1945) and started a national economic planning. In 1948 Portugal embraced the Marshall Plan and in 1959, the European Free Trade Association (EFTA), thus following the orienteering lines stated by the Planos de Fomento Nacional (national promoting plans) launched in 1953 [5-7].

With this as a starting point, the 1950s were a period of modernization and economic growth in Portugal and the decade in which the Estado Novo (the dictatorship regime) ‘discovered’ the designer, as a mandatory tool to achieve those goals- the industry renewal. With the emergence of a new client (the consumer), the Portuguese industry was forced to accompany this new taste and to modernize this sector due to new habits and new ways of life, which, for example, were reflected in the acquisition of modern and functional furniture for their homes [7].
One of the consequences of this modernization was the demand for new production methods and materials, and plastics were an example. To promote them, a patronal organisation, named Association of the Industrialists of Composition and Transformation of Plastic Materials (Grêmio dos Industriais de Composição e Transformação de Matérias Plásticas) played an important role in the dissemination of this new material.

Plastic articles produced by national industry were first introduced into the market in 1949 during the 1ª Feira das Indústrias (1st Industries Fair), organized by the Associação Industrial Portuguesa (Portuguese Industrial Association). The presence of this industry in the fair was used by the Association to show and enhance the Portuguese industrial progress:

‘(…)We had other sectors in which highlighting their activity would be advantageous (…) so as to demonstrate the capacity of producing certain articles capable of substituting many others, originated abroad (…) of new industries that gained a remarkable degree of development among us (…) such as plastics(…))’[8].

The impact of plastics diversity amongst the visitors was registered as follows:

‘(…)The public, who in its majority was unaware of this most new production, departed delighted from the visit to the Belem pavilion where such a promising production that would raise Portuguese industry to the level of the most modern in the world had been laden before their eyes’ [9].

The introduction of new materials in Portuguese industry, not only opened the door to new markets such as furniture, but contributed to encourage the creativity of designers as well.

One of the first players of the alliance between design and the plastic industry might have been Eduardo Afonso Dias. Designer and later professor was one of the firsts to adopt design as a political strategy for a business. Considered by many authors as a reference in national designed, he was born in 1938, in Lisbon, in a time when plastic industry was making its first steps in the country [10]. Eduardo Afonso Dias looked for national product empowerment and its distance from the handmade industry still predominant in the Portugal [10]. However this new mindset was hard to install in Portugal and Eduardo Afonso Dias, with others designers like for instance, Daciano Costa, were uncommon examples of this working practices [10, 11]. As an example of this situation, the first national exhibitions of design works (1971 and 1973) showed the lack of originality of Portuguese models, despite the INII efforts to promote the industry and the design. The current standard was the copy and replication of foreign objects and the presentation of original Portuguese models were very uncommon [11]. According to António Pinto (former employee of Portuguese furniture enterprise, Ádico) the design of this articles wasn’t carried out by a designer or artist engaged for that purpose but by managers and production warders with no formal preparation for it. The production of copies of foreign models was another recurrent possibility also mentioned by Eduardo Afonso Dias in his appointment:

‘I had some difficulties relating with the Portuguese business community, because their training was pretty weak.(…) I remember an example in the field of plastics. His company had huge technical capabilities and it all failed because the guy was a ‘street-smart’, copying all the models. He used to say: ‘Look, I go to the markets abroad, I buy one collection, and I come back and I do thus and so… ’ And I replied: ‘But it doesn’t work like that… even if you got the product and with
that price you make some business and increase production, that is not what matters. You need to have truly unique products, or you are screwed’ [12].

As a matter of fact his role in this sector was important and Eduardo A. D. set contacts with approximately 70 small to medium industrial enterprises, among them FaplanaLda, created in 30 April 1955 under the name of Fabal – Fábrica de Baquelite de Leiria e Romão e Rosa Lda. (Rosirom), devoted to the production of plastics objects and founded in Porto de Mós [13].

‘In my wanderings throughout the country I came across a factory. It was ROMSIROM, a factory that no longer exists, located in the Leiria region and where I developed the line ‘Progress’ among other… trash bins, double-body mugs for the national and international markets. They were a sales success in The People Stores. I do not know if they still exist, but thousands and thousands of units were sent there, hundreds of thousands of bins sold’[13].

Also in this appointment it can be seen that for Eduardo Afonso Dias plastics made possible the production of new items. However, the main advantage in their use was the innovation enabled and the production of new products for the market [11]. Put in other words, first it must be a need, something to be satisfied and only then, an object, and not the opposite [13].

‘At one point the owner of the factory (ROMSIROM) asked me to develop a mug for children, one that would not scold their fingers, double-bodied. ‘Find a way’, and that is how I came up with the Combi. It was a sales success, because the children did not scold their finger whenever they were holding the mug with a hot beverage [13].’

According to Eduardo A. D. e António Pinto they both stated that the plastic production was very positive in both internal and external markets. According to both (the respondents) the advantages of using plastics come from a much easier production, lower working and materials costs, shorter production time, better production final settings, new production ways, better product hygiene and better commodity and comfort in the made objects[13,14].

Nevertheless, in Portugal, the application of plastics in the field of industrial design was not common. Only from 1970s onwards the Portuguese industrial market started to adopt the new materials for their production and consumption. According to industrial periodicals the plastics industry in Portugal in the 1960s was still far behind other European countries, mostly because of its dependence on raw materials and technical support [15-19].However, in the 1970s, despite of oil crisis, it was registered a reinforcement of chemical and processing industries and, in the accessed journals, statistic references about the use of plastics like PVC and Polyethylene in the late seventies started to appear [15-19].As examples of this consumption, melamine dishes started to appear in the Portuguese kitchens as well as utility objects made of acrylonitrile butadiene styrene (ABS) and styrene acrylonitrile resin (SAN), polypropylene chairs and polyurethane foam sofas.

4. CONCLUSIONS

Plastics gained in few years, their own status quo and a remarkable social, technical and economic worldwide importance. Because of their properties and intrinsic characteristics they acquired such a degree of development that there is practically no field of activity where they are not employed.
In Portugal, the challenge of promoting these new and unknown materials was also taken by the industry and outstanding benefits were achieved for the national economy. Exhibitions and fairs were the stage for several demonstrations of the industry vitality and its technological breakthroughs. In there, some unique pieces designed by Eduardo Afonso Dias and Daciano Costa as well as furniture from the firms Metalúrgica da Longra and Fábrica Osório de Castrowere shown.

Since the appearance of new materials such as plastics, Portuguese consumers (designers, architects, various economic sectors, general public) still show a preference for synthetic products, denoting the maintenance of their popularity.

ACKNOWLEDGEMENTS

The authors are thankful to the interviewers for their testimony and time dedicated to this study.

NOTES

1. As examples of the first Portuguese artists using synthetic polymers in their productions, Joaquim Rodrigo (1912-1997), Ângelo de Sousa (1938-2011), Lourdes Castro (b. 1930) and João Vieira (1934-2009), are important names of the use of this novel material in art. Polyvinyl acetate based emulsions were used by Joaquim Rodrigo and Ângelo de Sousa since the early 1960s. Lourdes Castro used acrylic sheet in colour compositions and made use of the optical properties characteristic of that material. João Vieira, having worked as a designer for the industrial unit Flexipol – Espumas Sintéticas S.A., worked with materials often unknown to other artists and polyurethane was one of his favorite materials since 1970.

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L'EVOLUTION DE L'ELECTRIFICATION DES CHEMINS DE FER ROUMAINS

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Keywords — électrification, Chemins de Fer, locomotive électrique, train électrique

1. LA QUESTION DE LA MODERNISATION DES CHEMINS DE FER A L’AIDE DE L’ELECTRIFICATION

Le développement de la révolution industrielle en Angleterre a permis la découverte des moyens de transport plus rapides et plus efficaces que les chariots, les calèches ou les coches.

Après l’invention de George Stephenson en 1829 de la locomotive „The Rocket, le 15 septembre 1830 a été mis en service le premier chemin de fer du monde, sur le trajet Manchester-Liverpool” [1,9]. La première locomotive électrique a été construite par l’ingénieur écossais Robert Davidson en 1837 et roulait entre Edinburgh et Glasgow. La locomotive avait deux essieux portés par des moteurs électriques et elle a réussi à remorquer 5 tonnes à 6,5 km/h [3,9].
En 1840, en Allemagne, le mécanicien Johann Philipp Wagner a présenté un modèle de train électrique alimenté par des piles. Les essais sur un modèle de taille normale n’ont pas donné de résultats, les piles étant trop faibles [2].

En France, en 1864, à Versailles, les Français Louis Bellet et Charles de Rouvre ont fabriqué un véhicule coche à quatre roues, appelé Locomotive porte-lettre. L’alimentation du moteur se réalisait à l’aide d’une pile fixée sur un troisième rail central [2].

En 1898, la société Siemens & Werke a construit une locomotive électrique qui était alimentée par courant alternatif triphasé. La locomotive pesait 16 tonnes, une puissance de 176 kW et atteignait une vitesse de 60 km/h [1,3].

Le 15 octobre 1902 a été inauguré le chemin de fer électrifié Valtellina au pied des Alpes. L’alimentation a été faite par le courant alternatif triphasé par deux fils en air, et la troisième phase à l’aide du chemin de fer. La tension a été de 3,4 kV et la fréquence 15 Hz. Ils ont utilisé des locomotives construites par la société Brown Boveri & C.S.A Baden et Ganz, qui avaient quatre moteurs de 440 kW et atteignaient la vitesse de 35 km/h. Les moteurs construits par la même société avaient la même puissance de 440 kW, mais ils atteignaient la vitesse de 60 km/h [1,3].

En Autriche, la traction électrique sur les chemins de fer a été introduite en 1904, sur le trajet Insbruck-Fulpmes, en passant de l’alimentation avec 2,5 kV et 42 Hz à 3 kV et 50 Hz [1,3].

La Suisse a promu au début du XXe siècle un programme général d’électrification des chemins de fer. En 1904, en Suisse a été réalisée la première locomotive électrique avec un convertisseur; la locomotive bénéficiait d’un transformateur qui diminuait la tension de 15 kV à 700 V, et le convertisseur transformait en courant continu pour alimenter les deux moteurs, ayant le pouvoir de 183 kW [1,3,4]. Un rôle important ont eu le professeur W.Wysling et l’ingénieur Emil Hober Stocker. Ils ont passé, en 1905, de la fréquence de 50 Hz à 16,66 Hz. [1,3,4].

Aux Pays-Bas, ont été électrifiés les chemins de fer Amsterdam-Haarlem en 1904 et Rotterdam-Haga en 1908, et ils étaient alimentés par la tension monophasée 10 kV et 16,66 Hz [1,3].

En France, le courant monophasé de fréquence basse 12 kV et 16,66 Hz a été utilisé aux chemins de fer dans le Midi, qui a été électrifié pendant la période 1910-1917 [1,3,9].

En Hongrie, après la Première Guerre Mondiale, la société Ganz de Budapest, à l’aide de la contribution de l’ingénieur Kalman Kando, a proposé l’utilisation du courant monophasé à 50 Hz, avec une tension de 16 kV. Sur le trajet électrique Budapest Dunakeszi-Alag a été expérimenté le 31 octobre 1923 une locomotive à cinq essieux couplés par bielles, pesant 79 t.f., une puissance stable de 1980 kW (2700 C.P.) et atteignant une vitesse de 66 km/h [1,3,4].

Fig. 1. Locomotive électrifiée Ganz-Kándo en Hongrie à 3200 C.P [5]
Dans l’Union Soviétique, entre 1926 et 1935, la longueur des chemins de fer électrifiés a augmenté de 205 km à 7360 km. Les locomotives et les automoteurs électriques de l’Union Soviétique pouvaient fonctionner à deux tensions – 1650 V et 3300 V [1], [3, 4]. Ils ont construit des locomotives électriques à 8 essieux pour développer une traction dans la mesure permise par le coupleur automatique [1,3, 4].

Dans le système Ganz-Kandó, la variation de la fréquence du courant d’alimentation était discontinue, la France, par exemple, a préféré le système Ward-Léonard par lequel le réglage de la fréquence était continu. Dans la période 1954-1960, ont été construites 20 locomotives de type Co-Co, qui opéraient dans ce système. Les locomotives avaient six moteurs triphasés, 126 tonnes, la vitesse maximale 60 km/h et la puissance de 3.032 kW (4.120 CP). Le système a été adopté par la Hongrie entre 1956-1962 et ils ont construit 50 locomotives de type Bo-bo, qui pesaient 75 tonnes, 1.480 kW (2.000 CP), la vitesse maximale 80 km/h et une force de traction de 26 tf [1].

Un rôle important dans la modernisation et l’augmentation de la vitesse des trains a été l’introduction de la traction électrique. Cela a présenté des avantages pour: a) l’amélioration du service ferroviaire dans et autour de la périphérie des grandes villes; b) l’augmentation de la vitesse de croisière; c) le manque d’approvisionnement en eau; d) l’économie de carburant plus élevée; e) la réduction de la pollution par l’élimination des combustibles solides et liquides; f) la multiplication des transports [2].

2. LE DEBUT DE L’ELECTRIFICATION DES CHEMINS DE FER EN ROUMANIE

En Roumanie, le premier chemin de fer a été inauguré le 20 août 1854, entre Oravita et Bazias. Au début, il a été utilisé dans le transport de charbon, ensuite il a été soumis à des améliorations et finalement a été ouvert pour le transport des passagers à partir du 1er novembre 1856 [1,4]. Dans l’Ancien Empire, le 1er septembre 1865, la société anglaise a commencé à construire le chemin de fer Bucarest-Giurgiu, qui a été ouvert pour le transport des passagers le 26 août 1869 [2].

L’électrification des chemins de fer représente une action à grande échelle, engageant: a) des installations produisant de l’énergie électrique, b) des réseaux de transport de l’énergie électrique de la centrale/ plante électrique, c) la ligne électrique de contact, qui fournit aux locomotives le courant transformé, d) les locomotives et les automoteurs électriques [2].
Fig. 4. Locomotive électrifiée de courant continu monophasé [1]

Le 11 novembre 1906 la Société CFAP a été officiellement fondée et le 11 novembre 1913 a été inauguré le premier chemin de fer électrifié sur le territoire de la Roumanie, entre Arad et Podgoria [7]. Le chemin de fer appartenait à une société privée et avait 58 km en longueur et un écartement en mètre, le transport était assuré par les automoteurs à traction benzo-électrique à quatre essieux Dion-Buton pour la mise en marche du générateur de courant continu, et la traction était assuré par les essieux en arrière [7].

Fig. 5. Wagon électrique qui a fonctionné sur la section Arad-Pancota [8]

En 1913 a été présenté le premier projet d’électrification des chemins de fer roumains, qui supposait la construction d’une ligne électrifiée à travers les montagnes, qui reliait Valea Ialomitei de Valea Prahovei, entre Pietrosita et Sinaia [1,7]. L’ingénieur I.S.Gheorghiu a proposé l’électrification des chemins de fer Bucarest-Ploiesti-Brasov [3], mais le projet a été abandonné en raison de l’évolution de la Première Guerre Mondiale (juillet 1914 – novembre 1918).


En 1944, un groupe d’ingénieurs roumains, parmi lesquels Nicu Condacse a été envoyé par la Direction Générale des Chemins de Fer Roumains pour une formation technique en Allemagne [3].

3. L’ÉLECTRIFICATION DES CHEMINS DE FER ROUMAINS PENDANT LE REGIME COMMUNISTE 1965-1989

En 1948 a été fondé „l’Institut des Chemins de Fer Bucarest”, avec cinq facultés: l’exploit, la mécanique, les constructions, télécommunication et la projection. Ici a commencé à fonctionner un cours de locomotives électriques, soutenu par l’ingénieur associé Nicu Condacse [6].


Liviu Vintilă, a monté dans la station Predeal le poteau métallique numéro 69, le premier poteau d’électrification pour un chemin de fer, sur une fondation en béton monolithique, qui représente le début des travaux d’électrification ferroviaire roumains [3].


Le Gouvernement Roumain a ouvert l’offre pour l’achat des locomotives électriques et quatre offres ont été présentées:

a) Alsthom-France avec deux locomotives électriques, de type Bo-Bo, une seule cabine dotée avec des redresseurs à vapeur de mercure (de type ignitron) et avec des redresseurs à diodes de silicium [3,9];

b) VEB-Lokomotivbau Elektrotechnische Hennigsdorf - la République Démocrate Allemande, avec un prototype de locomotive électrique de type Co-Co, équipé avec des redresseurs à silicium, un bloc redresseur et un gradeur d’origine française et un transformateur d’origine belge [3,9];

c) Tchécoslovaquie Skoda avec une locomotive électrique de type Bo-Bo, dotée avec des redresseurs à silicium [3,9];

d) ASEA-Västerås – Suède avec deux locomotives électriques de type Bo-Bo, équipée avec des systèmes électroniques avec redresseurs à silicium.

Les premiers essais ont été effectués sur deux locomotives électriques françaises. Pour des raisons commerciales, ils ont signé un contrat avec la société ASEA-Västerås - Suède, qui en même temps a convenu que les usines Electroputere Craiova achètent l’autorisation de production de ces locomotives électriques. Dès la signature du contrat, les locomotives électriques fabriquées par les Suédois pouvaient être fabriquées en Roumanie également [1,9,10].

Il y avait des tests comparatifs, qui supposaient remorquer les trains de fret de divers tonnages sur la route Brasov-Predeal et la fonction de surveillance de moniteur pour les Chemins de Fer Roumains a été confiée à Octavian Udriste, le chef du dépôt Brasov [3].

La première locomotive électrique ASEA, de type 060 fabriquée en Suède a parcouru le 9 décembre 1965 le trajet de preuve entre Brasov et Predeal, ce qui signifiait la fin des essais technologiques et la transition vers l’exploitation commerciale du secteur [10].

"...Après la mise en service de la ligne électrifiée Brasov-Predeal, la première locomotive appartenant au Dépôt Brasov a parcouru sur cette route plus de 180 courses, remorquant plus de 1300 tonnes” [3].

Au Dépôt de Chemins de Fer Brasov, a été apportée une nouvelle locomotive électrique qui “...est entrée en exploitation à toute capacité sur la ligne électrifiée Brasov-Predeal” [3], et la première locomotive électrique de 7350 C.P. ”...a parcouru 20000 km remorquant plus de 20000 tonnes”.


Le premier train remorqué par une locomotive électrique est entré en Bucarest le 16 février 1969, ce qui signifiait la fin des travaux d’électrification du secteur Ploiești Vest – Chitila –Bucarest.

Avec l’électrification du secteur Brașov-Ploiești-Bucarest, une série de travaux ont été effectués pour l’adaptation et la systématisation des constructions et installations ferroviaires: le renforcement des ponts et digues, l’augmentation des rails, la systématisation de 24 stations et dépôts, la centralisation électrodynamique de 1023 commutateurs, l’équipement avec un bloc automatique des sections du transport [2, 6, 9, 10]. Quatre sous-stations ont été construites (Dârste, Valea Largă, Ploiești Vest, Chitila), reliées au Système National - courant alternatif triphasé, 110 kV, 50 Hz, qui fonctionnaient à distance par l’action des séparateurs des lignes de contact. Toutes les stations sont dirigées par le Dispatcher de l’Energie Ferroviaire, qui a été situé dans l’immeuble du département IFTE Ploiesti, en 1969 [3].

L’une des principales directions dans lesquelles les travaux sur le secteur Brasov-Ploiești-Bucarest ont été achevés a été le montage de la caténaire qui soutenait la ligne de contact, en préférant les poteaux en béton et les poteaux métalliques étant utilisés dans des cas limités. Sur la route Campina - Bucarest ils ont monté la caténaire avec de la suspension compensée complètement qui permet l’augmentation de la vitesse commerciale jusqu’à 160 km/h; entre Campina - Brasov ils ont monté la caténaire avec de la suspension quasi compensée, obtenant la vitesse maximale de 100 km/h.

4. L’ÉLECTRIFICATION DES CHEMINS DE FER ROUMAINS APRES 1989

Après 1989 il était prévu l'entretien et les réparations des lignes de contact, des stations de transformation et coordination. En même temps, de nouveaux travaux d'électrification ont été réalisés par le montage de la ligne de contact et des stations de transformation sur les chemins de fer Bucarest - Constanța, Bucarest - Videle, Simeria – Cluj - Dej, Suceava - Vatra Dornei - Dej [1,9].

De nombreux travaux de modernisation pour les installations d'électrification ont été réalisés sur le couloir IV- pan européen, le secteur Bucarest - Câmpina et Bucarest - Constanța.

![Train électrique roumain, construit à la Société SofTronic Craiova](image)

Fig. 9. Train électrique roumain, construit à la Société SofTronic Craiova

Le rôle décisif du temps a laissé son empreinte dans chaque activité économique et sociale. Une énorme quantité de processus historiques et scientifiques ont également déterminé l'évolution du transport ferroviaire roumain. De nouveaux investissements dans l'infrastructure ferroviaire sont nécessaires, en corrélation directe avec la recherche, le développement et l'innovation afin de promouvoir un chemin de fer durable, capable de répondre aux défis environnementaux.

REFERENCES


[5] Noua locomotivă electrică ganz-kândo a căilor ferate maghiare de 3200 C.P; Electrificarea căilor ferate, Oficiul de presă, editură și documentare C.F.R., p. 43;


Abstract — Réaumur (1683-1757), a real encyclopedic scientist of the XVIIIth century, was the one who introduced experiment in metallurgy. By creating new materials, by introducing the macro- and microscopic study of metals, by his contacts with scientists from many countries, he was at the same time a forerunner of European scientific cooperation. The old Association Internationale pour les Essais des Matériaux was set up in 1895 by Tetmayer, who chaired its first congress in Zurich; vice-chairman was elected Adolf Martens (1850-1914), director of the Office of Materials Testing in Berlin. The Romanian section of the Association included, among others, Alfons Saligny, who had set up, in 1886, the first testing laboratory at the Bridges and Highways School in Bucharest. Other members were C. Mironescu and G. Pfeiffer (president).

A second remarkable event of the international co-operation took place in the same year, 1896, in the metallography field. At Floris Osmond’s (1849-1912) proposal, the structural constituents of steels and cast iron received names in the honor of some great metallurgists: martensite (Martens), sorbite (Sorby), austenite (Roberts-Austen), troostite (Troost), ledeburite (Lederbur).

In Romania, Cristea Nicolescu-Otin cooperated with R. Kubnel (Berlin) in his researches on metallography and thermal analysis, published between 1910-1913. Later, Traian Negrescu (1900-1960), disciple in Paris of Leon Guillet and Georges Urbain, cooperated with the Swedish C. Benedicks and A.F. Westgren to study the carbides from the chrome steels through quantitative spectroscopy. In 1927, T Negrescu set up in Bucharest the Laboratory and the Faculty of Metallurgy.

In 1928, under A. Mesnager’s lead, the new International Association for Materials Testing was set up in Paris, with four sections, the chairman of the “Metals” section being Walter Rosenhain. At its first congress held in Zrich (1931), Romania was well represented by N. Vasilescu-Karpen (chairman), C.D. Busila, G.E. Filipescu, G. Stratilescu, M. Mazilu, C.C. Teodorescu and others, next to the great metallurgists A. Portevin (Paris), E. Piwowarski (Aachen), R. Kuhnel (Berlin), W. Rosenhain (London) etc.

In the last 50 years, a great number of international associations have been set up in all the branches of material science and metallurgy. Worth mentioning is one with a general character, FEMS (the Federation of European Materials Societies), which rallies the main national associations and has been publishing since 1994, the “Euromaterials” journal.

In Romania, over 20 societies appeared on the field of materials science and several faculties of Materials Science and Engineering were set up – the first one in Cluj-Napoca in 1990. At the new Academy of Technical Sciences (1997), one of the sections is that of Materials Science and Engineering.

Mots-clés — science des matériaux, métallurgie, coopération européenne, contributions roumaines
1. INTRODUCTION

La fin du XIXᵉ siècle a marquée, du point de vue de la relation science-industrie, le début d’une nouvelle époque: celle de la recherche scientifique dirigée vers l’industrie qui continue d’exister jusqu’à nos jours, quand le progrès industriel et celui scientifique sont étroitement liés. Un exemple dans ce cas est la création, il y a un siècle, de la science des matériaux, en majorité métalliques, dont l’application a révolutionné l’industrie et a eu de grandes conséquences sur le développement de la civilisation. [1]

Les étapes de l’histoire de la science des matériaux résultant des grands événements qui ont exercé une influence décisive sur sa formation et son développement. A mon avis, ceux-ci sont les suivants: [2]

– l’introduction de l’expérimentation en métallurgie et la découverte de nouveaux matériaux (Réaumur, 1722) [3];
– la découverte des constituants et des transformations des phases dans les alliages, c’est-à-dire la création de la théorie des alliages et des traitements thermiques grâce à deux méthodes d’investigation: la métallographie et l’analyse thermique (Osmond, Le Chatelier, Roberts-Austen, Martens, 1887-1895);
– la découverte de la diffraction des rayons X et leur application en cristallographie (Bungetianu, 1896, von Laue, 1912, Bragg, 1913), [4];
– l’idée des défauts cristallins (dislocations) et leur découverte expérimentale ultérieure (Taylor, Orowan, Burges, Frank etc. 1934-1939).

On cherche à obtenir une caractérisation scientifique des matériaux en général par une théorie structurale unitaire qui est en train d’ouvrir de nouvelles perspectives dans leur compréhension profonde, dans l’action de création de nouveaux matériaux à hautes performances, dans l’optimisation de leur choix et de leur employé.

2. UN PIONNIER DE LA COOPERATION SCIENTIFIQUE EN EUROPE

La coopération européenne dans le domaine de la science, de la technologie et les implications dans la société ont eu un célèbre précurseur: René Antoine Ferchault de Réaumur (1683-1757), un vrai encyclopédiste du XVIIIᵉ siècle. Il a introduit l’expérimentation en métallurgie, il est celui qui a fondu la science des matériaux par la recherché et la création de matériaux nouveaux comme l’acier obtenu par la carburation du fer, la fonte malléable à Coeur blanc (la méthode européenne), des mat, des matériaux céramiques (porcelaine de Réaumur) etc. Par son activité dans d’autres domaines, physique, sciences naturelles, par ses contacts avec les hommes de science de maints pays (Suède, Hollande, Suisse, Angleterre, Belgique, Allemagne, Italie, Russie, Pologne) il a ouvert les voies de la coopération scientifique européenne. Il nous transmet un message écrit il y a plus de deux siècles et demi, mais tout à fait actuel :

« Nous nous devons premiérement à notre Patrie, mais nous nous devons aussi au reste du monde. Ceux qui travaillent pour perfectionner les sciences et les arts doivent même se regarder comme les citoyens du monde entier». [5].
Dans l’ouvrage « La fonte malléable », traduit de l’allemand par René Castro (Dunod, Paris, 1936), E. Schuz et R. Stotz écrivent : « Les deux écrits de Réaumur sont parmi les meilleurs qui aient jamais été publiés sur un sujet métallurgique. Il a été le premier à étudier la fonderie de fer d’un point de vue scientifique. Il est par ces travaux légitimement considéré comme le fondateur de la sidérurgie scientifique…L’invention avait devancé son époque, écrit Boeck (Geschichte des Eisen, 1897, III, p.236)…Cette époque-là n’était pas mûre pour l’invention de Réaumur…le lecteur acquiert la certitude en lisant les écrits de Réaumur qu’il s’agit là d’idées et de notions tout à fait personnelles ».

3. L’ANCIENTE ASSOCIATION INTERNATIONALE


A la suite de la proposition de Wohler et des essais faits par Johann Bauschinger (1834-1893) de Munich, en 1878 on a décidé l’introduction de l’essai de traction pour les matériaux de voire ferrée.


Tetmayer a présidé le premier congrès de Zurich. Vice-président a été élu Martens. Alfons Saligny (1853-1903) a fait partie de l’Association avec Constantin Mironescu et Grigore Pfeiffer, comme président de la Section roumaine.

4. PRESENCES ROUMAINES

Pendant ce temps, Anghel Saligny (1854-1925), le grand ingénieur roumain, a élaboré le projet et a construit le plus long pont d’Europe (1895). Son Mémoire sur le projet du pont sur le Danube à Cernavoda (1888) est un exceptionnel ouvrage sur les propriétés mécaniques et technologiques des aciers étroitement liées aux conditions métallurgiques d’élaboration et aux changements de structure dus à leur usinage ultérieur. Le chapitre « Le matériau de la superstructure » fait preuve de la profondeur de ses idées, de la richesse de la documentation faite dans les pays d’Europe en ce qui concerne l’élaboration et les propriétés de l’acier. C’est ce matériau qu’il a adopté avec courage et compétence, sans utiliser le fer recommandé par les sommités européennes en matière, les professeurs Winckler et Schwedler de Berlin, Collignon de Paris. [7] Ils ont collaboré cependant
dans les jurys des concours pour le projet (1882 et 1886) ; la Compagnie Fives-Lille de Paris a emporté en 1890 l’adjudication des travaux et le matériau fut livré par le Creusot. [8]

A Resita, dans le Banat, il y avait dès 1880 le laboratoire d’essais physiques (mécaniques), enrichi ensuite avec des sections comme la métallographie, l’analyse dilatométrique etc. la machine de traction: Deutschland » de 25 tonnes, la plus ancienne du pays, provenait de la fonderie d’Anina, d’avant 1870. Pièce de musée, elle a des colonnes doriques avec des cannelures (Fig 1).

Bauschinger a étudié dans son laboratoire de Munich les matériaux produits à Resita et il a présenté, lors d’une exposition à Budapest en 1885, le livre contenant les recherches: «essais de résistance des fontes, fers et aciers de l’usine de Resicza faits au laboratoire de l’Ecole Polytechnique de Munich par M. le Professeur Bauschinger » (Fig. 2)

En 1920 prend naissance à l’Ecole Polytechnique de Timisoara (nouvellement fondée) le Laboratoire d’essais des matériaux (Fig. 3). [9] On construit beaucoup d’appareils dans les ateliers de la Société des Tramways, comme par exemple la machine de traction « Elastica » (1926) (Fig. 4), grâce à la prodigieuse activité du professeur Corneliu Miclosi (1887-1963) qui, la même année, enseigne et publie le premier cours de métallurgie physique.

A Bucarest, le premier laboratoire complètement outillé a été fondé en 1886 à L’Ecole des Ponts et Chaussées par l’éminent chimiste Alfons Saligny, qui avait fait ses études lin sous la direction d’A. W. Hoffmann. En 1924 est créé le laboratoire de métallurgie Polytechnique, qui en 1927 est complété par une nouvelle section de métallographie et traitement thermique et en 1930 par des appareils de rayons X, spectroscopie etc. grâce au professeur Traian Negrescu (1900-1960).

Fig. 3. La salle d’essais mécaniques du Laboratoire de l’Ecole Polytechnique de Timisoara. On peut voir : la machine Mohr et Federhaff de 50 tf ; la machine Losenhausen de 10 tf ; la machine Rejto de 800 kgf pour des tissus ; l’appareil de dureté Martens ; la machine de torsion Amsler.

Fig. 4. La machine « Elastica » de 10 tf à ressort, construction entièrement soudée, protégée et réalisée dans les Ateliers de tramways de Timișoara par Micloși en 1926.

5. COLLABORATION DANS LE DOMAINE DE LA METALLOGRAPHIE


Au début du XXᵉ siècle apparaissent en Roumanie les premières recherches métallographiques et d’analyse thermique de niveau international. Elles sont dues à Cristea Nicolescu-Otin (1879-1954) et sont publiées à l’Académie Roumaine (1910-1913). Le premier ouvrage est un exemple de

6. LA NOUVELLE ASSOCIATION INTERNATIONALE


L’Association comprenait 4 sections:
A. Métaux, président le professeur Walter Rosenhain (1875-1934) de National Physical Laboratory, Teddington, vice-président de NAIEM ;
B. Matériaux inorganiques non métalliques, président M. Ros ;
C. Matériaux organiques, président J.O. Roos de Hjelmsatar, Stockholm ;

La section A englobait en 10 sous-groupes les principaux problèmes de la science des matériaux métalliques et leurs essais : fontes, aciers, matériaux résistants à de hautes températures, la fatigue des métaux, les traitements thermiques, la soudure, les alliages légers, les essais mécaniques, les déformations plastiques etc. Un sous-groupe spécial « Les progrès de la métallographie » comprenait : systèmes d’alliages et la relation entre composition, structure, propriétés ; analyses thermiques et dilatométriques ; inclusions non métalliques ; progrès de la microscopie.

Les premières communications de la Nouvelle Association ont été publiées en 1930, avant le Congrès, en 4 grands volumes in quarto correspondant aux sections. Parmi les auteurs du volume A (Métaux) on remarque A. Baikov (Leningrad), C. Benedicks (Stockholm), G.F. Comstock et F.B. Coyle (Etats-Unis), W. Guertler (Berlin), R. Hadfield (Londres), P. Luwick (Vienne), E. Piwowarsky (Aachen).

Dans la préface, A. Mesnager présente le rôle de la publication, pour faciliter l’échange international des idées, en vue de la préparation du Congrès de Zurich.
W. Rosehain montre dans l’introduction du volume relatif aux métaux que l’essai des matériaux a reçu une interprétation très élargie, en comprenant les méthodes d’étude de la nature, de la structure et des propriétés de matériaux. « Le caractère international de ce volume va faire connaître à chacun la différence des vues dans les divers pays et la variété des méthodes d’expérimentation au moyen desquelles on a essayé d’étudier les propriétés des métaux. La réalisation de cette variété et la grande richesse commune que les scientifiques et les expérimentateurs de tous les pays découvrent en discutant leurs problèmes, démontreront l’importance capitale de l’échange international des idées et des connaissances acquises. Les problèmes fondamentaux relatifs aux métaux et leurs essais dans des buts industriels, qui sont les mêmes dans chaque partie du monde, sont abordés dans les laboratoires et les ateliers des pays respectifs. Souhaitons que l’étroite collaboration internationale dont le présent volume est un témoignage, contribue largement aux progrès rapides de notre science. »

Au premier congrès de Zurich en 1931, la Roumanie a été représentée par N. Vasilescu-Karpen et C.D. Busila, membres du Comité d’honneur du congrès ; Gh. Em. Filipescu et Gr. Stratilescu, professeurs à l’École Polytechnique de Bucarest, délégués officiels ; M. Mazilu, chef de l’Institut Technologique CFR ; le professeur C.C. Teodorescu, membre du Bureau Permanent de l’Association et son assistant St. Nadasan de l’École Polytechnique de Timisoara ; Dr. A Steopoe de l’Université de Bucarest etc.

7. CONCLUSIONS


Quant à l’enseignement supérieur technique, à partir de 1990 a été créée la première section de spécialisation « Science des Matériaux » à la nouvelle Faculté de Science et Génie des Matériaux de l’Institut Polytechnique de Cluj-Napoca, suivie par d’autres Facultés à Bucarest et Galati (les anciennes Facultés de Métallurgie), Iasi, Brasov etc. Par leur création, de nouvelles prémices de coopération interne et internationale existent.

A l’Académie Roumaine a pris naissance en 1988 une Commission pour la Science des Matériaux ; il y a des commissions similaires au niveau des Filiales de l’Académie de Cluj-Napoca,
Timisoara et Iasi qui ont des sessions chaque année lors des manifestations nommées « Journées Académiques ».


BIBLIOGRAPHIE


CHEMICAL PRODUCTS IN THE COLLECTION OF THE K. K. CONSULAR-ACADEMY VIENNA

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Abstract — More than 30% of the objects contained in the Merchandise and Product Museum at the k. k. Consular-Academy Vienna are Chemical Products. At present the inventory of the collection is reviewed to identify existing objects stored at the Technical Museum Vienna. Some of the objects kept at the Product Collection have labels of the k. k. Consular-Academy, but most of the Chemical Objects are not branded with such labels. It is difficult to identify them definitely as a part of this collection. The research on the inventory will solve this question.

The Oriental Academy was founded in 1754 based on an Imperial Order by empress Maria Theresa. The Academy's initial purpose was to enhance Austria's position in the Balkans and the Near East by improving the nation’s trade and cultural relations. The curriculum emphasized oriental languages, political sciences and general sciences in order to educate diplomats and merchants. The Merchandise and Product Museum at the Consular Academy comprised hundreds of chemical products and more than thousand of synthetic dyes, donated by companies from Europe, namely Wagenmann, Seybel& Co, Vienna; Rademacher& Co, Prague; Meister Lucius & Brüning, Höchst; Borysław AG, Borysław; or Brüder Janoušek, Prague. Many of these products are preserved in the original customary packing; as a result of this the company’s economic development can be reproduced. Additional to the dyes there are sample cards for textiles and papers, some of whom include instructions in detail for the process of coloration.

Keywords — k. k. Consular-Academy, product Museum, Oriental Museum, dyes

1. INTRODUCTION

The Merchandise and Product Museum at the k. k. Consular-Academy Vienna is part of the Viennese Commodities Collection at the Technical Museum Vienna. The emergence of this well-known collection dates back to the Vienna International Exhibition in 1873. Numerous samples and raw materials from the Vienna International Exhibition and later objects from the Oriental Museum (k. k. Orientalisches Museum) were largely unknown on the European market at that time, and thus had a high commercial value.¹

The collection of the Commercial Museum (k. k. Österreichisches Handelsmuseum) was continuously enlarged with valuable exhibits such as carpets, silken clothes as well as metal and ceramic wares. In 1922 the collection was transferred to the University of International Trade and
Technology in Times of Transition

Commerce. From the beginning of the 20th century to 1971, this collection was enlarged to include 30,000 objects and was the largest collection of its kind all over Europe. The value of the collection results in its presentation of goods, materials and items that show the means of production of both Austrian and international manufacturers. The collection exhibits items traded in Vienna such as textiles, food products, spices, wood products and ceramic ware as well as stone and energy feedstock.

2. THE COMMERCIAL MUSEUM AT THE K. K. CONSULAR ACADEMY

The former Oriental Academy was founded in 1754 based on an Imperial Order by empress Maria Theresa. The Academy's initial purpose was to enhance Austria's position in the Balkans and the Near East by improving the nation's trade and cultural relations. The curriculum emphasized oriental languages such as Persian, Arabic and Turkish as well as political sciences and general sciences in order to educate diplomats and merchants.

The offered courses were completed with commercial education, product technology and industrial engineering science.

Based on the curriculum, developed by the director of the Academy, Michael Freiherr Pidoll von Quintenbach, the retitled k. k. Consular-Academy became an international leader in the field of diplomatic qualification at the beginning of the 20th century. At the location at Boltzmanngasse 16, in the 9th district of Vienna, various lecture halls, a library, a billiard room, a reading room, a music room and a commodities museum were available for the students.

The Commercial Museum at the k. k. Consular Academy was situated in a large hall, endowed with ceiling-high display cases along the wall and display cases in the middle of the hall for direct revision. A large amount of the artefacts were preserved in glass cylinders. Most of the objects can be identified as stock of the Consular Academy by reference to the labels on the boxes or glasses. On the left third of the labels, a code and the inventory number is inscribed. On the right two-third is the imprint 'K. u. K. Konsular-Akademie', below the designation and the manufacturer or trader. A second identification attribute is a red cross signed on most of the Consular Academy objects, especially glasses with dyes are marked with this cross. Currently, it is part of our research work to resolve the code on the labels and the meaning of the red cross on the objects.

In the 1930s the Academy organised many field trips for the students to visit trading companies, transportation and communication facilities, industrial enterprises, factories, coalmines and publishers. Various product
samples were ordered, from foreign countries and continents, to complete the commercial collection. Almost three quarters of the Academies objects were donated by the industrial or trading companies, just a few products, approximately 150 objects, were bought.

3. CHEMICAL PRODUCTS IN THE VIENNESE COMMODITIES COLLECTION

The chemical products in the Viennese Commodities Collection are divided into two parts: The collection of the k. k. Consular Academy and the collection of the Institute for Technology, University for Trade and Commerce. It is to assume, that all objects are having the provenance from these both institutions.

Both parts are organized similarly into raw materials, energy resources and end products:
- Basic materials
- Phosphates
- Sulfates
- Fertilizers
- Carbonates
- Chromates and Oxides
- Energy resources: Wood gas, Bitumen and mineral oil products
- Tannery and Dressing (for waterproof finishing)
- Essential Oils.

Approximately one third of the Academy's collection (more than 700 objects) and one-tenth of the entire Viennese Commodities Collection (more than 2000 objects) are chemical products. It seems, that the structure was maintained when the Academy's collection was transferred to the Institute of Technology.

Table 1. Summary of chemical products

<table>
<thead>
<tr>
<th>Section of Collection</th>
<th>Quantity of objects approx.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Industrie</td>
<td>730</td>
</tr>
<tr>
<td>Basic materials</td>
<td>50</td>
</tr>
<tr>
<td>Phosphates, Sulfates, Fertilizers</td>
<td>160</td>
</tr>
<tr>
<td>Carbonates, Chromates, Oxides</td>
<td>50</td>
</tr>
<tr>
<td>Dyes</td>
<td>220</td>
</tr>
<tr>
<td>Wood gas</td>
<td>20</td>
</tr>
<tr>
<td>Bitumen and mineral oil products</td>
<td>80</td>
</tr>
<tr>
<td>Dressing (waterproof finishing)</td>
<td>20</td>
</tr>
<tr>
<td>Sugar industry</td>
<td>20</td>
</tr>
<tr>
<td>Essential oils</td>
<td>50</td>
</tr>
</tbody>
</table>

The Sections for dyes are divided into different colours. In the inventory book there are 70 registered objects of white, brown and grey colours, 70 objects of red and black colours, 80 objects of blue and violet colours. All other sections include stages of processing from the raw materials (e.g. mineral oil, wood) to the final products (e.g. petroleum, machine oil or acetone, wood tar).
Table 2. Important Companies and their presented Products

<table>
<thead>
<tr>
<th>Important Companies</th>
<th>Materials, Goods</th>
<th>Quantity of objects approx.</th>
</tr>
</thead>
<tbody>
<tr>
<td>L. A. Bauer &amp; Co, Vienna</td>
<td>Mineral ores</td>
<td>40</td>
</tr>
<tr>
<td>W. J. Rohrbeck's Nachfolger, Vienna</td>
<td>Salt, Acid</td>
<td>30</td>
</tr>
<tr>
<td>Treibacher chem. Werke, Vienna</td>
<td>Rareearthscompounds</td>
<td>30</td>
</tr>
<tr>
<td>&quot;Boryslaw&quot; A. G. für Erdwachs- u. Petroleumindustrie, Boryslaw</td>
<td>Solid paraffin</td>
<td>15</td>
</tr>
<tr>
<td>Brüder Janoušek, Prag</td>
<td>Essential oils</td>
<td>50</td>
</tr>
<tr>
<td>Chemischen Fabrik, Kasern</td>
<td>Dyes</td>
<td>40</td>
</tr>
<tr>
<td>Farbwerkevorm. Meister Lucius &amp; Brüning, Höchst, a/M</td>
<td>Dyes</td>
<td>100</td>
</tr>
<tr>
<td>A. Schram, Prague</td>
<td>Fertilizers</td>
<td>30</td>
</tr>
<tr>
<td>Günther Wagner, Hannover</td>
<td>Dyes</td>
<td>160</td>
</tr>
<tr>
<td>Julius Rütgers, Angern</td>
<td>Dyes</td>
<td>20</td>
</tr>
<tr>
<td>Karl Rademacher &amp; Co., Prague – Karolinenthal</td>
<td>Basic materials, Carbonates</td>
<td>40</td>
</tr>
<tr>
<td>N. Schefftel, Vienna</td>
<td>Bitumen</td>
<td>15</td>
</tr>
<tr>
<td>Oest. Verein f. chem. u. metall. Produktion, Aussig</td>
<td>Basic materials</td>
<td>50</td>
</tr>
<tr>
<td>Wagenmann, Seybel &amp; Co., Vienna</td>
<td>Basic materials, Phosphates, Acids</td>
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<tr>
<td>Mineralölfabrik, Floridsdorf</td>
<td>Mineral oil products</td>
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<tr>
<td>Pardubitzer Mineralöl-, Paraffin-, Ceresin- u. Kerzenfabrik D. Fanto &amp; Co</td>
<td>Mineral oil products</td>
<td>30</td>
</tr>
<tr>
<td>Union A. G. für chem. Industrie, Vienna</td>
<td>Wood gas products</td>
<td>15</td>
</tr>
<tr>
<td>Verein der Petroleumverarbeitenden Industrie Österreichs</td>
<td>Mineral oil products</td>
<td>15</td>
</tr>
</tbody>
</table>
The most interesting aspects of the dyes-section are sample cards showing colourings on textiles. These cards are made by the colour manufacturers, donated samples to the Commodities Collection.

The sample card in Fig. 4 by the company Leopold Cassella& Co includes a widespread method description for the colouring process. The blue samples on the left side are coloured by the blue samples, shown in Fig. 3. Most of the sample cards include such a description for the textile manufacturers.
4. CONCLUSIONS

At first sight not so inspiring information on labels and boxes may become the key to verify the provenance of historic product samples. Knowledge on the product samples will increase the value of the collection enormously. Scientists will find a chance to work with the collection, their research will lead into further projects to transfer ancient knowledge into the future.

ACKNOWLEDGEMENTS

The results of our research are supported by funds of the Österreichische Nationalbank (Anniversary Fund, project number: 15587).

NOTES


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LES DEBUTS DE LA FABRICATION D’EXPLOSIFS EN ROUMANIE (1920-1938)

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Résumé — Cet article analyses les conditions qui ont initié et mis en œuvre la fabrication industrielle d’explosifs en Roumanie, par rapport à la situation des Etats d’Europe Centrale et de Sud-Est, juste après la fin de la Première Guerre Mondiale, des conditions dans lesquelles, au cadre du Groupe des Sociétés Nobel, la stratégie d’exportation de capital continuait afin de développer la fabrication d’explosifs. Ici sont présentées les modalités techniques et d’organisation pour la construction de l’usine d’explosifs à Făgăraș, les démarches concernant l’infrastructure, les employés, la production. Les éléments de la croissance pendant 1920-1938 sont mis en évidence, ainsi que les conséquences socio-économiques au niveau local et national.

Mots clé: — explosifs, Société Nobel, la Première Société d’Explosifs en Roumanie, l’Usine d’Explosifs à Făgăraș, Nitramonia

1. PRÉMISSES


En Roumanie, l’entrée du capital austro-hongrois, français, hollandais et anglais date depuis les années 1900, investi en particulier dans l’industrie chimique – pétrole, les savons, dérivés chlorés[2]. Introduite dans l’industrie chimique, la fabrication d’explosifs comme production spéciale de l’industrie de l’armement est devenue importante pour assurer la défense du pays, mais elle est devenue néanmoins rentable par son utilisation dans les secteurs industriels, miniers et dans la construction des ponts et des tunnels. L’industrie minière est confrontée à certains défis d’approvisionnement des matériaux explosifs; c’était donc urgente la production d’explosifs miniers[3]. Le secteur de la production d’explosifs a présenté un plus d’intérêt pour diverses personnes, groupes
d’experts militaires, pour les banques, qui voulaient tous faire construire une entreprise avec une stratégie militaire appropriée, soutenue par/et avec la participation de l’État dans les cas extrêmes.

Les autres pays d’Europe Centrale et de Sud-Est, formés après la Première Guerre Mondiale avaient le même but. C’est un cas particulier le cas de la République Tchècoslovaquie, où il y avait déjà une entreprise d’explosifs - Dynamit Nobel Chemical Company, construite par Vienna Group AG Dynamit Nobel en 1873[4]. L’abolition de la monarchie et l’incorporation de la ville Presbourg dans le nouvel état a soulevé plusieurs questions pour Dynamit Nobel. La production a stagné et on cherchait de nouvelles solutions à son lancement. L’usine a été équipée d’installations adéquates pour la production de guerre : l’expansion au cours de la guerre, avec de nouvelles sections pour la production de nitrotoluène, l’acide picrique, des mèches de coton, la poudre sans fumée et des explosifs de sécurité. Il restait encore l’aspect non résolu du capital social et la modalité de coordonner la production. Dans les conditions économiques et politiques de l’après-guerre, Vienne Dynamit Nobel AG Group était prêt à se conformer à toutes les conditions imposées par les partenaires de la République Tchèque et Slovaquie, de modifier la structure du conseil d’administration et la structure du capital. Les entreprises Société Centrale de Dynamit de Paris et Nobel Industries Ltd, Londres (plus tard, Imperial Chemical Industries Ltd) ont accepté de participer au capital pour fabriquer des explosifs dans les étapes suivantes. Pendant les années 1920-1930, une série de filiales ont été fondées par le même modèle, en Autriche, Yougoslavie, Hongrie, Roumanie et Suisse (Fig. 1).

Le début de la fabrication d’explosifs en Roumanie a suivi la même modalité.
2. LES DÉMARCHES EN ROUMANIE

Les premières négociations pour la mise en place de l’entreprise d’explosifs miniers en Roumanie ont commencé à partir de l’année 1919 par le Conseil de la Transylvanie (le Conseil a été le gouvernement de la Transylvanie dans la période 2 Décembre 1918 - 4 Avril 1920), un rôle important dans le lancement de ces négociations l’a eu l’ingénieur Ernst Eisenberger.

Le document de la fondation et les statuts de la société appelée “La Première Société Roumaine d’Explosifs” ont été publié dans le Journal Officiel no 201/le 12 décembre 1920. Le capital social de la société a été 20 millions lei divisés en 40.000 actions de 500 lei chacune, dont l’État apportait sa contribution de 2 millions (représentant les privilèges accordés à cette société). L’emplacement de l’usine a été établi „aux alentours de Fâgăraș”, comme région centrale qui offre donc un maximum de sécurité au pays. Ils ont indiqué la contribution du groupe Nobel, par Dynamit Nobel A.G. de Pressbourg.

Dans les années à venir, la Société opéra sous la loi pour la création d'une société roumaine pour la fabrication d'explosifs, publiée au Journal officiel le 24 Février 1924. Dans la nouvelle loi, on mentionnait que „l'Administration du monopole d’État est autorisé, en collaboration avec la société roumaine et éventuellement d'autres, d'être une société à responsabilité limitée pour des actions roumaines pour la fabrication d'explosifs en Roumanie". Par conséquent, l’Administration accorde pour „plus de 30 ans après la promulgation de cette loi, le monopole de la fabrication des explosifs". Après l'expiration de 30 ans à compter de la mise en service de l'usine, l'usine, avec toutes les dispositions et ses accessoires deviendra la propriété de l'Etat roumain en bon état de fonctionnement, sans que la société puisse demander une indemnisation.

Les proportions du capital sont les suivantes: l’État 10%, des capitaux étrangers 40% et le capital privé roumain 50%. Le capital étranger est représenté par les groupes et les Sociétés Nobel Industries Ltd. et Dynamit Nobel A.G., le siège à Vienne, qui participeront avec leur capital “en nature”: les installations, les machines et l'assistance technique. Ces deux groupes sont tenus de fournir les spécialistes pour la construction et la mise en service de l'usine.

L’assistance technique sera fournie en apportant le personnel technique et les spécialistes étrangers. Pendant la période limitée qu’il a été transféré en Roumanie, le personnel technique et spécialisé apporté de l’étranger, des spécialistes dans la fabrication d’explosifs d’après le modèle “Processus Bratislava” ont offert de l’assistance technique au personnel roumain, formant ainsi des spécialistes importants qui, à leur tour, allaient former des ouvriers, des contremaîtres et des techniciens à l’usine de Fâgăraș.

Les statuts ont déclaré que, à part les matières explosives utilisées dans l’industrie minière pour les mines et les carrières, pour la construction de ponts et de routes de fer l’entreprise "sera en mesure de fabriquer ou de participer à la production d'autres produits chimiques, sans même que ce soit un monopole et potentiellement explosif de la guerre, mais seulement par un accord spécial avec l'Etat".
3. ASSURER L'INFRASTRUCTURE

Immédiatement après l'enregistrement de la Première Société Roumaine d'Explosifs, par la Chambre Commerciale de la Cour de Braşov, le 10 Février 1921, Nobel Group de Vienne a envoyé en Mars 1921 l’ingénieur expert Burmester pour déterminer l'emplacement optimal de la future usine à Făgăraș.

En accord avec les autorités locales ils ont mis en place des chantiers de construction de l'usine, une zone de 93 hectares, située à une distance d'environ 3 km de Făgăraș, obtenu de la part de la Commission Agraire des terres expropriées. Pour assurer l'approvisionnement en eau du ruisseau Berivoi aussi, ils ont acheté encore 320 toises de terrain de Emil Stoff, le propriétaire du moulin (Fig. 2) sur le ruisseau Berivoi.

Les documents officiels de la Société et de l'adressage ont donné garantie au succès de l'investissement ainsi que en Juin 1921, le Groupe Nobel a envoyé un autre spécialiste, l’ingénieur Neubner et qui avec l’ingénieur Burmester ont conçu un plan pour la préparation d’un futur travail technique et la localisation des ateliers. Pour les ateliers de la dynamite et nitroglycéline ils ont prévu un système souterraine et pour les autres constructions des systèmes de bâtiments normaux. Les travaux commencés ont eu un caractère débutant, pour assurer l’infrastructure. Le chemin de fer a été conçu comme route parallèle au village Ileni jusqu’au moulin Stoff, où on entrait sur le territoire de l'usine. Pour cette ligne ils étaient nécessaires trois ponts en béton, pour la construction desquels ils ont embauché la compagnie Demeter Gärtner et Comp. S.A. Brasov. Le pont principal sur la rivièrê Berivoi a commencé à être construit en Novembre 1921. Au début de Juillet 1922, les Usines Resita ont commencé à produire des titres, des jonctions et d'autres matériaux ainsi que les accessoires nécessaires pour cette ligne. La longueur de cette ligne, à compter de la gare de Făgăraș jusqu’à sa fin, était de 3855 m, avec 7 jonctions. Le 18 Juillet 1922 ils ont publié l’autorisation de la mise en service de la ligne.

Fig. 2. Le Moulin Stoff situé près de l’usine d’explosifs (vers l’année 1922)

Fig. 3. Un moteur à traction et wagon pour la ligne étroite
Certaines expéditions ont été fournies par la traction animale: par des bœufs ou des chevaux.

En 1923 a été construit le chemin de fer étroit "Decauville" pour le transport intérieur, d'une longueur de 1710 m. Le rapport du 31 Décembre 1925 indique l'existence en fonction pour le transport interne, du chemin de fer Decauville avec la ligne de 60 cm et la longueur 1740 m, équipé de 10 petits wagons [6].

En 1922, ils ont commencé aussi les travaux afin d'assurer l'approvisionnement en électricité. Le Rapport de 1925 montre que les moyens pour produire la force motrice de la société sont : une machine à vapeur de 120 CH et deux moteurs à combustion interne, un de 30 CH, et l'autre de 900 CH. Les machines électriques qui mettent en marche les installations de l'usine sont alimentées de sa propre centrale électrique, équipée de quatre générateurs électriques chacun de 184, 80, 27, et 8,5 kW. Il y avait deux compresseurs d'air chacun de 5 atm.

En 1929, il est mentionné l'embauche du contremaître Iosif Hoflinger à l'usine électrique Diesel, un bon maître qui a formé à son tour de nombreux travailleurs qualifiés. En 1932 on est mentionnée aussi à la conception et au commencement de l'installation de petites centrales hydroélectriques de 80 HP sur la rivière Berivoi.

4. LA CONSTRUCTION DE L'USINE

L'année 1922 c’est l’année où les ateliers et les bâtiments de l’usine d’explosifs de Făgăraș ont été construits. Au début de 1922 on amène à Făgăraș deux spécialistes de l’usine de dynamite de Bratislava, l’ingénieur en chef de fabrication Karl Berkovits Merry et l’ingénieur en chef Vesel, qui y se sont présentés à mi-Mars 1922. Ils ont procédé avec une grande énergie, ainsi que le 11 Avril 1922 on a commencé la construction de logements (le début des colonies actuelles de l’usine) et le 2 mai 1922 on a commencé la construction de l'usine [3].

Les entreprises roumaines ont surpassé les défis de la construction d'une nouvelle usine au plus haut niveau. La Tour de l’Eau (Fig. 3), un bâtiment spectaculaire à l'époque, a réussi grâce à l'ingénieur en chef Victor Muli, à l'Entrepreneur Demeter et Gärtner. Comp. S. A. Brașov, tout ayant une riche expérience acquise dans la construction de la société des usines de fusil à la compagnie Moosbierbaum Skoda Wetzlar, Autriche[7]. Au cours de la surélévation de la tour de l'eau il y avait des changements nécessaires pour assurer la construction contre la gelée. Le toit fut changé et un tube en béton a été inséré dans le réservoir, de sorte que, "après une telle exécution, non seulement s’est créé une plus grande certitude pour les marchés de l'eau à l’usine, mais aussi son aspect architectural s’est embelli"[8].

Le 28 mai 1922, on constate officiellement que, bien que "le temps était mauvais et capricieux" la construction de l'usine a progressé assez rapidement. La zone étendue offerte à l’usine d’explosifs miniers a commencé à gagner le profil spécifique de l'industrie.

Pour les opérations de sécurité des bâtiments ont été construits à une distance "apt" l’un de l'autre, le "système de drapeau".

Le 16 Septembre 1922, quatre spécialistes de Bratislava sont arrivés et ils commencent immédiatement l’assemblage de l’atelier pour la poussière mêlé d’astralite et la mise en service de la machine à vapeur. Ils ont commencé à travailler aux installations électriques d’alimentation. À mi-décembre 1922 "les logements des cadres et de certains travailleurs de la colonie étaient prêts, ils pourraient être habités "[9].
Le 4 Avril 1923, tous les bâtiments commencés en 1922 ont été achevés et ils ont obtenu "l'autorisation appropriée pour les exploiter". Le 7 mai 1923, la direction de la Société rapporte au ministère des Finances que «notre usine d'explosifs miniers à Făgăraș est terminée et prête à entrer en service”.

Le Rapport sur la situation de la „Première Usine Roumaine d’Explosifs” de Făgăraș pendant 1920-1923 montre, au secteur investissements, la destination de chaque dépense faite jusqu’en 1923. A partir de ce rapport ils "ont assuré que l’usine sera mise en service au début de 1924".

Ils ont commencé l'achat de matières premières : "l'acide sulfurique fumant, l'acide sulfurique, des rouleaux de papier, du papier d'emballage, de la dextrine, des planches caisses, du gaz, du charbon, de la paraffine, du savon, du carton gris, du sel, etc".

D'autres matières premières devaient être commandées de l'étranger, ce qui soulevait des questions difficiles de la monnaie et donc l'opposition du ministère des Finances. Dans les rapports de cette époque-là: glycérine pour la dynamite, trinitrotolylène, ammonium salpêtre, mononitrotolulène, salpêtre, sodium farine, charbon, papier, etc., acquis de l'Allemagne, de la France, de l'Amérique du Sud, de la Tchécoslovaquie, de l'Autriche[10].

L’événement le plus important de l’année 1924 pour la „Société” a été la mise en service des usines d’explosifs de Făgăraș: le 22 février 1924 – l’usine d’acide nitrique ; le 1 mars 1924 – l’usine d’explosifs de sécurité ; le 25 mars 1924 – l’usine de dynamite.

Le Rapport de 10 mars 1924 présente: "aujourd’hui l’usine est en marche et cela nous permet de prévoir en 1924 une exploitation bien satisfaisante".

Dès 1924 Les usines de Făgăraș sont devenues une réalité non seulement technique, mais aussi économique, qui a augmenté chaque année.

5. LE PERSONNEL DE L’USINE ET LA PRODUCTION

La compagnie a été fondée avec le personnel technique et les travailleurs étrangers - les Tchèques, les Slovaques, les Allemands. Les ingénieurs suivants y sont mentionnés Carol Berkovits - Directeur, Richard Neubner, Gustav Burmester, contremaîtres et techniciens Gustav Wendrinsky, Joseph Szubados, Julius Août, Tschur Takues[3]. Les travaux sur le chantier de construction des
Les débuts de la fabrication d'explosif en Roumanie

Les usines ont attiré les premiers travailleurs des villages situés autour de la ville de Făgăraș: Hurez Ileni, Rausor, Beclean, Hârseni, Recea, mais aussi des travailleurs des villages plus lointaines Vistea, Venetia etc. Ils ont fait appel aux soldats russes sous la direction de Wrangel, retirés de la Russie soviétique et reçus par la Roumanie dans le camp dans la Forteresse Făgăraș[11].

La période depuis la mise en place de l'usine et jusqu'en 1940 peut être considérée comme une première étape dans le processus de la professionnalisation industrielle de la population rurale dans la région. La sélection des travailleurs était faite par les ingénieurs de l'usine et la formation a été faite sur place, au travail. Les principaux critères de transition de groupe de chantier - en tant que travailleur - au groupe de production étaient: la compétence, la diligence, la capacité et l'intérêt pour la profession.

En 1924 a commencé la fabrication complète jusqu'en mars. Dans les 10 mois ont été faites: 65% de nitroglycérine dynamite, dacite, des explosifs anti-déflagrant, astralite et des explosifs de sécurité. Ils ont livré au Monopoles d'État à des prix fixés par la loi, qui ne pouvaient pas être "inférieur au coût et sans l'avantage" 585035 kg d'explosifs, "couvrant ainsi la totalité de la consommation du pays." Ils commencent à ce moment-là la fabrication de l'acide nitrique[12]. Les années à suivre, ils ont introduit de nouveaux produits: la poudre noire (poudre de la mine, poudre fine pour la chasse, poudre superfine pour la chasse, poudre pour les mèches) et des bobines –mèches (doubles, gutta-percha, pour les grenades).

La Figure 5 présente la production d'explosifs, poudre noire et bobines-mèches[13].

La Figure 5. La production d'explosifs, poudre noire et bobines-mèches à Făgăraș entre 1924-1939

La production et la consommation ont augmenté pendant les années 1934-1936 grâce à l’intensification des exploitations minières d’or dont la rentabilité “parait être de mieux en mieux” et pour laquelle on exigeait de grandes quantités de poudre noire.

L’augmentation de la demande pour l’industrie de l'extraction du charbon et de l'exploitation minière de métaux, qui sont les plus grands consommateurs d'explosifs, a fait de telle manière que la production de l’usine croît sans cesse en Făgăraș. De nouveaux investissements seront proposés et approuvés [14, 15]. En 1936 une nouvelle société par actions est fondée – Nitramonia, qui propose la construction d’une usine d’acide nitrique synthétique, ainsi qu’une usine de nitrate d’ammonium à Făgăraș. La diversification de la production et l’augmentation de la capacité de fabrication d’explosifs de mine et pour les constructions se déroulent jusqu’en 1938, quand les produits militaires deviennent plus importants que ceux civils.
6. CONCLUSIONS

Pour la Roumanie, entière, grâce à l’union de la Transylvanie avec le Royaume de la Roumanie, le 1er Décembre 1918, la stratégie de développement socio-économique a les mêmes objectifs, parmi lesquels le plus important c’est la défense du nouvel état, la réorganisation de l’armée et le développement des équipements et matériels nécessaires.

L’emplacement de l’usine d'explosifs à Făgăraș a eu un fort impact sur la région entière: la construction des logements et des écoles, un grand mouvement de masse de la population des zones rurales vers les zones urbaines et autres régions de Făgăraș, l’apport des spécialistes et la mise en place de centres de recherche. La Première Société Roumaine d’Explosifs (1920), la Société Nitramonia (1936), l’Industrie Chimique Făgăraș (1942) et Synthesia (1944), ces quatre sociétés roumaines anonymes par actions ont constitué la première pour la création du Combinat Chimic Făgăraș, fondé après la guerre, qui deviendra une des entreprises chimiques les plus importantes d’Europe dans les années soixante-dix et quatre-vingt du 20ème siècle.

NOTES and REFERENCES

DEVELOPMENT OF THE INFORMATICS REVOLUTION IN ROMANIA

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Abstract — In the present paper, there is presented the epopee of the first Romanian electronic computers and the activity developed by Mihai Drăgănescu, as pioneer and promoter of the informatics revolution in Romania. Mihai Drăgănescu, since 1968, as Permanent Secretary of a new Government Commission for the endowment of national economy with modern computing equipment and automatic data processing, promoted several principles and guidelines which allowed creating a wide system, to unify society. The concept of institutionalization of the national information system, presented by Professor Mihai Drăgănescu, in works published after 1967, has outlined the theoretical and practical aspect leading to management, informatics development in Romania. Professor Drăgănescu has developed during 1967-1971 and 1976-1985 the first national program for the introduction and use of electronic computers in the Romanian economy and society.

The existence of the Romanian concept for achieving computerization, developed by Professor Mihai Drăgănescu, has been a contributing factor to the Romanian integration in European and global process of building a global knowledge-based society. In the last part of the paper, the author highlighted Mihai Drăgănescu’s role for the present and the future, as an example of high scientific personality who, through a creative, competent and responsible activity, developed scientific and managerial works which are examples for us and for our followers.

Keywords — science and computing technology, information and communication, informatics revolution in Romania, technological evolution.

1. INTRODUCTION

The development of information and communication technology, the most dynamic branch of science and technology revolution today, would not have been possible without the extraordinary discoveries in the fields of semiconductor physics and microelectronics. In these circumstances, it is natural that those who founded the Romanian school of electronics engineering and semiconductor devices, professors Tudor Tănăsescu and Mihai Drăgănescu should be initiators and promoters of the informatics ‘revolution in our country.
2. THE EPOPEE OF THE FIRST ROMANIAN ELECTRONIC COMPUTERS

Professor Tudor Tănăsescu (1901-1961), founder of the Romanian school of electronics, had a significant role in strengthening and developing the research team of the Institute of Atomic Physics in the construction of digital computers and their use in various fields (in particular, for the engineering and technical calculations). He also contributed to the improvement of doctoral training specialists needed in the field of computers, which began in 1965, focusing on three core areas: circuits and devices for computers, digital computers and analogue and hybrid computers. [3].

Eng. Victor Toma (1918-2008) PhD, has designed in the Institute of Atomic Physics Bucharest the first Romanian tube computer named CIFA-1. The logic project of this computer had been presented in 1955, by the Institute of Atomic Physics, at the International Symposium in Dresden. In 1957, IFA put into operation the computer CIFA-1, based on electronic tubes and magnetic drum memory. The Institute of Atomic Physics also put into operation other Romanian electronic computers of the first generation designed by Victor Toma. After the first (1957), Victor Toma followed: to design and Institute of Atomic Physics to put into operation CIFA-2 (1959), CIFA-3 for the Computer Centre of the University of Bucharest (1961), CIFA-4 (1962). In 1964, Victor Toma designed an electronic computer CET-500 of the second generation (based on transistors and memory ferrite) and, in 1967, a perfected copy named CET-501 type. A 2nd copy, of CET-501 was designed and put into operation for the Metallurgical Enterprise Hunedoara [8].

All electronic computers made in Bucharest at the Institute of Atomic Physics have been effectively used to solve a large number of scientific and technical issues presented by IFA and other beneficiaries. For the effective use of his Romanian electronic computers, Victor Toma held an extensive training for specialized staff: engineers, mathematicians, programmers. In this way, in IFA, the Electronic Computer Laboratory became a Computer centre equipped with computers and specialized staff where high-quality work was being conducted, 24 hours per day, seven days per week. Significant for the use of these computers is the "Collection of computer programs CET-500" published in 1967 and prefaced by Academician. Miron Nicolescu, president of the Romanian Academy. The volume made up of 850 pages was prepared by 41 authors who had effectively solved computing problems in 15 scientific and technical fields. After the equipment of economy with computers, most of these authors have become basic teaching personal, in the electronic computing centres [9].

Between 1968-1988, Victor Toma also built: a Data Entry Systems on floppy disks (EDIT), a system for the quick transfer of information from the magnetic tape to the printer, and projected a data transmission system telephone channel between Baneasa Meteorological Institute and IFA-Măgurele, a crossing equipment for transferring the information on paper tape in Morse code signals, an electronic timer used in the pyrotechnic industry, an automation equipment for stenography, an equipment for information encryption and an electronic timekeeping station. Later on, he also achieved a digital electronic system counting the votes for the Romanian Parliament [2].

For his entire scientific activity and research, for his contribution to the development and promotion in Romania the information and communications technology, Victor Toma was awarded, in 1957, the Labour Ordain Class III and on April 21st, 1993 he was elected honorary member of
the Romanian Academy. In 2003 he was also awarded with the knight level of the National Order "Star of Romania" [9].

In the years 1958-1959, at the Energy Institute of the Romanian Academy, V.M. Popov (b.1928) coordinated the design and execution of the analogue computers MECAN I and MECAN II, which were equipped with dozens of operational amplifiers and linear elements and systems based on the hyper-stability principle. In 1957, V.M. Popov published the first work that marks his pioneering contribution to the hyper-stability principle and he was recognized worldwide as the first author [7].

In 1961, at Timișoara Polytechnic Institute, the first computer MECIPT-1 (electronic computing machine Polytechnic Institute of Timisoara) was made with tubes by the engineer William Lövenfeld and the mathematician Joseph Kaufmann, and in 1962-1968 also participated Vasile Baltac to build completely transistorized computers MECIPT-2 and-MECIPT 3.[3].

The Computing Institute Cluj-Napoca, founded in 1957, by Professor Tiberiu Popoviciu (1906-1975) had a section dedicated to computing machines, and in 1957, a computer was built with relays, achieving an experimental model MARICA (Arithmetic Calculation Machine on the relay in the Computing Institute of the Academy ). During 1958-1959, in the Computing Institute Cluj-Napoca, was also built a Numerical Computer DACICC 1 (Automatic calculation of the Institute of Cluj), with tubes, transistors and memory ferrites (transistorized reproduction-in part-of the MECIPT-1) and in 1968 the computer DACICC 200 fully transistorized, was made for the Central Agricultural Research Institute [4]. In the Computing Institute of Cluj-Napoca, the first Romanian results were obtained in the field of the linear programming and nonlinear approximation in languages. [10].

3. INFORMATION REVOLUTION IN ROMANIA

Professor Mihai Drăgănescu developed the school of electronic and microelectronic devices at a time of great creative effervescence in the Bucharest Polytechnic Institute. Among the graduates of the Faculty of Electronics and Telecommunications from Bucharest, Professor Drăgănescu formed a strong department in "devices, circuits and electronic devices." The PhD School in electronic devices and microelectronics, led by Academician Mihai Drăgănescu, has trained more than 30 doctors, specialists of great value, too their pioneers [9].

In these circumstances, it is almost natural that Professor Mihai Drăgănescu, who founded the Romanian school of electronic engineering and microelectronics, who held an important theoretical and practical technical work in Romania for the manufacture of integrated circuits and electronic calculators from third generation and the phase transition of our country to silicon, should also be the founder and promoter of the information revolution in Romania.

Professor Mihai Drăgănescu (1929-2010), pioneer and promoter of the information revolution in Romania, conceived in the period 1967-2002 a new theory of information-based structural-phenomenological and conceptual elements concerning information and knowledge society, in Romania [9]. The qualitative distinction between a person and a personality is his creativity, initiative, embodied in innovative activity and a retrospective on the life and work of Academician
Mihai Drăgănescu reveals a personality dedicated to finding novel solutions in action, appropriate to the changes that occur in the technical environment and social environment.

Assuming the task to talk about the quality of professor Mihai Drăgănescu as a pioneer and promoter of the Romanian information revolution is neither simple nor easy, but I joyfully comply with this task, with feelings of satisfaction, for it means not only fulfilling a duty, but also remembering lived realities, along with academician Mihai Drăgănescu, both as an expert (1968-1971) of the Permanent Secretariat of the Government Commission for the endowment of economy with modern computing equipment and automatic data processing, as well as a scientific secretary of the Section of Science and Information Technology of the Romanian Academy (from 1992 to 2010).

In 1966, Professor Mihai Drăgănescu, aware of the existing technological reality, together with academician Nicolae Teodorescu prepared and submitted for approval an official statement on the introduction and use of electronic computers in the Romanian economy and society; the proposals made in that statement, helped launch the first program of computerization in Romania. Therefore, the following year (1967), Mihai Drăgănescu was commissioned to lead a team to develop the "Program for supplying the economy with modern computing equipment and data processing automation" [7]. To understand this better, it is required first and foremost to meditate and to remember those who have had the wisdom and ability to promote scientific and moral strength in our country, science and information technology, launching its first action in this respect at a time when cybernetics as a science was still denied by some circles of the Romanian communist party and state power from those years and about one year before the French Academy to give in April 20, 1967 first scientific definition of Information Technology.

In spite of the difficulties, realistically assessing the field of information in Romania since 1967, Professor Mihail Drăgănescu promoted several principles and guidelines which allowed the new ideas to substantiate, to create a system-wide unit of society. Among these ideas are mentioned:

- The fundamental idea of a national uniform information system can not be created at once, but only gradually, by evolutionary stages, by covering the computing experience that was acquired through successive improvements and retouching; ensuring compatibility information subsystems;
- Training of users, including administrative leadership at all levels in all phases of system development;
- Creating a data transmission system using both existing telecommunication lines and using, also the installation of specialized data lines.

During 1967-1971, Professor M. Drăgănescu, in the position of Permanent Secretary of the Government Commission for the endowment of economy with modern computing equipment and automatic data processing, held talks with highly developed countries worldwide to manufacture integrated circuits and electronic computer of the third generation, successfully concluded negotiations with France, laying the bases for professional electronics in Romania, initiated and led the construction of regional computer centers, computer schools, led the research leading in the field (artificial intelligence, robotics, industrial computers). Through all this developments, the computer was founded in Romania. The days that followed were not always favorable for computer
development in Romania and, for this purpose, the potential scale of our country, at the time, was not achieved.

Romanian experience in computer science started from the requirements of an existing company and crystallized, under Professor Mihai Drăgănescu, around the concept of national information system which develops according to its design; engineering was not an ordinary type. In 1968, the Institute of Research for Electronic Computing Machine, later called the Institute for Computing Techniques (ITC), has been founded which focused on all those who have worked in the field of electronic computers at IFA in Bucharest and the Universities of Timisoara and of Cluj.

In 1968, during the visit made in our country, De Gaulle acted under the motto: "Donnez aux Roumains tout ce qu’ils veulent" and, as a result, Romania was able to purchase from France license for IRIS computer, for the Factory of integrated circuits, built in Băneasa, and for Factory of electronic computers [1]. Romania was accepted by France as a partner in the development of the first computer model of family IRIS in the “Compagnie Internationale pour l’ Informatique (CII)”. The professor, the Permanent Secretary of the Governmental Commission, signed the Agreement for the Cooperation between Romania and France in the field of Informatics. The agreement signed with France had secret character at that time and referred to the Romanian-French cooperation in all areas of strategic focus. Computer IRIS 50 was adapted in Romania under the name of Felix C256, and it was manufactured, at the beginning, in France on the base of the SDS 960-a computer that was developed in France in 1967-1969.

The uptake of cutting-edge technologies Felix C256 -IRIS 50 was made simultaneously in France and Romania, and the manufacture IRIS 50 and use of computers have raised problems both to the licensor and to the licensee. In addition, the computer was new, had a wide range of uses, which required special efforts in making application programs for different areas, programs that could not be imported, likewise not compatible with basic software with tools and systems management of files and databases developed for computer Felix C256 [5].

The computing system FELIX C-256 had an operating system SIRIS-3 that was an off-line sequential time grant different users (batch-processing). It was necessary for the processed work to be designed and prepared elsewhere; then run on the computer, by allocating a computer for each user. This procedure required an office or data centre where users came to run programs on the computer. At first, this system gave satisfaction; subsequently, organizational reasons, time, distance, began to experience problems and as a result, quite vehement criticism against those who campaigned to procure this license [4].

Highlighting the assimilated computer into production by making an application program through the design and implementation of an appropriate institutional framework obtained by:

- Creation of the Institute for Research in Informatics (ICI), responsible with taking over the license application and programs in the country to achieve national library of programs modeled on European Program Library (EPL) of the company IBM. The Institute for Research in Informatics (ICI), was led by Professor Mihai Drăgănescu in the period from 1976 to 1985 and has contributed to the guidance of scientific activity in computing to new areas: artificial intelligence, robotics, industrial informatics, and management actions: [8].
• Creation of a training centre in the ICI and training the specialists for the use of computers;
• Creation of regional centres for automatic data processing services and training specialists to future beneficiaries of the computers in the territory, based on type project in two versions, regional centres implemented in Timisoara, Cluj, Iasi, Pitesti and Craiova, which were to be generalized in all district capitals;
• Creation of centres, institutes of higher education in major universities, research institutes and enterprises representative of the large industrial areas [6].
• Today, more than 40-45 years after the end of the French contracting license for computing reducing its appearance only problem strictly technical specialist, I can state the following:
• If Romania had not retrieved the license, which had a group of specialists with appropriate training, it would not have achieved, in a relatively short time, a comparable system in terms of technology, performance hardware, the operating system and software available to third generation systems;
• The takeover license facilitated:
  • A formation in a relatively short time, an impressive number of specialists in computer science at a level comparable to the international one;
  • Addressing informatics nationally in a consistent and systemic manner, which resulted in solving the specific problems, of both economic and social nature, as well as the general ones [5].
  • In connection with the license purchased from France, in those years, varied opinions and comments circulated. The Permanent Secretariat of the Governmental Commission was subject to malicious attacks, many criticisms, even from people who were aware of the conditions imposed, to wit embargo licenses computers that would have been a better solution for assimilation into production.

With the abolition, in 1971, of the "Governmental Commission for the endowment of the national economy with modern computers and automatic data processing", there began a period of confusion for organizational informatics, when there were parallels and the activity related to subordination grew complicated, because of inefficient subjective symptoms unexplained by specialists. It was a time when the experts’ opinion was not sought or did not matter. The lack of a regulatory framework to govern the incentive caused the Romanian industry computing, although begun in good conditions, which provided good prospects, not to be competitive on the European and Romanian industry of programs, not to develop creative specialists. This has led many computer scientists Romanian to emigrate. At present, hundreds of professionals have an important role in informatics technology in USA, Canada, France, Germany, Australia etc. Imports of computers was virtually halted in Romania, from the early 1970s, while imports of electronic components west of the early 80s of the twentieth century.

The program, approved in 1967, was the first program of the development of informatics in Romania, which outlined the main directions of activities of computer science until 1985 and has seen some changes in 1971. Because of the misunderstanding of the principles and ideas of indicative value, set by Professor Mihai Drăgănescu, and real phenomenon informatics development in 1971, a part of the political decision-making power pole has been convinced that
the national leadership of the Romanian state information should be achievable within a few years. Exacerbation achieve national information system in confronter reality, a compromise after the 80s of the twentieth century, the idea of a national information system and management has provided no investment informatics and blocked imports in hard currency, including component manufacturing [5].

In the aforementioned period have been achieved, however, with many difficulties, several systems for micro applications (management of stocks and of fixed means), to assist government administration. There were made and processed systems that have been implemented in various industrial enterprises. In fact, computer applications at the micro level, while continuing premises integration, offered more the image of the islands than integral parts of systems.

Professor with daily teaching tasks, Mihai Drăgănescu managed to mobilize employees to work efficiently, to develop fruitful and they all have their best. Everyone who had the honor to work under his direct guidance continually grew in scientific value. They say that in the shade of large trees, nothing else but bushes grow. In the presence of a great man, such as Academician Mihai Drăgănescu, the staff received continuous light. I feel much honored that I was able to unfold a large part of my work under the direction of the scientist, teacher, manager, human and citizen-Mihai Drăgănescu

4. CONCLUSIONS

1. In 1953, the epopee of the Romanian electronic computers began. Victor Toma had priority in developing the first Romanian electronic computer, which has been the first computer in the countries of Eastern Europe, except those produced in the former Soviet Union.

2. Victor Toma was the prime figure in Romania in the field of electronic computers. Toma Victor's achievements influence are immense in Romania, not only among specialists in electronics, but also among Romanian mathematicians and economists.

3. Romania is the sixth country worldwide to have built in its own conception, a computer with electronic tubes, and the 11th country that have built also in its own conception, a transistor computer.

4. The concept of institutionalization of the national information system, presented by Professor Mihai Drăgănescu, in works published after 1967, outlined the theoretical and practical aspect leading to management, informatics development in Romania. The existence of Romanian concept for achieving computerization, developed by Professor Mihai Drăgănescu, has been a contributing factor to facilitate Romanian integration in European and global process of building a global knowledge-based society.

5. During 1967-1985, in Romania, under Professor Mihai Drăgănescu, the first national program for computerization, one of the largest programs in the country's technological fields of integrated circuits and computer was achieved to an extent of more than 80-85%.

6. In the frame of the international political conditions during 1965-1970, the purchase of the French license was an inspired and advantageous action for Romania, which placed the
country in a advantageous position in the international context of the time. Romania succeeded in constructing among the European socialist countries, apart from the former USSR, the first computer of the third generation and succeeded in exporting until 1989, such computers, in these European socialist countries.

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Abstract — Only a few weeks after the Fukushima nuclear accident from March 2011, the German federal government decided that the country was going to phase out nuclear energy by 2022. Among different economic and political considerations, this decision hit an entire technoscientific community, whose members are currently experiencing an existential struggle over their somber professional future. Yet what seems to be the simple misfortune of an unlucky career choice possibly bears a deeper meaning as nuclear energy was once considered one of the most promising technologies in history. How could it then have such a terrible fate in one of the most technically advanced countries in the world? I contend that a close look at the history of the German nuclear science community and the emergence of one particular reactor technology, namely inherently safe reactors, will help answer that question.

Keywords — inherently safe reactors, German nuclear community, Chernobyl, Fukushima

1. INTRODUCTION

According to their initial proponents, inherently safe reactors would render active reactor safety systems useless and secure in an irrefutable way the safety of nuclear power plants. This techno-utopian idea reached the top of the agenda of nuclear scientists shortly after the Three Mile Island accident. Inherently safe reactors came to be regarded by many nuclear experts as well as some social scientists (Goldberg et al. 1996, 94) as the necessary and unique solution to the crisis of public trust that the global nuclear community was struggling with. The idea was also picked up by key actors from the German nuclear community, yet not all of its members agreed that inherently safe reactors were the only way to go ahead in the given circumstance. As a consequence of this quarrel between different strands of thought within the nuclear community as well as of the two “normal accidents” from Chernobyl and Fukushima (Perrow 1984), the German nuclear community currently appears to be unable to recover from the social disgrace into which their métier has slipped due to the repeated severe failures of a technology that once promised “energy too cheap to meter” (Strauss 1954). All that said, the history of the (German) nuclear community is somewhat reminiscent of the fate of the Ancient Greek mythological character of Sisyphus, warning about the perils of pursuing the full understanding and control of nature’s laws in modern Western society. The punishment for such an endeavor comes in the form of a meaningless, assiduous effort to restore a privileged status lost in the abyss of social disgrace. The exemplar history of the German nuclear community might also be of relevance to other technoscientific communities, which are or will eventually be involved in prolonged sociotechnical controversies.
1. BACKGROUND AND ANALYSIS

1.1. THE EXPERTS’ RESPONSE TO NUCLEAR ACCIDENTS: INHERENTLY SAFE REACTORS

The Three Mile Island (TMI) nuclear accident of 1979 was arguably the first event of its kind to evoke widespread media attention and exposure (Friedman 2003, 55-65). It also made clear for both scientists and laypersons that nuclear technology entailed serious risks which had to be addressed immediately. In response to this new way of perceiving nuclear power, which was until then regarded as relatively safe, the concerned US governmental bodies and the community of nuclear experts had to take a stance regarding the causes of the accident as well as what could be done to avoid such “mishaps” in the future. The results were such that on one hand, the National Science Foundation initiated and funded a program for the reassessment of the very discipline of risk analysis (Miller 2003, 163-202). On the other hand, experts began to think about what could be done to prevent any conceivable accident in the future. The lessons learned from the TMI accident provided the motivation and starting point for what was to become a paradigm shift in the field: inherently safe reactor designs.

What experts in the field concluded from the detailed analysis of the causes of the accident¹ is straightforward even to non-experts: The main cause of the accident was not to be found inside the reactor core itself but in the equipment that was installed to protect the core from a meltdown: the active safety systems. Considering that these systems rely on the correct functioning and reliability of equipment such as pumps, valves, sensors, and countless pipes, it is impossible to provide guarantees that accidents will never occur simply because all these individual components have certain failure probabilities themselves. Moreover, even if the failure probabilities of specific components, such as a pipe or a pump, could be determined by probabilistic analysis, quantifying the risk of a concomitant failure of several components in a cooling system comprising hundreds of components would pose considerable difficulties. To deal with this problem, a previous reactor safety study of the US Atomic Energy Commission² pledged for the introduction of so called “subjective probabilities” which were embedded in widely used Probabilistic Risk Analysis methods. In other words, where failure probabilities of complex systems could not be effectively determined because of missing data or intractable calculus, they would be replaced with experts’ assessments of those probabilities—a process identified by Carolyn Miller as the conversion of ethos into logos (Miller 2003, 169).

After reflecting on the lessons of the TMI accident and the shortcomings of various probabilistic risk assessment methods, the experts envisioned a reactor that would not need active safety systems for preventing the release of radioactive materials into the environment at all, regardless of the postulated accident type and scenario. If the decay heat produced by the reactor core could be effectively removed prior to a radioactive release or a core meltdown, the confidence in nuclear energy shattered by the TMI accident would be restored. At the same time, a reactor not posing any safety risks would be a “forgiving reactor”, that is a fault tolerant reactors, and a new start for atomic energy would be possible (Weinberg and Spiewak 1984, 1398-1402). The rationale for this new type of reactor was as follows. Even when the reactor is shut down safely (i.e., the fission reaction is stopped), decay heat, which represents about 8% of the nominal thermal power of the reactor, will continue to be produced for days and weeks. Therefore conventional reactors must be
cooled for as long as decay heat is still produced by the fission products inside the core. The ambitious goal to create an inherently safe reactor could thus be achieved by controlling the decay heat without the help of active safety systems. And so the concept of an inherently safe reactor, which would be endowed with technological means of controlling the decay heat, was born. Wineberg and Spiewak, two of the most prominent nuclear scientists at that time, defined an inherently safe reactor as one “whose safety depends not on the intervention of humans or of electromechanical devices but instead depends on immutable and well-understood laws of physics and chemistry” (Weinberg and Spiewak 1984, 1399). Refocusing on the safety of nuclear reactors rather than their efficiency paved the way for a very ambitious project, which in some sense can be considered utopian.

According to its proponents, the “forgiving” inherently safe reactor would have to be smaller than conventional pressurized water reactors in order to produce a manageable amount of decay heat. However, from an economic point of view, the loss in power would be compensated by the fact that there would be no need for active safety systems, as the reactor would safely shut down and manage the decay heat by itself. Small reactors could then be installed close to large cities and wherever else needed thanks to their inherent safety features. Thus, from an economic point of view, the reduced power would be compensated by the proximity to cities, which would secure their energy needs in a clean and safe way. In order for inherently safe reactors to be financially feasible, it was necessary for regulatory authorities like the US-NRC to loosen their demands over safety features such as a high pressure containment cell or earthquake proofing (Weinberg and Spiewak 1984, 1402). To make their case even stronger, the proponents of inherently safe reactors calculated that in a world with a projected 5000 pressurized water reactors, there would be a core meltdown every other year. Therefore, inherent safety was not only an option but a prerequisite for ensuring the continuity of the nuclear industry in the first place (Weinberg and Spiewak 1984, 1401).

In what follows, some of the theoretical and worldly challenges posed by one of the two inherently safe reactor designs that made it through the scrutiny of the experts from that time will be discussed. To this end, the journey will take us to Germany, where Dr. Lohnert and his associates from Siemens/Interatom promoted the HTR-Modul, a small-size high temperature and inherently safe reactor. Yet when the HTR-Modul was about to be licensed for commercial construction and operation in Germany, another mishap interfered with the process: the Chernobyl accident.

1.2. Inherently Safe Reactors in Germany

In Germany, nuclear power has never been far from the top on the list of public issues, and almost all citizens have an opinion on the topic. A strong anti-nuclear movement has played a key role in German politics since long before the Chernobyl accident, and antinuclear protests have been frequent and dramatic, sometimes marked by violence. When the much feared radioactive cloud finally arrived from Ukraine in 1986, the German public reacted with fear, partly due to the alarmist coverage the accident received in German media. Following this public reaction, the German federal government issued a moratorium on nuclear energy, which stated that no new nuclear power plants were to be built on German territory while existing ones could still be operated until the end of their lifespan.
As both human error and technological failure were identified as principal causes of the Chernobyl accident, the industry-affiliated German nuclear scientists started working on a strategy that was to eventually lead to a rescindment of the moratorium. For those scientists, the human error component of the problem was not at issue thanks to the strong and disciplined German safety culture compared to the propagandistic and careless Soviet one, as the latter was perceived during the Cold War. However, such an argument was not strong enough to convince public critics because human error could intuitively never be entirely excluded. For these reasons, the experts’ attention was drawn to inherently safe reactor designs, one of which was being developed by the German company Siemens/Interatom under the aegis of Dr. Lohnert. The aftermath of the TMI accident from the US was being repeated in Germany, and many experts reached the same conclusion: the survival of the nuclear industry as well as that of the academic nuclear community depended on a “forgiving” inherently safe reactor.

In the High Temperature Modular Reactor (HTR-Modul) (Reutler and Lohnert 1983, 22-30) design the key to inherent safety is represented by its fuel elements, called pebbles. These are graphite spheres the size of tennis balls containing a large number of coated particles. Each coated particle is itself a smaller sphere of less than 1 mm in diameter, which contains a tiny core of nuclear fuel surrounded by four layers of carbon and carbide shielding. Particles and pebbles are designed in a way that, in principle, prevents the reactor core temperature from exceeding the melting point of the coating. This approach makes a core meltdown theoretically impossible because the small amount of uranium contained in a coated particle cannot yield enough energy to produce dangerously high temperatures even in an uncontrolled chain reaction. In a reactor that uses this type of fuel, pebbles are moved in a cycle from the top to the bottom several times until their potential is expended. According to its designers, the reactor does not need a pressurized containment building because the pebbles are small containment structures themselves; nor would it need additional active or passive safety systems, such as water pumps and valves.

Co-owning the patent on the HTR-Modul, Dr. Lohnert approached the research community to rally help for producing proof in favor of its inherent safety features. In cooperation with colleagues from the Jülich National Research Center, where an experimental version of the HTR-Modul had been running since 1968, the scientists had to prove that the temperature inside the reactor core would under no conceivable circumstances reach a temperature higher than 1600°C, which would deteriorate the carbide coating of the nuclear fuel and thus lead to a core meltdown. In an overly-confident rhetorical style, the conclusion of one of the studies from that time aimed at proving the inherent safety of the HTR-Modul states that

“[f]rom these calculations we conclude that any hazardous radiation dose to the environment can be excluded if the maximum fuel element temperature stays below 1600°C. It goes without saying that the HTR-Module, having a power output of 200 MW, inherently limits its maximum fuel element temperature below this value, regardless what accidents might be postulated.”

(Lohnert et al. 1988, 257-263)

For the reactor designers there was no need for additional proof. The experiment showed that inherent safety was possible and that the laws of nature, represented in this instance by the temperature, could effectively be kept under control regardless what accidents might be postulated.
Other experiments and simulations were carried out in order to determine the consequences of air and water ingress accident scenarios. All these studies supported the idea that the HTR-Module was indeed inherently safe thanks to its specially designed spherical fuel elements.

Yet in spite of these promising results, the AVR reactor was shut down in 1988 by the German regulatory authorities due to a series of deficiencies and safety-related reactor incidents, which were not made public at that time. A long-classified report for the state government of North Rhine-Westphalia, which was declassified in 2011 as a rather late consequence of the German Environmental Information Act of 1994, revealed an unacceptable risk of so-called super-criticality, which can lead to an uncontrolled fission reaction and ultimately to a core meltdown. In a report by the Jülich Research Center from 2008, the alleged inherent safety of the HTR-Module was reassessed (Moormann 2008). More precisely, the report stated that the coating of the spherical fuel elements would be unable to retain radioactive metallic fission products and called for the development of a new fuel element capable of retaining all fission products. Dr. Rainer Moormann, the author of the report and a longtime member of the HTR-Module group, concludes that

“[p]reviously a superior safety behavior of pebble bed reactors was claimed compared to other nuclear systems including an allegedly catastrophe free design. According to the above presented arguments there are doubts, whether this depicts reality.” (Moormann 2008, 33)

Roughly twenty-five years after the HTR-Module was first claimed to be inherently safe, the Moormann report showed that the ambitious goal of fully understanding and controlling the immutable laws of physics and chemistry as set by the initial proponents of the inherent safety concept was far from being attained. However, within the nuclear community, Dr. Moormann is now considered a whistle-blower, which means that the debate about the inherent safety features of the HTR-Module is not yet and perhaps will never be closed.

1.3. THE GERMAN NUCLEAR PHASE-OUT DECISION IN CONTEXT

The 1979 Three Mile Island accident significantly contributed to the Green Movement’s rise and the birth of the German Green Party in the early 1980s. Ever since, the party has grounded a substantial part of its political program in anti-nuclear protest. Growing German public resentment toward nuclear technology peaked with the 1986 Chernobyl accident, which received terrifying media coverage (Ionescu 2012, 260-267). In response to the Chernobyl accident, the Social Democratic Party, which had supported nuclear energy previously, now changed its policy and passed a resolution to abandon nuclear power within 10 years. In 1998, the Green-Red (Green Party-Social Democratic Party) coalition government changed the law to allow the eventual phase-out of nuclear power, an act known as the moratorium on nuclear power. Despite the consistent public opposition to nuclear power, in 2010 the new Christian Democrat government led by Angela Merkel announced the intention of extending the lifespan of reactors by 14 years for those built after 1980 and by eight years for all others. This moment provided nuclear scientists with an opportunity for psychological relief and for getting out of their hiding place. Yet this wave of optimism was soon to reach an unexpected and sudden end in 2011.
The Fukushima accident in March 2011 left the German nuclear science community stupefied. Many experts had harbored the feeling that another accident would end the nuclear era in Germany, and that feeling was about to be confirmed. The German government ordered the shutdown of the nine German reactors built before 1980 immediately after the first phase of the Fukushima accident. On March 27th, a traditionally antinuclear Red-Green (socialist-environmentalist) coalition won the state elections in the highly industrialized Baden-Württemberg for the first time in history. Although this event cannot be attributed solely to the Fukushima accident, one cannot deny the accident’s contribution to the outcome of the elections. The Federal Government decided that the nine German reactors shut down immediately after the accident would never go back online. Soon after that, the Christian Democrat government returned to the previous plan to phase out nuclear energy by 2022 as expressed in the moratorium of 1998 by the socialist government of that time. A federal "Ethics Commission for Secure Energy" was appointed to evaluate the impact of this decision. The commission's report regarded a nuclear phase-out as a possibility, albeit at the high cost of increased dependence on energy imports and the loss of a few gross domestic product points.4

The German nuclear science community thus received its sentence to extinction in the voice of a federal government consisting of a coalition of parties which had traditionally been supportive of nuclear technology. This had a deep emotional impact on a group of people whose profession had abruptly become undesirable in their own country. German nuclear experts also found that their government took the phase-out decision in the absence of a definitive analysis of causes of the Fukushima accident as well as a thorough reassessment of the actual safety of nuclear energy facilities in Germany (Ionescu 2012, 267). Twenty five years after the Chernobyl accident, through the nuclear phase-out decision the German nuclear community was undermined once again because of a highly unlikely and unexpected event that occurred thousands of kilometers away from Germany. Yet this time, the Fukushima boiling water reactors were based on a similar technology as the one used in some of the German reactors. Perhaps this rationale combined with the kairotic (Miller 1994, 81-96) political decision of removing the nuclear issue from the public agenda in future elections is what led to the German nuclear phase-out decision.

2. CONCLUSION

In modern Western Society technoscience is believed to have replaced the role of the sacred and scientists did and may still enjoy a priest-like status (Bensaude-Vincent 2001, 99-113). Mircea Eliade also notes that a diffuse mythology pervades all aspects of modern life and regardless of how secularized, degraded, and hidden these myths may be, they can be encountered everywhere (Eliade 1960). All that one has to do is to recognize them. More recently, sociologist Gérard Bouchard called for a “new sociology of social myths” (Bouchard 2013, 95-120) motivated by the consistent absence of this analytical angle from most sociological inquiries. Considering the extraordinary history of the German nuclear community, could we then perhaps speak of the birth of a sociotechnical myth?

Indeed, scientists themselves have pointed out that within the very essence of the pursuit for scientific knowledge one can find traces of some of the myths from the cradle of Western civilization—Ancient Greece. For example, the Nobel Prize-winning microbiologist Joshua Lederberg notes that “[t]he age-old impulse to control ‘dangerous knowledge’ is embodied in our primeval myths, like the trial of Prometheus” (Lederberg 1972, 596-614). Considering the techno-
utopian idea of an inherently safe “forgiving” reactor, in the case of the German nuclear community an analogy with the myth of Sisyphus might be even more appropriate. The Sisyphean and Promethean myths share a number of motives, notably the hubristic and deceiving attitudes of the mythological characters towards the gods and their generosity towards humans. In addition to this, Sisyphus brings along the motives of punishment through meaningless and assiduous effort, of death’s temporary enchainment, and of his ability to negotiate with the gods and gain his freedom from Tartarus, thus opening the floor for a more compelling mythological interpretation of the emergence and outcome of complex sociotechnical controversies. According to Camus, Sisyphus “[was] accused of a certain levity in regard to the gods” and stole their secrets (Camus 1991, 124-138). After stealing the gods’ secrets and using them to obtain provisions of water for the citadel of Corinth over which he ruled, Sisyphus even managed to enchain Thanatos, the god of death, and keep him captive for a while. To end his trickery, the gods banished Sisyphus to Tartarus, the embodiment of abyss, where he was sentenced to push a rock up a hill just to see it roll back again shortly before reaching the top. Sisyphus’ abilities to negotiate with the gods are also rendered useless after having deceived them a number of times.

With the Manhattan project, the forefathers of the nuclear community symbolically enchain death by developing a weapon so dreadful that it put a violent end to WWII. The strategy of deterrence used during the Cold War also reflects the symbolic captivity of death by the threat of total nuclear war (Beres 1983). A deadly technology was then converted into one that generously promised “energy too cheap to meter”. Sisyphus’ attitude towards the gods and the ontology of the world resembles that of the nuclear community in general, who gained an almost sacred status owing to their symbolic triumph over death. In particular, it resembles that of the proponents of inherently safe reactors, who believed and publicly claimed that the full understanding of the immutable laws of physics and chemistry was not a thing of the impossible. Yet while attempting to fully understand and control the immutable laws of physics and chemistry, nuclear scientists had entangled themselves in nature’s bureaucracy with all its composing elements: uncontrolled phenomena, failing materials, social rejection, and hostile politics. The rehabilitation of the social image of the nuclear community has also proven to be a truly Sisyphean task: for each time that the public seems to have had forgotten the last nuclear accident, another one occurs—thus rendering the nuclear community’s social rehabilitation efforts useless. With the phase-out decision taken in Germany shortly after the Fukushima accident, the punishment of the German nuclear science community also consists of a loss of the relevance and recognition of their métier in their own country.

From a sociotechnical point of view, the relevance of the exemplar fate of the nuclear community for other existing and future domains of technoscience is that it might serve as a warning of the possibility of falling into the abyss of disgrace and meaninglessness whenever one is striving for the full understanding and control of nature’s laws. Yet, how effective can such a warning be? Sociologist Neil J. Smelser notes that, “a myth has a structure that is ambivalent in at least two senses: it contains a wish and its appropriate negation, and it permits an ambivalent orientation to each of its parts on the part of the hearer” (Smelser 1983/84, 1-15). The myth alone will therefore not guarantee that the latent potential for utopia—the wish—will always be moderated by the eventuality of punishment. Only the collective ritual commemoration and actualization of the myth under the supervision of initiated members of the concerned community can effectively convey its message to every individual within that community.
NOTES


REFERENCES


THE EVOLUTION OF TELECOMMUNICATIONS IN ROMANIA

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Abstract — Communications, as the primary means of transmitting information, represents an important factor in ensuring the progress of a country, thus the interest in promoting and introducing in Romania the latest techniques and technologies in the field. In this paper the steps of telecommunications development in Romania are presented. The first part represents a brief overview of the early nineteenth century communications and early twentieth century, going from wired to radio communications. The most important part of the paper is devoted to the aspects of the development of modern communications: radio, television, data, mobile etc., through terrestrial or satellite links, following the transition from analogue to digital technologies. Romania has followed closely the countries that promote new technologies in telecommunications, introducing and promoting these technologies, so today sound and video broadcast networks have developed, as well as mobile communications networks, satellite communications, radio relay, etc.

Keywords — telecommunications, telephony, radio communications, evolution

1. THE FIRST STEPS IN THE DEVELOPMENT OF TELECOMMUNICATIONS IN ROMANIA

The communication is an important possibility to transmit the information to the distance with a good fidelity.

This is the major interest in the whole world to develop the telecommunications techniques and technologies. Romania, like the other countries, promoted rapidly the new technologies. This progress is illustrated in Fig.1 so it was presented by regretted academician professor Mihai Draganescu in his „The Telecommunications History in Romania”.

The Romanian modern telecommunications history can be said to have begun with the telegraphy in 1850, after the invention of electric telegraph by Morse in 1836 and experimented first time like telegraphic line between Washington and Baltimore in first January 1845. Then there followed a rapidly developing of the telegraph lines in USA and in Europe (France 1845, Belgium, Italy, Switzerland, Austro-Hungary, Russia in 1853).

In the Romanian Countries (Muntenia, Moldavia and Transylvania), the first telegraph lines was installed in Brasov and Sibiu in 1850, between Bucharest and Giurgiu in 1853, and then in 1854 are extended at Bucharest – Ploiesti - Predeal and in 1855 in Bucharest-Pitesti-Craiova and Ploiesti-
Technology in Times of Transition

Buzau-Braila. In the same time the telegraph lines were installed in Moldavia between: Cernauti-Suceava-Falticeni-Iasi-Vaslui-Barlad-Tecuci, Tecuci-Focsani-Galati and Iasi-Tg.Frumos-Tg.Neamt and also in Transylvania by the Austrians.

<table>
<thead>
<tr>
<th>Years of developing in the world</th>
<th>Years of introduction or experimentation in Romania</th>
</tr>
</thead>
<tbody>
<tr>
<td>1832-1844</td>
<td>1853</td>
</tr>
<tr>
<td>1876</td>
<td>1877</td>
</tr>
<tr>
<td>1895</td>
<td>1901</td>
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<tr>
<td>1894-1923</td>
<td>1937, 1955</td>
</tr>
<tr>
<td>1882</td>
<td>1993</td>
</tr>
</tbody>
</table>

Fig. 1. The progress in development of the major telecommunications techniques and technologies in Romania compared to other countries

In 1854 the first telegraph school was inaugurated for the instruction and education of the Romanian specialists in this domain, with the aid of the ruler Barbu Stirbei.

During the Romanian independence war, 1877-1878, the king Carol the First used intensively the telegraphy for the coordination of military operation.

In 1876 the American researchers Elisha Gray and Graham Bell discovered a new device, the telephone. The first telephone conversation took place in Boston, in 1876, and then in Philadelphia. Between 1878-1880 the phone lines in SUA, France, Germany, England were installed for internal communications and then for continental communications (first communication was between Paris and Bruxelles).

In Romania the first telephone lines were installed in Transylvania, 1881-1882, (Timisoara, Sibiu, Cluj, Oradea, Arad), then in Moldavia (1882-Iasi, 1884-Galati).

In Bucharest the first private telephone line was installed in 1883, and then in 1884 the first public line was installed.

At the end of XIX century there was a revolution in telecommunications technique by passing from cable to radio communications. In 1873 Maxwell and in 1888 Hertz discovered the first theoretical and the second experimental existence of electromagnetic waves. Then Marconi realized in 1895-1897 the first radiotelegraph communication (wireless) with immediate applications in naval radio link (American ship „St.Paul” 1899 and German ship „Kaiser Wilhelm der Grosse” in 1900). Romania begins to install the first radiotelegraph communications for Maritime Service. So, in 1903 the radiotelegraph stations on „Elisabeta” cruiser and in Giurgiu, Calarasi and Cernavoda harbours were installed. These new radiocommunication networks, telephone and telegraph, were intensely utilized during the first Word War, for organizing and coordinating of specials war activities. In this time was in function some fixed stations in Bucharest: Baneasa, Herastrau, Filaret. The Filaret station during this war was transformed in a mobile radio telegraph station, installed in 2-3 wagons, being the first station in the world working in a train.
An important and significant event in our telecommunications history was marked in 1927 by the inauguration of the first telephonic switching centre of rotary type installed in Bucharest and having a capacity of 10,000 subscribers and in 1934 the construction of the Palace of Telephony in Bucharest was finished.

An intensive campaign (1916-1918) for the introduction of radio broadcasting in Romania was promoted by illustrious Romanian personalities, so in 1925 the association named "Radiobroadcastings Friends" was created and then in 1928 in Bucharest ,,The Romanian Radiobroadcasting Society". For transmitting the radio programs the radio station in Bucharest was designed, Herastrau and others in Iasi, Galati, Brasov, Sibiu, Giurgiu, Cernavoda, Chisinau. The first transmission by which the national broadcasting ,,Radio Bucharest" was inaugurated was on 1st of November 1928 and the speaker and first director was Dragomir Hurmuzescu. Then the others radio stations were installed in Baneasa, MW, 1929, Bod-Brasov, LW, in 1936. In 1930 there were 60,000 radio subscribers in Romania.

After radio developing, the second major discovery in telecommunications domain was the television transmission. The first public television transmission on the telecommunication link was in 1927 between Washington DC and New York (Bell Telephone Laboratories). In 1937 in Romania the first television transmission was experimented at Bucharest University and after two years, in 1939 some public demonstrations were made. Between 1953-1955, a well known professor Alexandru Spataru at the Bucharest Polytechnic University lead the researches in television domain and realized experimental equipments first for the black and white television and then and for the colour television. The public black and white TV transmission began in Romania in 1955 and in 1964 the colour public TV.

The first public TV transmitter was installed in Bucharest and began its transmission on the first of January 1957 and the second transmitter was installed in Moldavia in 1959. In Romania 38 TV stations were installed between 1962-1974, for program 1 and 8 for the 2 TV program and from 1968 the colour TV began to be transmitted regularly.

2. THE TELECOMMUNICATIONS DEVELOPMENT IN LAST DECADES

The evolution of the communications technologies, at the end of 20th century was determined by the transition from analogue to digital technologies. The appearance of the digital technologies, the progress made in producing of a new electronic components, the combination of the computers techniques with the electronics transmissions created the possibilities to transmit a lots of different information (voice, data, multimedia, TV etc.), and in the same time with a economical use of frequency spectrum.

Romania has known a rapid evolution in all segments of the telecommunication domain in the last decades. Now in our country there are many public and private radio and television stations. So there are in function about 39 radio station in MW, 20 stations in SW, 65 stations in USW and one station in LW (from 1939, located in Bod-Brasov).

Regarding the transmission of public radio program, the situation is the following:
“Romania News” is transmitted by 84 transmitters in FM and AM modulations covering more than 99.5% of population; “Romania Cultural”, transmitted by 46 FM transmitters, covering 98% of population; “Radio Regional”, has 12 regional centers and locale studios belonged to Romanian Radio broadcasting Society whose programs are transmitted by 37 AM and FM transmitters; “Romania International” has the public programs for the foreign countries produced by Romanian Radio Broadcasting Society and transmitted by 6 SW transmitters.

In the last years began the digital radio transmissions only for Bucharest, T-DAB, from Bucuresti - Herastrau station with the programs: Romania Actualitati, Romania Muzical, Radio Bucuresti and Radio 3 Net.

For public TV programs broadcasting are three telecommunications networks:

**TVR1** - is a network with national covering composed by 550 transmitters and retransmission equipments in VHF-UHF covering about 99% of populations;

**TVR2** - is a national covering network composed by 93 transmitters and retransmission equipments in UHF covering about 93% of Romanian populations;

**TVR Regional** has 5 transmitters in UHF: TVR Cluj, TVR Iasi, TVR Tg. Mures TVR Timisoara, and TVR Craiova;

For digital TV, DVB-T, there are 6 pilot projects located in Bucharest and Sibiu for a lot of programs: TVR 1, TVR 2, TVR 3, TVR News and TVR-HD (public programs) and Kanal D, Prima TV, Antena 3, Antena 1 Sibiu, Music Channel and Money Channel the commercial programs.

The connections between the studios, the sources of audio and video programs, and also for telephone subscribers, and the broadcasting, transmissions stations, located in different regions on the country was developed a large radio relay network.

The actual radio relay network and the previous development are presented in Fig. 2.

![Fig. 2. Romanian Radio Relay Network](image-url)
A very important event for diversification and development of radio and TV programs in Romania produced in 1992 was foundation of Audiovisual National Council. This was a moment for opening of competition market for Radio and TV. Now there are in Romania more then 590 radio and 295 TV licences (terrestrial and satellite) for commercial programs.

Another very important moment in the whole telecommunications history consisted in the lunch in Cosmos in 1957 of the first satellite. We can say that with the 1961 year was inaugurated the satellite communications era.

Initially the satellite communications assured the intercontinental telecommunication connections or television transmissions but in time, they gain new valences in many applications.

The first commercial satellite was Early Bird (INTELSAT I, geostationary satellite). For the INTELSAT I system was built 3 earth stations in Europe: in France at Pleumeur-Bodou, in Germany at Raisting and in England at Gunhilly. Through these stations, it was ensure the transmission of 240 telephonic channels.

Our country had a vanguard position in the field of communications based on satellites, been first and the only country from the socialist system that used the INTELSAT system and building the first station at Cheia (Prahova), that become operational in 1976.

Fig. 3. Cheia Earth Station

It was a courage attitude of Romania, in the conditions when already was operational the soviet satellites non-geostationary, MOLNIA from the ORBITA system. Conforming to the visibility conditions of the INTELSAT satellites in Romania, were placed two antennas pointing towards the Atlantic and Indian satellites, for telephony traffic and TV programs. In 1994 a new digital earth station for EUTELSAT system began operational assuring 395 telephony circuits for European communications and TV programs. A new development of Romanian earth station Cheia was in 2005 year when new, modern equipment was mounted that transformed the earth station Cheia in an important Spatial Romanian Center Cheia with 7 earth stations with different frequencies, powers and antenna dimensions. A new telecommunications services was provided for different partners:
data transmissions, VPN, Internet, broadcasting TV digital, radio broadcasting, VSAT stations, operating and maintenance for telemetry station.

Fig. 4. Cheia Earth Stations for Internet, voice, TV, hub VSAT

Fig. 5. Hub VSAT

A new and very important communications service had a large and rapid development in the last decades, the mobile cellular telephony. It was introduced in Romania in 1991 by a mixed Romanian- American society named CNM-NMC (National Mobile Communications), by
association between Romanian Autonomous Radio Communications Company and Metromedia International-USA, offering paging and trucking services.

The cellular mobile telephony became operational by 1992 by association between Romanian Autonomous Radio Communications Company and Telephonica Spain, operating in 490 MHz frequencies band. The 1996 year, can say, that represent the year of major development of cellular mobile telephony in Romania by participation on our telecommunications market of two well known European operators ORANGE and VODAFONE. Now it is the largest and useful communication service in Romania with a lot of facilities and a millions users and grate operators, ROMTELECOM, COSMOTE.

The Internet, like a very convenient and chipper alternative modality for communication and information had a spectacular development in Romania. The first steps in this direction were made by the initiation in 1971 of a first studies regarding the opportunity and the efficiency of introducing the computers network in our country. These studies were be done by Central Institute for Informatics (ICI). The success was assured by realization and operation of a first computers network in 1985, by the project named “Unirea”. The Romanian personality that promoted and leads the works to introduce the Internet in Romania was the Academician Professor Mihai Draganescu.

Now the explosive development of the computers facilities is well known and also the applications in all domains of our activities, being an indispensable instrument in our life.

But all these realizations were not being possible to be obtained without a solid and serious Romanian higher education system in telecommunications domain.

Our telecommunications school followed the technical world development. Starting with 1919 year, Augustin Maior founded the first telegraph and telephone school in Transylvania. After some years, the professor Iancu Constantinescu developed at Bucharest Polytechnic University an electro-communications department for telegraphy and telephony, and organized in some time, the first telecommunications laboratory in our Romanian university.

We can’t forget the distinguished and great scientific peoples which had major contributions in the development of telecommunications domain, like Professor Gheorghe Cartianu who conceive and realized the experimental transmissions by frequency modulations transmitters. He is the author of scientific book “Frequency Modulations” which was translated in many other languages.

Professor Theodor Tanasescu was another big savant, known like the founder of Romanian electronics school, Professor Alexandru Spataru which experimentally tested the TV equipment, academician professor Mihai Draganescu with a many contributions in informatics domain and many others Romanian distinguish researchers.

In the Romanian Telecommunications Universities good professors are teaching who educated the generations of students to be good specialists, this leading throughout history to a constant interest around the world in the development of communications means and techniques for the formation of good specialists many of them working in leading companies around the world and bringing the important contributions to the development of telecommunications domain.
3. CONCLUSIONS

Following the development history of telecommunications in Romania we found that there was a continuous evolution and modernization. Romania, by special efforts, managed to constantly track the global developments, being connected with all the achievements in this domain of crucial importance in this age of communication and communications.

REFERENCES

Abstract – The given paper presents some problems appearing during the design and exploitation of torpedo boats equipped with metal hulls, which were created by Polish engineers. After many years of exploiting wooden-hulls torpedo boats, of Soviet construction type 183, the time came to start using the more advanced ships from Polish shipyards, which, unfortunately, turned out to be of a rather poor quality. The production of the ships started with an experimental boat (type 633 D), which was being exploited between 1965 – 1980. Since 1972, there were newer, improved versions, type 664. The main advantage of those ships was their impressive speed and weaponry – four torpedo launchers – but the crew’s life conditions were far from perfect. Despite many design and building attempts of yet another improved versions of the ships type 657, 653, 655, 660 662, 663 the duty of boats type 664 ended in 1986. This means that years between 1972 and 1986 were a difficult time for the boats’ crews as they had to deal with many technical problems. Some of those technical problems are described in this paper.

Keywords – torpedo boat, shipyards, technical development, exploitation

1. INTRODUCTION

The MTBs (Motor Torpedo Boats) were included in the Polish Navy expansion concepts as early was 1920 – 1929, according to which, the Navy was to receive fifty-four of such vessels. However, Poland’s limited financial ability prevented those plans from happening.¹

The very first time when Polish Navy ensign was engraved/hoisted on the board of a motor torpedo boat was in England in July 1943 when the Englishmen gave Polish Navy an MTB marked as “S4”. It was a compensation for withdrawing artillery MTBs “S1”, “S2” and “S3”. Another six MTBs (“Vosper” type from “S5” to “S10”) were leased to the Polish Navy for the time of war, from May to October 1944. They were redistributed to the 8th MTB flotilla serving in the area of the English Channel. Once World War II was over, the ships were given back to the British admiralty².

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¹ Zdzisław Kryger, Plany i rzeczywistość możliwości bojowy polskich ścigaczy, (Biuletyn Historyczny Muzeum Marynarki Wojennej, Gdynia 2010, nr 25), 98.
² Jan Marczak, Kutry torpedowe, (Gdynia 1968), 19.
The MTBs type D-3 were the pioneers of the new sea force of the Polish Navy after 1945, when the Second World War was over. The vessels were gained as a part of the World War II reparations from the Soviet Union and were in fact the first ships of this kind which belonged to Poland.\(^3\)

At the beginning of their service, the vessels were a part of the Submarine Motor Torpedo Boats Division. Between 1946 – 1956, on the boards of KT-81 and KT-82, the first crews and cadres were trained, which later on served as the beginning of the Third MTB Brigade.\(^4\)

There was another type of MTB serving in the Polish Navy, nineteen vessels type 183, given by the Soviet Union between 1956 – 1958. Those were fast ships, 25.5m long with the speed up to 40 knots.

The vessels were equipped with two small double cannons 2M3M caliber 25mm as far as artillery weapons were concerned. The torpedo weaponry consisted of two torpedo launchers type TTKA – 53 (angle 12\(^\circ\)). 53-38, 53-38u and 53-39 torpedoes were used.

The Boats’ main drive consisted of four Diesel engines type M-50F, with the maximum power of 1200 KM and 1850 gear/min.

MTB type 183 also had four smoke bombs type MDW and one smoke-causing utility type DA-7.\(^5\)

\(^3\) Anatolij Efimowicz Taras, *Istorija torpednych katierow*, (Mińsk 2005), 216.
\(^4\) Archiwum Marynarki Wojennej (Arch. M. W.), sygn. 3522/74/78.
\(^5\) Formularz taktyczno – techniczny kutra torpedowego typu „183”.

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2. BACKGROUND & ANALYSIS

Contemporary directions where the sea combat would take place, forced the Polish Navy to put a pressure on increasing the number of small and fast battleships among its ranks. Due to the areas where marine combat would take place, the number of such vessels kept on increasing among the western countries. It was decided not only to gain the vessels from the Soviet Union, but also to create a concept of building MTBs in Poland. According to tactical and technical guidelines, an MTB built in Poland was supposed to serve mainly to carry out torpedo attacks, to lay mines and to make a reconnaissance. In the beginning, there were four different concepts and ships’ designs, which were given numbers: 657, 653, 655, and 660. The 657 ship was the smallest one, the 660 one
was the biggest. All four types of MTBs were designed to be built on a very similar fuselage, characteristic of half-sliders, which was to assure the ability to sail at high speed. Unfortunately, they were unable to move with the required speed of 55 knots and once, two partitions were flooded, it was no longer unsinkable. Special metal sheets were designed to build the ships, made of aluminum alloy knit together. The above-mentioned designs were the subject of a special counsel meeting in the Soviet Union, which took place in August 1958, during which a conclusion was made concerning, for instance, the shape of the future Polish MTB. None of the four designs were accepted by the Soviet experts (both Navy and shipyard workers were asked for their opinions), nor the Technical Committee by the Polish Navy Headquarters in Gdynia.

The Polish Navy Headquarters issued an official order to prepare two new concepts of MTBs. The designs were named 662 and 663, they had the same fuselages as the previous models, however, it was suggested to install two different types of diesel engines; the 662 model was to be designed with originally GDR engines 20KVD25, and the 663s were to be equipped with the well-known and already used in the Polish fleet Soviet forked diesel engines model M-50 (those were chosen in the end). However, many critical opinions concerning the projects were formulated, starting with the general image (especially superstructure and a too high chimney) and ending with the lack of mine lanes and the lack of possibility for the ships to throw down deep-sea bombs. A quite averse placing of torpedo launchers was also pointed out; their muzzles were sticking out of the fuselage’s outline. Other comments concerned, for example: the lack of de-magnetizing facilities, the lack of inner communication and too small fuel tanks. Despite all the negative comments, the 663 project was continued.

3. RESULTS

In 1965, on the basis of a project being carried out by the Central Warship Construction Bureau - 2 in Gdańsk and after over one and a half year long shipyard tests, an experimental MTB marked as 663D was built in Gdańsk Northern Shipyard. The MTB was handed over to the Polish Navy and was given the name of ORP “Błyskawiczny”, its tactical side number was 451. A Polish ensign was hoisted on November 6th 1965.

Fig. 2. MTB type 663D (The Polish Navy collection)

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6 Iwona Pietkiewicz, Tomasz Neubauer, Niezrealizowana wizja serii nowoczesnych polskich kutrów torpedowych w latach 1965-1986, (Colloquium nr 1, 2013), 8.
7 Pietkiewicz, Neubauer, Niezrealizowana, 9.
8 Arch. M. W., sygn. 3563/76/34.
A series of MTB 664 project, in accordance with their technical and tactical requirements were destined mainly to carry out torpedo attacks, building mine enclosures and for reconnaissance and supervision. Once some construction and equipment differences have been introduced, a series of eight MTBs were built and launched in Gdańsk Northern Shipyard between 1971 and 1973. The beginning of constructing light marine strike force units allowed to believe that the Polish warship industry, which gained the needed knowledge and experience while building vessels type 663D and 664, would eventually become competitive while providing similar services in the future. However, the 664 MTB’s service in the Polish Navy lasted only ten to fifteen years.

The characteristics of MTB type 664 were:

- **The main measurements:**
  - Total length – 24,78 m,
  - Maximum width – 7,79 m,
  - Anverage draught – 1,14 – 1,26,
  - Full displacement – 108,05 t.\(^9\)

- Artillery weaponry consisting of one double automatic sea cannon caliber 30 mm type AK-320

- Torpedo weaponry consisting of four torpedoes placed in torpedo launchers caliber 533,4mm type OTAM-53-206 with gunpowder fire (caliber 533,4 type 53-39). Two torpedo launchers were placed on starboard side and two on port side, systematically, according to the ship’s plane of symmetry

- Mine weaponry had three variants. In variant one, it consisted of two mines type KDM – 1000. In variant two it consisted of six mines type KDM – 500. In variant three it consisted of twenty mines type JAM.

- The 664 MTB’s main chemical equipment consisted of six single smoke bombs and smokes type MDS.

The ship was equipped with four lines of shafts. Two of them, the outer ones, were powered by engines type M50F3 in the arrangement of: two engines – a three-gear transmission – a shaft line. The two inner ones were powered by a gas turbine in the arrangement of: a gas turbine – a reducing-distribution transmission – a shaft line\(^{10}\).

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\(^9\) Archiwum Stoczni Północnej (A. S. P.), nr inw. 0545.

\(^{10}\) A. S. P., k. 73-74.
Table 1. A list of MTBs type „664” and the time of they served for the Polish Navy.

<table>
<thead>
<tr>
<th>Name</th>
<th>Tactical Number</th>
<th>The date of being handed over to the Polish Navy</th>
<th>The date of the end of the service</th>
<th>Time of service</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORP Bitny</td>
<td>KTD-452</td>
<td>1970-12-30</td>
<td>1986-01-31</td>
<td>15 years and one month</td>
</tr>
<tr>
<td>ORP Bystry</td>
<td>KTD-453</td>
<td>1971-12-30</td>
<td>1983-12-31</td>
<td>12 years</td>
</tr>
<tr>
<td>ORP Dzielny</td>
<td>KTD-454</td>
<td>1972-06-22</td>
<td>1981-12-31</td>
<td>9 years and 6 months</td>
</tr>
<tr>
<td>ORP Dziarski</td>
<td>KTD-455</td>
<td>1972-08-30</td>
<td>1982-12-31</td>
<td>10 years and 4 months</td>
</tr>
<tr>
<td>ORP Sprawny</td>
<td>KTD-456</td>
<td>1972-12-07</td>
<td>1986-11-15</td>
<td>14 years</td>
</tr>
<tr>
<td>ORP Szybki</td>
<td>KTD-457</td>
<td>1973-02-28</td>
<td>1984-08-31</td>
<td>11 years and five months</td>
</tr>
<tr>
<td>ORP Odważny</td>
<td>KTD-458</td>
<td>1973-08-14</td>
<td>1986-01-31</td>
<td>12 years and 4 months</td>
</tr>
<tr>
<td>ORP Odporny</td>
<td>KTD-459</td>
<td>1973-09-30</td>
<td>1986-11-15</td>
<td>12 years and one month</td>
</tr>
</tbody>
</table>

Source: Narcyz Klatka, *Kutry torpedowe typów „663D”i „664”,* (Przegląd Morski/12, 1997), 52.

4. CONCLUSIONS

The main reasons behind such short time of Polish MTB service are: Polish shipyards’ lack of any earlier experience in building ships of such kind, the usage of an innovative drive based on gas turbine which, at the maximum speed (approximately 55 knots) caused the fuselage raise above the sea level and later on made it hit the waves with great power. Mediocre quality of the fuselages made of hydronalium caused the side plating to crack (there were over two hundred and forty of such cracks spotted on the first four MTBs between 1971-1977). The social and life conditions on
the ships were also exhausting. The crews during their service at sea had to face constant high level of noise, vibrations, over 15G overloads, the lack of proper meals and rest and constant stress. While the Polish MTBs were being built, no conclusion based on a previously used MTB type 663D were drawn and it was the 663 type that was notoriously known for all those problems and failures. Taking under consideration the squandering of the technological processes used to build light marine force units, adding the costs it generated (around one hundred million PLN for each) it seemed it would have been wiser to buy the well-known and new Soviet MTBs type 206 (each costing around a hundred million PLN). All of the Polish MTBs ended their service in the Navy Shipyard in Gdynia where they all had useful, from the Navy’s point of view, parts dismantled and were later on transported to the War Harbor in Hel, where the fuselages were even more dismantled.

The only souvenir showing the shape of a Polish MTB left is an exhibit item of a 664 type (KTD-458 ORP „Odważny) which can be found in the White Eagle Museum in Skarżysko Kamienna.

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THE STUDY OF INFORMATION TECHNOLOGY USE IN THE COLLECTION, TRANSMISSION AND PROCESSING OF RADIOLOCATION INFORMATION

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Abstract – Radiolocation is the newest branch in radio technology, the radar method has emerged before World War II, but it developed especially during the great conflagration, having by then applications almost exclusively in the military field. Later, due to remarkable performances and possibilities, radiolocation started to be utilized more and more in civilian activities, from geology to astronomy and space domains, decisively contributing to the scientific successes of our contemporary society. Presently, the large-scale use of information technology in radiolocation, allows processing (collecting, processing and transmission) the enormous volume of radiolocation-related data and information of civil and military purpose (the integration degree of the two domains is greater and greater) which are utilized in the present. Nowadays, an efficient management of an extremely crowded air-space is no longer possible without utilizing the 3D type high-resolution modern radars and integrated systems for command, control, computers, communications and information which operate in real-time with guaranteed trustworthiness, accuracy and safety of delivered information to the local and international beneficiaries. In the book entitled Use of Information Technology for Collection, Transmission and Processing of Radiolocation Information, I wished to bring a few modest contributions to a field of large interest for the academic and civil communities with important preoccupations and achievements. The problematic of utilizing information technology in the sense of the approached theme is not exhausted at all, but on the contrary, new perspectives are foreseen due to the technological offensive without precedent which currently takes place. Scientific research during doctoral and post doctoral studies were focused on the following main ideas: deepening the theoretical knowledge base in the field of radar; radar digital signal processing; use and development of new IT solutions in the field of radar and implementing modern information system management of airspace.

The paper presents some basic theoretical concepts of radar, brief history of radar, principle of operating and classification as they were treated in a chapter in the book mentioned above.

Keywords – air-space, data, information technology, principle of radiolocation, radar

1. INTRODUCTION

Radiolocation is the newest branch in radio technology, the radar method has emerged before World War II, but it developed especially during the great conflagration, having by then applications almost exclusively in the military field. Later, due to remarkable performances and possibilities, radiolocation started to be utilized more and more in civilian activities, from geology
to astronomy and space domains, decisively contributing to the scientific successes of our contemporary society.

History of radar in Romania begins in 1943, when the German Army first radars installed in the area of the capital Bucharest and in the oilfields of the Prahova Valley. After the war only imported production Soviet radars. In order to assure interoperability with NATO since 1990 have been imported from U.S. radars.

2. BRIEF HISTORY

Radar is an area of Radio communication equipment dealing with the observation of airspace, land, water and space, in order to highlight the presence of objects (targets) remote, determining their exact position in space by measuring the coordinates of the parameters movement and highlighting certain physical characteristics and structure with electromagnetic waves reflected retransmitted by them or their electromagnetic radiation. In Anglo-Saxon terminology, RADAR stands for RA dio D etecting and R anging.

Historically, no nation or person can claim to have invented the radar method. This should be seen rather as the result of accumulation, development and improvement of outcomes research by scientists from different countries. There were still some important inventions peg base knowledge discovery in the radar.

Here are some of them:
- In 1865, the English physicist James Clerk Maxwell developed his theory of light and propagation, which described the radiation (light) electric-magnetic nature.
- In 1866, the German physicist Heinrich Rudolf Hertz discovered electromagnetic waves and Maxwell's theory proves so.
- In 1904, the German engineer Cristian Hülsmeyer invents “the Telemobiloskop” which fails to measure the travel time of electromagnetic waves to a ship and back, thus calculating the distance to it, shown in Fig. 1. This was the first practical radar experience. He registers first patented invention.

![Fig. 1. Telemobiloskop](image)
- In 1921 the electronic tube named “Magnetron” was invented by Albert Wallace Hull, shown in Fig. 2 and Fig. 3.

![Fig. 2. The first magnetron](image1)
![Fig. 3. Section by magnetron](image2)

- In the year 1922 A.H. Taylor and L.C. Young from the U.S. Naval Research Laboratory locates the first timber ship.
- In 1930, L.A. Hyland, all of the U.S. Naval Research Laboratory, first locates the plane.
- In 1931, the first time a vessel is equipped with radar. Horn radiators are used as parabolic antennas.
- In the 30s of the last century signaling systems for objects were studied with continuous radiation methods based on Doppler-Fizeau effect. On the occasion of ionospheric measurements it was observed that the presence of aircraft in the area has produced a strong electromagnetic field perturbation. It was also noticed that the radio link between the two vessels is interrupted then if they pass through another vessel.
- In 1935, was patented “radar principle” by A. Taylor and L. Joung in England.
- In 1935, he created the first radar aircraft using pulsed radiation. At that time it consisted of dipole antennas arranged in a planar grid, which was moved manually.
- The Scottish physicist Sir Robert Watson-Watt is considered to be the father of the radar, descendant of the famous inventor of the steam engine. In February 1935 he prepared and submitted the study entitled “Detection of aircraft by radio method” and then experienced the method by using two BBC radio antennas, located at a distance of 10 km from one another, the wavelength of 50 m, succeeding location bombing of a plane at a distance of 25 km, shown in Fig. 4 and 5. On 04.02.1935 the first patent radar was granted.

![Fig. 4. First British radar](image3)
![Fig. 5. British radar principle](image4)
History records that the radar method was applied successfully in 1936 in the Royal Navy (Royal Navy) under the name “Radio system against the danger of collision” (with 26 MHz working frequency 200 MHz).

In 1936 an electronic tube named “Klystron” was created by Metcalf and Hahn. This will become one of the most important elements of the radar being used as a tube amplifier and oscillator, shown in Fig. 6.

Since 1940 various radars are created in the USA, Russia, Germany, England, Italy, France and Japan.

Until the start of World War II and later during 1940-1945, research has continued, radars range of 200-300 km being made, ground based and ship. Radars were also made with range 2-10 km, located on aircraft for their own protection and for tracking enemy targets. Began to be used radio waves centimeters wide, with wavelengths of 10 cm and 3 cm, and decrease the time pulse survey resulted in increased capacity of separation distance.

After the Second World War-II the radar began to be used increasingly for more civilian applications.

In Romania the first radars have been installed since 1943 by the Wehrmacht, the benefit of air defence of Bucharest and Ploiesti oil zone. Radars Würzburg and Freya ensured early alarming the hunting aviation and antiaircraft artillery Romanian and German, shown in Fig. 7 – Fig. 9.
Later, after the occupation by the Soviet Union, and Romania joining the Warsaw Pact Soviet radars were imported of different types and destinations:

a) Search radars: P-3, 8, 10, 2, 14, 15, 18, 20, 35, 37, Oborona, K-66, ST-68U;

b) Height Finders: PRV, 10, 11, 13, 16, 17;

c) Precision Approach Radar: RSP, 7, 10;

d) Missile Radar Control: PW S-75 Dvina, Wolchow.

After the collapse of the Warsaw Pact and the accession of Romania to NATO, the U.S. imported radars type FPS-117 and Gap Filler, operating in the system of research, aerial surveillance and management of aviation, together with the old: P-18; P-37 and PRV-13.

Currently, radars are found on all types of missiles (ground-ground, ground-to-air, air-to-ground, ballistic and cosmic) on all types of satellites and spacecraft in aviation and maritime navigation and are always present in all fields of science and technology to the current.

3. PRINCIPLE OF RADAR OPERATING

The installation for reporting the presence objects (targets) and determining their coordinates is called a system of radiolocation, radiolocation station, radiolocator or radar. In radiolocation, the main carrier of information about the target is reflected signal or echo signal from this, similar to the sound terminology. After the source of these signals, radar can be categorized into two main categories, namely:

- **Active radiolocation with passive response**, where the signal received from the target is echo signal emitted (radio signal) and reflected by it, shown in Fig. 10. In this case, it is called primary active radiolocation. This is based on the radiolocation contrast, which consists in the distinction of reflection characteristics compared to the target characteristics of the propagation environment.

- **Passive radiolocation**, the target is highlighted by its natural or artificial radio radiation. In this case, the radar has only receiver and transmitter missing, shown in Fig. 11. An example of passive radiolocation is radio astronomy. Galactic radio sources are put into evidence and localized using special receivers, very sensible.

- **Active radiolocation with active response**, the radio signal reached the target, triggers a local installation called transponder (Transmitter Responder) which transmits a signal back to the radar receiver, shown in Fig. 12. This is known as secondary active radar. By this method the distance of detection and radiolocation contrast increases substantially (theoretically doubles). It is used to determine state ownership targets, observing targets at great distances and Earth's artificial satellites. Signal can include additional information (flight height, number of programming, target type, target identification number, etc).
The radiolocation systems or radars are complex systems and comprise mainly of the following subsystems: antenna, switch antenna, emitter (transmitter), receiver, indicator, supply system etc. Modulated pulse radars have a single antenna equipped with a special switch antenna for switching from transmitting in receiving mode and vice versa. The radar transmitter generates pulses of high frequency and short duration which can be modulated in amplitude, frequency or phase. With the antenna are emitted into space as radio signals. Direct wave that reaches target induces oscillations in its body and these acts as an electromagnetic field generator. Secondary reflected electromagnetic wave or echo signal creates in antenna a radar signal which is the bearer of information about the target, shown in Fig. 13.

The amplitude characterizes in some measure the size of the target; the delay time to the beginning of the radio signal underpins the determination of the distance and the oscillation frequency variation due to the measurement of radial velocity Doppler phenomenon. Also, the polarization parameters of the echo signal are used in assessing the target shape and the relationship between sizes. Direction of the reflected signal contains information about the angular coordinates of the target. The radar receiver performs primary processing of the received signal by separating the useful signal of noise. It can be shown using the indicating system, sent in analog shape (voltage or current depending on the parameters distance, azimuth and speed) to system of the automatic accompanying of target, or by numerical processing (secondary processing), in digital shale, C4I2 systems (system Command, Control, Communications, Computers = C4, Intelligence and Interoperability = I2).

The radar receivers operates with internal noise that can cause neutralization of the useful signal, the occurrence of false signals and errors in measurement coordinates. The same effect has passive jamming resulted from the land reflections and from of tin foils launched by the opponent. All that jamming should be considered fluctuation propagation velocity of radio waves in the atmosphere and change their trajectory random due to refraction. In addition, jamming source of fluctuations is the target weight in relation to the center of its movement trajectory, which can lead to fluctuations in amplitude until the disappearance of the reflected signals. Against the radar, especially military
ones, active jamming can be used intentionally created. Unintentionally active jamming can be created by means of radio neighbours.

Whatever complexity and destination of radars based on the following characteristics in common:

- the use of electromagnetic waves (radio) for signalling presence and determination of the target coordinates;
- transmission of the random signal in the form of a pulse, which allows increasing the separation action and the precision;
- the use of antennas with a very narrow directional characteristic which allow precisely determining azimuth the target;
- transmitter and receiver are located in the same place;
- distance to target is determined by the speed of electromagnetic waves equal to the speed of light in free space ($c = 300,000$ km/sec, in reality weather, fog, rain, clouds, etc., influence the precision determination of distance).

The radar systems can be classified according to several criteria: working range; the location; destination; type of signal sampling; the number of channels used; methods used to determine the coordinates etc. Working band radars, corresponding Very High Frequency (VHF) domain from 3 MHz ÷ 75 GHz ($\lambda = 10$ m ÷ 4 mm). After working range (wavelength) range radars can be: metric; decimeter; centimeter and millimeter.

Names of the radar bands in military (L, S, C, X, Ku, K and Ka bands) were part of a secret code during the Second World War that scientists and engineers can collaborate without disclosing information. After the war names were declassified and added millimeter band (mm).

Later names were adopted by the IEEE-Institute of Electrical and Electronic Engineers. Names of the military radar bands are largely used today in the radiolocation, terrestrial communications, satellite communications and electronic countermeasures both military and commercial. In the tables below are given radar allocated frequency bands, the wavelength are determined by the relationship:

$$\lambda_{[cm]} = \frac{c}{f} \left[ \frac{cm}{s} \right] = \frac{3 \times 10^{10}}{f} \left[ \frac{1}{s} \right] \times 10^6 \left[ \frac{1}{s} \right].$$

(1)

Table 1. Radar bands according to IEEE

<table>
<thead>
<tr>
<th>Band</th>
<th>Frequency</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>1-2 GHz</td>
<td>30-15 cm</td>
</tr>
<tr>
<td>S</td>
<td>2-4 GHz</td>
<td>15-7,5 cm</td>
</tr>
<tr>
<td>C</td>
<td>4-8 GHz</td>
<td>7,5-3,75 cm</td>
</tr>
<tr>
<td>X</td>
<td>8-12 GHz</td>
<td>3,75-2,50 cm</td>
</tr>
<tr>
<td>Ku</td>
<td>12-18 GHz</td>
<td>2,5-1,67 cm</td>
</tr>
<tr>
<td>K</td>
<td>18-27 GHz</td>
<td>1,67-1,11 cm</td>
</tr>
<tr>
<td>Ka</td>
<td>27-40 GHz</td>
<td>1,11 cm-7,5 mm</td>
</tr>
<tr>
<td>V</td>
<td>40-75 GHz.</td>
<td></td>
</tr>
</tbody>
</table>
Table 2. Radar Bands allocate to the military

<table>
<thead>
<tr>
<th>Band</th>
<th>Frequency</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF</td>
<td>3-30 MHz</td>
<td>High Frequency</td>
</tr>
<tr>
<td>VHF</td>
<td>30-300 MHz</td>
<td>Very High Frequency</td>
</tr>
<tr>
<td>UHF</td>
<td>300-1000 MHz</td>
<td>Ultra High Frequency</td>
</tr>
<tr>
<td>L</td>
<td>1-2 GHz</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>2-4 GHz</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>4-8 GHz</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>8-12 GHz</td>
<td></td>
</tr>
<tr>
<td>Ku</td>
<td>12-18 GHz</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>18-27 GHz</td>
<td></td>
</tr>
<tr>
<td>Ka</td>
<td>27-40 GHz</td>
<td></td>
</tr>
<tr>
<td>mm</td>
<td>40-300 GHz</td>
<td>millimeter</td>
</tr>
<tr>
<td>Under – mm band</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q</td>
<td>40-60 GHz</td>
<td>Universal name</td>
</tr>
<tr>
<td>W</td>
<td>60-95 GHz</td>
<td>Universal name</td>
</tr>
<tr>
<td>V</td>
<td>50-70 GHz</td>
<td>microwave</td>
</tr>
</tbody>
</table>

Table 3. Bands ECM (Electronic Countermeasures)

<table>
<thead>
<tr>
<th>Band</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>30-250 MHz</td>
</tr>
<tr>
<td>B</td>
<td>250-500 MHz</td>
</tr>
<tr>
<td>C</td>
<td>500-1000 MHz</td>
</tr>
<tr>
<td>D</td>
<td>1-2 GHz</td>
</tr>
<tr>
<td>E</td>
<td>2-3 GHz</td>
</tr>
<tr>
<td>F</td>
<td>3-4 GHz</td>
</tr>
<tr>
<td>G</td>
<td>4-6 GHz</td>
</tr>
<tr>
<td>H</td>
<td>6-8 GHz</td>
</tr>
<tr>
<td>I</td>
<td>8-10 GHz</td>
</tr>
<tr>
<td>J</td>
<td>10-20 GHz</td>
</tr>
<tr>
<td>K</td>
<td>20-40 GHz</td>
</tr>
<tr>
<td>L</td>
<td>40-60 GHz</td>
</tr>
<tr>
<td>M</td>
<td>60-100 GHz</td>
</tr>
</tbody>
</table>

4. CLASSIFICATION OF RADARS

After the number of parameters that determines the radars are divided into two categories:

- Bidimensional radars, or 2D radars, can only determine the azimuth and distance to the target. Rotation in azimuth of the directivity diagram type cosec square is mechanically, shown in Fig. 14.

- Radar three dimensional or 3D Radar, can determine the azimuth, distance and target height. Directivity diagram type cosec square is achieved by electronically movement in elevation and mechanical in azimuth of the pencil beam, or fusiform, shown in Fig. 15.
After the main areas of use radars are classified as:
- **Air Defense Radar** – ADR;
- **Air Traffic Control** – ATCR;
- **Fire Control Radar or Radar Tracking** – FCR or RT;
- **MultiFunction Radar** – MFR;
- **Radar for measuring speed** – Speed Gauges – SG;
- **Airborne Radar** – AR;
- **Mortar Locating Radar** – MLR;
- **Radar Satellites** – RS;
- **Weather Radar** – WR;
- **Ground Penetrating Radar** – GPR.

After the site of the radar can be:

a) **Terrestrial**:
   - to control and air traffic management in the aerodrome;
   - to ensure landing;
   - to observe airspace;
   - to directing aviation fighter intercept;
   - for the discovery and tracking of ballistic missiles and artificial satellites;
   - to directing anti-aircraft artillery systems and systems-air missiles;
   - to discover mobile land targets;
   - to the discovery of ballistic missiles and cruise;
   - to meteorology.

b) **Naval**:
   - to provide navigation;
   - to provide navigation in ports;
   - to research airspace;
   - to uncovering naval targets, cruise missiles and aerial targets at low altitude evolving;
   - to the discovery of ballistic missiles and artificial satellites;
   - to directing artillery systems, anti-aircraft artillery and missiles placed on ships.

c) **Placed on aircraft and missiles**:
   - radio telemeter and radio altimeter;
- for intercepting targets and directing air to air missiles;
- radio warheads;
- for warning irradiation by radar;
- research panoramic land;
- to precise terrestrial research (the observation side);
- to measure the speed of own flight;
- to close of warning about a danger zone;
- to remote airspace research and early warning;
- transponder (radar installation for asking and answers);
- to identification or recognition, IFF (Identification Friend or Foe).

d) After random signal form:
- with continuous radiation (unmodulated, modulated frequency, with modulation type noise);
- with radiation pulses.

e) After the number of channels used:
- with only one measuring channel;
- with more channels (separated spatially, separated frequency spatially, separated in frequency).

5. CONCLUSIONS

The place of the radar in science and technology is recognized today all over the world.

Basic principles of radar were discovered by physicists, but engineers and technicians from different countries fighting in the Second World War made radars so successful that they had practical consequences in the decisive victory over the Allies, even more than the Nuclear weapons.

After the war, the development of radar technology has experienced an unprecedented scale and has penetrated all areas of modern science. Today one cannot conceive of research in astronomy, medicine, meteorology, geodesy, air and naval space research without radar technology applications.

REFERENCES

MONITORING AND CONTROL CHART OF COMPLEX HYDROPOWER DEVELOPMENT ”LOTRU”

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Abstract — The work briefly presents the studied hydropower development Lotru, the flowing within the hydrographic sub-basin processes identification, the personalization of intakes of these sub basins, their encoding within the overall result, the implementation of a data base and the rules for a real--time operating. The Lotru – Ciunget HPP has an installed capacity of 510 MW (three groups equipped with Pelton turbines of 170 MW), installed flow of 81 cm/s, a drop of 809 m gross and was commissioned in 1972. At the time of edification (during the 70s--80s), the hydropower potential planning principles, the laws on environment and water management, the operation of the economic system, the existence of a socialist planned economy, etc. were different from the current requirements.

This work presents modern concepts regarding the complex capitalization of the water resources: the power supply estimated value of the water, related to the adduction routes to turbines, the technological process of a hydropower development. The monitoring and/or control chart of a hydropower development can be a co-ordination instrument of the water resource within the hydrographic basin by the operational settlement of the optimum ratio between the captured and servitude flows; a safety system in case of extreme torrential phenomena, in order to avoid the secondary adductions warping.

The IT application is materialized in a MS Access 2000 database transposing the theoretical model to optimize the exploitation of water resources within the complex intakes development and hydropower plants of the Lotru basin. In the IT application framework, there are program menus and video formats for the values’ defining and recording typical to the intakes development, for the flow daily reports and other information, also constituted as historical data and results that help to define the optimization model, as well as for the calculation, interpretation and display of the values resulting from the information processing according to the defined theoretical model.

The daily results of this data updates and of the IT processing include information about: inflow discharge, captured flow, hydraulic intakes, installed flow overcome, as well as the final results within a video format type results matrix of the intakes branches.

The application is designed in open system, allowing improvements, adjustments, simplifications.

Keywords — monitoring, hydropower, evolution of designing, Lotru hydroelectric power plant
1. INTRODUCTION

The Lotru river, the main affluent of the Olt river has a flow of 76 km length. It springs from the glacial lake Galcescu in Parang mountains, and its hydrographic basin covers a surface of 1024 square kilometers.

The hydropower development (HPD) of the Lotru river (Fig.1) is the most complex development from Romania and among the biggest in Europe. Mainly, this consists of:

- 3 hydropower plants (Ciunget, Malaia and Bradisor) with a total installed power of 643 MW.
- 3 pumping stations (Petrimanu, Jidoaia and Lotru-pumping) with an installed power of 61.5 MW with backwater heights between 185 m and 324 m and a flow water rate of 27 cm/s installed within pumping.
- 7 dams, of which: 1 rock fill dam with central clay core (Vidra – 121 m), 5 concrete arch dams with heights between 42 m and 62 m and a dam of local materials (Malaia – 21 m).
- 81 secondary intakes with secondary adductions (galleries) network of 152 km.
- 3 MHPs (micro hydropower plants) with an installed power of 1.75 MW.

The hydropower plant (HPP) Lotru-Ciunget has an installed power of 510 MW (3 groups equipped with Pelton turbines of 170 MW), an installed flow rate of 81 cm/s, a gross head of 809 m and it was started up in 1972.

The reduced water specific consumption for the power supply production, the possibilities of multiannual power compensation that Vidra development has, the possibility of adjustment and intervention within Romanian National Energetic System, pumping utilities, determine a special attention of the so called adductions and intakes secondary network, that assure approx. 75% of the annually accumulated water volume and implicitly of the mentioned actions.

Taking into consideration the above mentioned, the objects of the Lotru hydropower development can be grouped into two categories: the main branch and the intakes and secondary adductions network.

The main branch contains: the dam and Vidra basin, the plant’s intake, the adduction gallery, the overflowing surge, the pressure node, the pressure tunnel, the Lotru – Ciunget underground plant and the spillway tunnel.

The intakes and secondary adductions network (system) assure the substantial increase of the water reserve and a high efficiency of the hydropower potential, by debts collecting from the basin of the Lotru river and from the adjacent basins and their concentration into the Vidra basin. The intakes and secondary adductions system has, as we were reminding above, a substantial energetic contribution to the power supply production of the Lotru – Ciunget HPP, and its objectives are grouped, after the geographical spreading in regard to the Vidra development, into: The North Branch, The South Branch and The West Branch.
2. THE WORK'S CONVENIENCE

At the moment of building (during the ’70s – ’80s), the principles of the hydropower potential development, the legislation regarding the environmental protection and water management, the economic system operation, by the meaning of the existence of a planned socialist economy etc. were different from current requirements.

We have analyzed the Lotru development as a technologically operational system, within an individual operational elements system, in order to influence, as decision making, the real-time behavior of the objects and to determine the overall functioning in terms of efficiency and effectiveness.

The adaptation of the operation activity objectives of the major hydropower developments according to the new regulated context (European Directives and national legislation regarding the energy market, environmental and water policies, in particular) requires the transformation of the informational system attached to the process to the useful information in real time mode and immediately recoverable.

The input values provided by nature: water flow and gross head require as verifiable data necessary to help later in designing of any economic scenario. The paper work reveals the issues of an arborescent hydropower development with territorial spreading in the Romanian Southern Carpathians: the Lotru HPP.

The basic elements of a development must be identified, customized, informational known by monitoring and in real time operated by the dispatcher decision.
3. PROCESSES IDENTIFICATION AND OPERATION SCHEMES CONFIGURATION

By analyzing the Lotru development scheme, we have identified the objects (intakes, branches/sub-branches – gravitational and by pumping), hydrographic sub-basins, as well as the technological processes, lines and diagrams. The elements were codified and the synoptic diagram was concluded, so through the Access database the actual operational diagram was done with the effect of decisions making.

3.1. THE SCHEME OF DEVELOPMENT

From the operation point of view, a HPD, a HPP, a hydropower unit can be described through many sub-states caused by a variety of events (these can be seen from the operative reports and deviations of the electrical-hydro-mechanical normal schemes).

Knowing the system and therefore its components requires a comprehensive investigation able to capture the necessary details. As wide as the perspective of knowledge, it remains a limited horizon, the observer (dispatcher) never having a complete picture of the causes that generate the various states. Therefore the possible measures to prevent those events, but unable to prevent others with their costly effects.

We can consider this technical system partially observable. The subsequent evolution of the HPD, the hydroelectric waterfall or the HPP with its particular problems can be predictable and has to refer to the system past (data banks, banks of facts) or to the new trend occurring in behavior and not associated with a known previous state.

In relation with the positioning of principal axis where the concentrate effort capitalizes the HPD gross heads and water flow, the scheme elements have been identified in their reception area, with their ranking in importance as energy intake and functional role.

3.2. IDENTIFICATION

The elements: intakes, branches/sub-branches have been customized and have been established the connections in technological scheme.

A water intake from a complex hydropower system has a distinct identity. To achieve its functionality we need to know the environmental characteristics where this is placed, the own constructive characteristics and its framing within the operational system.

The hydrographic basin requires its possible operating range. Among the basin parameters necessary to be known, we reminded the following: surface, medium altitude, afforestation level, hills slope, course slope captured etc. With these parameters we can characterize the dissipation processes of precipitations energy, erosion, alluvial transport processes etc.

We consider useful to characterize all these objects that define the intake, that those particularities to be permanently available for operative analysis of some events that take place. In respect to the mentioned characteristics, the identification data of the intake object are important:
module flow, installed flow, capacity of decantation, as well as energetic importance of the object within the development.

To hierarchy the intakes of the *Lotru* HPD, we considered only the largest capitalization of the gross head, the *Lotru* HPP, this fact allows with sufficient accuracy, through the average specific consumption of water required to produce one KWh, the value ordering of objects.

The identification sheet of intake appeared as an immediately need for the stated purpose of its knowledge personality and it includes the following main elements: code, type, installed flow, gross amount of water, average altitude of the intake and the basin river, the slope coefficient of erosion, distance to nearest accumulation, as well as the branches and sub-branches that belong to it, to identify the routes of recovery.

The supply branches (gravitational and by pumping), in this case four in number, including the main supply, have been ranked on a “whole is more important than a part” principle, taking into consideration the tributary flow, sediment entrainment, recovery routes, water loss through discharge or the running technological conditioning pumping stations.

The concentration of the captured water flow through the system objects is a distinct technological process. The knowledge of it is necessary for its technical and economical efficient operation.

The process includes several successive stages to the final concentration of water. After the caption of water, the first stage takes into consideration its collection through supplying channels. The capacity of storage is given by the physical dimensions of the supply (length and diameter) and the transport one by the slope and its surface accuracy. The simultaneous achievement of both functions is realized in relation to the particularities of the objects (intakes).

The technological line of an arborescent HPD represents the arranged wire flow of the water, from the joint place to the storage place. From this site, the water is used for energetically function, after that, this one is returned in the unarranged channel. On this route are connected the hydraulic and hydropower structures that add value to captured water: the actual intake, the gallery / supply channel, intermediate storage, pumping station, pipes, aqueducts, surge tanks etc. The added value of the gross water taken from the natural sites should be the sum of the costs of maintenance, repairs and operations through the detailed evaluation.

The conceptualization of technological line (Fig. 2) can facilitate the consistent regulation of water services and would leave the prejudgment that hydro energy, renewable one, it would very cheap and that the buildings from the upstream of the technological line would be “the secondary works”. The technological lines identified for the *Lotru* HPD can be flexible analyzed according to the recovery routes, in context of other hydro distinct neighborhoods: the *Olt*, *the Sadu*, HPD for micro hydropower plants. This analysis can provide optimal solutions to avoid administrative conflicts of interest and maximize the useful effect.
4. THE RESULTS OF SOFTWARE AND HARDWARE APPLICATION

The IT application is materialized in a MS Access 2000 database transposing the theoretical model to optimize the operation of water resources within the complex captions development and hydropower plants of the Lotru basin.

In the IT application framework, there are program menus and video formats (Fig. 3) for the values’ defining and recording typical to the intake development, for the flow daily reports and other information, also constituted as historical data and results (including image information) that help to define the optimization model, as well as for the calculation, interpretation and display of the values resulting from the information processing according to the defined theoretical model.
The video format with the program’s main menu figuratively includes the intakes of the *Lotru* development into a logical functional structure (Fig. 4) based on the technological chart. Options and sub formats schematically represented by component objects for the routes that group the intakes from a sub area by which aggregates the individual intake values within the model, and by which acquires, processes, interprets and visualizes their corresponding values, can be called from this video format.

**Fig. 4. Operational structure of video formats**
The daily results of this data updates and of the IT processing are pointed for each grouping level, including information about: inflow discharge, trapped flow, hydraulic intakes, installed flow overcome, as well as the final results within a video format type results matrix of the intake branches with information regarding their utilities, ranking, pressure indicator on some intakes and control indicator for operation / shut-down function. Also, the result of the IT model still shows as a video format type routes assessment chart, showing the energy value of the intake routes and the intervention schedule related to these.

5. CONCLUSIONS

The paper work proposes a new concept of analysis turned towards objects and then to all objects of a complex hydropower development to capture the efficiency of this technical – economic system from real-time data acquisition point of view.

The system addresses in its reality of the energy – informational system, taking into consideration the development of system – subsystem specific mechanisms relations, control – self – adjustment in order to facilitate the decentralization of decision, based on the principle of subsidiarity and the allocation of each object with its own performance indicators.

Among the advantages of using this application, we remember:

- Real-time tracking of an arborescent development, spread on a large areas (about 8000 square kilometers, including the other developments subordinate to the Lotru HPD) and with objects in inaccessible mountain area.
- The assessment of each object status and the quantification of the contribution of overall technical and economic indicators.
- Each water intake, called “secondary”, becomes a “main” object treated at the different level of responsibility.
- Compared to a general object, possibly treated by common rules, each intake becomes an object with its own identity as it will collect data and facts to customize.
- The intervention in real-time mode provides efficiency, which cannot develop properly only in this way.
- The human activity is directly related to effectiveness, not just the formal confirmation of a work without the possibility of control.
- From our point of view, the control and monitoring of intake behavior, especially at the floods, has to be operationally effectuated, not just once at 5--10 years by direct verification.
- The environmental effects have a direct influence on the intake objects and we can occur into the process during its evolution and not after.
The data and the events that can be stored within a year can compensate the lack of data sporadically collected in decades, allowing the possibilities to develop the specialized researches.

The management of the anthropogenic factor actions on the relatively isolated objects becomes more efficient.

The proposed concept makes possible the monitoring and control through dispatch activity of a highly branched and a hydraulic scheme of hydropower development.

The decision for the operation of pumping system receives the adequate information support.

The management of the water volumes becomes transparent and does not generate its own conflicts of interest within the hydropower development.

The possibility of remote control operation for functional adjustments.

The database, kept up to date with history, may allow the functional analysis and decision making for objects maintenance.

A complex hydropower development, such as the Lotru HPD has been completed based on the sustainability principle and remains within the natural and social-economic landscape for more generations, knowing permanent adaptation, renewals of equipment, technologies, sometimes of initial functions. Materials are physically getting old, equipment and technologies quickly become morally outdated, society modifies its laws, sometimes the existential paradigms.

Changes became obvious when they take place within short periods. The Lotru hydropower development knew important technological reformation and new managerial challenges within a radically changed causal area:

- The Romanian Revolution from 1989 has changed the political system, and the economy passed from a sever, socialist planning to the capitalist competitive market economy system, to a new property foundation, to a new legislative frame;
- The change all over the world, touched by information technology, has technologically assessed, redesigns, conversions from analogic to digital and radical change of monitoring, protection, command and control installations with a qualitative and quantitative increase of their efficiency;
- The global matter of environment has determined, quick conforming to regulations within the field, for a development realized within given conditions, less restrictive;
- The opening of energy market, with new regulations, has assessed adequate technologies and new managerial approaches;
- Political crises with expense account into economy produce perverse effects by intervention of instant interest on cost of those on long term, frequent strategy changes, vassal management, stress on human resource, disorder of values scale etc.
Our work wants to be a future technological application, specific to transition periods, to conform human – environment relation, by knowing within real time and processing with maximum efficiency of a primary resource, renewable, with multiple functions and possible to maintain to future generations: the potable water and storable clean energy within big basins – already erected, with assumed environment costs – an environment according to stipulated requirements.

This application can be customized for any arborescent hydropower development, the Lotru HPD, with all its complexity, still being an easily replicated model.

The benefic effects of application, on long term, of the proposed solution are obvious and the necessary costs replace other operational costs, by decreasing them to the purpose.

NOTES

Abstract — The paper begins with an overview of the existing types of electric machines mass produced worldwide after the World War II as consequences of new materials and technologies setting up and new concepts generated by numerous limits in new fields applications (spacecraft, shipbuilding etc.). First of all/in the beginning the paper presents the new materials and technologies that allowed changes in design and production of a new class of electric machines in ’50s – ’70s of 20th century. Then, there are also presented new concepts that came out in ’80s - ’90s of the 20th century. These concepts led both to structure alterations and changes in the principles of operation. The paper deals with the way of implementation of two major concepts for a new class of electric machines in the beginning of the 21st century: the electric machine as an integrator of electromagnetic, mechanic and information subsystems and the electric machine as a system in permanent interaction with the environment. Certain conclusions emerged as a consequence of the analysis: promotion of electric machines new structures, which, through the materials and technologies, including specific geometries, would have the lowest possible environmental impact, on its entire lifecycle; new operation characteristics of the existing and future classes of electric machines both through design process rethinking and through widening and refining the integration concept.

Keywords — electrical machines, cybernetics, permanent magnets, constructal theory

1. INTRODUCTION

Electric machines are remarkable outcomes of the industrial era of mankind. The main structural types were designed in the second part of the 19th century, respectively in the first part of the 20th century. Their invention is due to the creative fever of 19th century with many results in this fascinating area of physics, in general, and of engineering, in particular. There are remarkable discoveries and inventions: the principle of electromagnetic induction – Michael Faraday – 1831; the unified theory of electromagnetic phenomena – James Clerk Maxwell – 1869; DC generator, industrial type – Zénobe Gramme – 1871; biphased induction motor - Galileo Ferraris – 1885; triphased asynchronous motor – Nikola Tesla – 1887, Dolivo-Dobrowolski – 1889; triphased synchronous motor – Nikola Tesla – 1888 [Multon 1995].

In this context, it is worth mentioning that most electrical rotating machines invented in the 19th century used an initial structural concept of these electromagnetic devices, which allowed a relatively easy design as a result of the principles discovered (first of all, the principle of electromagnetic induction), respectively the concept of cylindrical symmetry. Moreover, the
inductive magnetic field was the result of electric current flowing through windings (DC, respectively sinusoidal AC). The structural symmetry designed by the pioneers in this field also allowed getting a radial distribution of magnetic field for the electrical rotating machines. The industrial era required production and transmission of forces of great amplitude, but of low frequency.

The first change in electric machinery came out after 1930 and was induced by some new types of materials - based on the new concepts conveyed by the quantum mechanics - able to produce an inductive magnetic field (of excitation) without feed current flowing. This new type of materials was represented by the permanent magnets [Emil Burzo 1982]. At the same time, the new models provided by the quantum allowed gradual change of isolating materials used for electrical rotating machines [Ifrim and Notingher 1981].

Cybernetics [Wiener 1948], [Wiener 1989] by Norbert Wiener of 1948 gave way to the first scission within the industrial era: manufacturing of various qualitative articles does not require only forces of high amplitude (which means bigger volumes and, consequently, higher energies) but, on the contrary, it is necessary to create feedback conversion systems that deal with both energy and information so as to maintain control over some given forces simultaneously with high precision in article processing. This way, it was possible to use a new concept in the framework of electric machinery topology: passing from a radial distribution of the magnetic field - within the structure - to an axial distribution of this field. By combining new materials, new technologies and new structural concepts (for example by removing rotor ferromagnetic core and the creation of certain disc topologies, respectively cup for rotor armature) there were conditions for easier implementation of the principles of cybernetics (design and production of feedback systems). New ways to implement the new concepts came in the ’50s - ’70s of the 20th century, especially through the multitude of new classes of applications demanding restrictions for the electric drive system and the electric machine, as heart of driving system (decreased size, electromechanic constants as low as possible, increased flexibility in speed change at the shift, etc.) The American space program had some remarkable requirements of the applications. The implementation of structural and functional concepts required for the new applications also made possible the landing on the Moon in 1969.

The research carried out in the middle of the 20th century finally came out with a new model, which proved to be a profound/important change in approaching electric machinery: the electric machine has to be designed and produced for a definite application. A generic electric machine is not adaptable or hard adaptable so as to operate in a feedback drive system. A higher flexibility of electric machines in the framework of driving chains may be obtained through a raise of data amount transmitted within these systems. Data amount increasement requires, however, adequate processing devices. At the beginning of the ’70s of the 20th century, such a device came true: the microprocessor. This device allowed new ways/changes in electric drive systems and also implementation of new morphological concepts to the electric machinery. The most important concept of the last 20-25 years of the 20th century was of integration. In order to achieve better performance of electric machinery (especially of those in dynamic running) a new change of paradigm was required: enlargement upon the information way - the opposite way - and not the energetic way - the direct / straight way. This was possible through integration of more elements in one block,
representing, in the new context, the electric machine. An example for implementation of this concept is the stepper motor, which is functional only as integrator of the following: control module (control of static converter / control of feeding source), electromagnetic machine (the actual motor), position transducers, and electromagnetic brake [Kuo et al. 1981], [Fransua and Măgureanu 1984].

The integration principle - the only one capable to deliver performant feedback systems - is used in the beginning of the 21st century on a large scale, allowing manufacturing of a new class of electric machinery such as synchronous brushless DC machine/motor [Pompermaier et al. 2012], transverse flux motors (a new concept of electric machine with modular structure and radial-axial distribution of magnetic field) [Joliet Technologies 2014], [*** ABB] etc.

2. THE REVOLUTION OF PERMANENT MAGNETS IN THE FIELD OF ELECTRIC MACHINERY

The emergence of permanent magnets gave way to a true revolution in the field of electric machinery. Paradoxically, this revolution in technics came on the background of a deep global social fever in the times of the Great Depression of 1929-1933, the political instability that finally led to World War II and the Cold War that followed after 1945.

The classical electric machinery (designed at the end of the 19th century) suffered a dramatic change produced by the permanent magnets, first of those Alnico in 1932 and then of those of ferrite in the 50s. This change first showed in electric machines that had one of the windings fed with DC, thus generating a time constant magnetic field (inductive magnetic field or the excitation magnetic field). Among the classic machines with this characteristic are: DC machines, respectively, synchronous machines. But, since the excitation winding is on stator (the fix part of the electric machine) in the DC machine, the same winding is placed on the rotor (the part rotating) in the synchronous machine. This characteristic required major constraints in the beginning as to the replacement of electromagnetic excitation with permanent magnets in the synchronous machine. Thus, the revolution of permanent magnets first emerged in the field of DC machines (with collector) providing instant advantages: loss diminishing and increase in efficiency. Yet, there is a shortcoming, since the permanent magnets do not allow a change in excitation flux, which is a method widely used in practice to vary shaft speed of this machine (in motor running). Fig. 1 shows this important characteristic generated by the use of permanent magnets in the case of DC machines that is decreasing in size.

In time, as the technologies and researches evolved, new types of permanent magnets emerged (based on the group of lanthanides in the periodic table of elements), of which there were successfully used two great classes (second part of 20th century): type Samarium-Cobalt (SmCo₅, Sm₂Co₁₇), respectively type Neodymium-Iron-Boron (NdFeB). These new types of permanent magnets practically revolutionized the whole field of electric machinery. In the second part of the 20th century (after the emergence of ferrite magnets, in the beginning of 50s), beside the changes in DC machines, there were changes in synchronous machines. It is to be mentioned, in this context, that the implementation of permanent magnets in the structure of DC machines and synchronous machines led not only to important economic outcomes, but also generated new paradigms,
respectively new topological concepts. This way, the DC servomotors with disc rotor (fig. 2) and cup rotor (fig. 3), synchronous machines with more air gaps (disc rotors with permanent magnets) etc. (fig. 4) came to sight. It is remarkable that the use of permanent magnets in the field of electric machinery led - besides the topological changes - to a change regarding magnetic field distribution within the structure: from radial distribution to axial distribution (fig. 2 and 4) and even hybrid (radial-axial or transversal), as in fig. 5.

Fig. 1. Comparative analysis between DC machines: a) with electromagnetic excitation; b) with permanent magnets excitation [Joliet Technologies 2014]

Fig. 2. Longitudinal section (a) and exploded view (b) of a permanent-magnet DC servomotor with a disk-type armature [Fransua and Măguereanu 1984], [*** ABB]

Fig. 5, b shows a cut-view of the machine (TFM). It consists of three pieces: the stator has the core component (1), a small air gap (2) and the coil (3). The rotor consists of magnets (4) and pole pieces (5). The direction of the magnetization is marked by (6) and is the same for every pole-pair. Considering all these, it may be concluded that the permanent magnets led to a true revolution in the field of electric machinery and put/laid the basis of transition from the applications of these machines of industrial era to generic and dedicated applications (in the field of decentralized energy sources, human-like robots, home automation, etc.).

Fig. 3. Longitudinal section of a DC servomotor with cup rotor [Fransua and Măguereanu 1984]

Fig. 4. Basic structure of multi-disc coreless permanent magnet synchronous motor: a) Halbach arrays; b) Multiple disc ironless stator PM machine [Aydin et al. 2004]
Transverse Flux Machines (TFM): a) 3D isometric view of the Transverse Flux Machine; b) Detail 3D cut-view of the machine [Pompermaier et al. 2012]

Thanks to permanent magnets there are at present the conditions for transition of electric machines to information era.

3. THE GREAT SCISSION IN THE FIELD OF ELECTRIC MACHINERY

This scission came at the same time with the emergence of many innovative concepts and technologies. The fundamental concept was that of feedback system as a excellence system with auto-control. The innovative technologies that may be mentioned are: development of materials with not null magnetic characteristics and open circuit (actual permanent magnets), development of insulating materials with high electric permittivity (dielectrics better than the Y and A type insulating materials used in classic electric machines in the beginning of the 20th century), invention of the bipolar transistor (the device that actually allowed large scale implementation of the principles of cybernetics). It is remarkable that all these innovative concepts and technologies emerged in the middle of the 20th and led to many paradigm changes in the following 50-70 years.

Wiener's fundamental concept of Cybernetics led, in a certain way, to a scission in technics: on one side the fields with a long history behind and many valid applications (mechanics, optics, etc.) and on the other side the new fields with industrial applications of half century (electricity, magnetism and the electric machines). The latter side experienced an astonishing progress as a result of the innovative concepts and technologies mentioned above. Moreover, this field (electricity and magnetism) was not a conservative one and that allowed its continuous progress in fields such as electronics (both low signal and power electronics), control system theory (which continually emphasized the principle of cybernetics) etc. The ascending spiral of the many branches of electricity and magnetism gave way to a network of information and generated a new paradigm that is of integrated microsystems. This way, technics made great progress since the creation of integrated microsystems brought together the artificial and the natural feedback systems in continuous interaction (with internal and external environment), but with permanent self-control [Bejan 2000], [Bejan and Lorente 2011]. Considering the above, the electric machines got, practically, into the information era.

As a conclusion, progress in a field (particularly of electric machinery) may be acquired only by a dramatic scission, by surpassing the obsolete and accepting the innovation, by finding new ways of implementing nonconformist principles. The integration principle may represent such a new way
since by the integration of microsystems may be acquired emerging properties able to provide new qualities to the integrator system that none of its pars has.

4. THE INTEGRATION PRINCIPLE AND THE INFORMATION ERA IN THE FIELD OF ELECTRIC MACHINERY

The beginning of the '80s marked a large scale implementation of the principle of integrated microsystems. Position adjustment incremental systems made the beginnings and brought a new class of electric motors, the stepper motors. These were meant to be accurate converters of input pulses into small shift angular movements (increments called steps). The new functional paradigm led to a morphological paradigm, which resulted in a morphological-functional paradigm (the stepper motor cannot operate unless it is a single whole block/system of component microsystems). Fig. 6 shows a stepper motor as a single whole system.

The elements of the block scheme - in Fig. 6, a - may be integrated in a single whole module, as shown in Fig. 7.

It is certain that such a feeding and control scheme of a stepper motor requires a microprocessor to put in order all the signals. Of course, this element is even more necessary in a feeding and control scheme in closed circuit of stepper motor (with feedback). In this case, the complexity of the scheme increases, since other devices such as position transducers, electromagnetic brake, etc. are necessary. It is clear that in order to control integrated microsystems that means mainly to control information and secondly to control energy. That is why, using the integration principle, the electric machinery is already in the information era. The way opened by the stepper motor has continued. In this context, it has to be mentioned the feeding and control of brushless DC motors. The following figures show the ways of feeding and control of an electronic switching motor (other name for brushless DC motor) using a microcontroller ATmega32M1.

This application has been developed and tested with ATAVRMC300 and ATAVRMC310 boards. The ATAVRMC300 board is the power board which embeds the bridge while the ATAVRMC310 is the processor board built around the ATmega32M1 processor. Figure 8 gives a block diagram of the ATAVRMC310 used with an ATAVRMC300 board.
I. VONCILÀ: Electric Machines

As a result of the above, the new approach (generated by microsystems integration) requires new morphological (structural) paradigms but, also, a new language. The information era requires dramatic approaches of the new structures and also of the language widely used in the industrial era. And the problems may get more complicated considering the amount of interactions with the environment.

5. NEW PARADIGMS IN THE FIELD OF ELECTRIC MACHINERY. DISCUSSION

The access of electric machinery to the information era requires, of course, new functional principles (adequate to easier implementation of the fundamental principle of cybernetics), new materials, respectively, new technologies and also consideration of new environmental interactions both inner and outer.

The consideration of the environmental interactions is an urgent problem today. The electric machine has to be considered and designed taking into account not only its useful aspects, but also its negative and disruptive aspects that may influence the space or the energetic networks it is connected with. Finally, the negative aspects end in affecting the environment. In this context, new paradigms that would allow to predict the long term behaviour of the electric machine from the design stage will be necessary. The CAD integrated in a single whole system (electromagnetic calculation of electric armature and strength calculation of constituent assemblies) both with electric field distribution (from the inner and outer environment) and heat field distribution (also, both inner and outer environment) is the future in the field of electric machinery [Kramer and Schwarz 1999].

To fulfill the new requirements, new mathematical models, so as to allow visualization of both useful and disturbing results of these integrated conversion systems (the electric machine is an integrator system relative to its internal environment, but an integrated system relative to the outer environment), new materials and technologies and new concepts and rules will be necessary. Since the main pollution of electric machines is by heating (in long term operation). In the near future, it will be necessary to implement the structural design principle [Bejan 2000] and adopt new topological solutions so as to maximize the "energetic flows" within the new structures.
In the near future, the electric machine will be an integrator / integrated system optimized geometrically and operationally according to the structural design principle, designed for a specific application, but with a high degree of flexibility and adjustment as a consequence of using bio-algorithms (natural feedback systems, especially living systems).

6. CONCLUSIONS

In the last century, the humankind has progressed from the industrial era (force amplification with the aid of machines) to the information era (force control with the aid of information). The paper emphasized on the transformation of the electric machinery field, pointing the moments in time, the discoveries and inventions that allowed the astonishing progress in the field.

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IV. PERSONALITIES OF SCIENCE, EDUCATION AND CULTURE

TECHNOLOGY IN TIMES OF TRANSITION
THE 41ST ICOHTEC SYMPOSIUM, BRASOV, 2014
ȘTEFAN BĂLAN, REMARKABLE PATHFINDER OF HISTORY OF SCIENCE AND TECHNICS IN ROMANIA, A CENTURY SINCE HIS BIRTH

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Abstract — The paper represents an homage to acad. prof. Stefan Balan with the occasion of 100 years commemoration from his birth. His life is chronological presented on domains of activity using a documenter material as well as vivid memories kept in minds of contemporary people and rendered in a way to mix the authenticity of official documents with the emotional testimony power of those who knew him closely. Along the paper are presented accurate biographical data (origins, family, schools), but also professional activity with its achievements and evolutions reflected in: academic and honorific titles, didactic career, papers, books, design works, those accomplished like a civil engineer, as well as those referring to the development of Romanian education and scientific research. All these are emphasized by a large number of original photographs: with family, friends, construction works etc.

There are presented also a large number of publications (books) from all stages of activity and some of them are accompanied by short comments.

This paper comes like a homage, to acad.prof. Stefan Balan, at 100 years since his birth, from the Romanian school of constructions and civil engineers for his contribution to the professional accomplishment of some thousands civil engineers, more than 30 doctorate degrees and for his example of sobriety, modesty and elegance in his relations with all who knew him like professor and scientist.

Keywords — theoretical mechanics, history of science, Romanian Academy, chronological dictionary.

1. INTRODUCTION (GENERAL BIOGRAPHICAL INFORMATION)

The year 2013 marked a century since the birth of Stefan Balan, in Braila event that occurred on the day of New Year 1913. He was the first child of spouses Gheorghe and Chiriachița Bălan. Photo 1 depicts Stefan child with his mother. Classes I-IV, were followed during 1919-1923 in "School. 7" in his hometown, where he had very good results, being among the best. Secondary education was made at the "High School Nicolae Balcescu" Braila between 1923-1930. He obtained excellent results, standing testimony to this, the commemorative plate engraved with the names of high school valedictorians which include that of Stefan Balan (Photo 2).
Between 1930-1936 he followed university studies at "Polytechnic School of Bucharest", Department of Civil Engineering. Graduate diploma project of Stefan G. Balan focused on "Developing Giurgiu port," and was held before a committee chaired by Gh Emanoil Filipescu, which included professors: Ion Ionescu-Bizet, Nicolae Vasilescu-Karpen, Henri Teodoru and Cezar Orășanu.

The "Graduation Commission" granted the maximum rating, "with distinction". Immediately after graduation, the illustrious professor Ion Ionescu-Bizet (1870-1946), shook hands with great warmth leaving without words young graduates; the state of emotion was overwhelming since this famous Romanian professor have fame of being the most discerning teacher of "Polytechnic School of Bucharest"(PSB). Unusual attitude of illustrious teacher to his former student engineer is probably explained by the fact that Stefan Balan obtained the highest average graduation in history since the beginning of school, and the previous record belonged for a long time to prof. Ion Ionescu Bizet.

In the first year after graduation, in 1937, the young engineer Stefan Balan, whose degree is given in (Photo 3) obtained also the cadastral engineer certificate (Photo 4). During the same year he engaged in the "Trams Society Bucuresti" at the recommendation of prof.eng Gh.Emanoil Filipescu (1882-1937) who held the position of CEO of the company. Here Stefan Balan has conducted professional activity between 1937-1940, successively occupying positions of engineer, head of department, and municipal director. From this stage he was design engineer, coupled with tasks concerning the execution of large industrial building at the time, of which we quote: depot Panduri for 150 trams, garage "Văcărești" for 180 buses, depot "Dudești" for 200 trams, all reinforced concrete structures, located in Bucharest.

Photos 5, 6, render images during the works execution in some of the above objectives. Add to this the participation, in 1947, for the design and implementation of the viaduct Caracau (Fig. 7).
In 1943 he married Irma Maria Iosefa Prefort (1914-1998), a pharmacist by profession (Photo 8); their only descendant is mr. dr.ing. Stefan Florin Balan, who has embraced also the career of civil engineer. Stefan Balan and his son at ICOHTEC Paris Congress in 1990 (Photo 9) and with his two nieces, Stefana and Monica today both architects (Photo 10).

2. UNIVERSITY CAREER AND ACADEMIC TITLES

Between 1938-1940 worked as a substitute teacher assistant and then as an assistant professor to prof. Cristea Mateescu, Department of Theoretical Mechanics, Faculty of Civil Engineering of PSB. In 1944 he was promoted to the rank of associate professor. During this time he developed his doctoral thesis entitled "Buckling of straight beams subjected to transverse vibrations", which he presented at the Faculty of Civil Engineering of the Polytechnic School of Bucharest, on June 15, 1945, before a committee consisting of: prof.eng. A. A. Beles, (President and Scientific coordinator) prof.eng. C.C. Teodorescu and prof. N. Cioranescu. The thesis has enjoyed remarkable success, and the author was awarded the grade "magna cum laude" thus repeating the successes achieved at high school graduation and university. Below are shown the covers of the two parts of the thesis (Photo 11) (Photo 12) and Ph.D. degree diploma (Photo 13).
In 1947 he was appointed substitute of Head of the Department of Mechanics, Faculty of Civil Engineering of PSB.

In 1948, he obtained the rank of professor, and in 1949 was appointed Head of the Department of Rational Mechanics at Faculty of Civil and Industrial Constructions, in Bucharest, a job he held until 1974 when he retired [1]. Becoming a consultant professor, begun the teaching of the course "History of construction" and simultaneously to be Ph.D. supervisor until the end of life.

In recognition of his scientific work as a consecration as a personality in research and education, in 1955, St. Balan become corresponding member of the Romanian Academy. Member of the Romanian Academy was elected in 1963, at the age of 50 years.

His exposures were pursued with pleasure, because they were clear and intuitively appealing. His colleague at the Department of Mechanics, Professor Mihai Alexandrescu says about it: "I understood later, following his exposures from assistant position, and later when I taught myself, how much pedagogical talent and depth were in his pleasing appearance."


Optional course "History of construction" introduced by the initiative and efforts of Prof. St. Balan at the Faculty of Civil, Industrial Constructions in 1976 is a concrete plan of one of his concerns placed outside the domain of mechanics. Photo 17 presents the thematic plan of that course for the academic year 1981-1982.

Laboratories of the Department of Theoretical and Applied Mechanics is another embodiment of the concept prof. St. Balan on the importance of combining theory with practical applications of engineering.

Postgraduate teaching activities (publications, PhD advisers).
From the concerns of St. Balan, leading to his achievements in teaching, include works that addresses to, according to their author to "all persons who want to broaden the horizon of knowledge, deepening material universe to some delicate issues".

Among his published works of this framework might include: "On the forces of inertia and the principle of d'Alembert" 1957; "Theoretical Mechanics" Technical Publishing House, Bucharest. 1959, 1963 and 1968, in collaboration with V. Valcovici and R. Voinea; "Complementary lessons of theoretical mechanics", Didactic and Pedagogic Press. 1969, 1975; "Theoretical Mechanics", the size and posture of a treaty is one of the Romanian reference books in the field, above any comments due to, the co-authors acad.prof. V. Valcovici, nicknamed "Romanian mechanics' patriarch" and Radu Voinea, former president of the Romanian Academy. "Complementary lessons of theoretical mechanics" refers to definitions of tensor calculation, matrix and tensor calculus application in mechanics, the relation between classical and relativistic mechanics, quantum mechanical concepts, wave and statistics. Beyond the theoretical value of the work itself, deserves to be highlighted the presence in it of two points defining scientific personality of the author: a) extensive historical information on personalities of classical mechanics and the modern era mechanics b) matrix calculation applications in the automatic calculation of structures.

Recall in this context that the first PhD thesis prepared under the scientific leadership of Prof. St. Balan belongs lui.prof.dr.doc. Petre P.Teodorescu and was sustained in 1955. More than 30 followed afterwards. In 1986 was presented under the acad. St. Balan, a doctoral thesis with the topic of history of science, developed by mr. dr. physicist Liviu Sofonea.

3. ACTIVITY IN THE HISTORY OF SCIENCE AND TECHNICS

His passion for the history of science and technics came from the belief St. Balan formulated explicitly in these words: "To understand the present and future of science have to know the origins, evolution and avatars or discussions were held - sometimes for centuries - to specify a detail today that seems unimportant or to complete a formula that today is taught in the first classes of elementary school. The study of history enables science to state that science is continually refining mankind and that it opens the prospect of entering the future" [2].

No doubt that this ongoing concern acad.prof. St. Balan is a bridge between teaching and research activity.

We now review the other component of the activity of prof. St Balan on the history of science and technology, presenting a list of titles below, its main historiographical publications in chronological order, grouped into three categories:

Works on personalities of mechanics: "Galileo Galilei" 1942, 1943; (Photo 18); "Galileo Galilei, his life and work" Bucharest, 1957; "And yet it moves" Bucharest, 1963; "Galileo's influence in Romania", Bucharest. 1973; "Copernicus", 1973;

Works on universal history of mechanics: "The history of mechanics" Scientific Publishing House, Bucharest., 1966 (collaboration with I.Ivanov) (Photo 19); "History of Mechanics", 1970 (in collaboration with I. Ivanov); "Chronological dictionary of universal science and technology" (Acad
Stefan Balan - Coordinator, Scientific and Encyclopedic Publishing House, Bucharest, 1979 (Photo 20);

Works on the history of science and technology in Romania: "Chronological History of Romania", 1972 (collectively) on the history of technics in Romania; "Romanian precursors in world science", 1975 (in collaboration with N. Mihailescu); "The chronology of the history of science and technology in Romania", 1975 (together with N. Mihailescu); "The history of science and technology in Romania", Romanian Academy Publishing House, 1985 (in collaboration with N. Mihailescu) (Photo 21).

From the above list we selected a very brief presentation of the monograph "The history of mechanics" which is a reference contribution to Romanian historiography. Without going into details we highlight a few characteristic aspects. This work contains 762 pages, are presented and briefly analyzed contributions over two and a half millennia of science heritage, an impressive variety of famous people, around 1000. The bibliography contains 1829 titles in ten languages (some of which are translations of the original), including magazines and other periodicals of international prestige. A considerable section of the book deals with historiography mechanics containing bibliographic references to over 20 magazines and about 200 famous authors from all over the world, including Romania.

Personality of scientific reference in the landscape history of science and technology, Stefan Balan acquired notoriety as that, among other things, was manifested by national and international recognition of his merits in this field of research. Delivering this recognition is shown in the list below, which highlights the positions held in various national and international scientific forums.

- In 1971 he was elected a member of the "Committee of science policy" of the "International Union of History and Philosophy of Science" (IUHPS), and in 1977 became a member of the board of this organization, a position he occupied until 1985;
- In 1978 he was elected a member of the "Academy of History and Philosophy of Science" in Paris;
- Between 1983-1991 he was president of the "Romanian Committee for History and Philosophy of Science" (CRIFS) Romanian Academy. In the same period, he held the position of editor in chief of "Noesis" published by the Romanian Academy;
Between 1981-1989 (elected in two legislatures) was president of the "International Committee for the History of Science and Technology" (ICOHTEC).

As a member of IUHPS management he had initiated the organization of the "XVI International Congress of History and Philosophy of Science" in Bucharest in 1981, the first scientific event of this scale in the field carried out in Romania;

His passion for the history of science and technology, crowned with remarkable results, gives prof. Stefan Balan a prominent place not only in the Romanian historical research but also in international campaigners, organizers and promoters of history of science and technics. As concrete evidence in this regard are official documents which sealed certification "Cabinet of history of science and technology" in the Institute of Construction Bucharest (1976) (Photo 22) and introducing optional course "History of construction" to Institute of Construction Bucharest, 1976, both actions being its initiatives. This course led by Acad. Stefan Balan had worked for 15 years until his death. Photo 23 Academician Stefan Balan takes one of his last presentations at Romanian Academy.

4. SCIENTIFIC TITLES AND FUNCTIONS IN DOMESTIC AND INTERNATIONAL FORUMS

Domestic and international recognition of personality Acad. St. Balan was manifested by a series of impressive features and honorary titles that have been granted. Some of these were mentioned in the section on the history of science and technology. In the following we present others, in chronological order: Member of the "Commission for Higher University Degrees" of the Ministry of Education 1956-1990; Vice President National Committee of Engineers and Technicians and Chairman of the Department of Civil Engineering between 1956-1990; Vice President of the "International Bureau of Education" (UNESCO) between the years 1958-1959; Vice President of the World Association "Congress of Scientists" (1962); RILEM member (1969); Chairman of the Scientific Council of the "Center of Solid Mechanics" of the Romanian Academy (1970-1977); member of the "Academy of Sciences in New York" during the period 1980-1991; Member of the "American Association for the Advancement of Science" (1981-1991); President of the "Department of Technical Sciences" of the Romanian Academy (1984-1991); Member of the editorial board of the "Revue des Sciences Techniques Roumaine, Mécanique Appliquée Series".
We present the most important national and international awards: "State Award" for its contribution to the "Romanian Technical Lexicon (1956); Award "Aurel Vlaicu" of the Romanian Academy for the book "Cromoplasticitatea" (1963); Order "scientific merit Class I" (1966); The title of "Grand Officer of the National Order of Merit" awarded by French President Ch De Gaulle (1968); The title of "Scientist Emeritus" (1970); Medal "Peace Medal" of the United Nations Organization, (1974); Award "Aurel Vlaicu" of the Romanian Academy for the book "The earthquake in Romania on March 4, 1977" (1983);

Finally, a recognition of personality acad. St. Balan who perpetuates his memory in the collective consciousness of generations of teachers and students: Amphitheater II-1 of Faculty of Civil Engineering, Bucharest, bears his name. (Photo 24). In the same manner his presence in "Little Pantheon" of the Department of Mechanical Construction Statics and Dynamics "department whose chief was over a quarter century (Photo 25), where the image appears alongside those of other personalities known Romanian technical education construction: prof. S. Hangan, acad.prof. A. A. Beles and prof. ing. Al. Gheorghiu.

5. CONCLUSIONS

Stefan Balan’s thread of life ended March 26, 1991, so shortly after the age of 78 years. It was still an active person occupying management positions within the Romanian Academy, President of the "Department of Technical Sciences, Editor of the Journal Noesis, President of the Romanian Committee for History and Philosophy of Science.

He left a vast scientific and didactic work, reflected in 42 books published in the country and abroad, over 200 public lectures and 62 scientific papers, presented at various events (congresses and other scientific forums, radio, TV and so on).

Today, after a century from his birth Romanian higher technical school brings homage for his contribution to the training of thousands of engineers and over 30 PhD's, and for the example of modesty, sobriety and elegance in its relationships with all those who met.

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AUTOMOBILE COACHBUILDING IN THE EARLY 20TH CENTURY IN PORTUGAL: CRAFTSMEN SKILLS AND CUSTOMS POLICY AS FACTORS TO SOFTENING PERIPHERAL STATUS

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Abstract – As it happened throughout Europe, automobile coachbuilders in Portugal developed their new activity from established carriage builders. Naturally, one can find very early the same design principles and the same construction techniques of carriages on the very first bodywork motor car production. In Portugal, despite the lack of an automotive industry, the coachbuilders had a very healthy and reliable activity, assuring a consistent production of approximately 15% of the overall annual car sales. Craftsmen skills were, obviously, one of the keys for this economic success. Years of training and a huge production experience lead to high quality bodies, similar to French and British work. On top of this, cost production factors (feedstock, labour and energy) and a custom protection policy gave to this industry the necessary boost for its development and consolidation. In the present work we will summarize the flourishing coachbuilders’ activity in Portugal, in the early years of the 20th century, studying the production costs and the influence of customs policy on its activities.

Keywords – Automotive Industry, Coachbuilders, Automobility

1. INTRODUCTION

At the end of the 19th century the horse heritage had a large influence on the raising of the automotive industry. In order to adapt the small thermic enginesto the existing rolling structures – already in use to produce energy for industries, with low output figures, but very simple to work and to maintain – engineers choose basic technical solutions. For that reason the very first automobiles were basically horse carriages with engines or simple structures designed according to bicycle principles, already largely developed and tuned – namely, the welded tubes frame, the roll bearings, the wire wheels and the transmission chain. Therefore, the horse carriages, or similar frames, fitted with engines, were reduced to the simplest structure possible without any kind of body for driver and occupant’s protection and comfort. This initial trend was emphasized by a lot of automotive historians, namely Georgano1 who stressed the minimalist design on the first relevant
German prototypes such as the Benz Tricycle, in 1886, or the Stahlradwagen built by Daimler in 1889. From 1890 onwards the new motor cars started to receive bodyworks directly inspired on horse carriages tradition, as it was stressed by Anthony Bird.  

The bodywork of the earliest experimental motor cars was a mere afterthought, little more than a seat perched a-top the machinery and when the car developed into an article of commerce, in the early 1890’s it was natural that the coachwork and fittings should follow established carriage patterns as closely as possible. Various mechanical details, however, obtruded themselves, and these dictated changes and finally demanded the evolution of quite new body styles which had little but their names – Phaeton, Cabriolet, Victoria, Dog-cart, Brougham, Landaulet – in common with the carriages on which they were based.

At the very beginning of the 20th century, motor car vehicles became a more family related purchase and comfort became a more important critical variable than power, speed and dynamical behaviour. Therefore, besides the dynamical behaviour, a motor car should also be able to avoid sun radiation, road dust, exhaust emissions, rain and snow: the car body was, thereafter, a key issue in the designing of an automobile. The historian Enrico Aceti stressed the evolution of the design and the growing conscience of protection needs.

Still, for many years, the main motor car builders were focusing their industrial work on the mechanical topics, building mainly chassis fitted with engines, transmission, suspension and brakes, I mean the overall without a body.

The motor car designers at first had no option; they hat to go to the established carriage builders. Similarly the carriage builders felt obliged, rather reluctantly at first, to provide the coachwork for the noisy stinking contraptions they so much despised. So we find very early in the business such famous names as Kellner, Rothschild, Mulliner and Hooper associated with the motor trade.
This strategy had a large influence on the development of several coachbuilder workshops, already used to build and assist horse carriages and some of them were then appointed as official coachbuilders for some brands, integrating the chain value of the new automotive industry. In fact, the coachbuilders already engaged to produce horse carriages, soon realize that there was still a lot of business potential to develop, since the tools and procedures to build motor car carriages were exactly the same adopted on horse carriages. In Europe names like Kellner, Rothschild, Binder, Mulliner and Hooper, amongst others, despite keeping their horse carriage production, went deep into the new motor car business, using its astonishing know-how.

2. BACKGROUND AND ANALYSIS

In Portugal, a small horse carriage industry was already active since the middle of the 19th century. These tiny workshops were, at the very beginning, just spots for maintenance and some tuning, but, gradually, they started to produce components like axles and wheels and, in the end, they were able to build an entire carriage. This kind of “learning curve” was also seen on other peripheral countries. Portuguese production of motor car bodies grew steadily, after 1905. Statistical reports regarding import figures for Portuguese automobile market shows that rolling chassis, i.e. chassis without bodies, rose up to almost 15% of overall motor cars sold in the country, as we can see in the following chart:

![Fig. 2. Sales Volume for rolling chassis in Portugal and its weight on overall sales](Boletim do ComércioMarítimo)

On top of the brand new car bodies’ production, Portuguese coachbuilder industry was also able to respond to a new market demands:

i) The body repairing process – Crashes and incidents started to increase due to traffic growing especially on big cities.

ii) The substitution of the initial body due to malfunction – In cases of poor quality production or after some years of intensive use, some bodies gradually loosed their functionality, demanding for deep changes or a complete replacement of the structure in order to upgrade design, comfort, layout, fabric and others.
iii) The production of a second body to change according to weather constraints or just for social and design reasons. In fact, for a certain type of customers, there was a demand for a closed body for winter purposes and an open one for the mild seasons.

iv) The development of motor cars on different segments of economy such as passenger transport, urban distribution or heavy duty transport giving room to a set of new opportunities in terms of design and production. Public transports in motor cars started in Portugal in 1905 and service lines spread all around the country, as a complement of train lines offer.

The Portuguese coachbuilding industry was definitely encouraged with the growing of several industries related –wood sawmilling and furniture – during the last years of the 19th century, raising the number of specialized workers and their training level. Apparently there was no lack of qualified labour work to match with the increase of demand for motor car bodies on national market and the industry was able to optimize their services without any kind of labour constraints. Obviously, the most important companies working on this field were settled on Lisbon and Porto – the bigger markets – but surprisingly there were also some workshops on smaller towns like Portalegre and Tomar. There are no details concerning design and production figures of each individual company but some contemporary articles point out an annual volume of around 40 units for the entire activity. The pictures known from press articles show some workshops, crowded with workers and body structures, chassis and raw materials, revealing an intense and committed activity.

![Fig. 3. Workshop of a Portuguese coachbuilder (Volante (Lisboa), Dezembro, 27, 1931, 35).](image)

### 3. CONCLUSIONS

In Portugal, the coachbuilder industry started effectively in 1905, with a sustained activity onwards, thanks to some key issues directly responsible for its growing behaviour, namely:

i) They were not “start-up” industries once they all came as a development of horse carriage industries already settled in the market. The Portuguese coachbuilders start their activities on horse carriage industry, first on maintenance, then by producing components and finally they were able to build all the body cars. This was an interesting advantage for the business
consolidation once they were able to use the same premises, the same tools, the same machinery and the same raw materials for both types of production. The handicraft skills of the entire staff were also fully recyclable for the new motor car business.

Fig. 4. Outside premises of the coachbuilder Emídio Quintela (Porto). Motorcars and carriages were able to share the same space without any constraints (AMP)

There was a clear custom policy to protect this new industry, overtaxing the motor cars imported with a complete body, towards rolling chassis that had smaller custom taxes.

ii) Production costs were smaller on hand labour side – despite the fact that specialized workers on this kind of industry were getting wages clearly above the average.\textsuperscript{14}

iii) Domestic raw materials (namely the different types of wood used to produce body structures) were also cheaper than the imported ones.

iv) The quality of motor car bodies produced on Portuguese workshops was good enough to face foreign competitors. In terms of design, national production was not focused on originality, but on replicating the best practices of French and British coachbuilders.

v) Finally, automotive industry kept for many years the procedure to design their cars with an independent chassis, giving to coachbuilders a total freedom to create their bodies.

Fig. 5. Chassis of motor cars on a working shop (AML)
As we have already stressed, the quality-wise Portuguese offer on motor car body production was competitive. Therefore, the economics was resumed to a simple cost balance. At this time, if a distributor has a motor car sold, he could place the order with or without a body, depending on the customer’s requests, but also on its ability to steer customer towards its own convenience. In Portugal, a motor car without body would pay less custom taxes, as we have already noticed. Let’s call the difference between custom taxes for a motor car with and without body the variable $\Delta_2$. This variable was, strictly, a political one, exogenous to the industry – but, nevertheless, decisive to steer the cost balance. On the other hand, we can define another variable, $\Delta_1$, endogenous to the industry, directly related with labour costs (hand labour and training), raw materials costs, energy costs, funding costs and eventually logistic costs. This variable would stress the total cost difference between a body designed and produced abroad compared to a body built in Portugal. The sum of $\Delta_1$ and $\Delta_2$ is the gain associated to Portuguese coachbuilder production. Typically, on the small market segment that sum could rise up to 20%, but on the upper segments that value could reach an amount around 8%. Despite these values, imported bodyworks were the majority on the market due to two critical reasons: on one hand, the lead time was shorter, once the capacity of foreign industry was far bigger than the domestic one; and on the other, an imported body was definitely fancier for the upper classes, used to consume regularly imported products.

The favourable cost balance on lower class motor car segments was, apparently, the key issue for the development of coachbuilding industry in Portugal. The news published on the specialized magazines pointed out a growing activity and a consistent demand for products and services. Even the Royal Family was a regular customer for this industry. Quality was also praised by the press assuring that its standards were at a European level.\textsuperscript{15} Definitely, one can conclude that craftsmen skills on Portuguese coachbuilding industry, with high standards production and competitive prices, were one of the key parameters in order to insure the survival of the workshops. On the other hand, a protectionist policy, implementing higher taxes for the foreign motor car bodies, was also able to give to the industry a bigger market and, consequently, a profitable trend for their activities.
As we previously saw, there were some variables that could be fixed and compared with other European countries in order to determine the peripheral level of this industry. In Portugal, approximately 15% of total motor car market was using bodies designed and produced locally. On the other hand, it would be also interesting to evaluate the parameters $\Delta_1$ and $\Delta_2$ on other peripheral countries in order to discuss their values and foresee some trends on further discussion.

NOTES

1 “On a souvent dit que les premières autos n’étaient que des voitures sans chevaux. Il est plus exact de dire que les véhicules pionniers furent des moteurs sur roues sans aucune carrosserie proprement dite. Cette considération s’applique certainement au tricycle de Benz de 1886 et au «Stahlradwagen» Daimler 1889, même si la première voiture de Gottlieb Daimler de 1886 avait été une charrette hippomobile modifiée. Il fallut attendre le milieu des années 1890, époque où les constructeurs commencèrent à proposer différentes carrosseries, pour voir les traits caractéristiques des voitures hippomobiles transférés à l’automobile, Au début il s’agissait toujours de carrosseries ouvertes car le moteur étant de faible puissance, aucun constructeur sérieux ne l’aurait chargé du poids supplémentaire d’une carrosserie fermée.” Georgano, Les Voitures de 1886 a 1930 (Paris: Librairie Gründ, 1990), 79.


4 Bird, Antique Automobiles, 135.

5 Body-engineering techniques for cars were literally carried forward from the days of the horse-drawn carriage. People were accustomed to instruct builders of carriages to design and create special bodies for them to meet their requirements. These coachbuilding skills, and also the personal customer contacts of the relevant companies, were carried over directly to the new horseless-carriage era”. Karl E. Ludvigsen, “A Century of Automobile Body Evolution”, The Automobile, 76.

6 “Dans les années vingt, les plus belles carrosseries étaient encore construites selon les méthodes traditionnelles remontant au XVIIIe siècle.” Georgano, Les Voitures de 1886 a 1930, 197.

7 “In Britain, for example, Hooper & Company was founded in 1805. For more than 130 years, it held the warranty to supply coachwork to the British Royal Family. Britain’s Barker was founded in 1710. Its first car body was constructed for Charles Rolls in 1905. The Mulliner line stems from the coachbuilding business of Arthur Mulliner, founded in Northampton in the 18th century. In 1900, H.J. Mulliner broke away from the family business to found a car body-building company in London.” Georgano, Les Voitures de 1886 a 1930, 204.


10 José Barros Rodrigues,“Os Automóveis na Rede de Transportes Públicos Portugueses: um exclusivo da iniciativa privada”, (paper presented at the annual meeting for the APHES, Braga, Portugal, November 15-16, 2013).


12 José Hipólito Raposo, Carros de Cavais em Portugal – Século XIX (Lisboa: INAPA, 1995), 104.

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MAN – MACHINE RELATIONSHIPS: BRITISH AND GERMAN FIGHTER ACES IN WORLD WAR II

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Abstract — World War II fighter aces have received much attention, especially in the English language media, and the literature is still growing. This is true of pilots from Britain and the United States but particularly of German fighter pilots such as Hans-Joachim Marseille who is often depicted as a romantic hero and as a “knight of the sky.” There is similar literature in German but because of Nazism and the lost World War II it is not as extensive. But the emphasis of this paper is on the relationship of British and German fighter pilots with their aircraft exemplified by the Supermarine Spitfire Mark I and the Messerschmitt 109 E. Both aircraft had their assets and deficiencies. While the German aircraft was light, agile and easy to produce it was rather difficult to fly. Pilots like Hans-Joachim Marseille developed an intuitive relationship with it bringing out its strong features to the full and often managing to carry out flight manoeuvres which their comrades regarded as impossible. The more benign Spitfire made combat easier for British pilots although they had to cope with the performance drawbacks of the carburetor engine. Generally speaking there does not seem to have been a large difference in the flying skills and technical skills of British and German pilots, although the overall quality of German pilots deteriorated in the second half of the war. Whereas in Britain high command considered individual praise of fighter pilots as detrimental to the achievements of the equally brave bomber and reconnaissance airmen, in Germany the government supported “stardom” of the fighter pilots. In the loose section of two, nicknamed the Rotte, the wingman usually kept the leader’s back free who was then credited with the “kills.”

Keywords— World War II, Britain, Germany, Fighter Aces, aircraft technology

1. INTRODUCTION

“Fighter Aces” in the two World Wars have received much attention, not least in popular literature and in the movies. Their bravery and sometimes chivalry was the subject of many, often questionable, publications. But what about their tools, their aircraft? Here, too, the literature is extensive, particularly in English. Regarding the relationship between pilots and aircraft, however, we are less well served: Literature on this is distinctly thin and there are no comparative studies on this issue.

My paper makes an attempt to tap into this field. It is to an extent based on published interviews with World War II pilots and their assessment of two prominent British and German aircraft, the Supermarine Spitfire Mark I and the ME 109 E. Regarding pilots, two World War II “fighter aces” are in the forefront, Douglas Bader and Hans-Joachim Marseille. Based on the present state of my research, my thesis is that the
differences between British and German fighter pilots and contemporary observers regarding man-machine relationships were small. It seems, however, that in Germany there was a bias towards emphasizing the spirit and character of the pilot who, if needs be, would be able to make up for any deficiencies in the machine. This idea was in line with and fuelled by Nazi propaganda. Interestingly enough that view was and still is echoed in English language literature on German War Aces; it obviously sells. The German Wikipedia entry on Hans-Joachim Marseille is five pages long whereas the British entry has forty-two pages. Of course, Britain had their fighter ace heroes, too, but they seemed to have had a more “functional” role in the context of a team composed of humans, aircraft, infrastructure etc.

2. AIRCRAFT: DESIGN AND PRODUCTION

Let us have a look at two representative World War II aircraft, the Supermarine Spitfire Mark I and the Me 109 E. The Supermarine Spitfire was a short range, high performance interceptor aircraft designed by R. J. Mitchell, chief designer of Supermarine Aviation, a subsidiary of Vickers Armstrong. The design was intended to make fast climbs possible in order to successfully attack enemy bombers. Mitchell designed the distinctive elliptical wing to have the thinnest possible cross section. Although the Spitfire Mk I had its maiden flight on 5 March 1936 it got into production only in mid-1938. The main reason for this significant delay was that several important components, especially the wings, were produced by contractors outside. (Price 1982, 65).

Like the Spitfire the Me 109 was an all-metal monocoque construction with a closed canopy and retractable landing gear. It was powered by a liquid-cooled, inverted V12 aero engine. In March 1936 the German Air Ministry received news that the British Supermarine Spitfire had been ordered into production which for the Ministry meant that the Me 109 (first flight on 29 May 1935) had to get into production rapidly. That happened from 1937 onward. The Messerschmitt designers had aimed at a lightweight design affording high agility. To allow fast production they tried to minimize the number of separate parts. There should also be easy access to the powerplant, fuselage, weapons etc. (Cross and Scarborough 1976, 60–61). One of the design drawbacks consisted in a narrow wheel track causing instability when the aircraft was on the ground. To increase stability the engineers splayed the legs outward with the result that the loads imposed during takeoff and landing were transferred up through the legs at an angle. Particularly inexperienced pilots found this difficult to cope with and this resulted in many ground accidents.

From the mid-1930s onward Germany tried to produce more and better aircraft than the later Allies, particularly Britain. For various reasons such as lack of raw material, factories and qualified labor Germany did not succeed. With regard to British air armament in the late 1930s there is an irony and a case if unintended consequences: For propaganda purposes the German Air Ministry significantly exaggerated the increase in German aircraft production and the Quality of the aircraft. This made it easy for Winston Churchill to ask for additional British government money to be spent on new aircraft. From March 1939 Britain’s growth of aircraft production exceeded that in Germany. (Braun 1995, 187-88).

Generally speaking the performance of the Spitfire compared to the Messerschmitt did not differ very much. But the Me 109 was more compact than the Spitfire and was designed for high speed flight. The Spitfire’s wings were about thirty per cent larger than the Messerschmitt’s which resulted in the Me’s
disadvantage of a higher wing loading. The Me 109's smaller wings were of Messerschmitt – patented single spar construction. But there was also an advantage to this: The trapezoid shaped wings were much easier to produce than the widely praised elliptical wings of the Spitfire. But the Spitfire could fly more slowly and had advantages in tight manoeuvres. Ironically, R. J. Mitchell, the Spitfire designer, has sometimes been accused of copying the wing shape of the German Heinkel He 70 which flew first in 1932. (Price 1972, 33-34). There was another asset the Spitfire had compared to the Me 109: When the wing roots started to stall the aircraft vibrated, warning the pilot and even allowing inexperienced pilots to fly the aircraft to its limits. (Bungay 2001, 78). But the advantages of the Spitfire's wing design came at a price: Its complexity and the precision work required from the manufacturers caused significant delays in production. This problem increased when the work was put out to subcontractors. (McKinstry 2007, 79).

With the Me 109 stall occurred more sudden. To remedy this, the Messerschmitt engineers used automatically opening leading edge slats thereby increasing the lift of the wing. Ironically this was not a German invention but a British de Havilland patent. The high angle of attack (AOA) increased the airflow at the wing and improved the slow flight properties of the aircraft.

3. AIRCRAFT, PILOTS AND AIR BATTLE

After concentrating on aircraft design and production I will now put an emphasis on the issue of aircraft and pilot. The technical features of the Spitfire and the Me 109 made differing demands on the British and German pilots. Especially in the German case great expertise was required which decreased as the war progressed. In the case of the automatically opening leading edge slats this asset came with a drawback: The automatically opening leading edge slats could open at different angles.

This resulted in differing lift conditions which could cause severe problems in handling the aircraft. Nevertheless in several cases Me 109 pilots managed to gain advantage in dog fight. This was mainly due to the experience they had gained under combat conditions as members of the Condor Legion in the Spanish
Civil War. At the beginning of World War II Germany had more experienced pilots than Britain which meant that British pilots were often unable to use the full potential of their aircraft. But this changed as the war continued.

There was another issue in which the Spitfire differed from the Me 109: The Me 109 used fuel injection whereas the Spitfire’s Merlin engine was equipped with a carburetor that could not cope with “negative “G”: In a near vertical dive the pilot had to take negative G. He was then at the outside of the curve; the effect of gravity pulled him out of his seat and threw him against his harness. The Merlin engine stopped delivering fuel whereas the Messerschmitt Daimler Benz engine with direct fuel injection was not affected by this. But there was a way for Spitfire pilots to minimize this negative effect. The Spitfire could roll over on its back and dive but this took a few seconds which gave the Me 109 pilot a welcome opportunity to disappear.(Forrester 1979).

Later, Rolls Royce engineers devised a footless carburetor which functioned reasonably well so that the Messerschmitt pilots had to change their tactics. RAF pilots who evaluated the Me 109E commended its excellent response at low and medium speeds, good low speed climb angle, lack of any tendency to stall and short take-off runs. But among criticism voiced were control heaviness at the upper end of the speed range, poor view for taxying, the absence of a rudder trimmer necessitating the continuous and tiring application of rudder to fly straight at high speeds and an uncomfortably cramped cockpit.(Green 1979, 542).

In dogfight maneuvers the pilot was on the inside of the curve his aircraft was describing. He was thus subject to “positive G” which rammed him down into his seat. Positive G could make him loose his consciousness because the blood rushed to his feet draining his brain. It is an irony that under those conditions somebody with a serious physical disability should have an advantage. This was the case with Douglas Bader (1910-1982), a well- known British World War II fighter pilot. Bader joined the RAF in 1928. He was a daredevil pilot flying dangerous and illegal stunts. In December 1931, doing some low flying aerobatics, the left wing of his aircraft touched the ground and he crashed losing both legs. (Bader 2004). He was fitted a pair of artificial legs and had to retire on medical grounds. But with the beginning of World War II Bader returned to the RAF, soon scored his first victory over Dunkirk during the Battle of France and participated in the Battle of Britain. It can be assumed that, apart from his flying expertise, Bader’s success as a fighter pilot was partly due to his having no legs.

As mentioned before pilots pulling high “G-forces” in combat often “blackened out” when the flow of blood went from their brain to other parts of their body, particularly their legs. Because Bader had no legs he could remain conscious longer thus giving him an advantage over his more able – bodied opponents. His near fatal accident of 1931did not reduce his willingness to undertake extremely risky maneuvers. He crashed repeatedly and, contrary to official orders which ruled that pilots should fly line-astern and attack singly, he preferred using the sun and altitude and to ambush the enemy. (Turner 1995, 24).
To an extent, Hans-Joachim Marseille (1919-1942), the German fighter pilot who became known as the “Star of Africa” by Nazi propaganda and later in a German movie of 1957, can in some aspects be regarded as a counterpart of Bader. Marseille claimed 158 victories all but seven against British Commonwealth pilots. Adolf Galland, a German World War II fighter ace, called him the “virtuoso among the fighter pilots” alluding to the fact that Marseille was able to make use of the Me 109 E’s possibilities to its extremes. As a child he was physically weak and looked like a ballet dancer. He was a highly gifted caricaturist and also played the piano well; his mother wanted him to become a concert pianist. As a young man Marseille was an “enfant terrible”, undisciplined and rebellious. Although the instances of his breach of discipline were exaggerated in the 1957 movie “The Star of Africa”, there is much evidence in the sources that even after he had joined the German Air Force he caused his superiors many problems. He obviously was a gifted pilot but violated virtually every rule of fighter combat and seemed to be unable to fly as a wingman. (Heaton and Lewis 2012, 25). He damaged and crashed numerous Me 109 Es and was often passed over when it came to promotion; Marseille was the oldest ensign in the German Air Force. (Cronauer 2012, 18). Baggy trousers, a shag pipe and a penchant for jazz music were his trademarks, and there were rumors that he had been a member of the German “Swing Youth” with the Nazis regarded with utmost suspicion. (Tate 2008, 92 - 94).
Fig. 3. Hans-Joachim Marseille

But from late 1940 his new wing commander Eduard Neumann seemed to have found the right way dealing with him. Marseille developed some idiosyncrasies, for example the tactic of diving into enemy formations from either above or below. This sometimes resulted in fire from all directions and in a badly damaged aircraft. He also became an expert in high angle deflection shooting, targeting the opponent from the side rather than from behind. (Spick 1996, 120-124). In his highly unorthodox way of combating Marseille often attacked under difficult conditions. When attacking Allied aircraft he, rather than using full throttle, dramatically reduced the throttle and lowered the flaps in order to reduce speed. He thereby shortened his turn radius significantly. (Kaplan 2007, 173). Marseille, who was promoted rapidly and became the youngest captain of the German air force, is a good example of a pilot who managed to overcome limitations in his aircraft, in this case problems of manoeuvrability. To be able to do this not only required experienced pilots but also a pilot who practiced an extremely risky way of flying. Unpredictable movements and a constant element of surprise were features of this. Marseille was a highly gifted pilot with well developed sense of spatial orientation, situational awareness and improvisation. Dettmann 1944, Walle 2003/4).

Horst Boog, a German air war historian, argues that from the mid-1930s German air force command privileged tactics over technology. (Boog, 1987). According to him German airforce command had insufficient knowledge of technical matters and the opinions of those officers who had that knowledge did not carry enough weight. In Britain and particularly in the United States cooperation between the “tactics and technology” have functioned better (Braun 2002). But as regards pilots and their ability to develop a “high tech feeling” and to handle the aircraft in a competent way it does not seem that there were serious deficiencies, at least not during the early stages of the war. (Kehrt 2010). Generally speaking there was probably no large difference between the flying as well as the technical skills of British and German pilots.
Later in the war, particularly after 1943, the situation changed dramatically. With the shortage of pilots in Germany the period of training was reduced and the entry requirements were lowered. In Britain it were, if ever possible, experienced pilots who trained the novices whereas in Germany the best pilots were sent to the battle front with little or no rest in between.

Apart from fighter aces like Douglas Bader there were other well-known British pilots such as James Edgar “Johnnie” Johnson, who came to the RAF as a qualified civil engineer, Adolph (Sailor) Malan or Robert Stanford Tuck. They received much public attention but compared to Germany “hero worship” was much more moderate. This was to a large extent due to the fact that high command considered praise of fighter pilots as detrimental to the equally brave bomber and reconnaissance aircrew with the result that the British air service did not publish official statistics of air victories. However the British press saw to it that the fighter ace’s victories did not remain unnoticed.

In Germany the matter was different. In several cases fighter aces, called “experts” in official jargon, became national heroes. Contrary to other nations shared victories by German pilots were credited to only one of the pilots concerned. This meant that in the two-planes formation, the smallest unit of a German fighter formation, one of the two pilots usually took the assistant’s role trying to keep the leader’s back free. The latter was credited with the “kill” and in several cases became a celebrated war hero. Although the flight instruction books discouraged extremely risky flight manoeuvres the pilot, when successful received official praise.

3. RESULTS AND CONCLUSIONS

During World War II new aircraft made new demands on pilots. Already in the Spanish Civil War German pilots gained experience with the Me 109, the German standard fighter aircraft during the war. But British pilots soon caught up and in their skill in handling the Spitfire they were similar to the German pilots and their Me 109s. Both planes had their advantages and disadvantages. The Me 109 was comparatively easy to produce, it was light and agile and its fuel injection engine had advantages over the Spitfire’s carburetor engine. However, because of a higher wing loading and other factors it was more difficult to fly, particularly for the novice. This problem increased as the war continued and Germany, fighting at many fronts, became short of qualified pilots. The Spitfire could fly more slowly and had advantages in tight maneuvers; when the wing roots started to stall distinctive vibrations gave a warning to pilots. As the war progressed air force demands led to continuous improvements in both the Spitfire and the Me 109. The engines became larger which led to various design and materials problems; both sides watched each other closely ready to react to any innovation the other party might implement. New developments like the Me 262 jet aircraft absorbed r&d and production capacities.

Regarding the relationship between aircraft and pilots in Britain and Germany during World War II we still need detailed studies based on archival research. Flight books, training manuals and related material could provide the desired information in a comparative perspective. Regarding later models such as the Spitfire Mark IX or the Me 109G there is considerable material on flight testing in the internet. This should be examined and analyzed in a systematic way. Comparative studies of fighter aces in the media in Britain and in Germany would also be of interest.
REFERENCES


Abstract — The paper aims to highlight a crucial period in the career development of the American designer Charles Eames (1907-1978) as reflected in his particular approach of the design process. The innovative steps Eames took for innovating furniture forms, materials and their subsequent technology are a worldwide example of the true mission of industrial design even today, after decades of successful experiments in this field. The highly experimental approach of form, ergonomics, materials and the contribution of Charles Eames at the evolution of crucial technological stages in view of the industrial production during WWII and the post-war decade are still building an exemplary work paradigm. It was hence possible to identify the dynamics of the creative process, based first on several biographical and historical facts, secondly on the evolution of the erratic and rather turbulent relationship between design and its industrial counterpart, as it was dictated by war, then by the transition to normality and by certain human needs as marketed by the American way of life. A few significant chairs, created and developed between 1940 and 1953, representing highlights of the history of twentieth century design as expressed by the “modern classics” phrase were selected and compared in order to illustrate vital elements of the design process, followed by short discussions regarding the materials which were used (moulded plywood, plastic, wire mesh), the technical solutions devised for the structural assembling as well as the specific technology that evolved from improvised devices to full industrial production. Unfolding the illustrated synoptic features of the creative process is expected to be a beneficial method for the good understanding of innovative industrial design and a useful instrument for designers, design critics and historians.

Keywords — Industrial design, innovation, Eames

1. INTRODUCTION

When we talk about design, we see the three fundamental axes that are able to designate the design process: functionality, originality and innovation. Innovation refers to form, function, materials or production technique. The chair design activity of Charles Eames, but also of his colleagues Eero Saarinen and Harry Bertoia, important representatives of American design, has been widely recognized and discussed. The groundbreaking contribution of Charles Eames to the history of 20th century industrial design and manufacturing (Dewey Eames 2006) has been frequently researched, either through a thorough biographic approach (Neuhart and Neuhart Book 1 2010), or through highlighting the pioneering role at innovating 20th century furniture design (Albus et al. 2009, Dewiel 1999), by handling new materials and adapting or improving materials.
and techniques for the industrial production (Neuhart and Neuhart Book 1 2010). However, a comparative and direct analysis of some of his most representative chair design concepts and characteristics such as form and composition, aesthetic and emotional value, user-friendliness, comparative functionality and ergonomics, structure and constructive details, together with a synoptic presentation of his approach of the design process is less present in literature. The evolution of Eames’ design process, tightly related to innovative materials and technologies developed during WWII, is crucial for understanding of the complex relationship between design and industry which has shaped the contemporary attitude regarding consumer goods. It is possible that Eames’ concepts regarding form, materialized in moulded plywood, plastics and wire, viewed through the proposed usability and parameters of the seating positions may prove to be useful for interior and furniture designers, for manufacturers and for design historians.

2. OBJECTIVES AND BACKGROUND

The paper aims at deepening the understanding of the design approach and concepts of Charles Eames, a prominent American designer, as well as his related design process, viewed from biographic as well as professional angles, in order to achieve an analysis of his contribution at the development of innovative form, structure, materials and technologies of mid-20th century chair design and manufacturing.

Due to either luck or perseverance Eames had a relatively early access to some of the most innovative materials and technologies developed before and during WWII: moulded plywood, reinforced synthetic resins and wire mesh. Figures 1, 2, 3 and 4 present his own decisive contribution at the developing of both materials and technologies during WWII and after.

The research work started with theoretical investigations regarding the dynamics of the creative process and was followed by the identification of the chronological order and typology of his designs, as related to the specific chairs which were to be analysed, presented in Figure 1. The chairs belong to a Modern Classics chair collection from the Transilvania University of Brasov. The analysis was carried on through direct collection of data, measurements and visual investigations, for the dimensions, angles, sitting positions, interactions with the human body and stability, followed by detailed technical sketching and drawing. Functionality and ergonomics, components and construction details, materials and technologies, style and composition were also analysed and compared.

Unfolding the illustrated synoptic features of the design and manufacturing stages is expected to be beneficial for the good understanding of innovative industrial design. The chairs that were investigated were created between 1941 and 1951. They are the result of pioneering industrial design rooted in the 1940’s.
<table>
<thead>
<tr>
<th>THE ANALYSED CHAIRS</th>
<th>BIOGRAPHICAL HIGHLIGHTS (after Neuhart and Neuhart, 2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Plywood LCW</td>
<td>1907, Born in St. Louis, Missouri</td>
</tr>
<tr>
<td>b. Rocking chair</td>
<td>Studied architecture at Washington University</td>
</tr>
<tr>
<td>c. Wire chair</td>
<td>1930, opened his own architectural practice</td>
</tr>
<tr>
<td></td>
<td>1938, 1 year fellowship at Cranbrook Academy of Art in Bloomfield Hills, Michigan; 1939, instructor for industrial design at Cranbrook; 1940, Head of the Industrial Design Department at Cranbrook</td>
</tr>
<tr>
<td></td>
<td>1940- Eames and Saarinen signed up at The Organic Design in Home Furnishing Competition at the Museum of Modern Art (MoMA); 1941 – Eames and Saarinen are awarded 1st Prize at two categories: A. Seating for a living room and B. Other furniture for the living room</td>
</tr>
<tr>
<td></td>
<td>1941 USA enter World War II</td>
</tr>
<tr>
<td></td>
<td>1941, starts building a pioneering moulding device at his home. 1942-1943, starts manufacturing moulded plywood transportation leg splints for the Navy and organizes a legal partnership called Plyform Wood Company</td>
</tr>
<tr>
<td></td>
<td>1943, sells Plyform Wood Company to Evans Products Company (EPC), turning it into Moulded Plywood Division of EPC, continuing splints manufacturing;</td>
</tr>
<tr>
<td></td>
<td>1944-1949, manufactures plywood furniture at EPC; 1946, Plywood chair made at EPC, exhibited in NY</td>
</tr>
<tr>
<td></td>
<td>1947, signs for furniture design with Herman Miller; 1947-1988, The Eames Office, in Venice, California; 1948, the Eames Office signed up at the International Competition of Low-Cost Furniture Design sponsored by the Museum of Modern Art (MoMA) and won 2nd Prize; 1949, An Exhibition for Modern Living, first exhibition project of the Eames Office</td>
</tr>
<tr>
<td></td>
<td>1949, developing the moulded reinforced fiberglass technology in collaboration with Zenith Plastics; 1950-1951, fiberglass armchair and side chair mass production, for Herman Miller; 1951-1953, developing the resistance welding technology for the Wire Chair for Hermann Miller.</td>
</tr>
</tbody>
</table>

Fig.1. Charles Eames: chair design and a few biographical highlights
3. COMPARATIVE ANALYSIS

The genesis and development of Eames’ creative attitude towards chair design is part of a larger story about a “diverse group of people who came together for a short time and who ultimately turned contemporary design in a new direction” (Neuhart and Neuhart Book 1 2010). Many of his biographical highlights are closely knitted with striking design renewal concerning form, functionality, material and technique. It is hardly possible to investigate, understand and comment upon the steps of his design process, if a few synoptically viewed moments of his life and work are not taken into account (Figure 1).

For the accuracy of the investigations, a thorough chronology of Eames’ chair designs had to be built up and presented. The fact that most aspects of his furniture designs emerged from only one major event, his participation at, with Eero Saarinen, and winning of the 1st Prize at the Organic Furniture Competition organized by the New York Museum of Modern Art (MoMA) in 1940-41, is relevant not only for the specific approach of his later design process but also for the accelerated impact of the post-WWII activities of converting competitive parts of the war industrial effort into a prosperous domestically-oriented industry.

3.1. MATERIALS AND TECHNOLOGIES

A synoptic discussion of materials and technologies used for prototyping and later in the industrial production of moulded plywood, wire mesh and plastic chairs are presented in Figure 2, 3 and 4. The main topics of the discussion are concerned with materials, general techniques, inspiration, objectives and works targeting mainly the industrial production. Eames’ dedication to solving the intricate problems of mass-producing his various chair prototypes with innovative forms and using new materials is exemplary for the orientation of 20th century design after WWII.

3.2. SITTING POSITIONS, DIMENSIONS AND ANGLES

The three investigated chairs show two sitting typologies: work position (upright sitting) and reclined position (relaxed sitting). The Wire chair is meant for the upright sitting, and the Plywood LCW and the Rocking chairs are meant for reclined sitting, specific to lounge chairs.

The study of the sitting positions started from the necessity of comparing the dimensional and angular characteristics of the three chairs with those recommended by various specialists, preceded by the evaluation of the degree of comfort offered by each of them. The results of the measurements are presented in Table 1, together with the normative recommendations (Neufert 2004, Grandjean and Kroemer 1997, EN 1335-1:2000).

The analysis of their ergonomics is shown in Figure 5 and 6, where the sitting posture is revealed and the position of the average (50 percentile) human being is represented as sitting on the respectively scaled side view of each chair. The drawings show the tilt of the torso, the leaning position of the legs as well as the freedom of arm movement. The Rocking chair sitting position is represented in three specific postures, vertical, frontally tilted and reclined, as allowed by this kind of chair.
The seat height of the Plywood LCW is 10mm above the maximum recommended height for lounge chairs and the seat height of the Rocking chair is below the recommended minimum seat height (Neufert 2004).

<table>
<thead>
<tr>
<th>MOLDED PLYWOOD CHAIRS</th>
<th>TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material</strong></td>
<td>Cranbrook, MoMA Competition, 1940-1941, Eames, Saarinen</td>
</tr>
<tr>
<td>In 1930-1940 plywood was adapted for wooden military aircraft, landing rafts, attack boats, railroad and ferry station seating, sleighs, furniture, doors. Various patents had been issued for bonding and moulding plywood and/or veneers. In 1937 a urea-formaldehyde resin adhesive was introduced, with rapid curing time under lower temperatures, reducing manufacturing costs. In 1944 phenolic resorcinol glues were introduced, for greater durability. In 1945 resorcinol and phenolic, as well as epoxy adhesives were widely used, for superior quality plywood.</td>
<td><strong>Inspiration:</strong> Aalto, Paimio chair 1931-1932; Breuer, Isokon chair, 1936-1937</td>
</tr>
<tr>
<td><strong>Objective:</strong> adapting the veneer laminating process to the designed chair shapes; extending plywood moulding beyond one-directional curved components into two-directional compound curves.</td>
<td><strong>Works:</strong> - experiments with assembling the legs to the wooden shell without connecting hardware, trying to use “cycle-welding” (a Chrysler technology for eliminating rivets, by using a layer of rubber between the connecting elements. - The Haskelite Manufacturing Corporation was selected to mould the shells, for mass-production - cast iron moulds were made and the veneer strips glued with innovative U-F glue were laid upon the mould; the mould and veneers were put into a rubber bag, a vacuum drawn on it, and then placed in the autoclave, in which steam pressure and heat were pumped; there were errors in moulding due to the unusual form of the shell; over the plywood, a thin layer of foam rubber covered by upholstery was laid; in 1942 WWII started and production at Haskelite did not continue.</td>
</tr>
<tr>
<td><strong>Techniques</strong></td>
<td><strong>The Kazaam, Los Angeles, 1941</strong></td>
</tr>
<tr>
<td>In the early 40’s, the Durand and Vidal methods for moulding layers of veneers in autoclaves were used for furniture manufacturing.</td>
<td>- Eames built the Kazaam device for moulding plywood, made of interlocking wooden strips, designed for a one-piece chair seat and back. It was heated with electrical resistance wire; an inflatable rubber bag was the male component for the mould - a vertical cut had to be made in the back of the chair, to relieve the tension of the wood; at the end of the moulding process, the chair was trimmed and sanded - this was the last solitary work in furniture development of Eames, on his way to mass produce his moulded plywood chairs.</td>
</tr>
<tr>
<td><strong>Plywood chairs at the Evans Product Company (EPC) 1943-1949</strong></td>
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</tr>
<tr>
<td>- Eames continues to experiment with moulded plywood with the financial support of the EPC; steel moulding presses were added to the production line-up, replacing the wooden Kazaams - parts of the moulding process could be mechanized, and required less time - after the moulding was complete, the plywood sections were trimmed using a routing template, then lacquered - the seat, back and legs were assembled to the spine with the shock-mount, a rubber disk to be bonded with phenol resorcinol glue to wood, providing an interface between the components without affecting the exterior appearance of the chair. Today epoxy glue is used for the rubber shock mounts.</td>
<td>- Plywood chairs at the Evans Product Company (EPC) 1943-1949</td>
</tr>
</tbody>
</table>

Fig. 2. Technology discussion for moulded plywood chairs (photo Matter and Matter 2010)
FIBERGLASS AND PLASTIC CHAIRS

Material
Fiberglass was made in two basic types: continuous filaments and staple fibres. The process by which both chairs (armchair and side chair) were made began by melting glass into marbles that were re-melted and transformed into filaments, a process that has since evolved into a “direct melt” method. In 1935 the development of polyester resins gave new impetus to the commercial exploitation of fiberglass. During World War II, a form of fiberglass known as FRPs (fiberglass-reinforced plastics) was developed for use in military applications, for radar system housings (radomes) and in structural components for naval vessels and aircraft.

Techniques
Several types of moulding were be used with FRPs, including the compression or matched-die moulding with two-part, male and female moulds with close fitting tolerances used by Zenith Plastics for the chair shells although during the 40 years of production the process required some adaptations in approach and execution.

International Competition Design of Low-Cost Furniture, MoMA, 1947
Inspiration: “design and production of good, inexpensive and attractive furniture”, the main idea of the MoMA competition officially opened for submission on January 5th, 1948.

The Eames Office paired up with one of six MOMA-selected design-research teams focusing on the utilization of new materials, tools and production methods. Charles Eames had participated in the competition with the University of California, Los Angeles Department of Engineering.

Objective: adapting the metal structure of the side chair and armchair for a new, low-cost material obtaining a multi-functional furniture capable of being adapted to a variety of spaces.

Works:
- small scale models and an early version clay prototype of the armchair
- experiments with assembling the aluminium legs to the fiberglass shell
- a series of clay and plaster moulds were made to obtain a resistant and aesthetic shell

Eames Fiberglass Armchairs and Side Chairs 1950-1951
- in 1950-1951 the Eames Fiberglass armchairs and Rocking chairs went into production at Herman Miller and work on the first side chair prototypes started.
- At Herman Miller today the Rocking chair shell is made of 100% recyclable polypropylene.

Eames Rocking armchair, with fibreglass shell

Fig. 3. Technology discussion for fiberglass and plastic chairs (photo left: Steelform)
### Material

The Eames Office first used resistance welding in 1949 and the bases of the fiberglass chairs in 1950. This technical repertoire became standard and often used by the time that the wire chair prototypes were assembled.

### Techniques

The seat was made in five operations: the first step consists of five horizontal pieces of wire for the seat section were cut and set in place (on a flat surface), resistance welded and then bent into shape to make the three-dimensional transition from seat to back. The horizontal and vertical wires were all resistance-welded and then bent on a special jig to obtain the desired curvature of the seat. A “double bead” perimeter rim was added for structural and stabilizing purposes. In the last phase a rectangular frame connecting the seat to the leg systems was added. (after Neuhart and Neuhart, Book 2, 2010)

### Eames Wire Mesh Chair 1951-1953

#### Inspiration:
Buckminster Fuller’s Geodesic Dome

A fellow technician called the 1951-'53 years “the wire period” when he and his co-workers started experimenting with wire structures for table bases and chairs. He came up with the idea while waiting for the production dies and tools for the fiberglass-reinforced armchair.

#### Objective:
The main goal was to design a functional, efficient, sturdy and lightweight chair made of the least amount of material.

#### Works:
- the original “geodesic pattern” did not meet the necessary structural requirements; the wires had been rearranged more closely together forming a perpendicular grid with a tighter and more rigidly defined geometry.
- because there was no surface to which they could be adhered, the shockmount system used on the moulded plywood and fiberglass chairs was not used on the wire chair and it was replaced by a rectangular frame with radius corners as a connector for the leg systems and the support for the seat.
- the leg systems were adapted from the fiberglass chairs and were also interchangeable (1). (Neuhart and Neuhart, Book 2, 2010)

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<table>
<thead>
<tr>
<th>WIRE CHAIRS</th>
<th>TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material</strong></td>
<td><strong>Eames Wire Mesh Chair 1951-1953</strong></td>
</tr>
<tr>
<td>The Eames Office first used resistance welding in 1949 and the bases of the fiberglass chairs in 1950. This technical repertoire became standard and often used by the time that the wire chair prototypes were assembled.</td>
<td><strong>Inspiration:</strong> Buckminster Fuller’s Geodesic Dome</td>
</tr>
<tr>
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<td><strong>Objective:</strong> The main goal was to design a functional, efficient, sturdy and lightweight chair made of the least amount of material.</td>
</tr>
<tr>
<td>The seat was made in five operations: the first step consists of five horizontal pieces of wire for the seat section were cut and set in place (on a flat surface), resistance welded and then bent into shape to make the three-dimensional transition from seat to back. The horizontal and vertical wires were all resistance-welded and then bent on a special jig to obtain the desired curvature of the seat. A “double bead” perimeter rim was added for structural and stabilizing purposes. In the last phase a rectangular frame connecting the seat to the leg systems was added. (after Neuhart and Neuhart, Book 2, 2010)</td>
<td><strong>Works:</strong> the original “geodesic pattern” did not meet the necessary structural requirements; the wires had been rearranged more closely together forming a perpendicular grid with a tighter and more rigidly defined geometry.</td>
</tr>
</tbody>
</table>

![Wire chair, 1951](image)

Fig. 4. Technology discussion for wire mesh chairs
Table 1. Comparative presentation of the dimensions of the three chairs and the recommended dimensions (Neufert and Neufert 2012, Grandjean and Kroemer 1997, EN 1335-1:2000)

<table>
<thead>
<tr>
<th></th>
<th>LCW</th>
<th>Rocking chair</th>
<th>Recommended for lounge chairs</th>
<th>Wire chair</th>
<th>Recommended for side chairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seat height (frontal measurement) mm</td>
<td>410</td>
<td>360</td>
<td>375-400</td>
<td>440</td>
<td>400-450</td>
</tr>
<tr>
<td>Seat depth (mm)</td>
<td>530</td>
<td>450</td>
<td>450-500</td>
<td>400</td>
<td>380-450</td>
</tr>
<tr>
<td>Total height of the chair (mm)</td>
<td>700</td>
<td>690</td>
<td>-</td>
<td>810</td>
<td>-</td>
</tr>
<tr>
<td>Seat angle</td>
<td>17°</td>
<td>13°</td>
<td>5-10°</td>
<td>4°</td>
<td>5-8°</td>
</tr>
<tr>
<td>Seat-backrest angle</td>
<td>100°</td>
<td>97°</td>
<td>110-120°</td>
<td>97°</td>
<td>105-115°</td>
</tr>
</tbody>
</table>

The seat depth of the LCW is 30mm above the recommended value for lounge chairs.
The seat angles of the Plywood LCW (17°) and Rocking chair (13°) are beyond the recommended seat angle limits (5 -10°).
The seat-backrest angle of the Wire chair is below the recommended minimum limit of 105 - 115° (Neufert and Neufert 2012).
Despite the incongruities observed at all three chairs, it is obvious that they offer adequate sitting positions which are certainly not deprived of comfort. Their design concept and form and material requirements allowed the designers to step off limits, without affecting the sitting comfort.

3.3. CONSTRUCTION DETAILS

Figure 1 presents innovative construction details of the investigated chairs. Most of the details illustrate the dialogue with specific manufacturers, an accurate solving of industrial manufacturing solutions and a highly innovative approach, in general eased by the development during WWII of the aircraft and motor industry.

“For the ease of manufacture and reasons of economy, a moulded plywood chair could best be realized by linking separate moulded-plywood head, back and seat components together by means of a structural spine made of wood and/or metal.” (Neuhart and Neuhart Book 1 2010). The seat and the back of the Plywood LCW chair are assembled to the spine with shock mounts and screws, the front and back leg units are assembled with screws to the spine (Figure 1, a).

“Some of the most elegant chairs they ever designed were made of plastic…The single shell chairs are masterpieces of economy - there’s not a superfluous detail to them. Inexpensive…they sold in huge numbers.” (Stungo 2000). Plastic shells asked for new construction solutions. In the case of the Rocking chair the legs are mounted at the bottom of the shell with a square metallic plate, welded to the leg, through which the screws reach the shock mounts (Table 1, b).

“From a formal standpoint, the Wire Chair is a ‘translation’ of the plastic side shell in the material of resistance-welded wire mesh. With minimal material requirements a chair was created that is a striking synthesis of strength and transparency” (Von Vegesack 1996). More complex mounting solutions are used for the Wire chair. A rectangular frame welded to the wire mesh at the bottom of the seat is the connector for the leg system (Figure 1, c). The seat pad is assembled with the wire mesh with four rectangular metal plates with semicircular curved edges, screwed into the pad supporting panel. The legs end with a steel ball welded at the end of each leg, fitted into a rubber and stainless steel boot glide (Neuhart and Neuhart Book 2, 2010).

4. CONCLUSIONS AND DISCUSSIONS

For the carrying out of the major objective of the paper, the following steps were set up and undertaken: 1) the identification of key biographical highlights of the professional evolution of Charles Eames, for the subsequent understanding of his pioneering chair design; 3) analysis of the contribution to the evolution of innovative materials and technologies of the 40’s and 50’s. 3) the analysis of the chairs’ ergonomics – dimensions, angles and sitting positions; 4) the comparison between the results of the measurements and the recommended dimensions and angles; 5) an investigation of the structure, components and innovative constructive details of the chairs. Stages 1) to 5) may be seen as a self-developing method structure.

The results of the analysis of the Wire side chair and the Plywood LCW and Rocking lounge chairs allowed the identification of their specific design approach, particularised by the new
materials involved. The synoptic presentation of the various sitting positions shown in Figure 5 and 6 allows a good understanding of the anatomical interaction and helps designers have an overview of the chair design process.

Due to the measurements results compared with the recommended parameters in Table 1 it became visible that none of the three chairs has all dimensional and angular parameters within the recommended limits, nevertheless being able to offer exemplary sitting positions.

The newly developed organic forms of these chairs announce the era of modernity, they are born from the pre-war/post-war vision of simple, middle-class oriented mass-produced objects, far from the exclusive line of concepts specific for example to Art Déco. The development of the use of innovative materials made available after WW II, like moulded plywood, glass fibre reinforced polyester resin and wire mesh was necessary for the industrial production of modern, attractive yet accessible furniture. It was the moment of the complete integration of the designer in the engineering process, as it had been assumed by the Bauhaus ideology.

ACKNOWLEDGEMENT

This paper is supported by the Sector Operational Programme Human Resources Development (SOP HRD), ID134378 financed from the European Social Fund and by the Romanian Government.

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THE ROMANIAN TITUS KONTESCHWELLER –
GLOBAL PIONEER OF THE RADIOPHONY

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Abstract — Through this paper we would like to highlight the work and achievements of a great (maybe the greatest) super-regenerative radios manufacturer in the world.

In the years following World War I, the world plunged into what is known as the “era when radio was king”. It all started in Pittsburgh in 1920, when the first public radio broadcast took place. People from all different professions have become avid radio fans.

At the beginning of years 1920 in Paris, two Romanian brothers, who were big radio enthusiasts, launched a business as manufacturers of radios sets. It was the Konteschweller brothers, Titus and Michael, who came from Romania.

At the end of 1923 the first radio set manufactured by Dr. TITUS factory appeared. The factory was located in Paris. The device was cheap and highly sensitive. Success in the era of these radio sets was very high. These devices have dominated the specialized market until the early 1930s. Dr. TITUS devices has won numerous awards at international specialized exhibitions and competitions. The most important contest won was a competition organized by the great magazine Radio News in 1927.

In the second part we will illustrate the rich work carried out by members of the PRORADIOANTIC Association to create a replica of the Dr. TITUS radio set from 1924.

Keywords — 1920s, super-regenerative radio set, a functional replica

1. INTRODUCTION

This is the extraordinary story of two Romanian brothers who, in the early twentieth century, under the impetus of great passions, left their names inscribed in the golden book of world radio.

Around 1890, the most famous pharmacy in Craiova was “Golden Eagle”, owned by Edurad Konteschweller. Edurad Konteschweller was not only a pharmacist, he was also a scientist, having published articles in professional journals (including overseas) and was a member of the Society of Sciences in Bucharest.

Eduard Konteschweller had two sons, Titus, born in 1894, and Michael, born in 1897. Naturally, Titus wanted to embrace a medical career. He studied at the faculty of medicine in Paris and immediately after graduation, caused a sensation with his work Pyretotherapia, published by Maloine & Fils in 1918. Titus Konteschweller proposed in this paper a new method of medical therapy by deliberately inducing a fever into the patient.
In Figure 1 we can see the Konteschweller family. Dr. Titus Konteschweller sits on the stairs between his mother and his French wife. Michael Konteschweller is standing in a high school uniform. Standing on the left side of the image is head of the family, the pharmacist Eduard Konteschweller.

1.1. Radio-phony the beginning

In this world, the year 1918 marks the end of the First World War. After having gone through a devastating war and having escaped the equally destructive Spanish flu, humanity goes through an unprecedented development, an economic boom, unique in history. All the new discoveries of art are launched on the market. Electricity, the automobile and aviation strengthen their positions as indispensable factors of progress.
However, nothing has been as revolutionary as radio. The possibility to participate live from one’s armchair at home in the events taking place hundreds or even thousands of miles away defined the 1920s as the “era when radio was king”.

Thanks to the appearance of Triodes, a new type of electronic tube, radios get cheaper and start to find their way into every home. Everyone wanted to have a radio. Collective auditions were held in special rooms, or on the street in front of the stores. For a few pennies, anyone can listen to the radio for five minutes at a slot machine. Exhibitions, fairs and specialized contests are held one after another. There are many manufacturers and radio dealers. Associations of amateur radiophony are established.

These associations grouped enthusiasts from many different professions who gathered once every few days around a radio to hear, among hissing and crackling, the local stations and distant foreign stations. Gradually the radio amateurs were starting to become real radio professionals who were beginning to work in the business of radio themselves. Thus, we should not be surprised when, among the experts in the field, we find lawyers, military officers, doctors, engineers; in general people with money because radiophony was quite an expensive activity.

From a technical point of view, there were two principles that dominated the radio market: super-heterodyne and super-regenerative. Super-heterodyne was very selective and sensitive, but it was expensive because it required a large number of tubes. Super-regenerative instead needed of only one or two tubes while providing very good sensitivity and sufficient selectivity. The issue of selectivity was not too important because broadcasting stations were rare. The important thing was to catch the more distant stations. In these circumstances, the super-regenerative dominated the 1920s market.

Certification of performance of radios was very simple; the owners sent letters to manufacturers of their equipment.

From a practical perspective the radio, or TFF station as it was then called, was quite a complicated machine (see Figure 2) [1]. The device itself was presented in a wooden box, beautifully polished and fitted with regulatory elements.

To provide better cooling, the lamps were mounted externally on top. The speaker was located nearby and consisted of a radio earphone and attached funnel together with two batteries: one for the filaments and one for anode voltage. The antenna wire was represented by a few meters of wire, located outdoors and mounted up high. Only very sensitive apparatus would, instead of the wire antenna, use a loop antenna, as shown in Figure 2.
2. Dr. TITUS COMPANY

Driven by a matchless passion for radio the young doctor Titus Konteschweller launched himself into this new area of technology. He set up a workshop production of super-regenerative TFF sets. The company was called Dr. TITUS and was based in Paris on Rue des Wattignies, no. 69; XII arrondissement. Michael Konteschweller who specialized in electrical technology at Bristol and at Paris, joined the firm Dr. TITUS, and contributed substantially to its development.

We find the first mention of Dr. TITUS apparatus in January 1924 [2]. Here we display that 1924 advertisement shown in Figure 3.

A portable version of the Dr. TITUS device is presented in the advertisement in Figure 4 [3]. From here we learn that the device is so portable that it was stolen in broad daylight, on 20 May, from the specialty Fair stands booth in Paris in 1924.

Fig. 3. The first mention of Dr. TITUS devices, in January 1924

Fig. 4. Advertising for TFF portable products

In Bucharest in 1925 the RADIOFONIA Association was founded to organize collective auditions and edit eponymous weekly magazine. In RADIOFONIA issue number 5-6 which appeared in January 1926, Michael Konteschweller published in detail how to construct a super-regenerative radio, and stated that the device was made by his brother Titus, in Paris and he, Michael contributed to this achievement.

Titus Konteschweller turned out to be a good manager. He carried out a specific activity. He published advertising in the magazines of the day, and he provided radio devices, free of charge, for organized collective auditions. And he developed a network of dealers and participated in contests and specialized national and international fairs.

Thus we see in the newspaper L’Ouest-Éclair, dated 10/06/1927, that at 14:00, Radio Paris-PTT (which emits a wavelength of 485 m, with the power of 500 W), would transmit a radio concert
organized by the General Association of Auditors of TSF, with the help of Dr. Titus Konteschweller's super-regenerative devices (see figure 5). The program included the overture to *A Midsummer Night's Dream*, selections from *Traviata*, *Manon* ballet etc. [4]. An affiliate dealer from Dr.TITUS's company located in Spain, near Barcelona, published in the local newspaper, next to the advertising section, a technical and functional presentation of the unit [5].

Of course an important dealer was the brother of Titus Konteschweller, Michael, who worked in Bucharest. Here, in Figure 6, show as a commercial of the time [6].

In Figure 7 we see the letter from Dr. G. Veyre in Casablanca, a letter in which he praised Dr. TITUS radio performance. In the same figure we see the logo radios Dr. TITUS factory [7].
2.1. The Radio News Contest

Titus Konteschweller participated with its radio devices in numerous exhibitions, fairs and specialized international competitions, winning numerous awards. A very special achievement of Dr. TITUS's company was winning the contest launched by magazine Radio News. In the middle of the third decade of the twentieth century, the magazine was one of the largest if not the largest radio magazine in the world. Radio News Magazine appeared monthly in New York with a circulation of 350,000 copies.

In April of 1927, the magazine Radio News launched a competition for commercial portable radios that operate on the super-regenerative principle; then considered to be the best. The conditions imposed were very strict. Among other things, the complete device had to fit within the size limitation of 12" x 8" x 7", namely: electronic assembly, tubes, headset, antenna and batteries. It gave very precise instructions, down to the detail of how to package the machine that would be sent to the editor. It puts up 11 awards, totaling $300, of which the first prize was $100 (about $10,000 at today's rate) [8].

In September of the same year the winners were announced, namely the only winner: Dr. Titus Konteschweller in Paris. His device won first prize. The other awards were not granted because the quality of the remaining entries was unacceptable. Dr. Titus's winning entry was awarded an additional prize of 6 honorable mentions (figure 8). Radio News Magazine expressed high praises for the winning device. Stating that it worked "very well - exceedingly well" and that there will soon be a version made with American components [9].

Figure 9 presents superregenerative with Titus Konteschweller won the Radio News contest.
Radios manufactured by Dr. TITUS have become so known and popular, that they were considered a true industry standard. In any specialty work they were cited as an example. Thus, Pierre Hemardinquer in his famous book The super-heterodyne and the super-reactive, published in 1926 at the Paris publisher Etienne Chiron makes his presentation of the super-reactive principle based on Dr. TITUS devices schematics, as can be seen from figure 10 [10].

And Michael Konteschweller was a well known personality in the field of radio. He appears in the works at the European level, alongside of the other great Personalities of radio: Guglielmo Marconi, General Ferrie, JA Fleming, Lee De Forest [11].

Brothers Titus and Michael Konteschweller are authors of many other inventions in the field of radio and automobile.
After 1930 the super-regenerative began to lose ground to the super-heterodyne. This was because the number of transmitting stations increased spectacularly and instead of the problem of sensitivity; there was now the issue of selectivity. Also, the due to the transition to mass production, the price of electronic tubes registered a significant decline. Last known advertisement devices Dr. TITUS is published in [12] and shown in Fig. 11.

Radios operating on the super-regenerative principle have been used for about 50 years, because this design is very suitable for ultra-shortwave reception. They were especially appreciated by radio amateurs.

3. EPILOGUE

Unfortunately, Dr. Titus Konteschweller died in 1930 at the age of only 36 years old.

Michael Konteschweller continued to work in radio, until his death in 1947. He wrote several books, some of which received a Romanian Academy Award. In the last three years of his life he was a professor at the Polytechnic "Gheorghe Asachi" of Iasi, Technical Department, working in the domain of weak currents.

A special achievement of Michael Konteschweller was the participation to the Romanian Industry Exhibition Fair, held in Bucharest, Carol Park, from 15.09. – 10.10.1934. On this occasion, Michael Konteschweller caused a sensation with a remote controlled boat. Sailing on the lake in the park, it was controlled by radio waves from the shore. The boat was able to execute six commands, respectively: forward, reverse, stop, left, right and siren. Boat, shore control station and antennas were made all under the concept of Michael Konteschweller. This was the first telemechanics experience in Romania.

4. ACHIEVEMENT REPLICA

In order to honor Dr. Titus Konteschweller who was one of the greatest pioneers in radio electricity and to commemorate the 90th anniversary of the launch of the first Dr. TITUS radio device, a group of enthusiastic members of the Radio Collectors Association in Romania PRORADIOANTIC, decided to construct a replica of this radio apparatus. The Original
Documentation was available. It was procured from various descriptive articles that were written in the magazines of the day. The work started with the development of a design in 3D format (see Figure 12) to determine the exact size. Having established what was the material from which the respective pieces were, it was easy to achieve it. The box was made of mahogany and the faceplate of ebonite, as the originals. In a similar fashion the capacitors and resistors were made, to have the same look and dimensions as the original model. Capacitors were made of aluminum foil and mica sheets pressed between two ebonite plates. Resistors were made by incorporating modern resistors in an ebonite covering. In all cases the labels were printed, according to the originals, on antiqued paper. The results can be seen in Figure 13. Tubes and other pieces are original and have been purchased via the INTERNET at specific prices befitting such antiques. The Dr. TITUS Replica machine, model 1924 can be admired in Figures 14 and 15.

We could write a book only for this single project. The most important thing is that the replica is performs correctly and works as well as the original. But who would ever be able tell?
5. CONCLUSIONS

Titus Konteschweller proves to be a leader among pioneers of the global radiophone. He received substantial support from his younger brother, Michael Konteschweller. Through their efforts, the two Romanians have made an important contribution to the direction of radiophone development and electronics in general.

During the ICOHTEC - Brasov 2014 symposium visitors would be able to admire Dr. Titus, model 1924 super-regenerative radio; an operational replica. This replica was achieved through the heartfelt efforts of the members of the PRORADIOANTIC Association. Only their enthusiasm made it possible to overcome all the obstacles and allow the apparatus to be realized.

Through these actions, we want to keep alive the memory of our Romanian ancestors in the field of world science and technology.

ACKNOWLEDGEMENTS

We thank Mrs. Silvia Popa from Făgăraș, which provided us valuable information on the biographical aspects of the Konteschweller family.

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CONTEMPORARY TRENDS IN THE DEVELOPMENT OF TECHNICAL EDUCATION IN BRASOV

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Abstract — The analysis made in this paper aim to underline the contemporary tendencies in the development of the technical education in the area of Brasov, Romania, taking into consideration the approved school network approved by authorities along the years. The evolution of the school network is presented starting with the years 1977/1978, the diversifying of the technological educational offer from the years 1982/1989 which alongside the mechanic and electric domain are augmented with the domains of industrial chemistry, light industry, constructions, forestry- forestry exploitation, wood processing, marking the development if the Romanian industry in the communist era. In the second part of the paper the transition stages and the contemporary trends of the technical education in Brasov are presented in correlation with the requirements of the labour market and European policies for workforce occupation.

Keywords — technological education, curriculum, school action plan, regional action plan, local action plan

1. INTRODUCTION

"The future of a nation is decided by the way it prepares the youth", asserted the great Dutch humanist Erasmus, in the 17th century. Indeed, the main purpose of school is to ensure our chances to accede to a better future by educating the native intelligence, already recognized of the Romanian youth. The technical education aims to develop those competences of the students that allow them to integrate more easily in the labor market but also to acquire professional skills that need to be recognized and appreciated by society.

2. ANALYSIS

The analysis in this paper aims to underline the contemporary trends in the development of the technical education in the area of Brasov, starting from the school network which was approved by the local authorities in education during the years.

For the school year 1977/1978, year when the second stage exam was introduced in the pre-university school system, 34 high schools existed in Brasov, 20 of which being industrial high schools, 2 agro industrial, 2 economic, 1 health, 4 high schools of Maths and Physics, 3 high schools of Philology and history, one pedagogical and one for natural science. The high school network in the county for the day courses disposed of 232 classes with 8389 places for the 9\textsuperscript{th} grade and 101 classes with 3610 places for the 11\textsuperscript{th} grade. For the Hungarian and German minority students there were classes where the teaching was performed in their mother tongue.
Starting with the school year 1982-1983, the school network is completed with the evening classes both for the 9th and 11th grades. It is compulsory in this context to notice the diversification of the technical education offer, which alongside the mechanical and electric domains are completed with the following domains: industrial chemistry, light industry, constructions, forestry-forest exploitation, wood processing. For the minority students of German and Hungarian nationality, there are still classes where the teaching is conducted in their native language. Another characteristic of this period is the fact that the possibility to continue the studies is extended for the 1st cycle (9th and 10th grades) within the lower secondary level.

### Table 1. Comparative data of school network from 1982 and 1989

<table>
<thead>
<tr>
<th>School year</th>
<th>No. of schools</th>
<th>Profile</th>
<th>Number of classes (day courses)</th>
<th>Number of classes (evening courses)</th>
<th>Number lower secondary schools with continuance of studies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>The 9th grade</td>
<td>The 11th grade</td>
<td>The 9th grade</td>
</tr>
<tr>
<td>1982-1983</td>
<td>34</td>
<td>23 industrial high schools</td>
<td>314</td>
<td>90</td>
<td>21</td>
</tr>
<tr>
<td>1983-1984</td>
<td></td>
<td>3 agro industrial high schools</td>
<td>290</td>
<td>100</td>
<td>11</td>
</tr>
<tr>
<td>1984-1985</td>
<td></td>
<td>1 health high school</td>
<td>252</td>
<td>66</td>
<td>7</td>
</tr>
<tr>
<td>1985-1986</td>
<td></td>
<td>1 pedagogical high school</td>
<td>224</td>
<td>125</td>
<td>8</td>
</tr>
<tr>
<td>1986-1987</td>
<td></td>
<td>1 economic high school</td>
<td>274</td>
<td>125</td>
<td>12</td>
</tr>
<tr>
<td>1987-1988</td>
<td></td>
<td>1 natural science high school</td>
<td>225</td>
<td>125</td>
<td>11</td>
</tr>
<tr>
<td>1988-1989</td>
<td></td>
<td>2 Math-Physics high schools</td>
<td>255</td>
<td>36</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Philology and history high schools</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The interpretation of the data presented in Table 1 can be made through a chart as the one below, in Figure 1. It can be concluded that during the period 1980-1990 the day courses are allocated more classes in comparison to the evening classes, but the students are still given the chance to continue their studies.

---

**Fig.1.** Graphical representation of the evolution of school network in the years comprised from 1982 to 1989.
If we compare the tendency in the years 1977/1978 with the one from 1987/1988 for the day courses we notice that a higher number of classes is allocated to the 11th grades, day courses, which opens the horizons for the continuance of technical high school level studies.

![Fig.2. Comparative graphical representation of classes allocation for day courses](image)

In the next decade, between 1990 and 1993, in school plans there are classes allocated for high schools, separately from professional schools and complementary schools (for apprentices). It is the moment when a lot of theoretical high schools until 1977, transformed between 77-90 in industrial or technological high schools, return to the traditional real and humanistic domains of study. Such famous schools for Brasov are still representative for the local education domain: Theoretical high school “Andrei Saguna”, Theoretical high school „Dr. Ioan Mesotă”, Theoretical high school „Unirea”, Theoretical high school „Aprily Lajos”- with Hungarian as teaching language, Theoretical high school „J. Honterus” with teaching being conducted in German language. From this moment the number of classes allocated to technical education in Brasov in the 22 high schools has the following figures:

<table>
<thead>
<tr>
<th>School year</th>
<th>Number of classes- day courses</th>
<th>Number of classes- evening courses</th>
<th>First year of professional education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The 9th grade</td>
<td>The 11th grade</td>
<td>After 8th grade</td>
</tr>
<tr>
<td></td>
<td>Day courses</td>
<td>Evening courses</td>
<td>Day courses</td>
</tr>
<tr>
<td>1990-1991</td>
<td>78</td>
<td>67</td>
<td>7</td>
</tr>
<tr>
<td>1991-1992</td>
<td>80</td>
<td>83</td>
<td>5</td>
</tr>
</tbody>
</table>
In this period of early 90s the technological high schools are renamed Industrial School Groups. The lower secondary level graduates of 8 classes are offered the occasion to finalize a professional training program by which they receive a qualification.

In the last years of the 20th century, the Romanian education goes through a series of transition phases. Due to fundamental changes and continual reorganization process, a series of legal measures are requires and thus in 1995 the Law of Education is adopted and the Romanian educational system falls under the responsibility of the Ministry of Education, Research and Innovation. In this period the first possibilities to access European funds emerge, by pre-university level institutions, in the technical domain. As an example there was the Phare Program VET RO 9405 by which two schools from Brasov benefitted from endowments.

The modernization of the Romanian education system begins in 1998/1999 by the reform begun by the ministry Andrei Marga. Starting from the 26th of November 1998 the CNDIPT is formed – the National Development Center for the Professional and Technical Education, public organization with juridical power, by the decision of the government no. 855, as a department of the Ministry of Education, Research, Youth and Sports. This institution proposes policies and strategies for the development of professional and technical education (IPT), elaborates the qualifications and the curriculum for IPT and develops the quality assurance system in IPT.

The technological education offer for Brasov undergoes a large development and diversification: direct route high school RD or high school progressive route RP (profile: technical, services, natural resources and environment protection, vocational /specializations), arts and crafts school (SAM), professional education after 10 years, post high school education, for the technological branch.
Table 3. High school- School network from the years 2004/2006

<table>
<thead>
<tr>
<th>School year</th>
<th>Number of schools</th>
<th>Number of profiles</th>
<th>Number of specializations</th>
<th>Number of classes</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-2005</td>
<td>17</td>
<td>4</td>
<td>25</td>
<td>944</td>
<td>26411</td>
</tr>
<tr>
<td>2005-2006</td>
<td>29</td>
<td>9</td>
<td>29</td>
<td>110</td>
<td>3025</td>
</tr>
</tbody>
</table>

Table 4. School of Arts and Crafts (SAM)- School network from the years 2004/2006

<table>
<thead>
<tr>
<th>School year</th>
<th>Number of schools</th>
<th>Number of profiles</th>
<th>Number of specializations</th>
<th>Number of classes</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-2005</td>
<td>32</td>
<td>15</td>
<td>34</td>
<td>656</td>
<td>17931</td>
</tr>
<tr>
<td>2005-2006</td>
<td>28</td>
<td>13</td>
<td>44</td>
<td>83</td>
<td>2099</td>
</tr>
</tbody>
</table>

Table 5. Professional school- School network from the years 2004/2006

<table>
<thead>
<tr>
<th>School year</th>
<th>Number of schools</th>
<th>Number of profiles</th>
<th>Number of specializations</th>
<th>Number of classes</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-2005</td>
<td>25</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>42</td>
</tr>
<tr>
<td>2005-2006</td>
<td>32</td>
<td>15</td>
<td>35</td>
<td>121</td>
<td>3396</td>
</tr>
</tbody>
</table>

In this period the accessing of the European funds continues, for the pre-adherence by the technical education institutions of Brasov. In this context we can mention the programmes PHARE TVET 2001-2003 and PHARE TVET 2004-2006 by which seven school groups in Brasov benefited from the infrastructure facilities, rehabilitation of school workshops and technological equipment for the laboratories.

Table 6. Post high school level - School network from the years 2004/2006

<table>
<thead>
<tr>
<th>School year</th>
<th>Number of schools</th>
<th>Number of profiles</th>
<th>Number of specializations</th>
<th>Number of classes</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-2005</td>
<td>14</td>
<td>8</td>
<td>16</td>
<td>16</td>
<td>426</td>
</tr>
<tr>
<td>2005-2006</td>
<td>19</td>
<td>12</td>
<td>27</td>
<td>69</td>
<td>1372</td>
</tr>
</tbody>
</table>

In the years that followed a series of policies were applied to improve the correspondence between the supply of education and training related to economic and social development needs of the area. Planning in education and training systems in the long term is structured in four levels:
(1) The strategies developed at national level by the Ministry of Education and Research,
(2) Regional action plans for technical and vocational education (PRAI),
(3) Local Plans (PLAI - at county level),
(4) School Action Plans (PAS).
The planning process PRAI-PL AI-PAS began in 2003 and it is renewed annually. Starting from 2005, 2013 the year 2013 was established as planning horizon (for the coverage of the period adopted by the National and regional development plans 2007-2013, which, in their turn, being synchronised with the planning horizons of the UE curricula). In the year 2012 the horizon PLAI was extended in the perspective of the year 2020 to cover the planning period 2014-2020.

PLAI constitutes and action frame at county level based on a set of priorities and measures derived from the analysis and agreed by the regional PRAI. Also, PLAI provides a reference framework for the development and harmonization of plans prepared by each school.

Currently, starting with the school year 2011/2012, the professional technical education is relaunched by the initiative of economic agents in the area. The educational offer is more diversified because the Central Region that includes Brasov is characterized by the highest index of industrial specialization in the country. It is the period in which the economic environment begins to engage directly in professional training at undergraduate level through partnerships between schools and companies. The school plan reflects this tendency:

Table 7. School network for the technological education in 2011/2013

<table>
<thead>
<tr>
<th>School year</th>
<th>Number of schools</th>
<th>Number of profiles</th>
<th>Number of specializations</th>
<th>Number of classes</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-2012</td>
<td>25</td>
<td>4</td>
<td>21</td>
<td>507</td>
<td>11619</td>
</tr>
<tr>
<td>2012-2013</td>
<td>24</td>
<td>4</td>
<td>87</td>
<td>473</td>
<td>8227</td>
</tr>
</tbody>
</table>

In graphical form, the results of this data can be interpreted easily. A significant drop is recorded of school population at the level of the region of Brasov:

These aspects are presented in the programming document PRAI for the county of Brasov.

By the analysis of the demographic evolution and the study realized by ADR Center on forecast NIS, by 2015 significant reductions are estimated at the county level in the groups 15-18 and 19-24
years, these framing the main target group for the vocational and technical planning (15-18 years for high school and arts and crafts, 19-24 years for post-secondary and higher education) - see tab. 8 and 9. For both age groups, Brașov seems to be the most affected district of the region in the forecast until 2015 (see data from PRAI, cap.2.2).

### Table 8. Prognosis for the population in the age group 15-18

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Abs.</td>
<td>%</td>
<td>Abs.</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Romania</td>
<td>1398034</td>
<td>880680</td>
<td>845285</td>
<td>-517354</td>
<td>-552749</td>
</tr>
<tr>
<td></td>
<td>-37.0%</td>
<td></td>
<td>-39.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centre Region</td>
<td>164024</td>
<td>103874</td>
<td>105162</td>
<td>-60150</td>
<td>-58862</td>
</tr>
<tr>
<td></td>
<td>-36.7%</td>
<td></td>
<td>-35.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brașov</td>
<td>38890</td>
<td>21896</td>
<td>23763</td>
<td>-16994</td>
<td>-15127</td>
</tr>
<tr>
<td></td>
<td>-43.7%</td>
<td></td>
<td>-38.9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Study ADR Centre "Evolution of the population of preschool age and school age in the Centre region between 2005-2025", realised on the basis of the prognosis INS

The age group 15-18 years old, in comparison to 2005 a decline is registered in the county with 43.7% in 2015 (the highest in the region) and with 38.9% by 2025 - see tab. 8

For group 19-24 years, in comparison to 2005, the projected decrease in the county is 39.5% by 2015 (the largest in the region) and 42% by 2025 - see tab. 9.

### Table 9. Prognosis of the population within the age group 19-24

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Abs.</td>
<td>%</td>
<td>Abs.</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Romania</td>
<td>1947386</td>
<td>1428109</td>
<td>1260223</td>
<td>-519277</td>
<td>-687163</td>
</tr>
<tr>
<td></td>
<td>-26.7%</td>
<td></td>
<td>-35.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centre Region</td>
<td>237126</td>
<td>166203</td>
<td>154632</td>
<td>-70923</td>
<td>-82494</td>
</tr>
<tr>
<td></td>
<td>-29.9%</td>
<td></td>
<td>-34.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brașov</td>
<td>60777</td>
<td>36796</td>
<td>35273</td>
<td>-23981</td>
<td>-25504</td>
</tr>
<tr>
<td></td>
<td>-39.5%</td>
<td></td>
<td>-42.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Study ADR Centre "Evolution of the population of preschool age and school age in the Centre region between 2005-2025", realised on the basis of the prognosis INS

The effects of these developments will directly affect the school population and the structure of the population of working age (fewer young people will enter the labour market), the potential impact on socio-economic development of the county.

On the other hand, in the 2015-2025 analysis, the estimated consolidation at regional level is that of midlife people (35-55 years) active on the labour market (due to the pyramid of ages from the demographic study realized by ADR Center on the basis of the data from the INS prognosis), which logically leads to a growing need for continuing education for adults - to the attention of interested schools to compensate for the loss of school population.
3. RESULTS AND CONCLUSIONS

The transformations in the Brasov are of Romanian education suffered because of the economic, political and social environment in the years 1977/2013. This paper provides an analysis of technical education in Brasov on the basis of the tuition plans approved by authorities. The technical education transition stages between 1997-2013 were also presented and discussed.

The evolution of profiles and specializations in technical schools Brasov, in the contexts mentioned above, was briefly mentioned as well as the modernization of technical education by tailoring education in accordance with the current requirements and in conjunction with existing programmatic documents.

There is obviously compulsory need of strengthening social partnership in VET training by involving in decision making and local planning the representatives of relevant institutions and organizations.

Regardless of the training domain, the diversity of economic agents categories needs to be taken into account (size classes, types of capital). In this context, the anticipation of the skill needed and the adaptation of the school offer to labour market needs becomes another priority.

Actions have to be taken also in the direction of systematic information, guidance and counselling of the students and an integrated approach has to be taken to initial and continuing vocational training in the perspective of lifelong learning.

The institutions providing technical and professional education should also get involved in programs of active steps to employment, particularly those providing new skills to young people who have not found a job after graduation.

REFERENCES

LA MISE EN PLACE DE LA SCIENCE SUR LES MACHINES

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Mots-clés — machines, mecanismes, Monges, Hachette, Lanz, Betancourt

Il est de notoriété générale que l’«Essai sur la composition des machines» de Lanz et Betancourt1, publié en 1808 avec le «Programme du cours élémentaire des machines pour l’an 1808» d’Hachette2, marque l’émergence d’une nouvelle discipline – la science sur les machines. Cependant, les conditions de la création de ce traité, sa publication par l’Ecole polytechnique dont ni Lanz, ni Betancourt ne faisaient alors partie, ainsi que le rôle de chacun des auteurs et l’apport concret de Monge dans la création de cet ouvrage sont longtemps restés inédits. L’ouvrage a connu par la suite des développements importants condensés, d’une part, dans les travaux d’Hachette, et d’autre part, dans une série de travaux parus 30 ans durant sous les noms de Lanz et Betancourt. Et ce malgré le fait que Betancourt, installé en Russie, n’avait pas participé à la préparation de la deuxième édition, alors que la troisième a vu le jour après le décès des deux auteurs.

Essayons de répondre à toutes ces questions.

L’impulsion au cours des machines à l’École Polytechnique a été donnée par Monge qui considérait la machine comme un ensemble d’éléments pour transformer les mouvements. Aujourd’hui, ces éléments primitifs sont appelés « mécanismes ». Dans son premier cours public de géométrie descriptive lu à l’Ecole normale de l’An III en 1795, il a évoqué la nécessité de diffuser parmi les spécialistes le savoir sur les machines. Plus tard, Monge a développé cette idée dans le
premier article du n° 1 du *Journal de l’École polytechnique* : « Enfin une des applications les plus utiles de la géométrie descriptive… c'est la description effective des formes et de la construction des parties élémentaires des machines... Chaque machine est composée de plusieurs parties élémentaires dont chacune a un but particulier »3. Les conférences de Monge ont été publiées par son assistant Hachette, en 1799, à l’usage de l’École Polytechnique.4

Monge a formulé trois autres points importants : la géométrie descriptive comme base théorique du dessin technique permettant la représentation précise de ces machines ; l’introduction des méthodes graphiques de construction des machines pour parer à l’insuffisance des méthodes analytiques de leur calcul encore faiblement développées ; la capacité de la géométrie descriptive à retracer les trajectoires imaginaires des mécanismes – de fait, la graphique de la cinématique. A l’époque initiale, ce potentiel de la géométrie descriptive était fondamental ; la naissance de la science sur les machines a, en effet, marqué la naissance de la cinématique des mécanismes.


Dans les *Développements sur l’enseignement* publiés en automne 1794, le programme de la géométrie descriptive comprenait les éléments des machines enseignés durant les deux derniers mois de la première année d’études. Cependant, par la loi du 22 octobre 1795, les cours d’enseignement à l’École polytechnique prévus initialement pour la durée de trois ans, ont été réduits à deux ans, et l’enseignement des machines a été reporté.

En 1797 Monge, trop occupé ailleurs, a confié sa chaire à l’École polytechnique à Hachette. Mais ce dernier était géomètre plutôt que mécanicien, et il s’est avéré incapable de rédiger ne serait-ce que quelques leçons sur les machines dans le cadre de ce cours.

En décembre 1805, le Conseil de perfectionnement a « réuni les cours spéciaux des mines et des ponts et chaussées en un seul cours général sur les éléments des constructions et des machines ».5 L’enseignement du *Cours sur les Éléments des machines* « utile à tous les corps d’ingénieurs » est confié à Hachette. Le 16 juillet 1806, ce dernier a présenté un rapport au Conseil d’instruction et il a donné « lecture du programme de ce cours dont il a préparé les bases », en proposant de prendre « les dessins de machines dont l’école peut avoir besoin » au Conservatoire des arts et métiers. Le programme en 5 leçons a été adopté par le Conseil de perfectionnement le 20 novembre 1806 et publié en février 1807 dans le *Rapport* concernant la session 1806.6 Il comprenait l’examen de 5 machines mais sans aucune tentative de leur classification.

L’année suivante, Hachette a lu 6 conférences sur les machines très différentes sur le fonds de celles faites précédemment. Elles se basaient sur la nouvelle version du programme adoptée le 6 novembre 1807 sous le nom du *Cours élémentaire des machines « faisant partie du Cours de géométrie descriptive*». Ce programme a été inclus dans le *Rapport du Conseil de Perfectionnement, session 1807*, arrêté en séance du 22 janvier 1808 et publié en avril suivant avec, en annexe, le *Cours de Géométrie Descriptive par Mr Hachette : Tableau des Machines Élémentaires et Légende du Tableau*.7 Il s’agit donc du programme d’enseignement de l’année académique 1807/08 ainsi que l’indique le *Tableau synoptique* joint au *Rapport*. 382
En janvier 1808, Hachette a écrit dans la *Correspondance sur l’École impériale polytechnique* : «Conformément à l’arrêté du Conseil de perfectionnement, la seconde année d’étude des élèves de l’École Polytechnique, a commencé le 24 octobre 1807 par le cours sur les machines...; le précis des leçons du professeur (M. Hachette) paraîtra dans le courant de cette année, en même temps que le travail de MM. Lantz et Betancourt sur les éléments des machines.»


Ainsi, le fameux *Tableau des Machines Élémentaires* offrant la classification des machines selon 10 transformations élémentaires du mouvement, les légendes associées et le programme créé sur sa base ont été créés par Hachette *duran les premiers 10 mois de 1807*, tandis que leur explication a été rédigée *duran les 8 premiers mois de 1808*. Retenons ces dates.

Mais d’abord, intéressons-nous aux protagonistes espagnols de l’histoire, Lanz et Betancourt.

Lanz est arrivé à Paris en novembre 1789 lorsque Betancourt s’y trouvait déjà. En 1795, il a suivi les cours de géométrie descriptive de Monge à l’École normale avant de devenir professeur à l’*École des géographes* deux ans plus tard. Cependant, l’École a fermé ses portes au printemps 1802, et Betancourt a proposé à Lanz le poste de professeur à l’*Escuela de caminos y canales* nouvellement créée à Madrid. En partance pour l’Espagne, le 30 juillet 1802, Lanz a sollicité et obtenu à *École polytechnique* des épreuves gravées destinées à l’enseignement de la géométrie descriptive, de la coupe des pierres et du bois, des ombres des cours analytiques de Prony et de Monge, dans l’intention des les utiliser dans ses enseignements à Madrid.

En 1803, deux ouvrages voient le jour à Madrid, publiés à l’Imprimerie royale : la *Geometría descriptiva*, qui regroupe les leçons de Monge à l’École normale, et le *Tratado de mecánica elemental* qui est la version espagnole du manuel de L.B. Francoeur. Les noms des traducteurs n’ont pas été mentionnés. Les candidats les plus probables sont : Lanz pour la *Geometría descriptiva* et Penalver pour le *Tratado de mecánica elemental*.

L’idylle amicale entre Lanz et Betancourt a pris fin en 1805. Le premier souhaitait retourner travailler à Paris, le second s’opposait farouchement à ce départ qui faisait, à ses yeux, l’obstruction au fonctionnement normal de l’*Escuela de caminos y canales*. Le disciple de Lanz que ce dernier avait proposé comme suppléant ne possédait pas les compétences requises. Dans une série de lettres adressées en aot et en octobre 1805 au chef du gouvernement Cevallos et à Godoy, Lanz a accusé Betancourt d’incompétence et d’incapacité de juger du niveau des connaissances de ses élèves. En novembre 1805, il a quitté Madrid ayant rompu ses relations avec Betancourt.

Lanz cherchait à s’attarder en France, surtout après le début de la révolte populaire à Madrid, le 23 avril 1808 et de la guerre de l’indépendance qui s’en est suivie. Il avait donc besoin de trouver des sources de financement locales, y compris en se faisant engager au service français. Décrocher un poste de professeur à l’École polytechnique constituait une échéance honorable mais pour cela, il
fallait proposer un projet innovant. La direction à suivre a été suggérée par des décisions du Conseil de perfectionnement adoptées en décembre 1805, puis en décembre 1806, qui visaient la création du « cours sur les éléments des machines ». Quelqu’un susceptible de proposer au Conseil un cours bien élaboré avait la chance d’aspirer au poste de professeur à l’Ecole polytechnique.

Cependant, pour se lancer dans une telle aventure, Lanz devait déjà avoir un fonds de pensée bien formé sur le thème. C’est ainsi que voient les choses Rumeu de Armas et Lucena Giraldo lorsqu’ils affirment que Lanz et Betancourt ont commencé à travailler sur l’Essai encore à Madrid (c’est-à-dire en 1803-1805) et que cette collaboration a donné naissance à un manuscrit en espagnol. Toutefois, aucun manuscrit de ce type ne semble avoir été utilisé dans l’enseignement à l’Escuela de caminos y canales. D’après A. Gutiérrez (1811), en 1805, le plan de cours sur les machines de Lanz correspondait... au Catalogue du cabinet des machines de Betancourt. Il s’agissait donc, à cette étape là, d’une « immersion » dans l’univers des machines et non pas de leur classification.

J. M. Vallejo affirmait en 1815 avoir entendu Betancourt lui parler à Madrid de « son travail importantissime qui comprend toutes les machines possibles puisqu’il s’agit d’une collection de différents mouvements et de leurs combinaisons ... pour convertir les mouvements d’un type en d’autres ». Le fait que Betancourt avait parlé de ce travail comme du sien propre peut signifier que la conversation était postérieure à son conflit avec Lanz. Dans ce cas là, les deux hommes avaient déjà travaillé ensemble entre le printemps 1803 et le printemps 1805.

Tout laisse à croire que l’initiative de ce travail revenait à Lanz inspiré par la traduction de l’ouvrage de Monge. Grâce à ce dernier, il a compris : tous les machines se composaient de quelques éléments dont l’un servait à transformer le mouvement. Cela signifiait qu’on pouvait tenter une classification de ces éléments, en s’appuyant sur « l’entrée » et « la sortie ». En revanche, la charge intellectuelle principale de ce travail devait incomber à Betancourt, du moins au début.

Tout d’abord, parce peu de temps avant ces événement lui et Breguet ont créé le télégraphe optique. Du point de vue de la logique mathématique, la classification des machines élémentaires selon les types de transformation du mouvement et la création d’un nouveau code télégraphique sont identiques. Le problème consistentrait alors dans deux cas à créer, à partir d’un nombre limité de signes, une série de combinaisons en mettant en corrélation avec chacune d’elles des éléments d’un ensemble connu numériquement supérieur aux signes disponibles utilisés dans les combinaisons. Les différences entre ces deux problèmes se manifestent à niveau plus fin, mais au-delà des nuances, le fonds du problème combinatoire demeurait le même dans les deux cas. C’est à peine si Betancourt l’avait formulé en mêmes termes que nous le faisons aujourd’hui, mais en tant qu’ingénieur il devait apprehender les analogies.

Il devait également changer d’optique et renoncer au principe fonctionnel de classification posé à la base du Catalogue du Cabinet des machines. Un tel effort intellectuel (beaucoup plus grand que celui de Lanz qui s’était attelé à la tâche avec la confiance d’un néophyte ayant découvert une belle théorie) justifiait à ses yeux de s’estimer l’auteur principal : il s’était trop – et depuis trop longtemps – investi dans le Cabinet des machines pour s’attribuer un rôle secondaire dans ce travail qui entraît justement en phase nouvelle. Si au moins Lanz avait demeuré à Madrid, Betancourt l’aurait probablement mentionné. Mais puisqu’il avait quitté l’Espagne, Betancourt pouvait parfaitement répudier un coauteur déloyal. Cela implique une autre conclusion : chacun des auteurs avait en sa
possession un exemplaire du manuscrit. Autrement, Betancourt se serait plaint que Lanz avait spolié son travail. Quant à Lanz, à la charnière de 1806 et 1807 au plus tard, il a présenté leur ouvrage collectif au Conseil d’instruction de l’École polytechnique comme son propre travail.

D’après Fourcy, le manuscrit a été transmis au Conseil d’instruction par « les instituteurs de géométrie descriptive ». L’un d’eux était Hachette. Qui était le second ? Bien que Monge n’eût enseigné la géométrie descriptive que pendant les deux premières années de l’existence de l’École, son nom n’a pas disparu des programmes ultérieurs. Mais alors on peut se demander si ce n’était pas Monge le relai de Lanz pour soumettre le manuscrit au Conseil ? Dans le procès-verbal du Conseil d’instruction du 15 janvier 1807, on peut lire ceci : « Monge et Hachette, qui ont examiné l’ouvrage, l’ont trouvé [assez] bon et susceptible de remplir le but qu’on doit attendre d’un traité de cette nature. Ils regardent la proposition de M. de Lanz comme très avantageuse ». Hachette, pour sa part, a écrit à la fin de 1808 que le manuscrit avait été accepté pour la publication « sur le rapport de MM. Monge et Hachette » avec le programme de ce dernier.

Reconstituons les événements antérieurs à ceux du décembre 1806 / janvier 1807. Lanz arrive à Paris à la fin de 1805. A peu près au même moment (décembre 1805), le Conseil de perfectionnement adopte la décision de créer un cours de machines. Le manuscrit que Lanz avait « dans sa poche » tombe donc fort à propos. La traduction, la relecture, la préparation des dessins prennent quelques mois. Fin 1806, Lanz transmet le manuscrit au Conseil qui confie son examen à Monge et à Hachette. Le nom de Betancourt est absent du procès-verbal. En présentant le manuscrit à son seul nom, Lanz ne se doute pas encore que Betancourt va bientôt se pointer à Paris.

Ayant pris connaissance du manuscrit, Monge comme Hachette devaient se rendre compte qu’il s’agissait ici d’une véritable percée. Les deux ont estimé « la proposition de M. de Lanz <...> très avantageuse ». En revanche, leurs réactions intimes pouvaient être beaucoup moins concordantes.

Pour Monge ce travail incarnait le développement de ses propres idées. En février 1807, le Rapport du Conseil de Perfectionnement voit le jour où, à la suite du programme assez primitif d’Hachette sur les machines, on lit les lignes suivantes : « Le conseil d’instruction favorisera, autant qu’il sera possible, la rédaction d’un Traité des Éléments des machines ». Nous doutons que l’initiative d’un tel texte pouvait émaner d’Hachette. On devrait plutôt y voir l’intervention de Monge qui essayait ainsi inciter Lanz à terminer au plus vite son ouvrage.

Pour Hachette, le manuscrit de Lanz était un cadeau empoisonné : il apportait un constat amère du caractère périmé des 5 leçons sur les machines concrètes qu’il venait de donner à l’École. Il s’était fait piéger et n’avait plus qu’à s’aligner à l’avis hautement approbateur donné par Monge au manuscrit de Lanz et s’atteler rapidement à la rédaction de son propre ouvrage.

Comparer les dates : son fameux tableau de 10 transformations élémentaires du mouvement, sa description et le programme ont vu le jour dix mois après qu’Hachette avait lu le manuscrit de Lanz. Quant au texte qui en offrait les fondements théoriques, il est paru six mois après la relecture par Hachette du manuscrit cosigné cette fois-ci par Lanz et Betancourt. Le tableau d’Hachette (10 lignes) n’est rien d’autre qu’une partie du tableau de Lanz (21 lignes) dont sont exclus les mouvements curvilignes. Dix-huit mois plus tard, Hachette insistera : « Tel est le système d’après lequel M. Hachette avait commencé le tableau ci-joint… des machines élémentaire, lorsqu’il apprit que MM. Lanz et Bétancourt avaient exécuté, d’après le même plan un tableau semblable ».
affirmation mérite qu'on s'y attarde vu qu’un regard rapide sur le livre suggère que l’idée initiale revenait à Hachette et que Lanz et Betancourt l’ont simplement développé en un cours autonome. L’aveu d’Hachette fait penser que leur travail était entièrement indépendant du sien propre. En réalité, à l’étape initiale c’est bien Hachette qui était entièrement dépendant du manuscrit de Lanz, et son programme de 1806/07 n’avait rien à voir avec la proposition de ce dernier.

Il lui importait de se distancer au maximum du travail de Lanz. La mise en comparaison des deux tableaux permet des considérations intéressantes : en copiant les dessins schématiques de Lanz, Hachette prenait soin à y apporter de petites retouches au niveau des manivelles, des cadres, etc., pour dissimuler son plagiat. Malgré cela, les dessins révèlent des similitudes fragrantes, à commencer par la composition de chacun d’eux. Hachette est tombé dans le carcan de la perfection des symboles graphiques, propres aux systèmes de signes, qui ont atteint, chez Lanz et Betancourt, la limpidité des idéogrammes. Toute tentative de modification ne faisait qu’altérer les dessins, de sorte qu’il a dû se contenter de retouches cosmétiques. Hachette avait donc de fortes raisons de redouter toute comparaison avec le travail de Lanz qui serait imminente en cas d’une co-publication. Le 14 août 1807, il a donc écrit au Conseil d’instruction en proposant de faire deux publications séparées. Malgré cela, le Conseil a opté pour une publication commune.

Si on ne peut pas enrayer le processus, il faut en prendre la direction. Et Hachette devient le rédacteur en chef de l’édition dans son ensemble. Mais déjà en avril 1808, à savoir cinq mois avant la publication de l’Essai de Lanz et Betancourt avec ses propres programme et tableau, Hachette a publié ces mêmes matériaux dans l’annexe au Rapport du Conseil de Perfectionnement et gagné ainsi une petite longueur d’avance. Quant à Lanz, occupé à mettre au point son manuscrit, la venue de Betancourt à Paris en mai 1807 a rendu sa situation particulièrement gênante. Il s’est retrouvé en présence de l’homme que quelques de ans plus tôt il avait injurié et traité d’incompétent. Mais sa présence à Paris rendait impossible, au risque de provoquer un scandale, la présentation de leur travail collectif sous son seul nom. Dans cette situation, il ne lui restait qu’une solution – trouver le moyen de se réconcilier avec Betancourt. Ce que, de toute évidence, il a fait.


Le 12 août 1808, le Conseil d’instruction a confirmé sa décision de publier, en un seul volume, le Programme d’Hachette et l’Essai de Lanz et Betancourt. L’ouvrage est imprimé le 22 septembre, à savoir 1 mois et 10 jours plus tard.

Ce livre pose les fondements de la science sur les machines.

Cependant Lanz a abandonné l’espoir d’améliorer sa situation grâce à cette publication. Le 6 juin 1808, il a prêté serment au nouveau roi d’Espagne, Joseph I Bonaparte, et en été 1809, il est retourné à Madrid. Quant à Hachette, il n’a jamais abandonné l’intention d’éliminer Lanz et
Betancourt de l’histoire de la science sur les machines : dans ses publications de 1811, 1814, 1819 et 1828 il s’obstine à ignorer l’existence de l’*Essai*.

Du point de vue de l’implication dans l’élaboration de la théorie des machines, la position de Betancourt diffère de celles de Lanz et d’Hachette. Sa participation revêt un caractère plus aléatoire, plutôt « épisodique ». A la différence des deux autres, ses contacts *personnels* avec Monge demeurent à ce jour non avérés, même si ce dernier fut nommé commissaire à l’Académie des sciences, à l’occasion du rapport sur la machine à vapeur à double effet soumis par Betancourt en décembre 1789. Pourtant, il n’en découle nullement qu’ils se soient jamais rencontrés en personne.

Résumons les points essentiels du programme d’Hachette et de l’*Essai* de Lanz et Betancourt. Les derniers introduisent la division de la machine en deux parties – le récepteur (élément qui perçoit directement la force motrice) et l’outil (élément qui exécute directement le travail), et ensuite ils examinent le lien cinématique entre ces deux éléments en essayant de comprendre comment le mécanisme intermédiaire transforme le mouvement. Ils prennent pour base les combinaisons de 4 transformations élémentaires du mouvement : rectiligne (de va et vient) et circulaire (de va et vient) et tiennent compte des transformations liées avec le mouvement sur une courbe donnée (aléatoire). Nous pensons que cette idée vient de Lanz : en tant qu’astronome il était familierisé avec les mouvements elliptiques des corps (donc mouvements curvilignes), et c’est à peine s’il pouvait se contenter des seules combinaisons des mouvements rectiligne et circulaire. Comme résultats, les coauteurs ont obtenu 21 combinaisons et ont présenté le tableau regroupant 21 transformations (dont chacune occupe une ligne) disposées en 20 colonnes. Les carrés obtenus de la sorte contenaient des dessins schématiques des machines élémentaires qui effectuent le type de mouvement donné. Sur 420 carrés seuls 165 ont été remplis, y compris 134 dessins et 21 descriptions verbales. L’*Essai* en tant que tel n’est autre que le texte explicatif à ce tableau. Outre les mécanismes à proprement parler, Lanz et Betancourt ont inclus dans la catégorie des machines élémentaires non seulement des combinaisons des éléments solides, mais aussi des ensembles ayant dans leur composition des éléments élastiques, fluides et gazeux.

Comme résultat, l’ouvrage contenait, ordonnés et expliqués, pratiquement tous les mécanismes utilisés au début du XIXe siècle. La bibliographie associée comptait deux bonnes dizaines de sources. Autrement dit, l’*Essai* était une véritable encyclopédie systématisée des « machines élémentaires » de l’époque. C’était aussi probablement le premier ouvrage où il n’était pas question des « machines simples », ce qui signifiait un passage définitif de la statique et la transformation des forces vers la cinématique et la transformation du mouvement.

A partir des années 1840, l’ouvrage a été sévèrement critiqué pour des inconséquences dans l’interprétation des « machines élémentaires ». On a reproché aux auteurs d’avoir inclus dans la catégorie des mécanismes des éléments fluides et élastiques. Pourtant, les critiques contemporains sont tout aussi incohérents lorsqu’ils comparent ce qui a été proposé au début du XIXe siècle avec la notion actuelle de « mécanisme ». On peut bien sûr, considérer, suite à Bogoljubov, que l’ouvrage de Lanz et Betancourt « compte parmi les éléments certaines actions dynamiques: la pression de la vapeur, la pression d’un courant d’eau sur les godets d’une roue hydraulique ; la pression du vent sur l’aile d’un moulin à vent ». Mais si on essaie d’appliquer au problème la logique des auteurs de l’*Essai*, on comprendra que c’est l’unique moyen, pour les éléments fluides et gazeux, d’exercer
une action sur les éléments solides, et de ce point de vue, il est incorrect d’affirmer que « les actions dynamiques » sont incluses « au nombre d’éléments » ; elles ne le sont pas plus que les actions statiques qu’exercent mutuellement les éléments solides. Simplement, Lanz et Betancourt ont proposé un autre ensemble d’élément où d’autres interactions sont possibles.

Nous pensons que la prise en compte des éléments élastiques, fluides et gazeux était un apport de Betancourt qui s’intéressait non seulement à l’hydrotechnique mais aussi à l’élasticité de la vapeur. Pour lui, le gaz était un élément actif. Ainsi qu’a dû le reconnaître A. Bogoljubovt, il y avait une graine rationnelle dans l’idée que les éléments pouvaient ne pas être uniquement solides. Cet historien s’est avancé plus loin que les autres dans son explication de l’ensemble syncrétique des machines élémentaires proposée par Lanz et Betancourt et il considérait que « la première classification des mécanismes est une classification des formes plutôt que celle de leur contenu cinématique ». Il s’agit, de fait, d’une collection assez syncrétique d’objets qui embrasse non seulement des groupes de mécanismes mais aussi des pièces isolées ou des machines toutes entières qui sortaient, à l’évidence, du cadre des machines dites « élémentaires ».


Les deux rééditions de l’Essai, de 1819 et 184019, ont été préparées par Lanz seul. La dernière de ces rééditions a vu le jour après son décès.
Pareillement à Lanz, Hachette a continué, la vie dura, à perfectionner et à rééditer son œuvre. C’est lui qui a formulé l’idée sur les trois composantes de toute machine : le moteur, les éléments de transmission et l’organe du travail. En revanche, l’Essai de Lanz et Betancourt a connu un rayonnement international bien plus grand que le Traité d’Hachette, et ce malgré le côté archaïque et syncrétique nettement plus prononcé du premier ouvrage et d’une plus grande rigueur scientifique du second. En effet, tandis que le Traité d’Hachette a été publié uniquement en français, cette langue des sciences commune alors à l’Europe savante toute entière, l’ouvrage de Lanz et Betancourt a été traduit en d’autres langues européennes, ce qui témoigne qu’au-delà des savants et des ingénieurs, il a trouvé un public intéressé dans l’univers beaucoup moins instruit de techniciens et de mécaniciens-praticiens.


Récapitulons.

La mise en place de la classification des machines élémentaires selon le principe cinématique est liée avec les noms de trois mathématiciens Monge et ses deux disciples, Hachette et Lanz.

Monge formule ses idées en 1794–1795 puis passe à autre chose. Hachette hérite non seulement de ses cours mais aussi du grand souci de ce dernier, la théorie des machines déjà imaginée mais guère élaborée. Cependant, l’affaire n’avance pas. En 1799, Hachette publie le cours de la géométrie descriptive de Monge où il reprend les idées de ce dernier sur les machines, mais cela ne le stimule pas pour autant à rédiger le cours sur les machines. Lanz traduit en espagnol les mêmes leçons de Monge publiés en 1803 à Madrid. Mais il ne travaille pas sur les machines.

Enfin, en 1808, Hachette d’une part, Lanz et Betancourt de l’autre, en s’appuyant sur les idées de Monge, publient un ouvrage collectif sur la théorie des machines. La contribution d’Hachette s’y résume au programme accompagné d’un schéma, son œuvre approfondie sur ce thème ayant vu le jour en 1811. Ainsi, 13 à 14 ans séparent l’idée de Monge de son développement par Lanz, 14 à 17 de son développement par Hachette. Quelque chose a dû se produire entre 1803 et 1808, qui a permis de réaliser le travail.


Ni Monge, ni Hachette, ni Lanz n’avaient pas une si bonne connaissance des machines, et c’est là, en grande partie, qu’il faut chercher l’explication du retard accumulé dans l’élaboration d’un nouveau cours scolaire et dans la mise en place d’une nouvelle science pressenti sur les machines. A la différence d’eux, Betancourt avait déjà l’expérience de la création du Cabinet des machines et de la rédaction du Catalogue de ce Cabinet.

Faisons le bilan.
Monge a formulé l’idée générale sur la possibilité de classer les machines selon le critère cinématique ;
Betancourt a participé à la création de la classification et l’a enrichi d’un contenu pratique et technique ;
à l’étape initiale (1806-1808), l’*Essai* de Lanz et Betancourt s’est avéré primaire par rapport au travail d’Hachette qui leur a emprunté les premières idées fondateuses de la classification et qui, lors de la relecture de l’*Essai*, en a tiré une connaissance approfondie sur les machines ;
Lanz et Hachette, ayant préparé, chacun, trois à quatre monographies sur le thème, ont su fusionner l’un et l’autre et donner à ce nouveau savoir synthétisé la forme d’une science achevée.

5. Hachette, *Programme du cours*, VI-VII.
10. Josef Mariano Vallejo, *Compendio de mecánica práctica: para uso de los niños, artistas, artesanos y demas personas que no tienen conocimiento del cálculo diferencial é integral* (Madrid, 1815), 73-74.
15. Hachette, *Programme du cours*, VIII.
SOURCE OF LIGHT AND COLOUR, NATURAL AND ARTIFICIAL, IN THE PERCEPTION OF A WORK OF ART

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Abstract — The importance of the sources of illumination of a work of art depends on the nature of the materials used in the installation, on the constituent materials. Metamerism - a phenomenon that occurs with changing the spectral distribution of the light, due to the change of the light source, the two objects being initially identical in terms of colour - is a problem often encountered in the practice of restoration, chromatic reintegration imitative, most exactly. If in restoration the phenomenon has negative connotations, in fine art it can be a starting point in the development of the new works of art through a careful study of pigments and exposure conditions. The study of the diffuse reflectance spectra (DRS) is an important step in understanding metamerism and its applicability in the field of visual arts, and together with other concepts: manner, technique, school and style, it can bring new approaches in fine arts and painting, it can translate into what the stories say: „during the day with a face, during the night with another”.

Keywords — natural, light, metamerism, painting

1. INTRODUCTION

In order to be appreciated, a painted surface must diffuse and reflect light long enough, both in terms of energy and spectrum.

The radiant energy conservation law is:

$$\Delta \Phi_i = \Delta \Phi_r + \Delta \Phi_t + \Delta \Phi_d + \Delta \Phi_a$$

(1)

As far as the indices i, t, d, are concerned they refer to the flows reflected, transmitted, diffused and absorbed by the atomic systems at the separation surface. By dividing the equation (1) by $\Delta \Phi_i$ incident flux, we obtain the relation:

$$I = R + T + D + A$$

(2)

Between the factors of reflection R, transmission T, scattering D and absorption A.

In the case of painting, transmittance tends towards zero, but the reflection factors (especially in the case of oil paintings) and / or the absorption factor are not zero.
The chemical composition of the paint layer determines the hue and the brightness of the color is determined by the concentration of the pigment.

1.1. The Metamerism

The metamerism is the phenomenon of reflection or transmission of differential optical radiation, for two or more pigments / dyes considered equal, depending on the spectral illumination. In other words, is the phenomenon by which the colour difference of two coloured objects changes by modifying the spectral distribution of illumination.

The two coloured surfaces are identical if:
- Are painted with the same pigment - identical chemical composition;
- Are illuminated with light in the same spectral range.

If you meet one of the conditions but not both simultaneously, the phenomenon is called metamerism, and the colour - metameric.²

The phenomenon is observed more by/at younger people than by/at elder ones, depending on the direction and observation of geometrical conditions. This is because the absorption spectrum in the visible range of the two objects differ significantly even though the tristimulus values (RGB) in light of day are the same ($\lambda_R=700$ nm, $\lambda_G=546,1$ nm, $\lambda_B=435,8$ nm).³

1.2. Chromatic Reintegration

The chromatic reintegration imitative of gaps in the paint layer is an important step in the whole process of conservation and restoration of paintings. It is the operation that highlights the entire recovery approach of a work of art.⁴

But, for a proper reintegration, there must be taken into account a number of factors related to the texture, scattering transparency and colour of the paint layer. Matching colours in a restored work should be ensured by the three basic characteristics of colour: hue, brightness and saturation.

It is impossible to repeat a process dependent on so many parameters. So, that the restorer’s work is very difficult and requires, besides artistic talent and rich knowledge of painting materials science, optics and spectroscopy.

Azurite, basic copper carbonate, is a mineral with the chemical formula $2\text{CuCO}_3 \cdot \text{Cu} (\text{OH})_2$. It is found in secondary deposits of copper ores associated with malachite - $\text{CuCO}_3 \cdot \text{Cu} (\text{OH})_2$. Due to good chemical stability under normal conditions, it was used in the mural outside of the churches of Bucovina.⁵

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² Istudor,I., Notiuni de chimia picturii, DAIM Publishing House, 2007
³
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⁵
2. BACKGROUND & ANALYSIS

The support used to depose pigments was prepared in the traditional technique of easel painting: cotton cloth, initially glued with gelatine standardized 4% which was applied a primer - gesso - composed of gelatine 9% micronized chalk powder (CaCO3, 37.5%).

TiO2 pigments and their mixtures were analyzed using diffuse reflectance spectroscopy (DRS) with UV-VIS spectrophotometer COLORSCOP. The spectral range was 190 - 1100 nm. Correlation of device was made using barium sulfate BrSO4. Mixtures were made by mixing in proportions of 1:4 to the mixture, and the 1:9 ratios (II) with TiO2. The pigments are: Ultramarine blue (I), Cobalt blue (II), Azurite (III), Azure blue (IV), Ultramarine Hell (V), Cerulean blue (VI) and TiO2.

![Image with pigments in natural light](image1.png)

Fig. 1. Image with pigments in natural light

![Diffusive Reflectance Spectra (DRS) in the form of commercial and natural pigments (azurite III)](image2.png)

Fig. 2. Diffusive Reflectance Spectra (DRS) in the form of commercial and natural pigments (azurite III)
3. RESULTS

The reduction of the metamerism phenomenon was observed in the visible pigments in case of mixtures with titanium dioxide TiO₂. Thus, the relationship between the spectral chemical composition and the Lighting is brought to equilibrium.

4. CONCLUSIONS

From an artistic perspective, the realization of such analyzes for a large number of pigments lead to facilitate the work of the restorer, which is the chromatic reintegration. The consequence of quality scientific reintegration is the correct interpretation of a work of art, independent of the light source. Another important aspect is the possibility to create a complex painting, in which the overlapping studied pigments by support bring together two distinct images, observable only if those lights have different spectral composition.

From the economic point of view, using mixed colour equivalent to natural pigments but much cheaper than those, produces less expensive restorations. Moreover, in terms of economy, the real gain is the possibility of exposing thus restored works of art, in galleries and museums, without modifying the existing lighting systems.

ACKNOWLEDGEMENTS

The participation at the International Symposium was possible through the moral and material support of Mr. Ioan Nani and the entire management team of S.C. Antibiotice S.A. Iasi - Science and Soul.

NOTES

5 Istudor,I., *Notiuni de chimia picturii*, DAIM Publ.
V. UTKIN AS A SCIENTIST AND DESIGNER IN THE FIELD OF SPACE ROCKET ENGINEERING (1971-1990)

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Abstract — This paper deals with the scientific biography of Vladimir Utkin, a Ukrainian engineer and designer of rockets and space systems who was the General Director of Yuzhnoye Design Office in the Dnepropetrovsk city, and thanks to whose results parity in the field of nuclear missiles was reached in the world after the global geopolitical, military, economic and ideological confrontation in the period of the Cold War. Moreover, his pedagogical activity in the field of technological education in Ukraine has been shown in the paper. After graduation from Leningrad Military Mechanical Institute in 1952 V. Utkin worked at Dniepropetrovsk Special Design Office of Plant в on creation of the first soviet ballistic missiles. In 1971 he became General Designer of Yuzhnoye Design Office. Under his leadership, the strategic missile systems, having no analogs in the world and being the basis of defense potential of the Soviet Union, were put into service. His team created effective liquid-propellant intercontinental ballistic missile SS-18 («Satan») and solid-propellant intercontinental ballistic missile SS-24 («Scalpel») of silo and railroad basing mode. Space rocket systems Cyclone, Zenit, and a wide range of spacecrafts for military, scientific, and national economy purposes were developed, the leak-tightness of propellant systems and long-term missile staying on alert in fuelled condition, mortar launch of heavy missiles from container, enemy's anti-missile defense penetration were ensured. Space launcher Zenit subsequently became the basis of successful international projects Sea Launch and Land Launch.

V. Utkin was an active participant of international scientific cooperation, including Interkosmos project. He was elected as an academician of Academy of Sciences of Ukraine (1976), an academician of Academy of Sciences of the USSR (1984) and a full member of International Academy of Astronautics. In memory of the scientist, V. Utkin Gold and Silver Medal for outstanding achievements in the field of space rocketry development were set. It was found that V. Utkin always contacted properly with Physical and Technical Faculty of Dnipropetrovsk University, and at Yuzhnoye Design Office the branches of main chairs of this faculty were set up to improve the quality of technological training.

Keywords — rocket engineering, Yuzhnoye Design Office, V. Utkin, Ukraine
1. INTRODUCTION

Rocket engineering and space exploration is one of the priorities of Ukrainian technological development. In this research Yuzhnoye Design Office in the city of Dnepropetrovsk and its General Director Vladimir Utkin played the key role. The development of environmentally friendly space launch system with fully automated launch «Zenit»; a series of satellites for Earth observation from space; international space projects «Sea Launch»; «Land Launch» and «Cyclone»; launch vehicle «Antares» for cargos delivering to the International Space Station are among the biggest achievements. In connection with this the analysis of rocket and space technology evolution in Ukraine is highly important and is the topic of joint NAS of Ukraine and Yuzhnoye Design Office project. Scientific and pedagogical activity of V. Utkin as a leader of a team and an extraordinary person who influenced the next generation of engineers and high technological education needs to be revealed. Those problems are solved in the paper.

Fig. 1. Vladimir Utkin

2. BACKGROUND & ANALYSIS

Issues concerned with the history of life and work of academician V. Utkin were discussed in some memorial books and papers [1-5]. New personal documents were found in the Archive of National Academy of Science of Ukraine and in the Archive of Russian Academy of Science [6, 7]. At the same time the complex research of V. Utkin’s personal traits, which allowed him to form a team of followers and make an essential impact on the reconstruction of high school in Ukraine, has not been done before our work.
3. RESULTS

The Ukrainian engineer and designer of rocket and space systems Vladimir Utkin was the General Director of Yuzhnoye Design Office in Dnipropetrovsk city. Thanks to his results parity in the field of nuclear missiles was reached in the world after the global geopolitical, military, economic and ideological confrontation in the period of Cold War.

![Launch of rocket «Zenit»](image)

After graduation from Leningrad Military Mechanical Institute in 1952, V. Utkin worked in Dnipropetrovsk Special Design Office of Plant № 586 on creation of the first Soviet ballistic missiles. In 1971 he became General Designer of Yuzhnoye Design Office. Under his leadership, the strategic missile systems, having no analogs in the world and being the basis of defense potential of the Soviet Union, were put into service. His team created the powerful and effective liquid-propellant intercontinental ballistic missile SS-18 («Satan») and sold-propellant intercontinental ballistic missile SS-24 («Scalpel») of silo and railroad basing mode. The space rocket systems «Cyclone», «Zenit» and a wide range of spacecrafts for military, scientific and national economy purposes were developed, the leak-tightness of propellant systems and long-term missile staying on alert in fuelled condition, mortar launch of heavy missiles from container, enemy's anti-missile defense penetration were ensured. Space launcher «Zenit» subsequently became the basis for successful international projects «Sea Launch» and «Land Launch». V. Utkin was an active participant in international scientific cooperation, including Interkosmos project. He was elected as an academician of Academy of Sciences of Ukraine (1976), an academician of Academy of Sciences of the USSR (1984) and full member of International Academy of
Astronautics. In memory of the scientist, V. Utkin Gold and Silver Medal for outstanding achievements in the field of space rocketry development were set.

V. Utkin always contacted properly with Physical and Technical Faculty of Dnipropetrovsk University. At the Yuzhnoye Design Office the branches of main chairs of this Faculty were set up to improve the quality of technological training.

Utkin’s personality was characterized by deep professionalism and responsibility, broad education, experience and outlook. He was a kind of creative, hard-working person with clear ideas and objectives, who, when faced with problems, worked to overcome them in an optimum and efficient way. Creating the most dangerous and destructive modern weapons Vladimir Utkin did all his best to secure the safety and reduce aggression in the world. A gifted scientific advisor, a conscientious organizer of research, an assertive and confident General Designer, who has always relied on his team, Vladimir Utkin could sometimes even argue defending his own point of view. In such situations he seemed to be a bit concentrated, closed, and reserved. General Director of Southern Machine-Building Plant (1986-1992) and President of Ukraine (1995–2005) L. Kuchma said: «He was a taciturn man, always serious and focused. General ... behaved even-tempered, restrained and dignified, as they say, was able to keep hitting» [2, P.7-8].

V. Utkin absolutely couldn’t stand bad work, preferring himself and encouraging people to do things «on the highest level» as in professional as well as in social field. At the same time the scientist got on really well with people he met and tended to tackle any conflict situations. Usually not a very talkative but optimistic, emotionally stable, well-balanced, and wise person with great sense of humor, he was friendly, loyal, reliable, kind, and helpful with colleagues and friends. Furthermore, he knew the history of his homeland, loved art, theater, poetry and classical music, was very good at reading poems.

V. Utkin was not only an outstanding scientist and engineer. On the other hand he was successful in the pedagogical field as well. V. Utkin always contacted properly with Physical and Technical Faculty of Dnipropetrovsk University, where a large group of well-known scientists in the field of rocket and space technology were brought up. They are now working in the Ukrainian research institutes, bureaus and enterprises of space industry of Ukraine. He was the chairman of the Faculty Scientific Council specialized in the defense of theses. His assistants, who often were graduates of this faculty, lectured there. He was also a member of the Scientific Council and the Chairman of the State Examination Commission in the Dnepropetrovsk State University.

Additionally, during Utkin’s leadership at Yuzhnoye Design Office the branches of main chairs of the Physical and Technical Faculty were set up at the Office to improve the quality of training. Those were «Design and Construction» (headed by M. Galas), «Engine-Building» (headed by A. Klimov), «Automatic Control Systems» (headed by A. Novikov), where the leading specialists of the Office worked as teachers. Such an integrated system made it possible to combine university technical education with technology and industry [2].
Fig. 3. At the Southern Machine-Building Plant: General Director of Yuzhnoye Design Office V. Utkin, President of the Academy of Science of the USSR A. Alexandrov, President of the Academy of Science of Ukraine B. Paton


Scientific and technological directions founded by V. Utkin are being investigated by his pupils, colleagues and followers nowadays. Among the scientific centers where they work there is Physical and Technical Faculty of Dnipropetrovsk National University organized in 1951 to train the stuff for space industry, machine building and power engineering. The large majority of faculty graduates work at Yuzhnoye State Design Office, A.M. Makarov Southern Machine-Building Plant, Institute of Technical Mechanics, Ukrainian research institute of manufacturing engineering. Physical and Technical Faculty is closely tied with The National Aerospace Educational Center of Youth coordinating nationwide youth projects in the aerospace sphere.

Physical and Technical Faculty provides training in the following areas: plane, rocket and spacecraft building, engines and energy generating systems for aircrafts, electrical equipment and electrical technologies, avionics, radio and television communication equipment, instrument manufacturing, technical protection of information systems, engineering materials, engineering and applied mechanics, alternative sources of energy, systems for non-destructive control, robotic
systems and complexes. There are some chairs at the faculty: The Chair of Designing and Construction of Aircrafts, The Chair of Engine Construction, the Chair of Energy, the Chair of systems of automated control, the Chair of Radioelectronic Automation, the Chair of Robotic Systems, the Chair of Engineering Mechanics, the Chair of Life Safety, the Chair of Foreign Languages for technical and natural specialties.

4. CONCLUSIONS

V. Utkin’s activity as a Scientist and Designer in the field of space engineering (1971-1990) and the professor of Dnipropetrovsk University made a fundamental impact on the arms race curbing and guarantee of nuclear parity in the world.

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Abstract - A history of Technology is first of all a history of people who created and who put in function the instruments which were created. By “transition” here we understand a certain kind of transition that manifested at the beginning of the 19th century in the Romanian Principalities. The paper presents a page of the history of this transition represented by one of the most important personalities of those times, Gheorghe Asachi. The Romanian scholar was born in Herta (today in Ukraine) at 01.03.1788 and died in Iasi (Romania) at 12.11.1869. The importance of Asachi’s contribution to the development of the cultural, scientific, educational and technical level in Moldavia is pointed by many authors whose books and articles tell about the life and works of this learned patriot. The transition in Moldavia in those times needed persons with general and technical education. Asachi had the competence to respond to the needs of his country, competence obtained through deeper levels of study. In 1804 he finished his studies in Lvov, being graduated in Philosophy and also obtained a diploma as engineer and architect. Since 1805 Asachi travelled to Vienna, attended courses of mathematics and painting, then to Rome, where he studied the archeology and Italian language. Among important facts which are owed to Gheorghe Asachi, we enumerate: the class of surveyors and civil engineers, where he taught mathematics with practical applications for geodesy and lessons of architecture; a gymnasium at Iasi; programs and books for schools of all degrees, inclusively for higher technical education; the Philharmonic and Dramatic Conservatorium; a vocational school. Asachi set up the first printing house with Latin characters, the first paper mill in Moldavia, edited books, calendars, almanacs and the publication “The Romanian Bee” in Romanian language.

Asachi is recognized as the founder of the engineering education in Romania and that is why we have the “Gheorghe Asachi” Technical University of Iasi.

Keywords – education, engineering, culture, higher school
1. INTRODUCTION

What a nation is today and how this is presented in front of other peoples is, in a great measure, a heritage from those who, many centuries ago contributed to the economic, scientific, spiritual progress of the society. Such a contributor was Gheorghe Asachi, turned into an emblematic personality of the Romanian people.

At the second half of the 18th century and beginning of the 19th, the great powers, the Ottoman and Russian Empires, dominated politically and culturally the life in the Romanian Principalities. The transition in Moldavia at the beginnings of the 19th century needed persons with a general and technical education. Asachi had the competence to respond to the needs of his country, competence obtained through the deeper level of his studies.

2. SOME AUTHORS ABOUT ASACHI’S ROLE IN ROMANIAN CULTURAL LIFE

The importance of Asachi’s contribution to the development of the cultural, scientific, educational and technical level in Moldavia was pointed by many authors whose books and articles told about the life and works of this learned patriot. The great Romanian historic Nicolae Iorga wrote about Gheorghe Asachi: “In those times, there was not Romanian to know as many as he did” [1].

Edgar Quinet wrote about Gheorghe Asachi (in “Roumains des principauté”, Paris, 1856): “he is the man who, more than anyone contributed to the awaking and to paving the way for the revival of the Romanian nationality”. Already in 1855, the magazine “România literară” (Literary Romania) wrote that the name of Gheorghe Asachi is found “in all the intellectual and industrial beginnings of Moldavia – a tireless champion of intelligence, while of a half century”. One of the Asachi’s biographers [1] characterized him as “having an exceptional scientific, cultural and artistic training, polyvalent spiritual capacities, being impregnated with the illuminist ideology in the sense of the Declaration of rights of man and citizen, adopted in the revolutionary France on 26th August 1789, youthful optimism, an immense love for his country, which has increased also by his travels in Italy, by the monuments owed to the Latin kindred, as being confident in his forces, determined to play a role of “reformer” in his country”.

“Asachi has been the most representative Moldavian learned man of his time”. His initiatives and his hard work were extremely necessary in that period, to build a solid foundation of the scientific disciplines, to organize schools in the national language, to stimulate the arts and trades, the industry, to promote the cultural values, to stimulate patriotic feels by reconsidering the glorious facts of the past [6].

3. GHEORGHE ASACHI - LIFE AND EDUCATION, STUDIES

The Romanian scholar Gheorghe Asachi was born in Herta (then being Romanian territory, today it is in Ukraine) at 01.03.1788 and died in Iasi (Romania) at 12.11.1869.
Being 9 years old, Asachi began his studies at the collegiums from Lemberg (today Lwow, in Ukraine) then at the University of the same city, faculty of philosophy, attending courses in Polish, Latin and German languages and studying mathematical logics, natural history, physics, metaphysics and ethics. In 1804 he finished here the university studies and obtained a diploma for engineering and architecture, such as he wrote in his “Autobiography”. A conclusive proof of his competences of engineer and architect is the realization of plans and construction of a building in a district of Lemberg and other houses in the city Iasi of Moldavia.

Since 1805 until 1809 Asachi, with a stipend from the Moldavian department of education, studied in Vienna mathematics with the illustrious astronomer Burg and attended courses of picture also.

A great avidity of culture, beside his wish of liberty, determined Gheorghe Asachi to refuse the proposal to be integrated as lieutenant in the Russian group of engineers that was present in Moldavia in the year 1809. Since 1809 till 1812 Asachi lived in Italy, where he studied archaeology, picture and Italian language and literature.

The years of study in Italy were for Asachi the most brilliant epoch of his spiritual formation. Literature, archaeology and picture were the domains where he persevered with an enviable passion. His encyclopedian spirit did not tackle only Italian Literature in its essence, but he has made investigations in more other fields of European arts and culture. Asachi knew Greek and Latin literature, knowledge gained in his studies at Lemberg and Vienna, and so he used it in the archive of the library of Vatican. Here he discovered the Dimitrie Cantemir’s manuscript of the „History of Ottoman Empire”. About his life in Italy, Asachi wrote that: „only one single life is insufficient to observe the masterpieces of arts and the natural phenomena of this country” [7]. Here he wrote poetry and was received as an extraordinary member of the Literary Society of Rome.

In 1812 Asachi came back in his country, Principality of Moldavia. After Napoleon’s defeat, the Moldavia’s leading belongs to the Greek “Fanariots”, appointed here by the Ottoman Power from Constantinople. In those conditions the Greeks had all the important functions in the state. Only the function to establish the boundaries of the landed properties could not be executed by Greeks, because they did not know Romanian language to read and decipher the existent documents. Asachi understood that the country needed surveyors, engineers, educated in the Romanian language and to this aim he created a special class in the frame of the existent Princely Academy of Iasi.

Asachi had a multidisciplinary education: philosophy, literature, mathematics, picture, history, archaeology, music; beside his native language, the Romanian, he knew Polish, German, Latin, Italian, French, English, Russian languages.

Asachi was confident in the fact that the development of a country was possible not only by political act, but also by the spiritual life. The priorities were the introduction of the Romanian language in all forms of intellectual activities, the organization and development of the public education in national language.

“The civilization of a nation has begun to exist when the fine arts flourished together with the sciences, because so as the positive sciences light the mind, the fine arts become quiet and ennable
the heart, explain the good taste and cheering the life of the people” wrote Asachi in its article about “The fine arts” [1].

Asachi’s biographer N.C. Enescu [4] remarks that this Moldavian learned man was the specialist, the technician or the counsellor of the official leaders of schools, for to be consulted and to accomplish the decisions taken by these ones or by the government.

Asachi worked also as a state archivist and as a referent (dignitary) of the Institution of Public Education (Epithropy, Guardianship) and in these qualities he has been involved in the field of civic education, to spread the knowledge about the historic past of the people.

Asachi demonstrated the adaptability of the Romanian language for the higher knowledge, accelerated the process to assimilate the European culture and also to create the national institutions with the aim to realize new values and spread them on all the territory of his country [5].

Asachi was confident in the force of education for the social progress, he stated that the school must be a state institution in the hands of citizens, an institution of the development of national culture; it must be connected with life, with problems of production and with the organization of the society. School must assure a firm training (grounding) of the fundamental disciplines.

In the time when he was a diplomatic agent (1822-1827) in Vienna, using his knowledge as an archivist, Asachi discovered Moldavian old documents, bought them and so, in 1843 three lands were recovered from Greek monks to pass back into the domain of the public education. But the period of his absence from country spoke of what important personality was Asachi for the continuity of the development of education process [5]. The historian of mathematics G. Andonie remarked that in this time almost all schools created by Asachi did not function any longer, professors taught only to boyars children in their private houses [2].

In September 1849 Asachi was appointed director of the department of culture and public education. He composed programs, scientific memories, lessons and books for schools.

Many intellectuals were formed in the schools founded by Asachi, where he brought illustrious professors from abroad.

In 1851 Asachi was a member of the committee to prepare the exhibition from London and in 1855 the exhibition from Paris. In this time he has functioned as a censor for printings.

In the last part of his life, Asachi was dedicated to the activity of writing. About Asachi’s poetry, it is appreciated as being the more positive part of his literary works; some stanza (verses, strophes) could honour any anthology [5].

4. SOME IMPORTANT YEARS OF THE ASACHI’S ACTIVITY

- 1813: On 15th of November, an anaphora gave to Gheorghe Asachi the approval to teach a “course of theoretical mathematics with practical applications in geodesy and architecture”. The class of engineering had 33 students, many of them being sons of landowners, inclusively the son of the Moldavia Prince being one of these students.
- 1814: the inauguration of the special class of engineering at the “Princely Academy” of Iasi.
1828: the set up of a Gymnasium in Iasi.

1829: Asachi was convinced by the importance of the press for the education and cultural level of the people. He is the founder of the Romanian press; from 1829 he began to edit the gazette “Albina românească” (Romanian Bee) and other publications. To have the successful publishing activity, later Asachi created a publishing house (Institute of the Bee) and his own paper mill, directing the politics to assure the raw material for the factory.

1829-1831, Asachi worked as a secretary of the Committee to elaborate the “Organic Regulations”, that was a sort of constitution for the Romanian Principality Moldavia (also for Walahia, i.e. Romanian Country) and, in this frame, he muster-minded laws in the benefice of the development of the Romanian high and higher education.

1830: Asachi, together with Mihail Zotta and Iacob Chihae, set up “The Reading Cercle of the Physicians of Iasi” and in 1834, “The Society of Medicine and Natural History”, the first scientific organism of Moldavia.

1832: Asachi founded a lyceum with two sections: one for sons of boyars and the other for petty bourgeois sons, these ones being named “stipend” students. Also in 1832 Asachi founded a printing house, named Institute of the Bee, where translated works and lithographs were published.

Understanding desiderates of national minorities, Asachi founded elementary schools for the Armenian and Jewish communities (1832-1842) and a printing Armenian section at the Institute of Bee, to print handbooks.

1834: the first institute for education of girls was founded. At its inauguration Asachi has spoken about the role of women in society, the importance of their education as good wives, mothers, housewives.

1835: the opening of the philharmonic and dramatic Conservatorium, at the Asachi’s initiative.

1838: the first attempt to founder the Mechanic Institute, sections of agriculture and mechanics.

1840: Asachi elaborated the “organic principles” of the vocational school; this school was inaugurated the next year.

1841: Asachi introduced the lessons of swimming and gymnastics for the students of the Academy, reorganized the primary (elementary) education for girls and also the elementary education in villages and endowed these schools with manuals, so are the Catechism, Arithmetic, Algebra for gymnasium, Elementary Geometry, Chronological table of the old History, Conspectus of the Moldavian History, Romanian Geographic Atlas.

1849: Asachi was appointed director of the department of culture and public education. He composed programs, scientific memories, lessons and books for school.

1855: Asachi published a geographical cart of Moldavia.

1868: a national reward is attributed to Asachi, for “important services brought to the country, since 1813 till 1862”. In 1870, after his death, a statue of Gheorghe Asachi is revealed in Iasi, in front of a school founded by him.
5. ASACHI’S ENDEAVOR TO FOUND A HIGHER EDUCATION IN MOLDAVIA

All the time Asachi insisted in the idea that the technical education in Romanian language is necessary for the progress of the society. So, the first institution for technical education in Moldavia was organized by Asachi: the School of Arts and Trade (vocational education), that has functioned in Iasi between the years 1841 and 1849 and has prepared the first masters (foremen) of the workrooms created in many towns of Moldavia. The school assured both the practical and theoretical education: the practical education in the six workrooms, the theoretical education by the courses of ethics, reading, writing, arithmetic, linear drawing.

The creation of the institution of technical higher education has had many stages, the first stage could be considered the class of engineers attached to the Price Academy, founded by Asachi in the year 1814, but interrupted five years later. Being professor, Asachi has written three books: Arithmetic, Algebra, and Geometry. First time these were in manuscripts only, translated from the books of Etienne Bézout, but the books published by Asachi in 1837 and 1838 were compilations with original contributions [2].

Asachi has tried four times to create an agronomical institute, but he has failed all the time. He proposed an agronomical-mechanical institute with two steps: a) in the first and second years a theoretical education containing arithmetic, accountancy, elements of agriculture, chemistry, botany, zoology, technology, linear drawing, measurements of lands, applied mechanics; b) the third year must be dedicated to applied all the economical knowledge on the land and on the model farm of that institute. At the end of these three years, the graduates received certificates to be appointed as economists. The plan could not be realized because the Father Superior of the monastery refused to give the land to this institute of education.

Asachi had begun to prepare and organize the opening of the higher education since 1832, announcing in his gazette “Albina Românească” (Romanian Bee) that “there are looking for professors with scientific knowledge and attestation” in the following disciplines: a) philosophy, logics, metaphysics, natural law; b) theoretical mathematics, theoretical and experimental physics, chemistry, history of the nature; c) practical mathematics, geometry, civil architecture, hydraulics, mechanics, constructions of roads and bridges; d) agrarian economy, medicine for animals; e) French language and literature. Professors for the first four categories, a-d, must know Romanian and Latin languages.

In the same time, Asachi has proposed to the schools administration (the Epitropy) to send young men to be specialized in Vienna and in France. This proposal was approved, so that in 1838 the first Romanian professors with university diploma obtained in Austria for superior mathematics, physics, chemistry and engineering came back.

The statutes of public schools of the Principality of Moldavia, drawn up by Asachi and approved by the Price on 14th June 1835, stipulated, among other conditions, the obligation of students in engineering to end first the two years of the section of philosophy (also for those in law and theology).
The National Academy proposed by the Prince Mihail Sturza was inaugurated on 16th of June 1834; Asachi named this school “Academia Mihăileană”. This had classes of secondary school and three faculties: Philosophy, Law and Theology. The “School of engineers” and the Institute of Arts and Industry (vocational school) were attached. A department of geology was founded in the school year 1842-1843. By 1847 new disciplines had completed the programs with analytical geometry and descriptive geometry for engineering, agronomy, mineralogy, geology.

The project for statutes of schools was written by Asachi in 1838 and approved by Prince on the first of October 1839. Beginning with the school year 1839-1840 the students were been received on the base of a competitive examination. The library of Academy was opened with the Prince donation of 600 volumes. Asachi has created technical rooms for physics, mathematics and chemistry and has introduced programs of gymnastics and swimming.

Asachi valued the career to be professor and had a care of this function to have a good wage and a convenient pension. Professors could obtain nobility titles and had a representative in the convention to elect the ruler [4]. About the academy professors, it might be said that Asachi has brought French, Greek, Czech, Italian, Polish, Romanian and Transylvanian Saxon professors, even a Russian engineer, and also teachers from Walachia, when he did not had specialists in Moldavia. But many difficulties were produced by the instability of teachers.

Unfortunately, in 1847 some courses were cancelled, Romanian language in the superior courses was replaced by the French language, some posts of professors were suppressed. Only on 2nd of October 1849 the Academy resumed its activity. However a true higher education did not exist yet.

Although the Princeley Academy was not at the European level, it marked an important progress in the education domain, in the social and economic life.

6. CONCLUSIONS

History recorded some periods of time which have had a special importance for the economic, social and spiritual life of the people from the Romanian Principalities. These periods could be considered periods of transition. Principality of Moldavia passed like a time period in the first half of the 19th century, international conditions being responsible by that state, so as it known from the history of the Europe. In this time Gheorghe Asachi was the man who, with a deep education, an open and creative mind, a persevering character, exceptional organizer, understood the importance of school and of material instruments for the development of education. Asachi carried on an activity with durable results, even if wars, epidemics, fire, political changes disturbed the normal ascending development towards the progress of school institutions. His activity has been at the base of the modern Romanian society.

Ending, we try to translate the words written by Cezar Buda [3] in his reverential article: „Gheorghe Asachi’s portrait from the auditorium of the Polytechnic Institute of Iasi - that bears his name - is a recognized proof of many generations who made use of the endeavours of the great
scholar, man of school, opener of new horizons for education of all degrees, preparing the future, that is to say our present time, in which we now honour his memory”.

REFERENCES

DIGITIZE DOCUMENTAL CULTURAL HERITAGE IN ROMANIA

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Abstract — The article presents the current frame of the Romanian national cultural heritage digitize process. Legislative aspects underpinning the digitize process are analyzed, the functions of the institutions with the digitizing coordinating role - Ministry of Culture and of Cultural Heritage Cultural Remembrance Institute – cIMeC, Romanian National Library - and the representative projects of the info documentary structures, heritage values owners. For the current status analysis of digitize and for Romanian digitize projects identification, a questionnaire has been designed and online distributed to cultural institutions. Using SWOT analysis the strong and weak points as well as the external environment opportunities and threats hampering ongoing digitizing projects were highlighted. Questionnaire conclusions and SWOT analysis results lead to proposal generating nationwide digitize activity improvements.

Keywords — digitization, SWOT analysis, cultural heritage

1. NATIONAL CULTURAL HERITAGE – THEORETICAL CONSIDERATIONS

According to Romanian legislation [1], national cultural heritage is broadly defined as: „the whole of goods identified as such, irrespective of ownership form to which they are subjected, representing a testimony and expression of evolving values, beliefs, knowledge and traditions.” It also „comprises all the elements resulted from the human and natural elements in continuous interaction.” Through the Urgency Ruling for alteration and addition of the Law no. 182/2000 regarding national movable cultural heritage safeguarding, in the definition of national cultural heritage were included the assets of museums public collections, archives and libraries as well as cultural assets of the cult institutions inventory. The exceptional value assets are composing the national cultural heritage thesaurus.

2. THE LEGAL FRAME OF HERITAGE DOCUMENT DIGITISATION

One of the most important liabilities of national movable cultural heritage assets holders is to protect these from any actions which could lead to degradation, destruction, loss, theft or their illegal export.
According to the Law no. 182 – 25th October 2000 regarding national movable cultural heritage, among the actions required to be accomplished by the holders of national movable heritage assets are [2]:

- providing the best custody, preservation environment and, as applicable, storage of the assets, preventing any deterioration, damage or destruction;
- providing the safety of/safeguarding the assets;
- prevention of use of these assets for events where integrity would be endangered;
- open access to these assets for public services of the Ministry of Culture and Cults professionals, in order to preserve them, where these are owned by private persons or organizations access will be possible only if written agreement on the access is obtained from the owner.

Written documentary heritage constitutes a fundamental component of the cultural heritage. According to the Law no. 186 of 9th of May 2003 regarding supporting and promoting written culture *) – republished in the Urgency Ruling no. 24/2006, written culture means the area including books, magazines, other publications with a literary-artistically, technical-scientific, edited on any kind of support.

3. HERITAGE ASSETS OF ROMANIA DIGITISE ACTIVITIES SWOT ANALYSIS

The SWOT analysis was used to highlight the following major aspects of Romanian cultural institutions heritage assets digitizing.

**Strong points**
- Romania holds an impressive amount of heritage assets, reflecting its identity and culture;
- digitizing offers new and improved ways of traditional documents and information accessing;
- following digitizing the original documents are protected due to diminished handling;
- digitize activity useful instruments were developed: translation of digitizing guidebooks for cultural institutions, edited by international organisms such as IFLA, Calimera, Minerva Group and nationwide methodology drafted;
- drafting and approval of the cultural resources digitize Public Policy and the fact that Romanian Digitize Library creation rallies authorities and cultural institutions to speed up and gain confidence in digitize projects for the highly valuable documents included in the owned collections;
- the existence of institutions established as digitize activities competence and coordinating centers (CIMEC for museums and museum collections, The Virtual Office of the Romanian National Library for The National Libraries Network) as well as the professional associations are contributing to cultural resources digitize process acceleration;
- remarkable are digitize initiatives /projects for the cultural heritage set out by libraries, museums, archives;
- cultural institutions managers planned both short and medium term digitizing projects;
- „digital divide” phenomena is diminished by equal access for all users, implicitly for those with sight or hearing impairment;
- digitize documents online publishing, especially of those having restrictive access regime while on traditional support, promotes the learning/research, creativity and enhances cultural life level;
cultural institutions and the staff have quickly adapted to the new technologies, especially ITC
- cultural institutions employees are willing to be involved in the digitize activities;
- communication between different countries trade colleagues leads to constructive concepts exchanges;
- organizing workshops, conferences on digitizing offers project leads to disseminations and experience sharing opportunities.

Weak points
- cultural institutions reduced budget for the activities, hinders digitize project inclusion on the list of main goals, as this is costly;
- currently there is an impressive number of precious documents, in a degradable status, which cannot be exploited;
- all Romanian cultural institutions are confronted with general staff shortages and in particular of qualified IT&C professionals;
- institutions are not inclined to work together to update data base and all digitized assets inventory lists in order to prevent reprocessing the same document/collection;
- although Romania has a valuable cultural heritage this is only in small extent accessible in the digitize environment.

Opportunities
- the efforts of the European Commission, through development of directives and recommendations regarding copy rights, digitize, dissemination, cultural content preservation as well as budgeting, encourages member states to develop national cultural heritage digitize projects;
- due to involvement in European projects, e.g. EUROPEANA, Romania is advertising the national heritage both at European and worldwide levels and each of the Romanian contributing institutions are promoting themselves;
- local/regional/national level partnerships are possible and also the involvement in such activities is offered;
- the digitize process can involve individuals on a voluntary basis;
- by the online document access a new category of user can be won: the young generation who is mostly a low physical library attendee;
- researchers, teachers, professors, specialists availability to select documents to be digitized;
- important international level projects progress is offering good practice model and considerable support for the Romanian institutions contemplating digitize project development.

Threats
- no national digitize funding program available to encourage a national project development;
- lack of a harmonized legal frame on copy right and digitizing, causes difficulties for the institutions managers
- absence of the national digitize preservation plan;
- user information requirements becoming more sophisticated;
- the growth of new digitize technologies use in the research/learning process;
- economical recession, felt in all areas of activity, culture included, leading to slashing budgets, staff cuts by redundancy;
- currently a national portal comprising all digitize heritage assets has not been developed;
there is no national metadata format standards;
there is no nationwide digitize project monitoring forum, consisting of individuals involved in the digitize process.

4. CONCLUSIONS AND PROPOSALS FOR EFFICIENT DIGITISE PROCESS IN ROMANIA

Cultural heritage institutions tried to keep up with the new technologies, by including these in their running activities. Digitizing, one of the main activities at international level, has aroused interest amongst authorities and cultural heritage institutions managers. Even if the national heritage is abundant and valuable both for Romanian history and civilization as well as for the European culture, the imposed funding slashing, because of the current economical restraints which lead also to staff shortages (due to considerable generated redundancy) prevented digitize projects progress or lead have isolated, small scale ones.

Libraries generally opted for a dedicated software use, while museums are using the open source ones. Even if the dedicated soft acquisition adds to the costs, its modules are offering digitize branching option and here, the Romanian National Library DigiTool software stands off.

Metadata are a major issue in digital library development. As known, metadata are the data describing the content and properties of any digital source. These must be among the first activities accomplished by librarians: record generating describing documents. Metadata are important to digital libraries as they are the key leading to document identifying and use. This is why metadata systems use is recommended. There are already set up metadata systems, pre-eminent being Dublin Core schema due to its particular way of attempting to determine the core elements required to define items. The majority of libraries have created the metadata using the Dublin Core schema, while museums do not have a common approach, using various types: XML, HTML METS. A very useful study, „Standards and recommendations in documenting cultural assets”[3], which in fact is the first of this kind in the Romanian specialized literature, presents the main data standards, metadata and compiling recommendations, recognized internationally and also used in Romania.

ACKNOWLEDGEMENT
This paper is supported by the Sectoral Operational Program Human Resources Development (SOP HRD), ID134378 financed from the European Social Fund and by the Romanian Government.

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HENRI POINCARÉ ENTRE LA SCIENCE ET LA TECHNIQUE

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Résumé — « Son érudition scientifique était si vaste et profonde et son pouvoir de compréhension si grand qu'il choisissait les sujets de recherche à sa volonté et il imprimait partout, avec la même puissance, les signes de son génie ». C’est ainsi que Henri Poincaré a été caractérisé par l'un de ses principaux collaborateurs, le savant roumain Spiru Haret. En effet, Poincaré a donné des résultats impressionnants dans l'analyse, la mécanique céleste, la physique mathématique et la philosophie scientifique. Il est considéré comme un des derniers grands savants universels, mais peu de gens savent qu'à la base de tous ces résultats, se trouvait une formation technique.

C’est la période d'études à l'École des Mines quand, de sa biographie s'avère une question obsédante pour sa future carrière : ingénieur ou mathématicien ? En parallèle des ses études à l'École, au cours de la première année, il prépare aussi une licence ès sciences à Sorbonne, qu'il obtient en août 1876. Sa formation d'ingénier est relevée par ses connaissances solides présentées dans ses journaux et mémoires des voyages d'étude qui ont resté comme des témoignes d’une formation d’ingénier intéressé des toutes aspects techniques étudiés à l’École. En juillet 1877, à la fin de la seconde année des études à l'École des Mines, Poincaré a effectué le voyage d’étude obligatoire de trois mois. Le long itinéraire (Paris, Vienne, Prague, Cracovie, Trieste, Gènes) a inclus aussi la région industrielle de la ville Reșița de Banat, conclut avec le « Mémoire sur la fabrication de l’acier dans le Banat ». Ce mémoire nous relève l’importance de l’industrie métallurgique à travers de la deuxième révolution industrielle pour l’Europe fin du 19e siècle. Bien que Reșița se trouvât à l’époque dans le Empire austro-hongrois, le voyage d’Henri Poincaré dans ce centre de l’acier a été son premier contact avec les Roumains. De retour en France, il travaille avec de nombreuses personnalités de premier rang de la Roumanie, devenant lui-même membre honoraire de l'Académie Roumaine.

Mots-clé — école des mines, ingénieur des Mines, visite d’étude, Académie de la Roumanie

1. INTRODUCTION

Jules Henri Poincaré est né le 29 avril 1854 à Nancy. Le père d’Henri était Léon Poincaré et sa mère était Eugénie Launois. En 1862, Henri entre au lycée à Nancy où il a étudié onze ans. Pendant ce temps, il a eu des résultats remarquables spécialement : en classes préparatoires, il a remporté
deux fois consécutivement le concours général des mathématiques, entre les meilleurs élèves de tous les lycées à travers la France.

Poincaré s'est classé premier au concours d'entrée à l'École Polytechnique (le 2 novembre 1873) en obtenant son diplôme en 1875. Sorti second de l'École Polytechnique, il est nommé élève ingénieur à l'École des Mines de Paris, d'où il est sorti 3e sur 3e.

Après avoir terminé ses études à l'École des mines, Poincaré a passé un peu de temps comme ingénieur des mines à Vesoul alors qu'il terminait son doctorat en mathématiques de l'Université de Paris en 1879. Le sujet d'une grande difficulté (*Sur les propriétés des fonctions définies par les équations différences*) a démontré son talent. La commission de l'examen a été composée par trois remarquables mathématiciens : Bouquet¹ (président), Ossian Bonnet² et Darboux³ (examinateurs).

Immédiatement après avoir reçu son doctorat, Poincaré a été nommé pour enseigner l'analyse mathématique à l'Université de Caen. Il devait y rester deux ans avant d'être nommé à une chaire à la Faculté des sciences de Paris en 1881. En 1886, Poincaré a été nommé pour la chaire de physique mathématique et probabilité à la Sorbonne.

Par l'intervention et le soutien de Hermite⁴, il a été nommé à une chaire à l'École Polytechnique. Changer ses conférences chaque année, il examinerait la mécanique théorique, l'optique, l'électricité, l'équilibre des masses fluides, les mathématiques de l'électricité, de l'astronomie, de la thermodynamique, de la lumière, et de la probabilité. Poincaré a tenu ces chaises à Paris jusqu'à sa mort à l'âge de 58 ans.

2. INGÉNIEUR DES MINES OU CARRIÈRE SCIENTIFIQUE?

L'attraction de jeune élève de Lycée a été les mathématiques et la physique. Ses préoccupations permanentes se trouvent dans ses dix-sept cahiers de notes (ayant presque 4500 pages) rédigées pendant ses études au Lycée de Nancy, à l'École Polytechnique et puis à l'École des Mines [1].

L'École Polytechnique a été la principale source qui a alimenté les deux importantes écoles techniques de l'époque : l'École des Mines et l'École des ponts et chaussées. À la fin de leurs études, les diplômés avaient la certitude d'une carrière avec beaucoup d'avantages matériels. L'École Polytechnique avait des partisans ardent dans sa famille. Son père Léon, médecin de formation, préférerait voir son fils entrer à l'École Polytechnique, suivant ainsi l'exemple de son propre frère Antonin Poincaré, polytechnicien et ingénieur des Ponts et chaussées. Durant les trois années à l'École des Mines, Poincaré n'est pas attiré par son métier : « Une nomination comme ingénieur dans une ville universitaire de province pourrait ainsi lui convenir en lui offrant la possibilité de changer d'orientation » [2].
Une tournure de sa carrière a été déclenchée par l'imminence d'être repartis en Bône (une ville de l'extrême nord-est de l'Algérie, aujourd'hui Annaba), quand sa famille a été paniquée. À l'aide de deux personnalités politiques locales (un sénateur et le maire de Nancy), son père a l'initiative d'intercéder auprès du ministre des Travaux publics, Charles Louis de Saulces de Freycinet (1828-1923), en invoquant les problèmes de santé du jeune homme et la préparation de sa thèse. Le résultat : le 1er avril 1879, Poincaré est nommé ingénieur ordinaire des mines, chargé du sous-arrondissement minéralogique de Vesoul (département de la Haute-Saône, la région Franche-Comté).

Sa décision de se tourner vers le professorat a été produite probablement, par la suite de l'accident tragique du puits du Magny : l'explosion se produit le 1er septembre 1879 et Poincaré a effectué l'enquête sur les causes de l'accident [2].

3. LA FORMATION DE L'INGÉNIEUR POINCARÉ À L'ÉCOLE DES MINES

Selon les souvenirs de Paul Appell, Poincaré a accordé une attention réduite pour les conférences à Mines. L’exception a été le cours de minéralogies, où professeur Mallard a utilisé dans la partie de la cristallographie, une approche mathématique élevée. Les documents qui nous montrent différents facettes de la vie d’étudiant Poincaré se trouvent dans ses cahiers des notes [1], sa correspondance, les journaux et les trois mémoires de voyage et aussi, dans le tableau des notes à la fin des études à l’École des Mines (http://www.annales.org/archives/images/poincare09fig1.jpg, accédé le 19 juin 2014).

3.1. VOYAGE D’ÉTUDE DES ÉLÈVES À L’ÉTRANGER


Ces voyages de grands itinéraires miniers et métallurgiques se déroulent durant l’été ; chacun d’eux donne lieu à la rédaction de 3 rapports qui sont ensuite remis à la seule direction de l’École. Leur rapports sont une véritable chronique, parce que les élèves des différentes promotions ont visité les mêmes installations à quelques années d’écart. Les équipes de deux ou trois élèves ont été reparties de parcourir les principales zones industrielles de la France et des autres pays de l’Europe (Belgique, Allemagne, Angleterre, Scandinavie, Bohème, Prusse rhénane, l’Allemagne du Sud, Silésie, Styrie, la Carinthie, Espagne) et plus loin, les Etats-Unis et la Russie [4].
3.2. LE JOURNAL DE VOYAGE DE L’ETE (1877)

Henri Poincaré a fait partie d’une équipe de quatre : les collègues de sa promotion Bonnefoy\textsuperscript{8} et Petitdidier\textsuperscript{9} et aussi, Lecornu\textsuperscript{10} élève de la promotion antérieure des trois premiers. L’itinéraire impose a une complexité évidente : Paris à Innsbrück par Studtgard et Münich (Salz Kammergut - mémoire Petitdidier, Brixlegg - mémoire Bonnefoy, Jenbach), Innsbrück à Villach (Bleiberg), Villach à Vienne (Gares et ateliers de chemins de fer à Vienne), Vienne au Banat (Resicza / Resita - partie des mémoires Petitdidier et Poincaré, Bogsán / Bocșa, Morawicza / Moravita - mémoire Petitdidier, Dognaska / Docnecea, Anina, Steyerdorf), retour à Vienne, Vienne à Prague et environs (Kladno, Prizbram, Budweis et mines de graphite - mémoire Bonnefoy), Praguée Cracovie (Mährisch Ostraw, Wielczka et Bochnia - mémoire Petitdidier, Szwosowice), Cracovie à Tarnowitz (Friedrichshütte, Silesia, Paulshütte), Tarnowitz à Pesch (Schemnitz), Pesch à Vienne, Vienne à Trieste (Leoben, Vordemberg, Eisenerz, Zeltweg, Treibach, Hüntenberg, Revali, Gratz, Köflach, Idria, Port de Triestre), Trieste Gènes (Gènes à Monte Catini et environs - mémoire Lecornu), retour à Paris. Les élèves ont reçu des instructions précises de rédiger le journal et les rapports.

La première page du journal (fig. 2) porte une déclaration commune : « Ayant effectué en commun le voyage d’Autriche Hongrie, nous avons pensé qu’il convenait de soumettre un seul journal de voyage, en nous partageant le travail également que possible. Nos renseignements étant identiques, il (eut) été inutile de faire quatre rédactions séparés, et nous n’aurions pu d’ailleurs terminer dans les détails voulus.

Nous avons (...) du journal les sujets de nos 8 mémoires, savoir :

Lecornu :
- Applications de l’acier fondu à l’industrie des chemins de fer en Autriche ;
- Étude des phénomènes d’éruption et d’émanation en Toscane.

Poincaré :
- Fabrication de l’acier dans le Banat ;
- Machines d’épuisement en Bohème.

Bonnefoy:
- Usine de Brixlegg (Tyrol) ;
- Gîtes de graphite en Bohème.\textsuperscript{11}

Petitdidier :
- Forge de Resicza (Banat) et mines de fer du voisinage ;
- Le sel en Autriche » ....

Fig. 2. La première page du journal (en bas, leurs signatures)
3.3. POURQUOI LA RÉGION DE BANAT?

Riche en ressources minérales, la région de Banat a été connue et exploitée depuis les Romains. Sa transformation en une zone industrielle active a été faite depuis le XVIIIe siècle, après 1718, lorsque Banat est devenu officiellement province autrichienne. Les Autrichiens ne tardèrent à exploiter les riches ressources minérales de la région, en mettant l'accent sur les districts Bocșa, Oravița, Dognecea ou Moldova Noua. Dans ceux-ci le travail a commencé, avec l'aide d'experts étrangers, en particulier les allemands catholiques qui ont été colonisés dans les établissements de Banat\textsuperscript{12}.

Le Banat a été visité par des voyageurs illustres, comme par exemple, le géologue Ignaz von Born (1742-1791), qui a laissé une étude très détaillée sur "Les mines du Banat, leurs caractéristiques géographiques et montanistes". Il rappelle la production de «boulets de canon pour l’artillerie impériale" quand il écrivait le 7 Juillet, 1770 sur Bocșa : "... Maintenant, cependant, la production de fer a été quelque peu entravée. Cependant, il y a quelques marteaux de fer, un four et un four à cuve qui diffère de ceux qui produisent fer à Roniz concassé que par la taille. Ici sont fondus les boulets de canon pour l’artillerie impériale. Le minerai de fer amené de Dognecea (...) donne un très bon fer. Les usines de Reșița ont commencé officiellement leurs activités le 3 Juillet 1771.

Les dernières technologies sont été mises en place dans les acièries de Banat. Ainsi, en 1868 à Resita le processus Bessemer pour la fabrication de l'acier a été introduit, seulement six ans après sa première utilisation, par la société Krupp. En 1876 à Reșița a été mis en service le premier four Siemens Martin.

C'est pourquoi le Banat, par les richesses de son sous-sol, de l'industrie de l’extraction minérale et de l’industrie sidérurgique florissante, présentait un intérêt particulier pour la documentation des jeunes professionnels des écoles polytechniques de l'époque.

3.4. LE JOURNAL DE VOYAGE DE L’ÈTE (1877)

Henri Poincaré a choisi d’écrire en 1877 son rapport intitulé « Mémoire sur la fabrication de l’acier dans le Banat ». Le rapport contient 78 pages. Les caractéristiques de ce rapport, aussi que les deux autres rapports de 1878\textsuperscript{13,14} sont données par ses notes minutieuses, très méthodiques, avec
les arguments les plus simples et les plus directs, illustrés de croquis et plans. Le mémoire rédigé au contact des dures réalités du métier, prend une ampleur et une richesse évidente. Les descriptions des procédés techniques, des conditions d'exploitation, des conditions de travail des ouvriers et des aspects économiques, annoncent le génie scientifique du savant. Le rapport a été organisé d’une manière qui souligne toutes ses connaissances enseignées à l’École (tableau 1).

Tableau 1. La table des matières du Mémoire sur la fabrication de l’acier dans le Banat

<table>
<thead>
<tr>
<th>Table des matières</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Généralités</td>
<td>1</td>
</tr>
<tr>
<td>Minerais employés</td>
<td>2</td>
</tr>
<tr>
<td>Fontes à acier</td>
<td>6</td>
</tr>
</tbody>
</table>

Du Bessemer Description du matériel
- Disposition générale 13
- Des convertisseurs 13
- Machines soufflantes 14
- Accumulateur 17
- Conduites hydrauliques 18
- R enversement des cornues 18
- Grues hydrauliques 19
- Conduite du travail 22
- Roulement 26
- Consommation 27
- Prix de revient 29

Acier produit
- Qualités chimiques 30
- Qualités mécaniques 32

Du Martin Description du matériel
- Gazogènes 34
- Combustibles 35
- Du four Martin 37

Du travail 39
- Consommations 41
- Prix de revient 43
- Ancien procédé mixte 43
- De l’acier obtenu : qualités chimiques 45
- Qualités mécaniques 48

Du Pernot Description du matériel – Gazogènes 49

Dispositions générales et Four Pernot 51
Le mémoire est illustré par dix pages des dessins. La plupart est rédigée à l’échelle 1/20 : four Pernot, Bessemer (plan et coupe longitudinales), robinets des conduites hydraulique, gazogène de Reșița et Anina.
4. POINCARÉ ET LES CHERCHEURS ROUMAINS


À la suite de relations personnelles de coopération et aussi, d'amitié avec des mathématiciens et astronomes roumains comme Spiru Haret (1851-1912), Nicolae Coculescu (1866-1952), Anton Davidoglu (1876-1958), Poincaré a été élu membre honoraire de l'Académie de la Roumanie.

5. CONCLUSIONS


Les rapports des visites d'étude à l'étranger des étudiants sont restés témoignages précieux de l'évolution de l'industrie européenne. Les trois mémoires rédigés par Henri Poincaré sont des bons exemples et particulièrement, la visite en Banat a donné une image complexe de l'état économique de l’année 1877 pour les historiens roumains.

NOTES

1 Jean-Claude BOUQUET (1819-1885), mathématicien français, chaire de mécanique physique et expérimentale de la Faculté des sciences de Paris (1872-1885), il a travaillé sur la géométrie différentielle et sur le développement en série de fonctions et de fonctions elliptiques.

2 Pierre Ossian BONNET (1819-1892), mathématicien français, diplômé de l'École Polytechnique et de l'École des ponts et des chaussées, il a renoncé à une carrière d'ingénieur pour se tourner vers l'enseignement et la recherche mathématique, élu membre de l'Académie des sciences en 1862.

3 Jean Gaston DARBOUX (1842-1917) mathématicien français, il a apporté des contributions importantes à la géométrie différentielle et l'analyse.

4 Charles HERMITE (1822-1901), mathématicien français qui fait des recherches sur la théorie des nombres, les formes quadratiques, la théorie des invariants, polynômes orthogonaux, les fonctions elliptiques et l'algèbre. Un de ses étudiants a été Henri Poincaré à l'Université de Paris.

5 Paul Émile APPELL (1855-1930) mathématicien et mécanicien, il se lie d'amitié avec Poincaré pendant leurs études en classe de mathématiques spéciales au Lycée de Nancy (1872-1873).


Marcel Paul BONNEFOY (1854-1881) ingénieur des mines, ancien élève de Polytechnique (promotion 1873 ; entré classé 10e, sorti major de 226 élèves) et de l'École des Mines de Paris (mis hors de concours le 27/3/1879, classé le 2e, nommé ingénieur le 28/3/1879), collègue et ami de Poincaré. Il est mort dans un accident de mine.

Jules Louis Isidore PETITDIDIER (1855-1884) ingénieur des mines, ancien élève de Polytechnique (promotion 1873) et de l'École des Mines de Paris (mis hors de concours le 27/3/1879, classé le premier, nommé ingénieur le 28/3/1879), collègue de Poincaré. Il est mort d’une maladie de poumons.


**REMERCIEMENTS**

RÉFÉRENCES


Abstract — James Hansen (b.1941), an atmospheric physicist at NASA’s Goddard Institute for Space Studies in New York City since 1967, its head 1981 - 2013, and now a professor in the Department of Earth and Environmental Studies at Columbia; he is best known for the development of climate change models, the mathematical equations that accurately simulate and predict the effects of temperature and pressure change, the ocean, cloud coverage, water vapor and carbon dioxide concentrations, and other factors on Earth’s climate.

Following his earlier studies of Venus’ atmosphere, Hansen and the Goddard atmospheric research group developed their first climate change model in 1974. A 1981 one-dimensional radiative-convective model calculated atmospheric temperatures as a function of height. It enabled Hansen to conclude that the measured atmospheric carbon dioxide concentrations would produce an earlier-than-predicted warming. Beginning in 1983 Hansen introduced three-dimensional general circulation models that with the aid of high speed computers enabled him to include variables such as air convection schemes and snow depths, and to estimate the change in mean global surface temperatures resulting from future greenhouse gas emissions.

In 1987 Hansen and Sergej Lebedeff undertook an analysis of surface air temperature records from 1,700 continental and island meteorological stations on every continent for the years 1880 to 1985. Their three-dimensional general circulation model created an artificial global temperature history and estimated the error resulting from incomplete spatial coverage of Earth. It showed that the four warmest recorded years were in the 1980s with 1981 and 1987 the highest, and that 1998 was the warmest year since 1880. The rate of temperature change in the 1980s-90s exceeded all rates of change recorded since 1880.

Much of the criticism of global warming came in the 1980s when the scientific evidence showed a definite rise in the annual global mean temperature curve. Hansen’s testimony before the US Senate Committee on Energy and Natural Resources in June 1988 triggered the renewed criticism.

Keywords — climate change, global warming, greenhouse gases, James Hansen

1. INTRODUCTORY: CLIMATE CHANGE, ITS THREE-STAGE HISTORY

Twenty- first century studies on climate change have their roots in the earlier studies on the causes of ice ages and glacier formation. Scientists, such as Arvid Högrom (1857-1940) and Svante Arrhenius (1859-1927), who studied ice ages and glacier formation, also suspected that the increasing fossil fuel combustion in the 1850s-1900 was increasing the concentration of atmospheric carbon dioxide (CO₂) and warming the Earth¹. The atmosphere’s composition was changing, and the changing atmosphere could change the Earth’s
climate. The few members of the nineteenth-century scientific community who accepted a changing atmosphere-changing climate theory nevertheless remained focused on accounting for the ice ages and glacier formation and only to a lesser extent on a global warming. The scientific community witnessed the tremendous technological transformation that was occurring in the western world in the last half of the nineteenth century. They recognized that the technological transformation was spewing huge amounts of heat-absorbing gases such as carbon dioxide into the atmosphere, but most of them remained convinced that little evidence supported a warming of the Earth’s atmosphere. If any warming was occurring, it would be slow and insignificant. The recognition that a changing atmosphere could change the Earth’s climate, resulting in a global warming, although only a minority believed within the scientific community, represents the first stage in the history of climate change.

As the twentieth century passed through its early decades, from 1900 through the 1940s, and evidence of any significant change in climate still lacking, research on the changing atmosphere-changing climate theory gradually lost the scientific community’s interest and faded from discussion. The successive tragedies of World War I, the Great Depression, and World War II pushed climate science theories further into the background. During this same time period, from 1900 through the 1940s, the causes of ice ages and glacier formation, the first applications of numerical methods to analyze weather patterns, and other climate issues remained relevant research interests of climate scientists. When linked to new evidence from infrared absorption spectra and gas chromatography published in the 1950s and to atmospheric temperature measurements for the same time period, the scientific community looked anew at the forgotten nineteenth-century changing atmosphere-climate change theory. Absorption spectra and chromatography showed an increasing concentration of atmospheric carbon dioxide compared to pre-1800s-50s concentrations, the atmospheric temperature measurements revealed a corresponding global temperature rise. The decades from 1900 through the 1940s represent the second stage in the history of climate change.

The research that began in the 1950s and continues in the 2000s represents the third stage in the history of climate change. The introduction of high speed computers and their programs that performed the numerous, difficult, and tedious calculations that the laws of physics and chemistry required, such as the equations of fluid dynamics and thermodynamics, resulted in numerical models that much more comprehensively and accurately simulated the consequences of climate-related variables (temperature, pressure, concentration) on the atmosphere. At that time, on 8 August 1975, Wallace Broecker (b. 1931), a geoscientist at Columbia University, upon evaluating the recent evidence, introduced in a scientific context the expression global warming in an article he published in Science.2 The scientific evidence supporting Earth’s warming continued to accumulate so that by the first decade of the twenty-first century climate science researchers nearly unanimously accepted the reality of the globe’s warming.

Little disagreement exists within the scientific community. The challenges to the scientific evidence have come mainly from the political side and the doubters who have an economic interest in denying the scientific evidence. The scientific debate, if ever one existed, has ended, but unfortunately the political debate has not. Climate politics has replaced climate science.

This paper focuses on the contributions of James Hansen (b.1941), an atmospheric physicist who from 1981 to 2013 headed NASA’s Goddard Institute for Space Studies in New York City and who is now an adjunct professor in the Department of Earth and Environmental Studies at Columbia. Hansen is best known
A. STRANGES: Is the debate over ..

for the development of climate change models, the mathematical equations that quite accurately simulate and predict the effects of temperature and pressure change, the ocean, cloud coverage, water vapor and carbon dioxide concentrations, and other factors on the Earth’s climate. He is one of the twenty-first century’s leading climate scientists.

2. HANSEN’S CONTRIBUTIONS TO THE CHANGING ATMOSPHERE-CHANGING CLIMATE THEORY

Following his earlier 1960s-70s planetary studies on Venus’ atmosphere, Hansen and the Goddard atmospheric research group developed their first climate change model in 1974 and have continued to improve their models’ reliability to the present time. Their first model successfully simulated the major climate features at North American sea-level pressure, about 1,013 millibar (mb), and at an elevation with a pressure reading of 500 mb. A 1981 one-dimensional radiative-convective model calculated atmospheric temperatures as a function of height. It enabled Hansen to conclude that the measured atmospheric carbon dioxide concentrations would produce an earlier-than-predicted warming. Beginning in 1983 Hansen introduced three-dimensional general circulation models that with the aid of high speed computers included variables such as air convection schemes and snow depths, and estimated the change in mean global surface temperatures resulting from future greenhouse gas emissions.

In 1987, Hansen and Sergej Lebedeff (1928-90), at Sigma Data Services Corporation in New York City, undertook an analysis of surface air temperature records from 1,700 continental and island meteorological stations on every continent for the years 1880 to 1985. The World Weather Records (WWR) that the Smithsonian Institution and later NOAA published provided the temperature records. A three-dimensional general circulation model that they developed created an artificial global temperature history and estimated the error resulting from incomplete spatial coverage of Earth.

The results, which were similar in both hemispheres, indicated a warming of 0.5 – 0.7 °C in the last century, and revealed a strong warming trend between 1865 and 1880 that raised the global mean temperature in 1980 and 1981 to the highest-ever instrumentally-recorded level. Hansen noted that a 1940 warming period occurred mainly in the northern latitudes, whereas the 1980-81 warming was more global. When extended to 1988, and then to 1999, the same warming pattern continued and showed that the four warmest recorded years were in the 1980s with 1981 and 1987 the highest, and that 1998 was the warmest year since 1880. The rate of temperature change in the 1980s-90s exceeded all rates of change recorded since 1880.

By 2001 Hansen had improved the validity of his temperature measurements by adjusting for the time of day he made a measurement, balancing the urban-suburban measurements, and including satellite measurements of urban night life intensity. He further refined his measurements in 2002-2005 by accounting for the influence of black carbon (carbon black, soot) on regional climate. A photometer, an instrument that measures the amount of light passing through it, detects the black carbon produced by the incomplete combustion of fossil fuels, biofuels or biomass. The particles, which are black because they absorb sunlight, reduce the amount of light passing through the photometer and, instead, heat the atmosphere and produce a
warming effect. The black carbon effect is usually regional and short-lived because the carbon particles eventually fall to the ground. The general circulation models that Hansen and other scientists used in climatology are mathematical equations of physics and chemistry that account for factors that influence atmospheric conditions, such as variations in composition and temperature, and aim to simulate (reproduce) and predict accurately atmospheric conditions. Their adoption began early in the twentieth century. The physicist Vilhelm Bjerknes (1862-1951), then at Stockholm, in 1904 introduced the first mathematical model in climatology and weather forecasting. His method of numerical forecasting that required his performing numerous and sometimes difficult mathematical calculations and solving of differential equations made his model’s application impractical. The English mathematician and scientist Lewis Fry Richardson (1881-1953), who held positions at the National Physical Laboratory in London, in industry and in the academic world, continued Bjerknes’ mathematical applications in climatology studies and published Weather Prediction by Numerical Process in 1922. Bjerknes’ and Richardson’s numerical approach and the methods based on mathematical functions that followed, proved inadequate because they provided only partial mathematical solutions. These models reproduced some of the variables of the atmospheric layers, but did not include all of the hydrodynamic and thermodynamic equations required in a model that accounted for the general circulation of the Earth’s atmosphere.

Improved climate models appeared in the 1950s. With the introduction of computers, such as ENIAC which made the first weather forecast in 1950, and computer programs such as IBM’s Fortran in 1956-57, computer programs performed the mathematical calculations that checked the validity of the variables included in the climate models. Climate models that reproduced and predicted the influence of weather variables began to appear in 1956 when the theoretical meteorologist Norman Phillips (b. 1923) at MIT and in 1974 at the National Weather Service, National Meteorological Center, introduced his numerical methods and produced the first general circulation model of Earth’s atmosphere. He introduced six equations that represented the physics of hydrodynamics and for the first time reproduced the global flow patterns of Earth’s atmosphere. Phillips’ simulation-based method became the accepted method that climate scientists used to develop circulation models that enabled them to understand and determine how energy moved through the atmosphere. His computer model allowed scientists to reproduce the entire atmosphere’s wind and pressure patterns.

These earlier breakthroughs were significant and laid the foundation for Hansen’s improved and refined general circulation models. The agreement between his models’ projections and observations, including temperature readings from satellites in the 1990s, which critics said disagreed with land-based station measurements that since the 1950s-60s revealed a warming but after Hansen’s correction of the satellite temperatures showed no disagreement between the two sets of temperature measurements, prompted Hansen to argue that the debate had changed. Climate change deniers had to stop questioning whether global warming was occurring and instead focus on the rate of global warming and what society should do about the warming.
3. DENIERS OF THE CHANGING ATMOSPHERE-CHANGING CLIMATE THEORY

Critics and criticism of the CO\textsubscript{2} changing atmosphere-changing climate theory have existed almost from the time scientists began publishing articles indicating Earth’s warming. Much of the criticism came in the 1980s, when the scientific evidence showed a definite rise in the global annual mean temperature curve. Two events in particular, both taking place in 1988, triggered the renewed criticism. First, Hansen in June summarized before the US Senate Committee on Energy and Natural Resources his years of research that showed Earth’s warming. Hansen testified that the Earth had been warmer in the months from January to June 1988 than in any five-month period since the beginning of temperature recordings in 1858. He believed with 99 percent certainty that the anticipated warming trend did not result from a natural variation or cycle of the Earth’s temperature. The increasing concentration of CO\textsubscript{2} and other greenhouse gases caused the warming\textsuperscript{11}.

Second, the United Nations Environment Program and the World Meteorological Organization (WMO) in December established the Intergovernmental Panel on Climate Change (IPCC). One month earlier, in November 1988, 35 nations including the United States met in Geneva at the first plenary session of the IPCC to examine climate change and the consequences of global warming on humanity. The session led in December to the formal establishment of the IPCC. The WMO and the United Nations Environment Program (UNEP), organizers of the session and co-founders of the IPCC, fund the IPCC Secretariat, the WMO hosts the Secretariat in Geneva. Membership is open to any nation that belongs to the United Nations or WMO. The IPCC, numbering about 2,500 scientific experts in climatology, ecology, economics, medicine, and oceanography from 60 countries, published its first climate assessment report in 1990, stressing the necessity of reducing greenhouse gas emissions. Other IPCC reports followed in 1992, 1995, 2001, and 2007. Their reports, with other climate change reports, indicated that the ten warmest years globally have occurred since 1990, with 1998 the warmest, followed by 2002, 2003, 2001, and 1997.\textsuperscript{12}

The critics seized on Hansen’s research, the IPCC reports, and numerous other reports supporting a rise in the global annual mean temperature, directing their attacks on the perceived errors, shortcomings, and weaknesses in the reports. The critics range from outright deniers of global warming to those who acknowledge the reality of global warming, but deny its human origin (anthropogenic) and significance. They argue that most of the warming resulted from natural causes.

4. CONCLUSION

Hansen’s climate science research led to numerous awards, including election to the US National Academy of Sciences in 1996, and awards from the AAAS in 2006 and the American Meteorological Society in 2009. In recent years, he advocated repeatedly and outspokenly for action on global warming. His public statements have drawn criticism from NASA during the George W. Bush (b. 1946) years, from CEOs of coal and oil companies, and from his friend, the theoretical physicist Freeman Dyson (b. 1923) at the Institute for Advanced Study in Princeton, New Jersey. Dyson, a global warming skeptic, said Hansen had turned his science into ideology. The scientific community thinks otherwise.
NOTES and REFERENCES


THE TECHNICAL PUBLIC LIBRARY: POPULARIZING SCIENCE VS. OFFERING SPECIALIZED SERVICES

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Abstract — Science and Technology have always been a major part of the communist ideology. In the last decades of the regime, the push for popularization of science and industrialization was strongly felt throughout the society. Public libraries were key institutions in the process of educating the New Man. This paper investigates the roles played by public libraries in disseminating information about Science and Technology in the Romanian communist society.

While union libraries or libraries serving manufacturers have been functioning for some time, there was a great need for both general and professionalized information services in the 1970s. Our analysis of the activities of a technical branch from a Romanian public library, that is a library serving the general public, reveals the duality of services offered by a library. On one hand, the library services—supported by the publishing industry and the regional cultural committee—were addressing the masses; on the other hand, they were targeting specialized professionals. Librarians from this public library created a special collection by broadly defining “science and technology” and developed in-house tools for searching and retrieving materials from that collection. In a culture of isolation with little knowledge of sharing practices, these librarians created specific instruments that connected their technical literature collection to other thematic local and national collections. By analyzing the branch’s activities archive from the 1970s and 1980s and corroborating these materials with oral histories of librarians that planned and implemented these activities, we gain an in-depth understanding of the roles played by public libraries in the socialist technical revolution.

Keywords — Oral History, Popularization of science, Public libraries, Technical library

1. INTRODUCTION

The official documents of the Romanian communist regime ascribed clear roles for public institutions. Public libraries were key institutions in the process of educating the New Man and were expected to promote the communist political ideology through all their activities1. Librarians were public workers whose professional development was deemed secondary to their political formation2. This political control over the work of librarians negatively influenced the quality of the information services they provided. However, throughout the country, there were librarians who implemented punctual solutions that would respond to local informational needs. The services implemented in some libraries in the late 1970s and the 1980s were, for the most part, following
political requirements of the period but, at the same time, were innovative, targeting the needs of the general public and as well as professional populations.

The push for the popularization of Science and Technology aligned with the industrialization in the late 19th century. There were, however, no universal characteristics for the ways in which the popularization of science was implemented, which differed based on the historical, economical, and political contexts. In the 1970’s, the popularization of science was no longer central to the push for the new technologies in the developed world. In socialist European countries, the push for popularization of Science and Technology was strong. Science and Technology were recognized as crucial fields for the development of the communist states and were promoted through education institutions and programs. Popularization of science was one the solutions promoted by the Romanian state in their attempt to educate the masses in the spirit of the Marxist dialectic materialism. The publishing of popularizing literature as well as of the specialized one allowed for technical and scientific materials to be widely available in libraries of that time. Public libraries, together with other types of libraries (union, factory, special libraries) were important actors in the process of delivering technical-related books to diverse populations.

For most public libraries, Science and Technology materials were simple additions to their collections. There was little difference in user service between new Organic Chemistry literature and traditional Romanian literature. A few libraries however paid a closer look at what these materials meant for their communities. This paper discusses one such library located in a blue-collar community and proposes a discussion on the types of new services provided. The diversity of services suggests that the community of users had diverse needs (even though they all might fit under the generous umbrella of “technology”). To be able to meet those needs the librarians came up with innovative in-house solutions to gather and organize the information in their collection. This paper opens a conversation about the degree of specialization of public library services and how these services fit with the popularization agenda of public libraries.

1.1. COMMUNIST PUBLIC LIBRARIES AND THE POPULARIZATION OF SCIENCE

In communist Romania, the public library network greatly developed after 1945. It grew to such an extent that in 1970, there were over 8100 public libraries of various sizes out of the 22338 total number of libraries that existed in the country. The declared role of these libraries was the education of masses “through books, and promoting science and technology through effective documentation and information”. The "cultural revolution" brought by the 1971 Nicolae Ceausescu’s Cultural theses increased the Party's coordination and control of education, culture, and the arts by forcing these fields to better conform to the ideology and "shared" beliefs of the socialist society. These beliefs continued to include the importance of the popularization of science for the masses. Hence, public libraries, as cultural-educational institutions of the communist state, were required to continue the promotion of Science and Technology.

Science and Technology as fields promoted for the masses through political means were seen primarily as desired alternatives to the “mysticism and obscurantism from the consciousness of the masses”. This take on popularization is different than popularization interests in the 20th century. The popularization of science in communist Romania had little to do with meaningful “edification, legitimation and training” of the population and more to do with the legitimation of an ideology.
The interest in the development of Science and Technology was not among the first priorities on the state’s list. Thus public library’s role was primary to promote Science and Technology literature and, only occasionally, to get involved in more meaningful ways of engaging with these knowledge fields.

1.2. Targu Mures library and its Technical Branch

Targu Mures is a city in the heart of Romania that has had a public library ever since 1913. The local tradition of providing free information for the public predates the public library by a century. The mixed ethnic population, mostly Romanian and Hungarian, was traditionally an agricultural and manufacturer community. However, early 20th century realities imposed a change towards intense industrialization and urbanization of the area. The region developed in the industrial fields of energy, heavy machineries, and chemistry to the extent that more than half of all local enterprises were industrialized by 1979.

This change in the community’s economic and cultural structure created new challenges for the local library. Technical literature and scientific publications were in demand, which prompted the public library to address this public need. In 1960, the public library reorganized its collection in a way that allowed for technical books to be grouped together with some incipient reference services to be provided for the public. Even though the services were successful, due to the lack of appropriate space and support from the authorities, the temporary collection was reintegrated with the library’s main collection after six years. It was in 1974 that the Technical Branch of the public library — named Cartea Tehnica — was officially created in a new dedicated space. The dedicated Science and Technology collection included material from the Sciences (Mathematics, Physics, Chemistry, Biology, etc.) and Applied Sciences (Technology, Industrial and Mechanical Engineering, Agriculture, etc.). The Technical Branch had open access shelves and a rich reference collection, which was hosted in the Cultural Palace, one of the most important historical building in town. This branch, just like other branches of the library, could have provided only classical library services and instruments to its public (like the Alphabetical Catalog, the Systematic Catalog, “New Books” Bulletin). However in the decades of its existence, new services were imagined, created, and used in this department of the public library. We will briefly look at some of these services in the following sections to better understand what were the roles played by this branch of the library in relation to promotion of Science and Technology literature. The new services will be presented by talking about the motivation behind their creation and how they were implemented.

Documenting these services was done through studying the archive of the library but more importantly through oral interviews with several librarians that worked in the Technical Branch in the 1970s and the 1980s. These in-depth interviews were crucial in understanding the type of services the library provided. There were services focused, as expected in a public library, on the popularization of science. However there were also services to address the informational needs of those looking for more specialized Science and Technology works. Often times these two aspects of library services (popularization vs. specialization) were competing for the few resources available in the library. The managerial decision to satisfy both these needs was supported by the professional instruments created in the library.
2. TECHNICAL BRANCH SERVICES

Opening a technical branch was an institutional answer to the pressure to promote Science and Technology literature in public libraries. The Mures county library was the first to open the dedicated Technical Branch with a Science and Technology collection\(^{21}\). A handful of librarians conspired to have this branch open in a generous dedicated space. One librarian, M.F.\(^{22}\), took the lead in creating instruments and services that would allow the new collection to easily circulate but struggled to bring them to life. A succinct analysis of these services reveals that the librarian’s interest was on the reader’s needs — a position not necessarily shared throughout the profession at a time of restrictive information sharing practices\(^{23}\). The microanalysis of the Technical Branch contributes to a better understanding of the types of services offered by communist public libraries.

As mentioned before, the Technical Branch collection was created by separating materials relevant for Science and Technology fields from the main library collection. The collection development for the branch however was guided by the community’s informational needs. “You bought what you wanted to have, from any field you wanted to. But here [at our library] we had a number of very clear fields [we were interested in]\(^{24}\). These fields mirrored the professional structure of the community and included Engineering, Chemistry, and the Wood Industry. The content of these materials was pertinent for both the popularization of science and more specialized industrial interests. Although only a small fraction of the public was interested in these specialized materials, the Technical Branch was able to provide for them. In what follows we will discuss services like the Thematic Bibliographies, public activities, the Keyword Catalog, and the Local Catalog of Foreign Books.

2.1. THEMATIC BIBLIOGRAPHIES

Thematic bibliographies are traditional aiding tools that were also used by the Technical Branch of the Mureș library. The role of bibliographies was not only to provide fast information on a number of topics but also to bring visibility to the newest materials in the collections. Bibliographies were periodically shared with interested local institutions. Requests for these bibliographies were addressed directly to the library by people or institutions from the community; the Technical Branch was able to offer free of cost satisfactory responses\(^{25}\) to these requests. Examples of bibliography themes include Bibliography for the Electrical Engineer, Bibliography of Emil Racoviță - for students, Bibliography about Plastic and Rubber Processing, and even a bibliography on “Holidays and Health”. Without any of them being exclusively popularizing or highly specialized, these instruments were used to respond to frequent requests from the public. The focus of these bibliographies suggest that the users of the Technical Branch were in search for Science and Technology literature for both personal and professional educational purposes and that the library made efforts to meet both these needs.

2.2. KEYWORDS CATALOG

Following years of experience working with the public interested in the technical collection during the 1960s, the librarians understood that “information was hidden in books” and thus a more
efficient catalog would need to include keywords from the books. Creating an additional catalog meant extra work and the librarians at the Technical Branch took on this challenge. They began creating descriptions for the catalog from the more recent materials of the most popular fields. Materials from Electronics and Electrical and Mechanical Engineering were first described in the keywords catalog. Later, in the late 1980s, descriptions for books from Computer Science and Marketing fields were also added. The descriptions in the Keyword Catalog included chapter level (and often times subchapter level) information that allowed for a timelier search of the requested materials. The main criteria used in the creation of the catalog was the classification of each publication based on the keywords that best described its content that was found in the title, in the content of the book or even “between the lines” of the book.

The Keyword Catalog was among the first of its kind in the country and was an efficient instrument for answering reference questions and retrieving relevant materials from the Technical Branch’s collection.

2.3. Public activities and Readers professions’ catalog

Answering users’ requests and questions was made easier with the help of the tools created. However, the librarians wanted to better assist their community and thus invested in activities and tools that brought the public closer to them. The public events included promotion of books, meeting with researchers and authors, exhibits, and even workshops. Oftentimes, the theme of these meetings was specialized and thus the participating public was consequently the specialized fraction of the general public. The interest of librarians to offer events that were of interest to the more technical public is also visible in the Readers professions’ catalog created in the branch.

In order to reach the “right” audience for the events organized by the Technical Branch, the librarians wanted to know what were the professional interests of the public. In addition to the registration forms of the library, the branch asked readers to fill out an additional form about their professional background. This way, the librarians knew who among the readers would be interested in a (specialized) presentation and were able to reach them when organizing a public event.

2.4. Shared catalog of foreign books

The more specialized the public library services were, the smaller the audience was. Nevertheless, specialized professionals from Science and Technology fields outside the library’s jurisdiction would inquire about and use the library’s services. The shared catalog of foreign books is such an example. The catalog was created under the guidance of the Technical Branch to provide information about the Science and Technology foreign books that were available at different libraries in the area. The Mures library, through the collection of the Technical Branch, was the public library that contributed the most to this catalog. The other libraries were specialized libraries (like libraries of industrial sites and factories). Coordinating such a project meant that the public library also assumed roles of a special library.
3. CONCLUSIONS

In the analysis of new services offered by the Technical Branch, we can see how the innovative tools were created to help readers access the needed S&T materials. These tools addressed the general public’s needs for technical information but, because of their efficiency, were also usable for specialized purposes. The double usage of these services prompts the question of where does popularization of science end and specialized services begin in a public library. Going beyond the required level of services for the popularization of science, librarians from the Technical Branch provided specialized service to their public. Even though only a smaller portion of the public was using these services in a specialized way, it is remarkable that these specialized services were even offered by a public library. Moreover these were efficient services, more advanced than those of specialized libraries in the region. In the absence of other viable alternative services, this public library expanded its role in order to answer to the public’s informational needs.

Eastern European Communist regimes invested heavily in educating the population in Science and Technology-related fields. This paper discussed the roles played by public libraries in providing access to Science and Technology literature. Besides the roles politically ascribed to libraries, we documented the “special library” role assumed by a public library through the personal and professional choices of its librarians. While this was not a generalized aspect of public librarianship in communist Romania, this article underlines the value of local solutions implemented by librarians. When assumed by the librarians and the library, these solutions were able to provide specialized information services for the rich fields of Science and Technology.

ACKNOWLEDGEMENTS

The authors would like to acknowledge all librarians that were generous in sharing their professional memories. The authors are also grateful to Tiffany Chao, Aiko Takazawa and Traian Serbanuta for providing feedback during the writing of this paper.

NOTES

1. See Consiliul de Miniştri, "Hotararea 1542/1951," Archiva Ministerului Culturii 2665, 1970. This very ideologized decision created the bases for the future development of libraries during the communist era.
Prelucrarea maselor plastic Oradea (255 km away from Tg. Mures). In 1986 he requested the thematic bibliography no. 47

Interview with M.F. March 2013


Interview with M.F. March 2013

An example of a letter requesting a specific bibliography is that of Covaci Silviu, an engineer from Oradea (255 km away from Tg. Mures). In 1986 he requested the thematic bibliography no. 47 “Prelucrarea maselor plastic și a cauciucului” (Plastic and rubber processing).

–I remember we started with the diode – we kept getting requests about the diode and other things from electronics and electrical engineering fields. Once the reader left, I opened a book and there was a large chapter on the diode. I was a librarian not a technician. [Readers] would come and ask about a piece of machinery they wanted. How could we solve this? We decided that we cannot catalog the whole collection with keynotes but we can do that for Electrical engineering and electronics.” (Interview with M.F. May 2014)


“In the end, however it became clear that we can serve the readers only up to a certain level. We could not serve the researchers interested in profound aspects of a small issue. But those that needed any kind of information could [come to us]. And they came: workers, farmers, engineers”. Interview with M.F. May 2014
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