Section 8.1 :
Mathematics and Mechanics in the Contemporary Period (since 1800)

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Pedro José da Cunha (1867-1945), Historian of Portuguese Mathematics

Pedro José da Cunha (1867-1945) is one of the four Portuguese historians of Mathematics who wrote a general History of Portuguese Mathematics.

He had his higher studies first at the Polytechnic School, then at the Army School, both in Lisbon, graduating in Military Engineering in 1891. He did research in Analysis, publishing papers on the theory of series, curves and surfaces.

From 1929 onwards History of Mathematics became his main field of research. His work in this field will be analysed, including his *Bosquejo Histórico das Matemáticas em Portugal* (*Historical outline of Mathematics in Portugal*), written for the 1929 Seville International Exhibition, and *As Matemáticas em Portugal no século XVII* (*Mathematics in Portugal in the XVIIth Century*), a paper he wrote connected to the 1940 Congress of the Portuguese Commonwealth.

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Interdisciplinarité chez les mathématiciens roumains

Si l'on considère les subdivisions utilisées dans les grandes revues de comptes rendus (*Mathematical Reviews*, *Zentralblatt für Mathematik*), la mathématique réunit aujourd'hui plus de soixante disciplines scientifiques.

Cette communication se propose d'exposer, premièrement, les contributions originales des mathématiciens roumains dans les secteurs de la science auxquels ils se sont consacrés. Deuxièmement, on mettra en lumière l'influence de la pensée de ceux-ci dans d'autres sciences, au delà de la mathématique abstraite, soit dans la mécanique, dans la résistance des matériaux, soit dans la philosophie, le droit etc. Et, troisièmement, on montrera avec des exemples que plusieurs savants roumains de mathématique pure ont réussi à s'illustrer dans le domaine de l'art, de la littérature ou dans la vie politique.

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The Geometers of God. Studying Pure Geometry in the Period of Revolutions

The confrontation between synthetic and analytic method in solving geometrical problems was particularly violent in Naples, around the turn of the nineteenth century. It took the form of the opposition between a powerful "synthetic school", which controlled such institutions as the Royal University and the Royal Academy of Sciences, and a rampant "analytic school", whose members were mainly teachers at the military and technical colleges. In this paper, I shall argue that such confrontation, far from being based on a mere "technical" divergence, was well rooted into the broader intellectual milieu of the protagonists. With reference to the general development of mathematics, this means attributing a decisive weight to the "contingent conditions" in which mathematicians take certain crucial decisions.

The Neapolitan debate was not even the case of an opposition between "backward" mathematicians and "modern" ones, as it has been claimed. In fact, the very constitution and institutionalization of the "ancient" synthetic school was accomplished <u>in response</u> to the latest mathematical news arriving from France during the last quarter of the eighteenth century. The two methods depended on two different "images" of mathematics that is to say, two different conceptions of the relation between mathematics and the world. I shall attempt to show how each of these conceptions can be seen as a part of a more general orientation either for or against the social and political changes which shattered the Kingdom of Naples between the French Revolution and the age of the Restoration.

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РАЗВИТИЕ МАТЕМАТИКИ В БЕЛАРУСИ

В Беларуси научные исследования в области математики начинались в Белорусском государственном университете (открыт в 1921 г.). В настоящее время исследования по математике проводятся в Академии наук Беларуси (создана в 1929 г.), трех университетах (Минск, Гомель, Гродно), ряде высших учебных заведений: технических, технологических, экономических и других.

В развитие математики внесли крупный вклад академик АН СССР В.П. Платонов, академики АН БССР: Е.А. Барбашин (1918-1969), Ф.Д. Гахов (1906-1980), Н.П. Еругин (1907-1992), В.И. Крылов (1902-1994), В.Г. Спринджук (1936-1987), С.А. Чунихин (1905-1985), И.В. Гайшун, Н.А. Изобов, члены-корреспонденты Ан Беларуси: Е.А. Иванов (1924-1985), Э.И. Грудо, А.Е. Запесский, Л.А. Янович, Л.А. Шеметков.

Основные направления научных исследований математиков Беларуси: 1. Алгебро-геометрические и дифференциально-геометрические свойства пространств и многообразий. 2. Аналитическая, качественная и асимптотическая теория обыкновенных дифференциальных уравнений. 3. Вычислителная математика. 4. Исследования по теории групп и близких алгебраических систем. 5. Историа математики и методика преподавания математики. 6. Комплексный анализ и его приложения. 7. Корректные и некорректные граничные задачи для уравнений с частными производными, дифференциально-операторных и псевдодифференциальных уравнений и уравнений математической фисики. 8. Линейные и нелинейные проблемы и их приложения в теории управления. 9. Математические методы в механике. 10. методы, алгоритмы и программы математического обеспечения вычислительных машин и систем. 11. Методы оптимизации стохастических систем и процессов. 12. Проблемы дискретной математики и математической кибернетики. 13. Разработка теоретических основ для построения интеллектуальных информационных и управляющих систем. 14. Робастный (устойчивый) статистический анализ данных. 15. Теория оптимального управления. 16. Функционально-операторные методы и обобщенные функции.

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Sobre las aportaciones de P.M. González-Quijano a la geometriá descriptiva

Cuando G. Monge (1746-1818) se plantea la representación plana de las distintas formas del espacio, lo hace mediante la proyección ortogonal del punto, elemento geométrico mas simple, sobre el plano de referencia. Su indefinición, desde el antedicho plano, obliga a la disposición de otro plano-perpendicular al anterior-con el fin de fijar la distancia del punto sobre el plano de la representación.

Sin embargo, el dibujo por dos proyecciones quedará estructurado en el plano solamente si a la doble proyección le es concomitante una superposición de aquéllas; ésto, se consigue mediante giro alrededor de la recta intersección de los precitados planos ortogonales.

Los problemas de la representación de espacios n-dimensionales fueron objeto de profunda investigación por estudiosos españoles, entre ellos, Antonio Torroja Miret (1888-1974) y Pedro González-Quijano (1870-1958).

Pedro M. González-Quijano, Ingeniero de Caminos (1894), Profesor de Hidráulica e Hidrologiá (1924), Académico de las Ciencias, especialista en Obras Hidráulicas y Climatología, gran pensador y publicista de numerosos artículos en revistas de la época, como Ibérica, Madrid Científico, Revista de Obras Públicas y otras, tiene una contribución a la Geometría Descriptiva que merece ser destacada. En efecto, del análisis de la Representación Gráfica de los Lugares Hipergeométricos (1894), Sobre un sistema de Geometría Descriptiva del Hiperespacio (1923) y Sobre algunos Lugares Hipergeométricos (1949), deduce, generalizando la diédrica de Monge, una representación plana del espacio superior tetra-dimensional.

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Cauchy and the Problem of Point-Wise Convergence

The paper seeks to insert a brief set-theoretic introduction to non-standard analysis (limited to extensions of standard functions to the hyper-real line) into the discussion of the so-called Cauchy's "mistakes". We concentrate on a word by word reading of the statements of his theorems (1821 and 1823) and definitions (of continuity) and we seek to develop the consequences of such reading. Our main conclusion is that, in 1853, Cauchy actually added point-wise, not uniform convergence to his 1821 theorem, because from a non-standard analysis perspective, in 1821 he already had sufficient conditions for uniform convergence.

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History of the Least Squares Method and its Links with the Probability Theory

The method of the least squares is perhaps the best example of the interaction between Science and Mathematics. Astronomy has been for a very long time, a field for applied mathematics and statistics. Astronomers, during Antiquity and the Middle-Ages, used very crude instruments for their observations which could introduce large systematic and also random errors. During Antiquity, the astronomers observed positive and negative errors. The astronomers didn't seem to have fixed rules to determine a parameter. *"If they made several observations of the same object they usually selected the "best" estimator of the true value"* (of a parameter). In other words, they used "point" estimators to a parameter. It is during the XVIIIth century, that the practice of the arithmetic mean became well established and recognized.

The history and the solution of the least squares problem is rich and multidisciplinary. It corresponds to a problem of approximation. The second aspect, initialized by Gauss, is probabilistic, and it is linked to the method of the maximum likelihood. Finally, the numerical mathematics have introduced new theorems, new algorithms, new concepts to the above problem. The classical least squares problem corresponds to a problem of mathematical modelling, that we call *"the hypothesis"* in statistics. This model is given a priori and we must find the estimators to parameters of a given model by using the data, the observations, obtained a posteriori by minimizing the sum of errors squared with respect to the model.

We comment the work of Gauss, Laplace, Legendre and Bienaymé, the English school of statistics in the XIXth century, the problem of induction in science, and the theory of the errors. We show the contribution of the least squares towards modern mathematics and the convergence in the mean.

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A Mathematician's Tale : The Life of Vito Volterra

Born in Ancona in 1860, Vito Volterra made his mark on mathematics and on the Italian school of mathematicians, to which he belonged, before he was 30. He died in Rome, in 1940, having lived a tumultuous life from the unification of Italy to the outbreak of World War II. To science historians, Volterra is an illustrious mathematician whose name is tightly linked to the theory of functionals and justly recognized in the Volterra-Lotka equations. To the wider public, Volterra is all but unknown-a pity, because Vito Volterra is a heroic figure, worthy of a biography. Drawing on materials in the Volterra Archive, oral histories, and family letters, the elements of such a work are presented.

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Leipziger Beiträge zur Theorie hyperkomplexer Systeme

Ende der 80er Jahre des 19. Jahrhunderts erscheinen mehrere Arbeiten Leipziger Mathematiker zur Theorie hyperkomplexer Systeme. Inhaltlich haben diese Arbeiten einen klaren Bezug zur Lehre von den kontinuierlichen Transformationen, so daß es naheliegt, einen Zusammenhang mit Lehrtätigkeit von Sophus Lie in Leipzig zu vermuten. S. Lie hatte 1886 die Nachfolge von F. Klein an der Leipziger Universität angetreten. Im Vortrag wird der Inhalt der Arbeiten von G. Scheffers, E. Study und F. Schur dargestellt, insbesondere welche Ideen sie von anderen Mathematikern aufnahmen und welche neuen Erkenntnisse sie zur Theorie hyperkomplexer Systeme erzielten.

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Un regard nouveau sur l'oeuvre de Jules Bienaymé, à la lumière de la correspondance et d'archives familiales

L'oeuvre du probabiliste Jules Bienaymé (1796-1878) offre un aspect déconcertant, qui allie des conceptions en avance sur son temps à des accès de laconisme allant jusqu'à l'omission totale des démonstrations. Un coin du voile est levé dans une lettre à Quetelet, où la présentation incomplète des résultats est imputée aux charges professionnelles et aux ennuis de santé. Le premier motif pèse lourd jusqu'en 1852, quand la carrière d'inspecteur des finances prend fin, par des péripéties détaillées dans les archives familiales. Des travaux plus argumentés viennent ensuite, à commencer par un mémoire qui donne sans doute la substance d'un doctorat entrepris en 1848 mais jamais paru comme tel. C'est aussi le temps des oeuvres polémiques. Mais les troubles de santé, surtout des tremblements incoercibles, paralysent progressivement la plume de Bienaymé jusqu'en 1871. Par après, celui-ci ne crée plus rien de neuf, tout en apportant encore de précieuses révélations sur des résultats antérieurs, par le biais notamment de relations épistolaires.

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The Formation of Hayashi's Quantification Theory

This paper studies the history of the formation of Hayashi's Quantification Theory (HQT), which is known as a general statistical method to obtain quantitative indices from qualitative data.

The Institute of Statistical Mathematics (ISM), where Chikio Hayashi worked, was established by the effort of Japanese statistical mathematicians during the Second World War. The post-war reformation of ISM, especially the establishment of the Department of Social Sciences, linked the traditional theoretical study of Japanese statistics with practical social survey. As a result of this linkage, a new statistical theory known as HQT was firstly formulated by Hayashi in 1950.

In the case of the first formulation, the parole prediction, most of the data from social survey were qualitative. Therefore, he had to convert such qualitative data into the quantitative data in an objective way. By maximizing the precision of prediction, he accomplished this to build his first formulation. Through this, he also established his general method of quantification theory which was to be developed by himself in 1950s.

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Tactical Configurations and Finite Groups

Mutual influence of researches of tactical configurations and researches on a permutation group is traced. A term "tactic" has entered in 1861 J.J. Sylvester. By tactic he named large part of the mathematics, in which problems of designing of combinations from elements of some set are decided. Sylvester attributed to tactic the theory of the permutation groups. Its sights on tactic were divided by A. Cayley. Large number of configurations in XIX century were investigated in geometry and combinatorial analysis. The most famous geometric configurations was Hesse configuration (9 points and 12 lines of the inflection of the plane curve third order), configuration 27 lines upon the cubic surface, configuration 28 bitangents to a plane quartic curve. The problems of the configurations will be interpretated for language the theory of groups. A term "the geometric configuration" has introduced K.T. Reye in 1882. For configurations a problem of a construction of group of automorphisms is actual. For finite group a problem of a construction of its geometry (that is configuration) is actual. In 1896 E.H. Moore has given definition of a tactical configuration, has resulted many examples of tactical configurations. In the 30th years of the twentieth century in the papers on the design of experiments R.A. Fisher has entered a term "block design". Particular cases of tactical configurations are finite geometries, Tits's geometries. Tactic-geometric interpretations of the groups promoted in XX century the solution of a problem of a classification of simple finite groups.

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The Origin of Hamilton-Jacobi Theory in the Calculus of Variations

The present paper discusses the process of constructing Hamilton-Jacobi theory, one of the important topics in the calculus of variations. W.R. Hamilton got the idea of the so-called Hamilton-Jacobi theory from dynamics. C.G.J. Jacobi elaborated Hamilton's dynamical theory and made it applicable to mathematical variational problems. I focus on Jacobi's procedure that bridged the great gap between Hamilton-Jacobi theory in dynamics and pure mathematics.

In his paper of 1828, Hamilton introduced the characteristic function in optics. Using this mathematical tool enabled him to determine the path of light rays, which follows Fermat's principle, by solving the first order partial differential equation.

In 1834 Hamilton constructed the characteristic function in dynamics, which is mathematically similar to the characteristic function in optics. When he introduced this function, he could solve the dynamical problem by integrating the first order partial differential equation. In his paper of 1835, he demonstrated the above-mentioned procedure in the canonical co-ordinate system which was introduced by himself. He also showed that Lagrange's equation of motion is derived from the so-called Hamilton's principle, a kind of variational theorem.

Jacobi, bringing together Hamilton's two discoveries, achieved the new idea of variational theory. The variational problems are reduced to the integration of the same type of partial differential equation as the dynamical problem. But he could not directly apply Hamilton's dynamical theory to the variational problem. Although one should consider the variation of integration of any differentiable function in variational problems, Hamilton took the variation of integration of the sum of the "potential function" and the kinetic energy in dynamics. This condition played an essential role in deriving the partial differential equations.

Jacobi found that he could remove this condition by using the canonical coordinates system in which one could construct the dynamical theory more mathematically. Although Hamilton used the mathematical property of kinetic energy in introducing the idea of this system, Jacobi succeeded in constructing a similar system without the condition of kinetic energy. By using his extended canonical coordinate system, Jacobi demonstrated the new theory in the calculus of variations in his lecture of 1842-1843.

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On Karamata's Majorisability

Jovan Karamata (1902-1967) phrased the notion of majorisability (majorabilité, Majorabilität) for the first time in the paper entitled *Théorèmes inverses de sommabilité I et II*, GLAS de l'Acad. Serb. des Sci., Belgrade, 143 (70), 1931, p. 1-24, 121-146, where he showed that *C*-majorisability, as a condition for the convergence of Abel summable series is more general than the well known conditions given by Tauber, Littlewood and Hardy-Littlewood.

One sided majorisability is defined in the following way:

A sequence of numbers $\{a_v\}$ is one-sidedly *V*-majorisable (from the right or from the left), what is simply represented by the expression :

$$V - \{a_v\} << V - \{A_v\} \qquad (\text{or } V - \{a_v\} >> V - \{A_v\})$$

if there exists a sequence of numbers $\{A_v\}$ which is *V*-summable and which is such that the inequalities $a_n \leq A_n$ (or an $\geq A_n$) are satisfied for every $n = 1, 2, 3 \ldots$

Both sided and absolute majorisability are defined in a similar way.

Karamata comes to the conclusion and shows that the condition of *C*-majorisability is included in the most general condition of convergence of Abel summable series by R. Schmidt, but he does not succeed to prove that the reverse is also true, that is that Schmidt's condition is identical with the condition of C-majorisability.

Karamata mentions the notion of majorisability in his later works few more times. In the paper *Sur certains "Tauberian theorems" de MM Hardy et Littlewood* (1930), he gives the conditions for one-sided majorisability for generalized C(p) and A(p) summability procedures; in *Über einen Konvergenzsatz des Herrn Knopp* (1935), he concludes that these two convergence conditions are not equal, and eventually, in the paper written with P. Erdös *Sur la majorabilité C des suites de nombres réels* (1956), his only work devoted entirely to the notion of majorisability, this is proved. The role of C-majorisability in limit theorems and in the proof of the prime number theorem is also shown in it. In the paper *Sur les inversions asymptotiques des produits de convolutions* (1957), the latter is elaborated.

Karamata's primary aim in introducing and defining the notion of majorisability as a general Tauberian condition, was to simplify the proof of inverse theorems of Tauberian nature, and this aim was successfully achieved. C-majorisability has an additional importance in the proofs of some theorems in analytic theory of numbers.

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The Development and the Present State and Some Applications of Poincaré's Integral Invariants

Three stages in the theory of Integral Invariants could be marked out. The Memoir *Sur le problème des trois corps et les équations de la dynamique* (1890) and the third volume of the book *Les méthodes nouvelles de mécanique céleste* (1897) were the most important works at the beginning of this theory development where Poincaré formulated its basic principles and applied it for two- and three-body problems, the demonstration of the existence of periodical solutions (with appropriate choice of initial conditions), the consideration of asymptotic and double-asymptotic solutions for three-body problems, the investigation of heavenly bodies stability. The works whose authors have come closely with the conception of integral invariants - are related to the initial period. The erroneousity of the widely spread opinion about belonging the theorem of phase volume constancy to J. Liouville has been shown and assumption about this opinion origin has been expressed in this report.

The groundlessness of S. Lie's pretentions on a priority for creation of integral invariants theory has been proved in this report. The central links of this period were the integral invariants of simultaneous states of holonomous systems.

The active development period of integral invariants began in 1895 and was over in the 30s years of this century. Its central point was E. Cartan's introduction of the integral invariants of simultaneous states into the differential equations theory. G. Drinfield's investigations on the applications of integral invariants in the differential equation theory were related to this period.

The third, i.e. the present period of the integral invariants theory development, began after the Second World War. The central part of this period is the introduction of the integral invariants for holonomical systems by V. Dobronravov. The theory of integral invariants is widely applied in heavenly mechanics, in the external forms theory, in the group transformation theory during this period. The fundamental theorem by Lee Hwa-Chung about the solelity of the universal integral invariants is related to this period also.

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Geometrical Imagination in the Mathematics of Karl Weierstraß

The approach of Karl Weierstraß (1815-1897) to mathematics, in particular to complex function theory, is usually characterized as an "algebraic" one as opposed to the "geometric" one of Bernhard Riemann (1826-1866).

From a letter to Hermann Amandus Schwarz (1843-1921) dated of March 14, 1885 one learns, however, that Weierstraß well had a geometrical imagination of the analytic objects which he studied, representing them by minimal surfaces in the space of pairs of complex numbers, and that he used this in order to find and prove results, e.g., the nowadays so-called Poincaré-Volterra theorem. Even more, a set of lecture notes on Abelian functions worked out by Georg Hettner (1854-1914) reveals that Weierstraß also conveyed his ideas to his students, including a geometrical visualization of the real four-dimensional space of two complex variables. (Remarkably, this part of the notes is not included in the version which has been published as volume 4 of the collected works of Weierstraß although Hettner was one of the editors of this volume).

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Des quantités imaginaires a le nombre complexe, d'après les Espagnols du XIXe siecle

A la fin du XVIIIe siècle, les professeurs de mathématiques des institutions non universitaires chargées par l'autorité royale de l'éducation scientifique et technique, réalisent un excellent travail. Beaucoup de leurs élèves apprirent, dans les livres écrits par des professeurs qui avaient étudié en France, la théorie et les derniers et les plus importants résultats mathématiques de l'époque.

La représentation géométrique des quantités imaginaires, bien connue dans les manuels mathématiques, fit l'objet des spéculations de quelques mathématiciens. A Madrid le Prof. Rey Heredia avec la collaboration de son ami Fernandez Vallin, tous deux de l'Institut de Noviciado de l'Université Centrale de Madrid, entreprirent l'étude des quantités imaginaires. Leur travail continuera jusqu'à quelques jours avant le décès de Rey Heredia en 1861. Les résultats furent publiés par le gouvernement. Bien que leurs réflexions ne furent pas bien comprises, elles eurent une forte influence sur les mathématiciens espagnols, comme le Professeur Clariana de l'Université de Barcelone qui, avec ses articles sur les quaternions et les vecteurs, introduit, à partir de 1878, la discussion sur les nombres complexes.

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An Impact of Zygmunt Janiszewski on the Development of Topology

The aim of my paper is to show that Zygmunt Janiszewski -one of the greatest polish mathematicians- has impacted on modern mathematics essentially. The rapid development of topology as a self-sufficient branch of mathematics is a merit of Janiszewski's theorems on continua theory, especially the characterization theorem of a two-dimensional sphere. It was the natural realization of the ideas of Riemann and Poincaré concerning the problem of a characterization of manifolds. Janiszewski was the first who noticed the close connection between set theory and topology and mathematical logic. He founded *Fundamenta Mathematicae* -a journal which was the first devoted to set theory and problems of topology and logic connected with that.

Using the example of the emergence of the mathematical concept of continuum, I intend to demonstrate how a connection topology with the foundations of mathematics led to the formation of continua theory.

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К вопросу о развитии математического моделирования в Болгарии

В научном сообщении, на основе анализа исторического и культурного развития Болгарских государств предложена периодизация процесса развития моделирования в болгарской науке и социальной практике: 1) Средновековный период - моделирование в иконографике и медицине, 2) Ренесансовый период - от начала Ренесанса в Болгарии до 40-ых годов XX в. - Моделирование в естествознании, медицине, литературе, архитектуре, 3) Современный период - этот период представлен более подробно.

После ознакомления с идеями Винера болгарские ученые проявили болшой интерес к проблемам применения математического моделирования в разных областях науки и практики. На фоне этого интереса и благодаря исследований по философии математики в середине 70-х годов XX-го века была создана интердисциплинарная научно-исследовательская груипа для целостного освещения методологии математического моделирования (МММ), инициаторым и руководителем которой является проф. Б. Чендов.

Учитывая регулярно проводившиеся под им руководством симпозиумов и редактированные ими сборников "Методология, моделирование, компютеры" - 5 тт. на болг. языке и "Методология математического моделирования" - 5 тт. на иностранных языках, как и на основании библиографскую справку, предлагается подробный анализ развития математического моделирования и в частности развития его методологии. Итоги : 1) Исследования по методологии математического моделирования в Болгарии имеют два направления: а) в области канонических наук и б) в области интердисциплинарных исследований; 2) Имеются значительные теоретические постижения, в особенности: определения понятий модели и моделирования, выяснения оснований моделирования и требования к моделям в науке.

Научное сообщение богато илюстрировано. Отдельно имеются 5 таблиц - модели, обобщающие некоторые научные постижения в области теории математического моделирования, имеющие на наш взгляд место в мировой науке.

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The Beginning of Polish Mathematics - some Topological Episodes

Up to the end of the 19th century Poland was not noted for mathematics. Suddenly, after the First World War, the Polish Mathematical School became widely known. Two cities became great mathematical centers : Lwow, where Stefan Banach and others worked on functional analysis, and Warsaw, where the main area of research was set theory and topology. How did it happen that topology flourished in a country without a significant mathematical tradition?

A remarkable profusion of results was obtained shortly after the war by Polish mathematicians. Many of them became classical, being mentioned in almost every book on general topology. Also Polish mathematicians proved many specialised theorems, and gave simpler proofs of known results. Up to 1925, five Polish mathematicians -Sierpinski, Janiszewski, Mazurkiewicz, Knaster and Kuratowski- published about 100 papers on topology.

In the one paper of Sierpinski we read with surprise the following :

"Note that as early one year ago Mr. Mazurkiewicz found an example of a curve which was simultaneously a Jordan curve a Cantor curve... Mazurkiewicz forms this curve by dividing the square into nine smaller squares using lines parallel to the sides and removing the interior of the center square, performing the same procedure on each of the remaining eight squares, and iterating this procedure ad infinitum".

We recognize the description of the Sierpinski carpet! Apparently the Sierpinski carpet was found by Mazurkiewicz.

Ricardo Romero
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La mécanique de Joseph Boussinesq (1842-1929)

En 1872 Boussinesq, dont Saint-Venant a révélé les travaux, publie son premier mémoire théorique. Celui-ci traite de la mécanique mais aussi de la physique en général. A cette époque, la conception de l'énergie exposée par Helmholtz en 1847 et celle présentée par Thomson et Tait en 1867 peuvent sembler discutables. L'une est trop liée à l'hypothèse des forces centrales newtoniennes, l'autre s'appuie sur la notion de force jugée contestable. Fondée à la fois sur une approche mécanico-moléculaire et sur la conservation de l'énergie, la mécanique de Boussinesq évite ces deux écueils. Originale, cette théorie est l'une des rares en France qui utilise la conservation de l'énergie proprement dite, et non pas seulement l'équivalence du travail et de la chaleur.

Boussinesq construit une mécanique physique au sens de Poisson -il l'appelle "mécanique générale"- tout en plaçant au premier plan la notion d'énergie: à partir de deux principes, la conservation de l'énergie et l'indépendance des mouvements, il dérive une notion purement mathématique de force et démontre les lois fondamentales de la dynamique ainsi que la première loi de la thermodynamique. Sa "mécanique physique", quant à elle, est une physique du macroscopique, qui s'apparente à la physique mathématique de Fourier. Ainsi Boussinesq réunit en un tout cohérent deux traditions de la physique française: la mécanique physique de Poisson et la physique mathématique de Fourier.

Dès les années 1830 Cauchy et ses successeurs complètent les travaux de Fresnel. Leurs résultats sont obtenus au moyen de calculs inextricables. De plus, des difficultés inhérentes aussi bien aux propriétés de l'éther qu'au rôle de la matière pondérable subsistent. Boussinesq, utilisant les travaux de Lamé sur l'élasticité, et intégrant directement l'action de la matière pondérable dans ses calculs, retrouve simplement ces résultats. Par ailleurs, il propose une expression mathématique de l'énergie thermique au niveau moléculaire. Grâce à ses conceptions dynamiques, il réalise une brillante synthèse entre l'Optique et la "Thermique", et en plus il donne une formulation nouvelle des travaux de Fourier.

La mécanique de Boussinesq est sous-tendue par une épistémologie qui rappelle souvent celle qu'Émile Boutroux attribue à Leibniz. Boussinesq assigne pour seul but à la Physique de produire des lois mathématiques. Ces lois sont obtenues au moyen de l'analyse et avec l'aide de l'expérimentation. Elles ne sauraient être que des lois approchées, car nous n'avons de la réalité qu'une perception incomplète. La "mécanique physique" de Boussinesq sera donc une physique de la moyenne. C'est par une harmonie entre les idées propres à l'homme et la structure du réel que cette connaissance est rendue possible. Ce savoir devra s'étendre à l'ensemble de la nature, y compris le vivant. Pour Boussinesq cela doit se faire à travers une dynamique supérieure, celle du "principe directeur".

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The Development of Research in Chinese Mechanical Mathematics in the Past Twenty Years (1977-1996)

The ancient Chinese mathematics represented by Jiu Zhang Sui Su is fundamentally a kind of mechanical mathematics, or in other words, constructural mathematics. The ancient Greek mathematics represented by Euclid's *The Elements* is a sort of axiomatic or existential mathematics. While those two systems are different, such differences in fact have supplied each other making significant contribution to the historical development of mathematics. However, since the invention of computer, the mathematical logic and methods in the new computer era display a remarkable similarity to the Chinese traditional mathematics system represented by Jiu Zhang Sui Su. Therefore, it is worthy to further research the principles and approaches in ancient Chines mathematics and their application in today's prelude research work.

Chinese mathematics master Wenjun Wu has employed the essence of mechanics demonstrated in ancient Chinese mathematics since 1976. In the past twenty years, he started from the mechanical proof of geometry theorems and landed in following fields : primary geometry and calculus geometry, equality proof and inequality proof, primary mathematics and applied mathematics. In those mathematical sciences and high-technical fields, he achieved many accomplishments.

In 1990, The research Center for Mathematics Mechaninization in the Institute for Systems Science of Chinese Academy of Sciences was founded under the leadership of professor Wenju Wu. In 1992, the national - focus - supported project named "Mechanical Proof and Its Applications" was established.. This project engineers the development in the field of mechanical mathematics and leads to quite a few achievements.

The updated research work lay in the areas as following :

1. Theorems and algorithms in mechanical proof
2. Theorems and algorithms of extraction in algebra
3. Applications of Wu-method in theoretical physics
4. Application of Wu-method in computer science
5. Application of Wu-method in mathematics science
6. Applications of Wu-method in Mechanical-man structuralization
7. Development of Wu-method in software system

There are a lot of world-class achievements. For example, to extract the well-known 16 unknowns mechanically by using Wu-method, and solve all solutions of classical "Zhengling Yang-Bexter Function" consisted of 64 cube multinomial functions.

In 21st century, we can expect further developments in mechanical mathematics. Meanwhile, we anticipate rejuvenation of Chinese mathematics. China is going to be a mathematics giant.

Erwin Nick Hiebert
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Reduction of Classical Thermodynamics to Statistical Mechanics as Philosophical - Historical Problem

The science of mechanics had more than a century's head start on the creation of a science of thermal phenomena. With its impressive triumphs in gravitational astronomy, mechanics occupied a unique position among the physical sciences for two centuries. By the outset of the 19th century it was evident that mechanics had taken pride of place within the hierarchy of the natural sciences. Given the enormous prestige of mechanics, and perceiving that the theoretical achievements in the other sciences, were so few by comparison, it is plausible to see that strenuous efforts would be made to demonstrate that heat phenomena can be reduced to mechanics or cast in the form of mechanics. Fourier approached the study of heat from a non-mechanical direction, and in so doing raised the science of thermal phenomena to the level of a distinct body of theoretical knowledge.

The essential problem -a classical non-trivial case of reduction- can be stated in the form of simple questions. Can thermal phenomena be reduced to mechanics? Is it possible to translate conceptions such as temperature, specific heat, and quantity of heat into the conceptions that characterize classical mechanics? This puzzling and challenging conceptual and mathematical problem gave 19th century scientists a chance to sail into the winds, to attack an issue that had teeth in it. The challenge was taken on, bit by bit, by Maxwell, Boltzmann, Loschmidt, Zermelo, Poincare, the Ehrenfests, Gibbs, Jeans, Einstein and many others. Although the goal of reduction was never reached by these investigators their ingenious ways of thinking about mechanics, the second law, statistics, and probability in due course led, if not from mechanics to thermodynamics, to a revolution in physics at the micro-level where causality, determinism, and chance events needed to be reappraised.

It is appropriate to mention here that throughout history reduction has shown to be implicit in, and fruitful for, deliberations that are motivated by the decision to build bridges and make scientific predictions that are parsimonious. The search for unity lies at the heart of reduction, is endemic to science, and is universal in its scope. Reduction may be a valid philosophical-historical stance to maintain in given cases; reductionism, in general, is untenable.

Seiya Aramaki
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Fields Versus Particles in the Formation of Gauge Theory

The attempt to understand the interactions between various elementary particles in a unified way basing upon the gauge principle had met the stumbling-block of the problem of masses of intermediate bosons. The breakthrough was made originally by overlooking deliberately the mass problem thereby attaining a unified and renormalizable theory of the electromagnetism and weak interaction. It is pointed out that there was a conceptual change of the picture of elementary particles, the change that the field is more fundamental than the particle so that the mass of particle is not the primary object but some consequence of the complex interaction of underlying fields.

The resurgence of the quantum theory of fields in the early 1970s was thus realized by departing from the traditional wave-particle dualism. A comparison shows that while there was found a faith to the field view point in this case, the faith was required only for theory itself in the formation of the renormalization theory in the late 1940s because there existed no theory competing with the field one.

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Ludwig Boltzmann - A Pioneer of Modern Physics

In two respects Ludwig Boltzmann was a pioneer of quantum mechanics. First because in his statistical interpretation of the second law of thermodynamics he introduced the theory of probability into a fundamental law of physics and thus broke with the classical prejudice, that fundamental laws have to be strictly deterministic. Even Max Planck had not been ready to accept Boltzmann's statistical methods until 1900. With Boltzmann's pioneering work the probabilistic interpretation of quantum mechanics had already a precedent. In fact in a paper in 1897 Boltzmann had already suggested to Planck to use his statistical methods for the treatment of black body radiation.

The second pioneering step towards quantum mechanics was Boltzmanns introduction of discrete energy levels. Boltzmann used this method already in his 1872 paper on the H-theorem. One may ask whether Boltzmann considered this procedure only as a mathematical device or whether he attributed physical significance to it. In this connection Ostwald reports that when he and Planck tried to convince Boltzmann of the superiority of purely thermodynamic methods over atomism at the Halle Conference in 1891 Boltzmann suddenly said : "I see no reason why energy shouldn't also be regarded as divided atomically".

Finally I would like to mention, that Boltzmann in his lectures on Natural Philosophy in 1903 already anticipated the equal treatment of space coordinates and time introduced in the theory of special relativity. Furthermore in the lectures by Boltzmann and his successor Fritz Hasenöhrl in Vienna the students learned already about non-Euclidean geometry, so that they could immediately start to work when Einstein's general theory of relativity had been formulated.

Section 8.2 :

Physics and Astronomy in the Contemporary Period (since 1800)

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Les apports de Marc Seguin à la naissance de la thermodynamique

Marc Seguin (1786-1875) est principalement connu pour ses innovations techniques et ses activités d'ingénieur civil au début de la première industrialisation en France : le pont suspendu léger par câbles de fil de fer fin, la chaudière tubulaire, la construction du chemin de fer de St-Étienne à Lyon. Toutefois, il manifesta une pensée scientifique très personnelle qui contribua à la mise en place des idées fondatrices de la thermodynamique, en particulier de l'équivalence entre la chaleur et le travail mécanique.

Ses première idées sur l'équivalence sont exprimées dans une lettre écrite en 1822 à l'astronome et physicien britannique John Herschel. Il affirme un principe général de conservation des "forces vives", qu'il situe dans la lignée des réflexions de son grand oncle Joseph Montgolfier. Il suggère que les mouvements microscopiques des molécules expliquent la chaleur, son transfert et sa conversion possible en travail mécanique.

Retenu par ses travaux d'entrepreneur, il ne reviendra qu'en 1839 à sa réflexion sur la chaleur et le travail mécanique. Il pose l'équivalence en principe de base de la compréhension des machines à vapeur et du calcul de leur puissance. Il tente de confronter ses idées théoriques et son expérience des locomotives. Il en ressort une prévision empirique des machines à vapeur haute pression, et la publication d'un tableau de données chiffrées mettant en correspondance la température de la vapeur et le travail mécanique que l'on peut espérer en retirer. En 1847, à la suite des travaux de Joule, Seguin présenta ce tableau comme une première mesure expérimentale approchée de l'équivalence. Nous examinons de manière critique les résultats et les méthodes utilisées. Si la revendication tardive sur la mesure de l'équivalence est excessive, Seguin définit toutefois la méthode à suivre pour y parvenir, dans le sens de la conversion de la chaleur en travail. Il annonce là les travaux de Hirn.

Contemporain de Carnot, mais en marge de la brillante École scientifique française des années 1820-1850, puis desservi par des travaux scientifiques tardifs abondants mais mineurs, Seguin est longtemps resté comme un précurseur méconnu de ce qui allait devenir "le premier principe de la thermodynamique".

Joke Meheus
Aspirant FWO, Universiteit Gent, Gent, Belgium

Inconsistencies in Scientific Discovery : the Case of Rudolf Clausius

Clausius' contribution to thermodynamics is usually described as the result of a simple standard procedure : eliminate some parts of Carnot's theory in such a way that the outcome is compatible with Joule's findings. This picture is suggested by the way in which Clausius presented his theory in his *Ueber die bewegende Kraft der Wärme und die Gesetze, welche sich daraus für die Wärmelehre selbst ableiten lassen* (1850). It moreover results from the fact that Clausius' reasoning process is usually interpreted in terms of Classical Logic.

I shall show that this picture is mistaken and that Clausius arrived at his theory through a complex creative process. The latter involved the elimination of several inconsistencies, an operation which was far from trivial. After a brief sketch of the problem as it presented itself to Clausius, I shall offer a reconstruction of his discovery process. This reconstruction will reveal that Clausius implicitly used a logic that enabled him to reason sensibly in the presence of inconsistencies and to eliminate the latter. I shall briefly outline this logic which has some unusual but nevertheless simple and transparent properties. Next, I shall argue that, in order to understand the way in which Clausius eliminated the inconsistencies, we need not only a specific logic but also knowledge of his "individual constraints". Finally, I shall show that localizing and eliminating the inconsistencies led to several interesting conceptual changes (for instance, in the concept of "heat" and in the concept of "reversible engine").

Yagi Eri[1], **Hayashi Haruo**
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Clausius and the First and Second Laws of Thermodynamics

Having studied R. Clausius's papers (1847-73) and his manuscripts (at the Library of the Deutsches Museum), the following results were found :

1. Clausius treated the first and second laws as a related set of equations, both of which were firstly presented by him in a differential form. This was found out by the analysis of all equations in his 16 papers on the mechanical theory of heat (from *Abhandlungen ueber die Mechanischen Waermetheorie*, 1864 & 1867). For the above aim, a sort of data-base, called *On the formation of R. Clausius's entropy*, was published by Yagi (by the financial support from the Japanese Ministry of Education) in 1989. See E. Yagi : *Thermodynamics*, part 9.5 of the *Companion encyclopedia of the history and philosophy of the mathematical sciences* (ed. I. Grattan-Guinness, Routledge, 1994).

2. Clausius's mechanical theory of heat contains Carnot's result (which was based on the material theory of heat), as the first order differential (approximation). Clausius himself considers the heat expended as the second order differential in the infinitesimal Carnot cycle which was used by Clapeyron to show Carnot's theory in 1934. See Figs from E. Yagi : *Clausius's mathematical method*, HSPS, 1984, 15:1, 177-195.

3. Clausius's mathematical method, adopted from Fourier, made it possible to indicate the first law of thermodynamics in the differential expression : Fourier's work on the analytical theory of heat (1822) had direct influence on Clausius's papers on the propagation of light (1849) and on the mechanical theory of heat (1850). I am grateful to the Library of the Deutsches Museum, Dr. Rudolf Heinrich and Dr. Wilhelm Fuetzl for their help and co-operation in allowing me to study Clausius's manuscripts when I visited in 1976 and 1996. See E. Yagi : *Clausius's entropy and irreversibility*, Abstract, 18th Int. Cong. History of Science, 1989, Hamburg-Munich. E. Yagi : *Fourier on Clausius III* (in Japanese), Abstract, Annual meeting of the Physical Society of Japan (March 29, 1997).

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La physique philosophique d'Adolf Fick (1829-1901)

L'oeuvre de Fick est une illustration exemplaire de la spécificité allemande dans la période de restructuration de la physique consécutive à la découverte du principe de la conservation de l'énergie. On se propose de montrer comment Fick associe la nouvelle vision dynamique du monde à une épistémologie métaphysique d'inspiration kantienne, et comment il parvient à construire deux théories en parfaite harmonie, une théorie physique explicative de tous les phénomènes du monde matériel, et une théorie générale de la connaissance de type idéaliste.

Le mémoire d'Helmholtz "sur la conservation de la force" et la théorie électrodynamique de Weber sont à la base des méditations de Fick sur les concepts physiques fondamentaux. On déterminera d'abord le contenu conceptuel que Fick perçoit dans ces oeuvres capitales et, du même coup, on situera ses conceptions dynamiques par rapport aux deux traditions newtonienne et leibnizienne.

A la différence d'Helmholtz, qui en est venu à se distancier nettement de son approche kantienne initiale, Fick s'engage dans une entreprise de refondation métaphysique de la Mécanique. Sa critique de la causalité prend appui sur une interprétation nouvelle du concept schopenhauerien d'influence d'une chose sur une autre. Une fois révisées, les catégories de cause et d'effet sont appliquées à la construction d'une représentation atomistique du monde extérieur, totalement dégagée de l'obscure notion de force. L'examen de ce principe explicatif fondamental révèle l'ambition de Fick de mettre en concordance ses conceptions dynamiques de physicien avec les pures opérations de son entendement. La reconnaissance explicite d'une étroite interdépendance entre la science et la théorie de la connaissance est-elle chez Fick une manière de réagir contre le positivisme envahissant d'une certaine physique mathématique dans le dernier quart du XIXème siècle?

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Cosmology and Technology

The history of modern cosmology shows that the development of standard big bang cosmology depended heavily on the development of technology in the field of particle physics. In later years, the influence became bilateral.

Big bang cosmology originated out of theoretical research mainly (Einstein, Friedman, Lemaître, de Sitter, Robertson, and others). Only Hubble's astronomical program eventually offered the empirical input the theoreticians couldn't neglect. Then again, only a couple of years later (in the late twenties) this empirical 'evidence' for a dynamical universe was generally accepted.

The interdisciplinarity between particle physics and cosmology proved to be very fruitful in the early forties. Through the work of Gamow, cosmology could benefit immediately of the findings of particle physicists. This was crucial though. Without the successes in that discipline, cosmology would probably not have been able to find that fast a solution for the helium-abundancy problem. Of course, cosmologists would have started their own particle physics research programs, like they did later on concerning the so-called 'dark matter' and the Higgs-boson.

The search of dark matter (the existence of ten times the amount of mass yet found in the universe has to be showed in order to prove that the universe is indeed geometrically flat, like many cosmologists " believe ") is a program initiated by cosmologists but executed by particle-physicists. The characteristics of the subatomic particles to be found are such that new and special technologies bas to be developed.

On one hand, cosmology implies new technologies in the sphere of particle physics. On the other, new technological progress expedites, or at least has a positive influence on cosmological research. The most important conclusion is the fact that we are dealing with two methodologically completely different disciplines which strongly influence technological progress and influence each other by way of technology.

Jean Eisenstaedt
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Light and Gravitation : the Force of an Idea

Light and gravitation, light and attraction, the velocity of light ... relativity·

We will follow the trail of light in the context of Newtonian dynamics -optics and attraction- from the late XVIIth. to the early XIXth. century.

More precisely we will deal with Newton's corpuscular theory of light and with John Michell's application of Newton's theory of gravitation to light.

We will show that between Newton's and Einstein's theories there exist some deep relations connected with light.

A soft historical prelude to relativity ... but without Einstein's ideas!

Pietro Cerreta
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The Birth of Quanta : A Historiographic Confrontation

Martin J. Klein's thesis is that quanta made their first appearance in physics on December 14, 1900, when Planck presented his derivation of distribution law for black body radiation to the German Physical Society. Thomas S. Kuhn, however, contrasts this interpretation, so-called "standard", postponing the event of about five years and awards it to Einstein 's reinterpretation of the theoretical foundations of that law.

The two thesis, however, agree upon the fact that quanta, even if only as a mathematical artifice, were conceived for the first time in 1872 by Boltzmann, who replaced the continuous variable of kinetic energy by a series of discrete values, "to help us to calculate physical processes" in the collisions of molecules. Moreover, they agree upon the fact that this mathematical "fiction" had an influence on Planck.

In this paper I intend to present the points of agreement and the points of contrast between these historical readings, with a particular attention to the role of Botzmann's mathematics in the facts examined. Finally, I will analyse the various positions taken by historians as Galison, Bergia and Tagliaferri on these points.

Arne Schirrmacher
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The Establishment of Quantum Physics in Göttingen 1900-24. Conceptional Preconditions - Resources - Research Politics

Collecting the Göttingen contributions to quantum physics from a conceptual point of view up to 1924 does not really provide a satisfactory story. A more coherent way to assess the local development is proposed by asking how a shift of focus towards quantum problems arose and what research politics it involved.

In particular, the period from 1911-18 was one of many decisions on staff and spending of funds. Analyzing the discussions in the philosophical faculty, the argumentation with the ministry, the decision processes and the spending of extra funds ("Gastprofessur", "Fermat-Fond", private income...) allows to give a better picture and to identify the personal and conceptual driving forces, i. e. David Hilbert and atomism.

As the leader of the Göttingen physics community Woldemar Voigt, who was sure to have good reasons to prefer phenomenology to atomistic reasoning, did neither research nor spread quantum concepts. Hilbert, the mathematician, used much of his time to learn about the new quantum concepts and all his weight to redirect resources in this field.

(Results communicated in this talk are part of a joint research effort of a working group at the Max-Planck-Institute for the History of Science, Berlin, that undertakes comparative studies for Berlin, Munich, Göttingen and Copenhagen).

Kojima Chieko
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Notes prises par Louis de Broglie lors des cours de Paul Langevin au Collège de France sur la théorie des quanta

L'existence du cours de Langevin au Collège de France sur la théorie des quanta est connue depuis longtemps. Elle est mentionnée dans plusieurs livres, en particulier dans sa biographie. Mais le contenu n'en était pas connu concrètement car Langevin ne le publia pas. L'un des documents où l'on peut prendre connaissance du cours de Langevin, est constitué par les notes de Louis de Broglie, dont on n'a presque jamais parlé en détail jusqu'à maintenant. A partir de 1991, peu après la mort de de Broglie, ses papiers et sa bibliothèque commencèrent d'être classés et rangés aux Archives de l'Académie des Sciences de Paris et dans la Bibliothèque de la Fondation Louis de Broglie. Ce travail fut achevé en 1993. Parmi les manuscrits, on trouve les notes prises au cours de Langevin sur la théorie des quanta. Selon ces notes, Langevin donna une série de cours pendant les mois de mai et juin 1919 et pendant quelques mois de 1924 à 1927. Comme il y avait peu d'occasions d'étudier la théorie des quanta en France, on peut considérer ces notes comme des documents importants pour connaître l'état de l'enseignement de la théorie des quanta à cette époque.

Après avoir résumé le contenu du cours de 1919, nous chercherons son influence sur de Broglie et sur l'idée de l'onde de matière. Quant au cours de 1924 à 1927, nous verrons dans quelle mesure Langevin traita de la nouvelle mécanique quantique en train de se constituer. A cette époque, en France, de Broglie avait soutenu sa thèse sur l'onde de matière et Langevin la connaissait puisqu'il en avait été le rapporteur. Nous verrons comment il traita la théorie de de Broglie dans son cours et nous examinerons son attitude envers la nouvelle théorie.

Józef Hurwic
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La théorie des quanticules de Kasimir Fajans

K. Fajans (1887-1975), l'un des éminents physicochimistes de notre siècle, est connu surtout comme auteur de la loi des déplacements radioactifs. Cependant, il ne faut pas oublier ses recherches importantes, thermochimiques et réfractométriques, sur la structure des molécules et des cristaux. En 1943, il introduisit la notion de quanticule pour désigner un certain ensemble d'électrons. D'après sa théorie, une molécule représente un ensemble de quanticules et de noyaux atomiques (nus ou avec les couches électroniques internes) interagissant électrostatiquement.

La formule quanticulaire de la molécule la plus simple, H_2, est : $H^+(e^-)_2H^+$. La quanticule di-électronique $(e^-)_2$ neutralise la répulsion électrostatique entre les deux noyaux H+. On trouve le même type de liaison dans la molécule Li_2:$Li^+(e^-)_2Li^+$ où $Li^+=Li^{3+}ls^2$. Il existe aussi des quanticules : $(e^-)_4$, $(e^-)_6$, $(e^-)_8$, $(e^-)_{10}$. Fajans attribue à la molécule HF la formule $H^+(e^-)_8F^{7+}$. Pareillement, les molécules H_2O et NH_3 possèdent une quanticule liante octa-électronique : $(2H^+,O^{6+})$ $(e^-)_8$ et $(3H^+,N^{5+})$ $(e^-)_8$. Citons encore les formules quanticulaires de quelques composés organiques : méthane CH_4, $4H^-C^{4+}$ où $H^-=H^+ls^2$; éthane C_2H_6, $3H^-C^{4+}(e^-)_2C^{4+}3H^-$; éthylène C_2H_4, $2H^-C^{4+}(e^-)_4C^{4+}3H^-$; éthylène C_2H_2, $H^+C^{4+}(e^-)_{10}C^{4+}H^+$.

La polarisation mutuelle des ions permet d'expliquer les propriétés stéréochimiques sans faire appel à l'hybridation.

La théorie des quanticules explique convenablement la différence importante entre certaines propriétés thermodynamiques de la molécule F_2 et celles des molécules X_2 où X=Cl, Br, I. Suivant la théorie de Fajans, la structure des molécules X_2 doit être décrite par la formule $X^+(e^-)_2X^+$, tandis que la molécule F_2 doit avoir une quanticule liante déca-électronique F^{5+} $(e^-)_{10}F^{5+}$ comme les molécules O_2 et N_2.

La théorie quanticulaire de la liaison chimique, bien que correcte et cohérente, n'a été que très rarement utilisée par les chimistes. Cela provient du fait qu'elle est d'une vingtaine d'années en retard par rapport à la mécanique quantique déjà bien enracinée en chimie.

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Spatial Quantization and the Discovery of the Bohr Magneton

Though the view that every paramagnetic substance has a definite magnetic molecular moment is old established among physicists, the conception that the atomic magnetic moment is a multiple of a "magneton" was originally introduced empirically by P. Weiss in 1911. The assumption immediately forced itself on physicists that Weiss'magneton was probably connected with the elementary quantum of action h.

In 1913 Bohr proposed the theory on the constitution of atoms and moleculars, which involved the assumption of the universal constancy of the angular momentum of the electrons. Using Bohr's assumption, the magnetic moment occurs not as an arbitrary quantity but as only certain discrete value. However only on the basis of the assumption, the value for the magneton was not obtained.

From 1913 to 1914, the value for the magneton due to a rotating electron on the Bohr theory was derived by Bohr himself, Chalmers and Allen respectively. The magneton they had derived is essentially the same as the Bohr magneton Pauli introduced in 1920. They did not search the Bohr magneton, because they tried to interpret the magneton Weiss proposed. It is interesting that an accidental relationship between the value for the magnetic moment on the basis of the Bohr theory and the value for Weiss'magneton has an influence on the theory of magneton. They paid attention to the relation that the former was almost exactly five times as large as the latter. But in contrast Pauli approached the magneton in a different way. At the beginning of the report to the 86th meeting of German Scientists and Physicians in Bad Nauheim in 1920, Pauli declared that it had been a long time since it knew a discrepancy between the quantum theory of the magneton and the observation. He had a strong conviction concerning the existence of the magnetic moment calculated from the assumption of the angular momentum of the electrons, and distinguished it from the magneton Weiss introduced. Then he called it "the Bohr magneton" Pauli stated why the obtained number were not integral multiples of the Bohr magneton in substances. To answer this question he proceeded to take spatil quantization into consideration. Pauli was a pupil under Sommerfeld, and had learned the rule of spatial quantization by the studies of Sommerfeld, Epstein and Landé respectively. Until then the hypothesis in generally was used to the study of the quantum theory of spectra, but it seems to Pauli that the hypothesis of spatial quantization is rather a substantial phenomenon than a rule of calculation. From the point of view of spatial quantization, in the case of the gases(known to be paramagnetic)NO and O2, Pauli obtained one and two Bohr magnetons respectively. Thus Pauli demonstrated the existence of the Bohr magneton. I conclude that Pauli simply did not introduce the Bohr magneton, but discovered the existence of the Bohr magneton.

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Physique quantique et causalité selon Bohm - Analyse d'un cas d'accueil défavorable

La proposition que David Bohm a faite, au début des années cinquante, de réinterpréter la physique quantique en récupérant un type de causalité analogue à celui de la physique classique, ainsi que son activité et celle des scientifiques qui ont soutenu cette proposition, de même que l'accueil de ces propositions parmi les physiciens posent des questions intéressantes pour l'histoire et l'épistémologie des sciences. Parmi ces questions on peut relever les suivantes : Pourquoi ces travaux ont-ils reçu un accueil si défavorable? Dans ce cas précis, quels ont été les principaux critères utilisés par les scientifiques pour choisir entre des propositions rivales? Il existe des avis divers sur ces sujets, comme celui de Cushing et celui que nous apportons. Les réponses à ces interrogations peuvent aussi apporter des éclaircissements à tous ceux qui sont en train d'assister, aujourd'hui, au renouvellement de l'intérêt porté au programme bohmien. Tout d'abord nous nous sommes préoccupés d'une prémisse. L'activité de Bohm doit-elle être analysée en tant qu'exercice exclusif pour mettre en évidence la possibilité de l'existence d'interprétations autres que celle de la complémentarité? Ou bien s'agit-il d'un programme visant à substituer la complémentarité et à développer la physique théorique inscrite dans un autre cadre épistémologique, à savoir, un cadre où la causalité, la continuité et des images claires dans l'espace et le temps sont récupérées? Nous avons choisi la deuxième option pour bien saisir les particularités de ces événements.

A la suite de l'analyse de l'article original de Bohm, où nous avons constaté l'équivalence empirique entre le modèle proposé et la physique quantique non-relativiste, nous avons fait une étude détaillée de l'accueil qu'il a reçu. Sur ce sujet le compte rendu fait par Jammer en 1974 -où il a remarqué des réactions de de Broglie, Vigier, Halpern, Epstein, Keller, Takabayasi, Schatzman, Freistadt, Fock, Rosenfeld et von Weisäcker- constitue déjà un point de départ. Nous avons tenu compte des nouvelles recherches comme celle sur la correspondance entre Einstein, Bohm et de Broglie (Paty, 1993) et trouvé de nouvelles traces de cet accueil, par exemple, chez Pauli. Nous avons en particulier pris en compte le rôle des années brésiliennes dans la carrière académique de Bohm. On sait que, persécuté par le Maccarthysme, il est resté à Sao Paulo entre la fin de 1951 et le début de 1955, période sans doute la plus importante pour l'étude de l'accueil réservé à son travail. Nous avons trouvé des traces des débats avec Feynman, Rabi, Rosenfeld, Beck, Bunge, Schönberg, Medina, Meyer, Anderson, Kerst, Mosshisky et Leite Lopes, outre des renseignements supplémentaires concernant les travaux en collaboration avec Vigier, Schiller, Tiomno et Schützer. Par ailleurs, la majorité des physiciens qui ont analysé et débattu la proposition des variables cachées, a refusé cette proposition, en s'appuyant sur des arguments variés. Elle a bénéficié, par contre, de soutiens plutôt épistémologiques et, de plus, de l'appui scientifique et aussi épistémologique très significatif de de Broglie, de J-P Vigier et de ses collaborateurs. Il faut arriver à la conclusion que des physiciens très importants ont analysé cette proposition, malgré le refus et le scepticisme ambiants. Il se dégage ainsi des preuves pour écarter l'argument de Cushing selon lequel l'interprétation causale a été refusée parce que les physiciens ne l'ont pas étudiée. En troisième lieu nous avons étudié l'activité de Bohm et de ses collaborateurs au cours des années cinquante : la prise de conscience des défis qui résultaient autant de la logique interne du programme adopté que des critiques reçues, les essais faits, les échecs et les réussites, en les comparant aux développements de la physique théorique pendant la même période. On peut rassembler, d'une part, les défis strictement scientifiques -obtenir une justification conceptuelle du modèle original, en obtenir une généralisation relativiste et traiter des champs et des particules- et d'autre part une tâche plutôt philosophique : fonder le choix d'une description causale, autrement dit, déterministe, en disant qu'elle était plus fondamentale qu'une description probabiliste. Nous voulons maintenant ne retenir qu'une conclusion. Les tenants de ce programme n'ont pas obtenu de résultats capables de distinguer, d'un point de vue empirique, l'interprétation causale de n'importe quel développement de la physique théorique.

Il nous semble que ce dernier résultat peut être placé à la base de la conclusion de cette communication. Revenons au point de départ. Pourquoi cet accueil défavorable? Il faut rappeler qu'il y a presque un consensus parmi les philosophes et les historiens des sciences : de nouveaux programmes et théories doivent faire des prévisions nouvelles et distinctes par rapport aux théories déjà établies. De plus, si on fait une analyse de ce programme selon les critères lakatosiens on aboutit à le considérer comme un programme dans la phase dégénérative. Une conclusion sans doute s'impose : les raisons les plus fortes qui expliquent un accueil défavorable ont été strictement scientifiques : absence de résultats nouveaux, capables d'attirer l'attention de l'ensemble de la communauté des physiciens et d'obtenir l'adhésion d'une partie significative d'entre eux.

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Einstein's Speech at the Imperial University of Kyoto - A New Interpretation of the Passages of it Concerning Michelson's Experiment

The only source of this Einstein's impromptu speech (Dec. 14, 1922) is a Japanese text written by Jun Ishiwara (1881-1947) (Ishiwara, 1923). The new translations based on a new interpretation of it are below. The former translations were made by Ogawa (1979) and Y.A. Ono (1982).

1. Einstein's knowledge of Michelson's experiment

- Ogowa's translation① "I had not carried out the experiment yet to obtain any definite result". (Ogawa, p.79)
- Ono's translation① "I did not put this experiment to the test". (Ono, p.46)
- Itagaki's translation① "I did not yet know enough this experiment".

2. Michelson's experiment and the motion of the earth in the ether

- Ogawa's translation② "when I had these thoughts in my mind, still as a student, I got acquainted with the unaccountable result of the Michelson experiment, and then realized intuitively that..." (Ogawa, p.79)
- Ono's translation② "While I was thinking of this problem in my student years, I came to know the strange result of Michelson's experiment. Soon I came to the conclusion that our idea..." (Ono, p.46)
- Itagaki's translation② "But when, still as a student I had these thoughts in my mind, if I had known the strange result of this Michelson's experiment and I had acknowledged it as a fact, I probably would have reached to know it intuitively as our mistake to think about the motion of the earth against the ether".

<u>Sources</u>

- Ishiwara : Aruberuto Ainsutain (Albert Einstein), "Ikani site watashiwa soutaisei riron a tsukuttaka" (How did I create the theory of relativity?), trans.by Jun Ishiwara, The Kaizo, vol.5, no.2 (Feb., 1923), pp.1-7.
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Einstein in Brazil : The Communication to the Brazilian Academy of Sciences on the Constitution of Light

In our communication we will discuss the context and the repercussion in the local scientific community of Einstein's trip to Brazil, in May 1925. We will present also several information, documents and photos concerning Einstein's visit to Rio de Janeiro. Einstein's trip has occurred in the twenties when he made travels to several countries of the world. He was first invited by Buenos Aires University for giving some lectures in Argentina. Einstein left Hamburg in March 5, 1925 and reached Buenos Aires in March 24. One month later, in his return to Europe, he stayed a week in Montevideo and another week in Rio de Janeiro. He made, in Rio de Janeiro, two conferences about Special and General Relativity Theory. He visited also many scientific institutions and tourist places. Einstein was received by President Arthur Bernardes and had receptions organized by Judaic and German communities. In a reception in the Brazilian Academy of Sciences, instead of a simple speech to the scientific institution and as "the best way to honouring it", Einstein preferred to make a short communication about the reality of light quanta. After Einstein's departure, it arose a dispute between some professors and scientists on the validity or not of the relativistic theories; this controversy reached also the press. Einstein's visit had an expressive influence in the activities of a small group of intellectuals and academics in their effort for establishing the "pure" scientific research in the country.

We rediscovered recently, in Rio de Janeiro, the original manuscript of the communication about the light theory presented by Einstein, in May 7, 1925. This paper, entitled *Bemerkungen zu der gegenwärtigen Lage der Theorie des Lichtes* (Remarks on the present situation of the light theory), was published in the Revista da Academia Brasileira de Ciências, in 1926, in a Portuguese version, but it is rarely quoted in the Einstein's biographies. The manuscript was given to Getulio das Neves, head of the Reception Commission. After the death of Getulio das Neves, it was preserved by his grandson Jorge Getulio Veiga. In his communication, Einstein made a direct yet generic comparison between corpuscular theory of light and the theory proposed by Bohr, Kramers and Slater (BKS theory), in 1924. In BKS theory the conservation of energy and linear momentum had only a statistical character, an idea not accepted by Einstein. He made also a general description of the device constructed by Bothe and Geiger for testing the statistical correlation between diffused radiation and the emission of electrons. In his brief communication, Einstein did not made detailed criticisms to the BKS theory; he limited himself to expose the general problem and the two main viewpoints about the constitution of light. He expressed too his hope that the experimental measurements could decide soon the validity of one of the alternative theories. At this time, he had some information about the preliminary results of Bothe and Geiger's experiments, but the definite results were published only in the middle of 1925, after his return to Europe.

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Mario Schönberg at the Free University of Brussels - 1948/53

This paper contains researches on Mario Schönberg (1916-1990), eminent Brazilian theoretical physicist. The object is to analyse his stay, as researcher and professor, with the nuclear physics group, at the Free University at Brussels (ULB). This research is based on interviews, made during the first months of 1997, with scientists contemporary of Schönberg's : I. Prigogine, Nobel Prize in Chemistry, 1977; M. Huybrechts, who was assistant to Schönberg at the ULB; M. Demeur, theoretical physicist, collaborator with Schönberg at Brussels, J. Reigner, professor at the ULB and ex-student of Schönberg; C. Dilworth, experimental physicist and collaborator of Schönberg, who was married to the Italian physicist G. Occhialini and J. Meyer, Brazilian physicist who was working in Paris in this period. I also studied administrative documents pertaining to Schönberg's activities, that I obtained in the archives of the ULB and scientific papers he produced (Nuovo Cimento, Physical Review, ...).besides some documents of the Schönbergs personal archives.

Schönberg arrived at Brussels at the end of 1948, at Occhialini's invitation, to lead seminars on theoretical physics and collaborate in several papers on the interpretation of experimental data from the nuclear physics group led by Max Cosyns. In 1950 he is made associate professor at the University, and maintained this position up to 1953, giving courses on elementary particles in high energies. During all this period he participated actively at the theoretical seminars with, among others, I. Prigogine and Genyau, while maintaining his scientific production with the experimental group.

At the same period, starting from the foundation of the World Peace Council (1948), Mario Schönberg travelled often to Paris to take part in the meetings of the Council and lead scientific seminars at the Institut Henri Poincaré. Also, according to the Council's archives obtained in Paris, Schönberg was a member of the Brazilian delegation to the International Congress for Peace in 49 (Paris) and 50 (Warsaw) and at the World Assembly for Peace in 1952 (Helsinki).

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Le concept d'événement dans les trois articles d'Einstein de 1905 et le problème de la synchronisation des horloges (Poincaré et Einstein)

1) Les événements indépendants dans la cinématique nouvelle.

Introduction historique : présence des événements indépendants au centre des articles sur les quanta de lumière (mars 1905), sur le mouvement brownien (mai 1905) et sur la théorie de la relativité (juin 1905). L'histoire des sciences est envisagée comme un outil de recherche pour la physique.

Formulation de la cinématique einsteinienne au moyen du concept 'd'événements dépendants et nécessairement indépendants' : la promenade aléatoire de la particule brownienne est le premier exemple historique de description d'une trajectoire en termes de suites d'événements. L'histoire suggère ainsi d'explorer la richesse de la cinématique nouvelle en prenant en considération non seulement les intervalles d'événements de type temporel (Minkowski) mais aussi les intervalles d'événements de type spatiaux (Schrödinger).

2) Les événements dépendants et la synchronisation des horloges dans la théorie de la relativité restreinte sans éther.

Poincaré pose dès 1900 la question du réglage des horloges dans le cadre de son étude sur le principe de réaction dans la théorie de Lorentz. Cette conception se retrouve dans la théorie de la relativité (avec éther) de Poincaré ('Mécanique nouvelle') de 1905. Einstein fonde la cinématique nouvelle de 1905 sur d'autres conventions pour synchroniser ses horloges dans chaque système d'inertie. Le concept d'événement joue un rôle déterminant dans la relation einsteinienne de synchronisation et la démonstration de ses propriétés (réflexivité et transitivité).

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The α-Particle Scattering and Instruments

The α-particle scattering was one of the main research topics in nuclear physics before 1932. The Rutherford atom model was proposed as a result of the experiment, and his discovery of artificial transmutation of element was connected with the phenomena of anomalous α-particle scattering. In order to explain these phenomena, Rutherford proposed his satellite model of nucleus, which was finally replaced by the new quantum mechanics of collision processes. Besides, the emergence of three important scientific instruments made the research possible : the scintillation counter, the cloud chamber, and the electrical counter. In the first stage, the scintillation counter was the main instrument to investigate the α-particle scattering. And then, the cloud chamber emerged as a powerful instrument in the research of nuclear physics. The electrical method was finally combined with the cloud chamber method, and the new experimental techniques led to a new ear in nuclear physics.

This paper will survey the development of theories and instruments in the experiment of α-particle scattering.

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The Social-historical Construction of π-meson in the 50th Anniversary of its Discovery

This is a story about the process which led Lattes, Occhialini, Powell and the Bristol University group to discover the π-meson in cosmic rays in 1947. It refers a theoretical prevision of this elementary particle and how the II World War scenario propitiated the meeting of these physicists. In particular, Lattes's central role was emphasized. Applying the actor-network approach in order to avoid the traditional division between scientific and social facts, the basic elements of scientific production - such as lab, colleagues, controversies, allies etc, - and their ties are discussed. It points out that, besides the anterior experience in cosmic rays, intuition, ambition, competition and hard work, the success originated from technical improvements of Ilford plates, the borax addition and the Pic du Midi and Chacaltaya exposure. This study exemplifies that historical-sociological knowledge might help to understand the complexity of the making of science.

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The "Radioactive Triangle" Manchester, Berlin, Vienna : Cooperation and Competition in the Early History of Radioactivity

In the early history of radioactive research, and especially in the decade before the outbreak of the First World War, there were four main centers of this field : Paris, Manchester, Vienna and Berlin. The investigation of these centres seems to show, that very close scientific relationships existed between the groups in Manchester, Vienna and Berlin, with a lively exchange of people, ideas and instruments, a so-called "radioactive triangle", which is not only a good example of the close international network of contemporary radiologists, but also shows a scientific differentiation against the Paris' group of Madame Curie and its more chemically orientated approach. In this sense this differentiation was part of the diversification of the field, which lead on the one hand to nuclear chemistry and on the other to nuclear physics.

This development will be demonstrated in the paper by discussing the works which were undertaken in Manchester, Vienna and Berlin and drawing out the close interaction, which existed between these three centres. To name but a few examples : for more than five years the young Hans Geiger worked under Rutherford in Manchester; George Hevesy, Kasimir Fajans or Rudolf Paneth were also research fellows at Rutherford's laboratory and imported the essence of his research to the continent; and in the other direction, the young James Chadwick came in 1912 from Manchester to Berlin's PTR completing his scientific education under Geiger. But the exchange between the centres was not restricted to people - for instance Rutherford obtained a powerful radioactive source from the Vienna Radium Institute, which was essential for his successful research, Rutherford and Geiger developed new methods for counting particles in close corporation, Rutherford and Meyer were the leading activists in organizing radium conferences and last but not least the scientific correspondence shows, that between the scientists in Manchester, Vienna and Berlin a very dense exchange of ideas took place about research programs, methods and instrumentation in general.

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The Frascati Research Center Forty Years after its Beginning : History and Balance

The Frascati Research Center was started in 1956 with the goal of jump-starting Italian research on high energy physics with the construction of an electron-synchrotron. It was the first large-scale Italian scientific enterprise. In the following years, the technical requirements of the synchrotron led to research in other fields, and, furthermore, a new field, plasma physics, better known as controlled nuclear fusion, was set in motion. Since then, many changes have taken place at the Frascati laboratory. Today, the site is occupied by five different laboratories, belonging to three different state agencies, totalling more than 1000 persons, with various interactions among them and the various Italian universities.

Aside from a few brief absences, the author has participated in the development of the Frascati Research Center since its inception. The scope of his presentation is to analyse these 40 years of scientific history in the light of the interactions between science and technology, between state agencies and universities, between Italy and other nations.

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Des observations astronomiques vieilles de deux siècles toujours d'actualité - un exemple relatif à Neptune

Lorsque Joseph-Jérôme Le François de Lalande (1732-1807) publie son catalogue de 50000 étoiles dans son *Histoire céleste*, l'An IX (1801), il ne se doute pas que deux siècles plus tard certaines des données qui y sont contenues feront encore parler d'elles. Les observations ont été effectuées principalement par Lepaute d'Agelet (1751-1788), avant son départ avec la malheureuse expédition de La Pérouse (1741-1788), et par son neveu Michel Jean-Jérôme Le François de Lalande (1732-1807), les travaux de compilation et de calculs étant pour la plupart effectués par l'épouse de ce dernier, née Marie-Jeanne Amélie Harlay (1768- ?).

La publication de cette compilation d'observations menées à un grand quart-de-cercle du constructeur anglais Bird (1709-1776) a, selon Lalande, plusieurs objets : poursuivre la tâche entreprise par ses prédécesseurs, compléter des catalogues antérieurs présentant des lacunes, apporter des données de comparaison pour la détermination des mouvements propres des étoiles, faciliter l'étude des étoiles variables et la découverte des comètes, contribuer ainsi à l'étude de l'environnement du système solaire par cet inventaire du ciel.

Outre l'intérêt que présente ce catalogue d'étoiles étendu jusqu'à la magnitude 11, il se révélera, en 1847, contenir une première puis une deuxième observation de la planète Neptune, découverte le 23 septembre 1846 à Berlin par Galle (1812-1910) et d'Arrest (1822-1875) à moins de 1° de la position annoncée, dès le 31 août précédent par Le Verrier (1811-1877) à différents astronomes européens.

Aux Etats-Unis et en Allemagne, Neptune sera repérée, dans le catalogue de Lalande, à la date du 10 mai 1795; puis, grâce à des manuscrits conservés à l'Observatoire de Paris, l'observation du 8 mai sera ajoutée. Ces deux observations seront immédiatement étudiées de plusieurs côtés et insérées dans les théories du Système solaire. Un bilan en est dressé qui se termine -provisoirement- par leur étude au Jet Propulsion Laboratory, en 1993, dans le cadre des éphémérides établies pour la navigation spatiale.

Lalande avait écrit dans la préface de son *Histoire céleste* : "Les nouvelles planètes qui existent peut-être, sont un objet également important de notre nouveau travail. M. Herschel en a découvert une par hasard, en 1781; et lorsqu'on en découvrira quelque autre, on la trouvera dans nos cinquante mille étoiles, et l'on aura tout de suite de quoi établir la durée de sa révolution ; ...". Les Lalande, oncle, neveu, nièce n'imaginaient certainement pas quelle étude serait encore faite, à la fin du 20e siècle, des observations trouvées dans leurs registres de la fin du 18e siècle.

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Modern Astronomy in India : Science in the Service of the State

Modern astronomy came to India in tow with the Europeans. The earliest recorded use of telescope barely 40 years after Galileo's to observe a transit of Mercury was atypical. More characteristic of the 17th and early 18th century was the sporadic use of telescope for geographical purpose by the Jesuits and by the European traders. Thanks to the 1761 and 1769 transits of Venus, viewed as an extension of the Anglo-French rivalry, astronomy received much support and new instrumentation. (A pendulum clock by John Shelton, identical to the ones used by Captain James Cook and in the determination of the Mason-Dixon time is still in use at Kodaikanal Observatory in South India.)

Astronomy was institutionalized in 1790 by the setting up of an observatory in Madras by the (English) East India Company, with a view to providing a reference meridian for the survey of the treacherous Coromandel coast. In 1800, as soon as South India fell to the British, there was started what later came to be known as the Great Trigonometrical Survey of India (GTS). Till 1830 there was hardly any distinction in the activities of the Observatory and the GTS. In 1843, the Observatory brought out a catalogue of 10000 southern Stars (revised for the UK Admirality in 1901). After this, the Observatory became largely irrelevant. What prevented its closure was the local British pride which stood up to the arrogance of the metropolis.

For reason of state, practical astronomy received all the favours while pure astronomy emerged as a poor cousin. Survey work was considered an essential part of military duty, while military officers were not permitted to be wasted on civilian pure astronomy. The value of the two streams can be seen from the price placed on them. In 1801 the ratio of survey superintendent's salary to the astronomer's was 1.46. Seven decades later it jumped to 3.21. A total of 15 surveyors were drawing more than the astronomer, three of them being FRS.

The attitude towards pure astronomy is best brought out by the Surveyor General's (Sir George Everest's) 1834 rejoinder on the loan of surveying instruments for making an astronomical observation : "The discoveries which the late astronomer of Bombay is likely to make in science would hardly repay the inconvenience occasioned by retarding the operations of the Great Trigonometrical Survey..."

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Sir Harold Jeffreys - Pioneer of Modern Planetology

The present time is the epoch of the unification of the physics of the Earth with planetology. In fact geophysics gives the answer to many problems of the origin and evolution of bodies of the solar system. It is noteworthy that Jeffreys was ahead of his time in thinking and working in such a framework.

Noticing in his work the importance of studying other planets as well as the Earth as fundamental to knowledge of the others he stands at the source of planetology. In 1937 in a paper on "The density distributions in the Inner Planets" he attempted to use the data available to test geophysical hypotheses about the variation of materials in the interior of the Earth. Moreover on the basis of tables for the density of the Earth he constructed the first model of the interior of Venus. From this he concluded that in Venus as in the Earth mantle and core differ in composition. In this work he also gave models of Mars and Mercury.

Jeffreys also did pioneering work in constructing models of the giant planets. Before his 1923 paper on "the Constitution of Four Great Planets" it was supposed that they consisted of hot gas. He tried to determine the surface temperature and came to the conclusion that probably for these bodies the ordinary equations of state of a liquid and rigid body applied.

The interest of Jeffreys in planetary cosmogony shows that he strikingly realized that it was not possible to construct a realistic evolutionary model of the Earth and planets without solving the problem of their origin. On the other hand, investigations in planetology gave indications to this fundamental problem of nature.

In his first cosmogonic investigations Jeffreys tried to construct theory of the formation of a planetary system on the lines of then ruling ideas of Jeans. In the late 40's and early 50's he gave a general analytical survey of this problem considering side by side tidal and catastrophic theories with the hypotheses put forward during the war by von Weizsacker in Germany and O. Yu. Schmidt in Russia, playing an important part in modern cosmogony.

He also put the question of the relation between the cosmogonic scenario and the structure and original state of the planets. He believed the original state have been hot, or effectively hot, and that is to-day the opinion of most investigators.

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Les points de vue de Schuster-Schwarzschild et de Milne-Eddington sur la structure physique des atmosphères stellaires

Durant la décennie 1930-1940, deux types de modèles d'atmosphères stellaires se partageaient les faveurs des astrophysiciens. D'un côté, se basant sur les résultats fondamentaux de A. Schuster (1905) et de K. Schwarzschild (1906), les premiers auteurs d'atmosphères solaire ou stellaires utilisaient un modèle simplifié où la "base" de l'atmosphère, appelée *photosphère* , émettait un spectre continu. Surmontée d'une couche peu dense, cette photosphère voyait son rayonnement diffusé à des longueurs d'onde spécifiques des atomes, des molécules et des ions qui composaient cette mince *couche renversante,* donnant ainsi à l'ensemble du spectre l'aspect d'un continuum strié de raies d'absorption. D'autre part, les chercheurs anglais, au premier rang desquels il faut citer A.S. Eddington et E.A. Milne, soutenaient que les phénomènes d'interaction matière-énergie qui donnaient lieu tant au spectre continu en émission qu'aux lacunes discrètes qui formaient le spectre d'absorption se passaient dans la totalité de l'atmosphère. Un certain d'hypothèses destinées à rendre possible le traitement mathématique du problème leur avait permis de proposer des solutions de type analytique. Les prédictions des deux types de modèles ne tardèrent pas à être soumises à une confrontation avec les observations qui fournissaient, au fil des années, des informations quantitatives de plus en plus précises.

Dans cette communication, l'auteur examine les différents développements auxquels ces modèles ont donné lieu entre 1930 et 1945, sous l'impulsion d'astrophysiciens des écoles hollandaise, (M.Minnaert, A Pannekoek), allemande (A. Unsöld), ou américaine (H.N. Russell, D.H. Menzel), constatant d'ailleurs au passage que, dès 1931, W.H. McCrea (Edimbourg) avait, en se basant sur les travaux d'Eddington, montré l'efficacité des méthodes purement numériques pour traiter ces questions. La plupart des précis d'astrophysique de l'époque (et jusque vers les années 1970) ont exposé l'un ou l'autre de ces points de vue. Les auteurs qui exposent les deux aspects (et certaines de leurs nombreuses variantes) se bornent généralement à les présenter en parallèle. Nous tentons de montrer comment peuvent se réconcilier les deux aspects, notamment à partir d'une relation attribuée à M. Minnaert, mais énoncée en fait par A. Unsöld en 1938. A ce propos, nous attirons l'attention sur le rôle important joué par le Hollandais A. Pannekoek, dont le rôle est encore généralement peu reconnu.

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Romanian Celestial Mechanics in the 19th Century

The Romanian research in celestial mechanics during the 19th century is intimately linked to the names of three scientists : Spiru Haret, Constantin Gogu and Nicolae Coculescu. All three obtained the doctoral degree in Paris.

In his thesis (1878), Spiru Haret tackled the solar system stability via the n-body problem. His result completed the contributions of Lagrange, Laplace, and Poisson in this field, pointing out the existence of secular terms in the third order approximation. Such a surprising result was commented and highly appreciated by both Félix Tisserand and Henri Poincaré himself.

His scientific merits have been internationally recognized : a crater on the Moon's invisible face bears today his name.

Constantin Gogu focused his thesis (1882) on the long periodic inequalities in the Moon's circumterrestrial motion. His arguments and results confirmed Delaunay's calculations, pointing out at the same time Stockwell's errors. Gogu became one of the most renowned European specialists in the lunar motion theory.

Lastly, the thesis of Nicolae Coculescu (1895) gave a description of the interrelated motions in the three-body problem for a particular case. His results as to the perturbing function and the expressions of its higher order terms were quoted by Henri Poincaré.

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Milutin Milankovic - Serbian Scientist and Thinker - Father of Astronomical Paleoclimate Theory

One of the greatest minds in the Serbian Science of twentieth century, Milutin Milankovic (1879-1958), was a versatile personality, of an ample culture, visionary spirit and with a rich instinct in his research. After finishing his studies of civil engineering in Vienna and obtaining the PhD in the same branch he was, as an engineer - expert in the field of reinforced-concrete constructions, the author of numerous patents and projects. His inventions were registered in the technical literature in German as very successful solutions in the civil engineering.

Nevertheless, his affection towards exact sciences, especially astronomy, mathematics and physics, resulted in his election as professor of rational mechanics, theoretical physics and celestial mechanics at the Belgrade University. From that moment till the end of his life his creating takes place under the auspices of this establishment and Serbian Royal Academy. His main work *Kanon der Erdbestrahlung und seine Anwendung auf das Problem der Eiszeiten* (1941) has had a real renaissance during the last two decades and his astronomical theory of paleoclimate is still one of the most up-to-date subjects of modern research. The mere fact of more than 300 references after his death dealing with his papers indicates that Milankovic's scientific contribution is only now alive and conquering the world's scientific thought.

He was a close collaborator to many of his famous contemporaries, geophysicists, such as Köpen, Brükner, Zeuner, Wegener and others.

The name of Milutin Milankovic bears one minor planet (1605), a crater on the Moon and one on the Mars, as tributes to his excellent scientific contribution to the fundaments of interdisciplinary research.

Milankovic's scope is rather large. In addition to the main works where the results of his scientific research were presented, he wrote several books from history of science, as well as the large work *Uspomene, dozivljaji i saznanja,* ("Memories, Experiences, Recollections"), in which he introduced himself, not only as an excellent historian of science and chronicler of his time, but also as a thinker stating a number of philosophical problems and endeavouring to offer corresponding syntheses of his thinking, syntheses of the contemporaneous knowledges, a picture of the world and a future vision. That part of his opus, much less known, also has a corresponding philosophical importance. He specially considered the science-classification problem, the nature of the gnoseological process, the properties of the scientific method and creating in science which are of permanent actuality.

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Constraint and Creativity in the Growth of Science in Independent India : A Study of Cosmic Ray Physics at TIFR, Bombay

The Tata Institute of Fundamental Research (TIFR) at Mumbai (Bombay) in India is among the leading institutions pursuing scientific research in India, with an established international reputation. TIFR was started in 1945 by H.J. Bhabha, a cosmic ray physicist known for his investigation of 'Bhabha scattering' and for the theory of cascade showers which he developed along with W.H. Heitler in the 1930s.

The time of the independence of India from colonial rule in 1947 marks the second wave of development of modern science in this century in India, characterized by large scale building of scientific institutions. The period is unique to scientific development in India since there was widespread recognition of the importance of science in national development at the policy level and the infusion of nationalist spirit among scientists. Bhabha's approach to institution building in this context was original and the paper first discusses the impact of his policies on the growth and success of TIFR.

The paper then analyses the growth of the experimental program in Cosmic Rays at TIFR in terms of two major determining relations :

a) the relation of the scientists to their colleagues in other parts of the world characterized by collaboration and competition and

b) the relation of the Institute to its geographic and social setting from which it drew its people and its resources and to which it was expected to contribute.

The approach adopted in the paper combines internal and external history of science with a detailed description of the major early experiments carried out at the institute. The research strategies by which scientists at TIFR aimed at maximizing the return, in terms of professional 'credit', by choosing appropriate 'investments' in research programs is discussed. In charting a path between the two constraining relations mentioned above and in meeting the twin goals of 'excellence' and 'relevance', the original research program in cosmic rays proliferated into several daughter research programs. This is a remarkable example of how a frontier area in fundamental science has so many wide-ranging spin-offs. Today many of the major areas in fundamental science find a place at TIFR and these have grown in a fairly organic manner.

The information and analyses presented in the paper will be based on documents available at the Institute and interviews with some of the scientists who contributed to the early development of the Institute.

Section 8.3 :
Earth Sciences in the Contemporary Period (since 1800)

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Synthetical Tendencies in Geological Sciences

Synthetical tendencies, striving for obtaining the generalized knowledge about geological objects and about the Earth in the whole were always in Geological Sciences and were the most important regulative idea of scientists' cognitive activities. The most various forms of synthesis were :

1. The generalizing works (e.g. by A. Verner, D. Cietton, Ch. Liel, E. Zuss, E. Og) connected with the introduction of new methods, ideas and principles into geological cognition that testify the expansion of object field of reality;
2. the appearance of borderline sciences;
3. the attempts of synthesis of geological knowledge round the great geological problems, such as the geological form of matter's movement, energetics of geological processes, the role of biosphere in geological processes, etc.

In the middle of the 20th century there appeared quite a new cognitive problem, connected with a search of logicomethodological ways of synthesis of geological knowledge and creation of general geological theory and general science about the Earth (theoretical geology) correspondingly.

A number of modern geodynamic concepts has already been pretending to be the general geological theory. However one must not consider the included in them synthesis complete, because they have different factual basis. That's why these concepts are considered not to be alternative but supplementary of each other. In this case the possible way of synthesis is the choice of one of the concepts as the basis synthesizing hypotheses with subsequent use of reductionism principle, that is logically possible for one-level concepts. The hypothesis of the Earth's expansion and pulsation, fixism and plate tectonic is called as synthezing one. However most geologists believe that general geological theory can be built on the basis of plate tectonic. Which as V.E. Khain notes, has already assimilated many elements of other tectonical hypotheses -contractioning, pulsationing and rotationing.

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Development of Geological Sciences in India in the 18-19th Centuries

The development of geological sciences in India in the 18th-19th centuries can be studied in three stages: 1701-1800, 1801-1851 and 1851-1900. The first stage marked the decline of the Mughal rule while the English were trying for a foothold in India through the East India Company and battles between them and the French were on both in Europe and in India. Most of the accounts of this period describe the social, economic and cultural aspects of the country. Michael Edward, Surendra Gopal, Keladi Basavaraja, particularly the last dealt with meteorology and astronomy, and geography of India. Description of the gold and diamond mines could be found in Mettee's work, while Buchanan, who undertook a journey from Madras to Malabar, uses rock terminology in correct sense. There was continuous activity in geological field in the second stage as pioneers like Laidlaw, Voysey, Capt. F. Dangerfield and Capt. Herbert who were attached to the Surveyor General's Department and the Great Trigonometrical Survey, contributed to geological sciences though they were not professional geologists. Voysey could as well be called the Father of Indian Geology, but he died of fever while travelling from Nagpur to Calcutta in 1824. D.H. Williams was appointed as Geological Surveyor in 1846 particularly to investigate the coal formations of India. He did not live long and was succeeded by McClelland. But it was the third stage which really brought about the development of geological sciences in India, because Thomas Oldham took over as Geological Surveyor to the East India Company in 1850. His long service of 25 years saw the birth and development of the geological Survey of India. Lord Canning took an enlightened interest in Geology and helped in placing the Geological Survey in proper footing. With Headquarters in Calcutta, a Museum and Library, suitable publications were started to let the public know the results of the researches of the Department. Geological education in modern sense also was initiated during this period as three universities were established in Bombay, Calcutta and Madras, with geology as one of the faculties. In a way, modern geological sciences were put on strong foundations in India by these pioneers and the growth could be seen in the fact that today there is hardly any University which does not teach geology!

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Research Projects Undertaken by Carlos De Gimbernat from 1817 to 1820 in the Vesuvius

This article deals with the various research projects undertaken, under the protection of the Bavarian Government, by the Spanish geologist Carlos de Gimbernat from 1817 to 1820 in the Vesuvius.

His knowledge in geology and his training in medicine make him specially suited for developing a novel line of research; Geology would be in the service of Medicine. His works combine the study of geological formations rich in sulphurated gases with the application of their results on ill people. All the technical aspects related with the adequate machinery's design and installation were also considered.

The forementioned applications are just a part of the hydric resources, exploitation which allows for a peculiar heatsource - aquifer geothermic system. Thus, Gimbernat develops 'Thermography' with the help of the fumaroles vapours. This method consists in dyeing, helped by the thermal waters' acids, any kind of fabrics with varied coloring.

Our scientist does not put aside the traditional aspects that the volcanic phenomena poses in his epoch; his writings are full of notes regarding subjects related to both the Vesuvius' volcanic materials and structure. The data concerns volatile, pyroclastic, and lavic elements; as well as subvolcanic materials, volcanic structures and constructions, the volcano's substratum, old sediments, submarine eruptions and recent eruptions. Out of all these are worth noting the experiments on the effects that the degree of cooling and pressure exert on the lava's crystallisation, where he achieved the growth of both pyroxenes and amphiboles. This discovery was worth his admission in London's Geological Society.

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History of the Earthquake Prediction Problem Development

History of the development of ideas and notions of the earthquake prediction possibility can be divided in three periods.

1. From antiquity to the middle of the XIX century. The direct observation of nature phenomena without their analysis. The origin of the idea of possibility to predict earthquakes.

2. From the middle of the XIX century to the beginning of the XX century. The origin of scientific problems to predict earthquakes in connection with general standard of knowledge and development of instrumental seismology.

3. From the beginning of the XX century to the 80s. Searching period of forecasting studies. 90s the period of analysis accumulated knowledge. The transition to theoretical-physical methodology. Peculiarities of the correlation between theoretical and experimental works at different stages of the development of the earthquake prediction problem. It has been shown, that among the causes of uneven development of this problem there is a chance factor, as catastrophical earthquake. The historical-scientific analysis of the development of earthquake forerunners. The tendencies of their further development.

The necessity of the study of social-economical and psychological aspects of this problem in the seismoactive zones is shown.

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The New Concept of the Mechanism of the Radonic Anomalies Formation before the Earthquake

The experimental studies to find out the earthquake forerunner and the theoretical ones of the source physics conducted for the last 30 years in many seismoactive zones didn't solve the problem of earthquake prediction but attached new impulse to the seismology development and earthquake source imaging.

It was noticed that the results of geochemical and geophysical field studies influence on the earthquake source view.

In 1965 R.A. Agamirzoyev and T.A. Zolotovitskaya (Geology Institute of Azerbaijan Academy of Sciences) when radiometrical observing in Shemakha earthquakes sources zones, at first, had found out the gamma-field level alterations in epicentre zone in connection with Mykhtekyan earthquake had taken place in 1965 and they explained this phenomenon as a result of alteration of radon content in a soil air in above-source earthquakes zone.

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Los fundamentos cientificos de la red sismológica mexicana. La participacion de las comunidades cientificas en la construcción de la red, 1888-1910

En este trabajo se parte de una perspectiva en la cual se concibe a la construcción de la red sismológica mexicana como un proceso complejo donde está implicito un sistema de instituciones y de diferentes actores tanto nacionales como internacionales. Para ello se tendrán en consideración por una parte, el papel que desempeñó en México un grupo de geólogos e ingenieros en este proceso, los cuales contaban ya con un cúmulo de conocimientos tanto instrumentales como teóricos que sirvieron de base para el desarrollo de los estudios sismológicos, que eran reconocidos internamente y además tenian una importante presencia a nivel gubernamental; de otra, las avances a nivel internacional de los estudios sismológicos que coincidieron con las necesidades prácticas y aún politicas de algunos países que por su alta sismicidad debian encontrar instrumentos que les permitieran medir estos fenómenos y en ultimo término predecirlos para finalmente lograr controlarlos.

En la década de 1880, los estudios sismológicos se intensifican en varios paises. Se modifican sus métodos y se sustituyen en gran medida las hipótesis y teorias por una orientación experimental, con el auxilio de instrumentos cada vez más precisos; se buscaba incrementar su medición a través de observaciones sistemáticas, metódicas y continuas y al mismo tiempo avanzar en la comprensión de los fenómenos sismicos y por ende en la sismologia como disciplina cientifica. México, no escapa a esta tendencia y por el contrario la comunidad de geólogos organizada de tiempo atrás en la Sociedad Cientifica Antonio Alzate impulsa desde entonces los estudios sismológicos como una nueva rama de la geologia.

Sin embargo, el impulso más importante que recibirá la geologia y posteriormente los estudios sismológicos se da a partir del establecimiento del Instituto Geológico Nacional en 1889, dependiente de la Secretaria de Fomento. El cual desde entonces y con la subvención del gobierno se convertió en el vocero de la comunidad geológica tanto internamente como a nivel internacional. Desde entonces, los contactos con el exterio se multiplican y México participa en 1903 en la Segunda Conferencia de la Asociación Sismológica, de tal modo que al año siguiente se establece una estación provisional contigua al Observatorio Astronómico Nacional. Para 1907 es propuesto como asociado y en 1908 se dio el decreto para el establecimiento del Servicio Sismológico Nacional dependiente del Instituto Geológico, que se encargaria de promover, instalar y dar mantenimiento a la red, cuyas primeras estaciones se inaugurarian en septiembre de 1910. Con ello nos proponemos comparar y contrapuntear las visiones y avances de las comunidades geológicas a nivel nacional e internacional que llevaron a la constitución de la red.

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Las bases de la instrumentacion sismica mexicana : Análisis de la integracion de la red sismológica mecanica 1889-1910

Aunque las primeras estaciones de la red sismológica mexicana fueron establecidas (en las ciudades de México Oaxaca y Mérida) a finales de 1910, en los meses de Septiembre y Octubre como parte de los festejos de los 100 años de independencia, los antecedentes cientificos y politicos que modelaron el proyecto de la red se remontan al siglo anterior y trascienden el ámbito nacional. La comunidad cientifica mexicana y en particular la "Sociedad Cientifica Antonio Alzate" estaba bien enterada y participaba en las discusiones y proyectos internacionales constituidos alrededor de los sismos esto sobre todo porque México formaba parte del Geosynclinal Circumpacifico en donde se habian producido el 41.08 de los sismos conocidos a nivel internacional y de ellos el 10.04 se llevaron a cabo en México. Los problemas de sismicidad en el país explican la continua preocupación de cientificos y aficionados para registrar de la manera más precisa posible los sismos que ocurren, sin embargo, esta situación poco sistemática comienza a ser insuficiente a la luz de las propuestas de las sociedades cientificas internacionales por conocer de manera sistemática la ubicación, intensidad y consecuencias de los sismos de tal suerte que empiezan a comprarse y desarrollarse instrumentos más precisos que son colocados como apéndices en las estaciones meteorológicas y manejados por los encargados de estas. A principios del Siglo XX las reuniones de la Asociación Nacional Sismológica a las que asistia México (primero como invitado especial y después como miembro de la sociedad) y en especial las celebradas en 1903 y 1904 a las que asistió el director del Instituto Geológico como comisionado mexicano legitimaron cientificamente el proyecto de constitución de una red sismológica nacional cuyos instrumentos arrojaran datos precisos de los sismos ocurridos en México y paises vecinos. A la legitimidad cientifica habia que sumar una serie de cuestiones que orientaron los caminos que seguiria la red : Estas se podrian traducir en algunas de las siguientes preguntas : Cuáles son los eventos sociales politicos e incluso económicos que apoyaron la construcción de un red tan costosa en equipos y mantenimiento, Cómo se consiguió el financiamiento, Quién o quienes lo otorgaron, Con que criterios se eligieron ciertos equipos sobre otros, Qué criterios se siguieron para ubicar las estaciones. Estas son algunas de las preguntas que guiarian el trabajo que pretendemos presentar en el Congreso.

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Napoles y los origenes de la paleontologia

El testimonio fósil es un hecho que los naturalistas tienen que explicar al interpretar la naturaleza con independencia del momento histórico. Así, el ideario creacionista, bajo la tutela bíblica, argumenta el Diluvio Universal como causa de los numerosos restos malacológicos presentes en las regiones montañosas. Sin embargo, la hipótesis de los cambios oragráficos fue un valor en alza que alejó el acto de la Creación del origen de los fósiles. En el renacimiento italiano Leonardo da Vinci, por ejemplo, predica contra los diluvistas, desarrollando su teoría de las corrientes fluviales como agente causante de estos depósitos. Paulatinamente el debate integra nuevos conceptos y en la centuria del seiscientos el interrogante es dilucidar la condición orgánica o pétrea de las muestras. ¿Se tratan de productos minerales generados por la naturaleza?, o ¿son restos de animales desconocidos que habitan remotos territorios? En nuestro trabajo exponemos las aportaciones realizadas durante el siglo XVII por los naturalistas napolitanos - Ferrante Imperato, Fabio Colonna, Agostino Scilla - para resolver esta cuestión. Obras que se difundieron por el continente participando con notoriedad en el debate paleontológico. Un ideario que precedió al campeón de la paleontología que fue Nicolás Sténon, teniendo amplia resonancia en siglos venideros. Naturalistas como John Ray, Benoit de Maillet, Charles Lyell, o el filósofo Leibniz, polemizan sobre estos trabajos señalando la ruptura que tales aportaciones suponen frente a la norma establecida, defensora de la capacidad genésica de la naturaleza y opuesta a la condición orgánica de los fósiles.

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Continu/Discontinu en Paléontologie évolutive au XIXe siècle

Les paléontologistes ont été, dès le début du XIXe siècle, attirés par le transformisme de Lamarck, continué par celui de Darwin. Leur argument principal a été l'affirmation de la continuité de la vie au cours des ères géologiques.

La problématique qu'ils ont utilisée dans leurs travaux a été celle des *espèces fossiles analogues*, inaugurée par le fondateur du transformisme. Ce sont les paléontologistes *invertébristes* qui, en exploitant le nouveau champ d'études qui leur avait été ouvert par Lamarck, ont tout naturellement été les premiers à soutenir la vision continuiste de la vie. Mais les *paléobotanistes* les ont suivis assez rapidement dans cette voie, et enfin les paléontologistes *vertébristes.*

Leur cible première a été le catastrophisme de Cuvier, fondé sur la discontinuité présentée par les séries fossiles. L'emploi des *fossiles analogues* a ruiné rapidement la doctrine de Cuvier dans l'esprit des paléontologistes.

Cependant, les paléontologistes transformistes se sont heurtés constamment au problème soulevé par Cuvier, et ils l'ont signalé honnêtement, en particulier celui des discontinuités majeures que les lignées présentaient à leur point d'origine. Ils ont essayé de gérer le conflit de ces deux concepts : continu et discontinu dans l'histoire de la Vie, sans réussir à le résoudre. Darwin lui-même s'y est heurté, qui a essayé de le contourner en mettant l'accent sur les lacunes de la géologie. On voit que ce problème, réactivé par Stephen J. Gould et Niles Eldredge sous le nom de "punctuated equilibria", est un problème récurrent en paléontologie évolutive, que les transformistes ont rencontré dès le début de leur discipline, c'est-à-dire depuis bientôt deux siècles.

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The Later Discoveries of Boucher de Perthes at Moulin Quignon and their Bearing on the Moulin Quignon Jaw Controversy

When Jacques Boucher de Perthes reported stone tools in the Pleistocene gravels of northern France at Abbeville, he was ignored by the French scientific establishment. Later, he was vindicated by English scientists, who came to the Abbeville region and confirmed his discoveries. But some of these same English scientists later turned on him when he reported the discovery of the famous Moulin Quignon jaw. Eventually the discovery was proved a hoax. That is how the standard history goes. But when considered in detail, the hoax theory does not emerge with total clarity and certainty. Boucher de Perthes felt the English scientists who opposed him were influenced by political and religions pressures at home. In order to restore his reputation and establish the authenticity of the Moulin Quignon jaw, Boucher de Perthes conducted several additional excavations at Moulin Quignon, which yielded hundreds of human bones and teeth. But by this time, important minds had been made up, and no attention was paid to the later discoveries, which tended to authenticate the Moulin Quignon jaw. This lack of attention persists in many histories of archeology. This paper details the later discoveries of Boucher de Perthes at Moulin Quignon, addresses possible reasons for their scanty presence in (or complete omission from) many histories of the Moulin Quignon affair, and offers some suggestions about the role the historian of archeology might play in relation to the active work of that science.

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The Development of Organic Geochemics in Azerbaijan

The geochemical study of organic matter, in Azerbaijan had been conducted in 30s in the Azerbaijan Scientific-Research Institute on oil-production by V.E. Levinson, A.T. Kochmarev and others who had investigated bituminosity of rocks of Middle Pliocene in Azerbaijan peninsula. During 1948-1949 the study of organic carbon and nitrogen in Cenozoic rocks were carried out by D.V. Jabrev. The bottom sediments of the Caspian Sea were investigated, too. Since 1950 the geological researches in the most large scales have been systematically conducting in the Geology Institute of Azerbaijan Academy of Sciences (by Sh.F. Mekhtiyev and others) and the Azerbaijan Scientific Research Institute on oil-production (by N.I. Khatskevich and others). In purpose on recognizing of the patterns of its distribution on the Mesozoic section complex analyses were conducted. The geo-geochemical effects on the organic matter has been studied, oil-gas-generating rocks have been determined, the prospects of oil-gas-bearing have been defined for the region. For the last time isotopic-geochemical investigations of carogene of oil-gas-mother rocks and oil field have been conducting to solve the questions on their genesis.

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Perlite Study History

Perlite history started at the thirties of XXth century. In Azerbaijan a great contribution to the study of perlites was made by the scientists M.A. Kashkai, A.I. Mamedov, P.P. Budnikov, A.I. Polinkovski, V.P. Petrov, Kh.I. Makhmudov and others. At present time perlite is in the focus in connection with possibility of bulged material application in different branches of national economy and industry. The problems of perlite formation, the peculiarities of their change, geographic situation and zonal structure of perlite deposits, and their physical-chemical and technological features application as well. Since 1968 the author has been studying systematically the /young/late Pliocene volcanic rocks /perlites/ in central part of Lesser Caucasus.

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Development Tendencies of Research of Azerbaijan Natural Surroundings Radioactivity

Four stages of research of natural surroundings radioactivity have been distinguished :

Ist stage (20-50ies of the XXth century). Gathering information about radioactivity of natural objects, mainly, about waters and mountain rocks. Studies are conducted from time to time.

IInd stage (50-60ies). Tasks of radioactivity research were stipulated both by political and economic conjuncture. They are as follows : search and exploration of nuclear fields, compilation of the catalogue of revealed anomalies. Study of radiometry possibilities for the purposes of direct searches of hydrocarbonaceous deposits. This stage is characterized by gathering a great experimental (field) material.

IIIrd stage (60-80ies). Change of search methodology. Analysis of results of field study, followed by theoretical researches to study genesis of anomalies, tied with deep-seated processes in the Earth's crust, tectonic disturbances, earthquakes, oil deposits.

IVth stage (80-90ies). Chernobyl catastrophe has caused the origination of new scientific direction-radioecology. The aggravation of environmental situation in consequence of human activity (in Azerbaijan-oil exploration and production) became the subject of radioecology research efforts.

In this connection development of radiometry enters a new qualitative level.

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Cold War and Global Warming : How the US Navy Got an Answer (Without Asking the Question)

At the end of the 1950s scientists began to take seriously the prospect that carbon dioxide emissions from industry may cause future global warming. Previously the consensus view had been that an increase in the amount of the gas in the atmosphere could not affect infrared radiation enough to matter, and that anyway extra carbon dioxide would be rapidly taken up by the oceans. These poorly based understandings persisted because there were very few resources for studying such an apparently unpromising question. The research during the 1950s that created a new picture was facilitated by resources which were provided only accidentally by other fields of study, mostly fields with short-term practical concerns--not least, Cold War military applications. The US Navy, Atomic Energy Commission, and other agencies supported work on infrared spectroscopy, oceanography, meteorology, etc. for national security purposes, scarcely suspecting that data, techniques, and even salaries and research stations would be co-opted into research that addressed the "greenhouse effect" of carbon dioxide. The paper will sketch scientific developments due to G. Callendar, G. Plass, H. Suess, R. Revelle and C. Keeling, noting their sources of material support and drawing conclusions on how Cold War imperatives affected the direction of research.

Section 8.4 :

Chemistry and Pharmacy in the Contemporary Period (since 1800)

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On the History of Naming Elements after Individuals

The practice of naming elements after scientists started in 1946 when the name *curium* was proposed for element 96 in honour of Pierre and Marie Curie. The background of this practice and the further use of it is discussed in the paper.

Definite names for the transfermium elements may be ratified at the 39th IUPAC General Assembly to be held in Geneva in August 1997. In the paper it is suggested that then, in honour of Henry Moseley, rational, systematic names based on the atomic numbers should be approved.

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Chemiker unter sich über sich und andere

Im vorigen Jahrhundert waren die Wissenschafter in einem regen Briefwechsel miteinander. In den Briefen schrieben sie nicht nur über Wissenschaft, aber ihre neueren oder eben unter Bearbeitung stehenden Forschungsresultaten und Plänen, sondern oft über sich selbst, über ihr privates Leben, noch mehr über ihre Kollegen nicht immer mit kollegialer Freundschaft. Der Vortrag zitiert eben solche Teile aus dem Briefwechsel von Berzelius, Wöhler, Liebig und Kolbe.

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Considérations épistémologiques de l'évolution des techniques et des instruments du laboratoire chimique

Dans cette communication, nous présenterons certaines réflexions de caractère épistémologique relatives aux instruments et techniques impliqués dans le développement de la chimie. Nous débuterons par les précurseurs "alchimistes" et leur philosophie de la nature. Aujourd'hui nous connaissons la complexité des appareillages tels que les chromatographes gazeux, les spectrographes, etc. qui permettent d'isoler, de purifier ou d'identifier les dérivés chimiques. Ces équipements et instruments modernes de laboratoire, assistés de puissants ordinateurs, nous offrent une haute résolution et permettent de décrire "l'infiniment petit", mais, grâce, ou à cause, de cette évolution les objectifs ont-ils changé fondamentalement? Quels sont les gains? Quelles sont les pertes?

Nous tenterons, donc, de présenter brièvement :

1) différentes caractéristiques essentielles (sûrement connues de beaucoup d'entre vous) des alchimistes. Nous les rappellerons car elles constituent une partie de la transmission orale et écrite des techniques de laboratoire. Certains instruments, ainsi que leur mode de représentation, seront aussi cités.

2) différents aspects du changement épistémique dans le laboratoire chimique.

3) un bilan épistémologique sur les tendances de la chimie moderne.

4) différentes considérations sur les instruments et les techniques chimiques actuelles.

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Role of Liebig in the Development of Russian Chemistry and his Education

1. Our analysis of the influence of Liebig's teaching ideas on the development of chemical education in the Russian High Schools and on the creation of the Russian chemical association shows that the most important founders of this Russian chemical association were the best of Liebig's pupils from Russia Alexander A. Voskresenskij and Nikolaj N. Zinin.

2. These Liebig's pupils founded in the 1840-1870s the most important Russian school of chemistry in the 19th century. From this school came such well-known chemists as Dmitrij I. Mendeleev, discoverer of the Periodical Law of chemical elements, Alexander M. Butlerov, the author of the original theory of the structure of organic compounds, Alexander P. Borodin, organic chemist and composer; the physical chemist Nikolaj N. Beketov and others.

3. All of these and other pupils of Liebig from Russia (Liebig's "scientific children") and chemists from their schools (Liebig "scientific grandsons") were the principal members of the chemical society in Russia in the 19th century. These spread Liebig's scientific ideas and made his laboratory method of teaching chemistry compulsory for the chemistry students in the various High Schools in Russia. Liebig's system of chemical education in Russia stimulated the forming of the Russian system of chemical education and the discoveries of important chemical ideas from the 1840s-1870s, especially the Periodical Law of chemical elements (Mendeleev, from 1869) on and theory of chemical "constitution" (structure) of organic compounds (Butlerov, from 1861) on.

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Les cahiers de notes des cours de chimie de Liebig (1845) et de Bunsen (1874/75) ainsi que du cours de physique expérimentale de Kirchhoff (1874/75) conservés dans une famille de pharmaciens d'Echternach (G.-D. de Luxembourg)

La famille Kuffer d'Echternach (Grand-Duché de Luxembourg) conserve dans ses archives familiales plusieurs cahiers avec les notes de cours prises à l'université par Joseph Namur et plus tard par son fils Léon Namur.

Joseph Namur (1823-1892) a fréquenté le cours de chimie de Justus Liebig à Giessen pendant l'année 1845. Son cahier de notes du cours de Liebig (chimie minérale et chimie organique) porte sur 93 leçons, dont la première a eu lieu le 18 avril 1845, Le texte est bien structuré et comprend un grand nombre de croquis illustrant les expériences du cours. Il existe de par le monde un certain nombre de cahiers de notes des cours de Liebig, mais ils sont assez rares pour justifier la présentation d'un cahier inédit et peu connu.

Nommé pharmacien en 1846, Joseph Namur s'est réorienté vers l'enseignement secondaire en 1848. Il a enseigné à l'école moyenne et industrielle ainsi qu'à l'école agricole d'Echternach. Il a été membre du conseil communal de la ville et du conseil d'administration de la Compagnie des chemins de fer Prince-Henri.

Son fils Léon Namur (1854-1893) a fait ses études à Heidelberg. Dans les archives familiales sont notamment conservées les notes du cours de chimie expérimentale de Bunsen (semestre d'hiver 1874/75) et du cours de physique expérimentale de Kirchhoff (semestre d'hiver 1874/75). Léon Namur a eu sa nomination de pharmacien en 1875, il a repris dès 1876 la pharmacie familiale à Echternach.

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Discovery of the Periodic Law. Mendeleev and Other Researchers on the Classification of Elements during 1860s

J. W. van Spronsen, a Dutch historian of chemistry, has written that there were six independent discoverers of the periodic law : A.E.B. de Chancourtois, J.A.R. Newlands, W. Odling, G.D. Hinrichs, J.L. Meyer and D.I. Mendeleev. They all classified almost all the elements already discovered based on Cannizzaro's atomic weights and some relationship between groups of elements. However one can distinguish four levels among these researchers' work :

Level I : Hinrichs. His level was that of researchers of 1850s who tried to discover numerical regularity among atomic weights of similar elements.

Level II : Odling. He barely understood the meaning of table obtained. He only thought that he had a convenient arrangement of elements.

Level III : Chancourtois and Newlands. They clearly understood the significance of the table obtained and speculated the content of the law. They used a substitute of atomic weight (Chancourtois' *characteristic numbers* and Newlands' *numbers of* elements) so that they could overcome the apparent regularity of atomic weights of elements in a same group. But they insisted on the seeming regularity obtained : Chancourtois' period of 16 for his helix and Newlands' Law of Octaves.

Level IV : Mendeleev. He understood the complex character of the law obtained by compiling the periodic table of elements. He approached the system of elements from various points of view and extracted the multiple relationship among properties of elements.

Meyer was in a little bit complicated situation. He went through level I to level IV. When he modified the table in 1868, he reached the level II. When he saw Mendeleev's first periodic table in 1869, he clearly understood its implication and compiled his periodic table to reach almost Mendeleev's level. As for the meaning of the table, Meyer was very cautious at this point. Only after the appearance of Mendeleev's long paper on the periodic system in German in 1871, Meyer became assured of the correctness of the law and tried to apply it fully to systematize inorganic chemistry.

Why could Mendeleev go so far among researchers on classification of the chemical elements? The reasons come from social as well as scientific context. The scientific reason originates from his superior chemical concept for the state of chemistry in 1860s. I think his concept of element played a crucial role for the discovery.

For consideration of social reasons, one should pay attention to the fact that six researchers except Meyer and Odling mentioned above were all worked on a kind of periphery of chemical academic world. Mendeleev worked in a peripheral country, Russia. His research was not in the mainstream of the chemical research of his day however Mendeleev was the founding and influential member of the newly established Russian Chemical Society. Mendeleev had a large audience and supporters. This favourable social as well as scientific context in which he worked during 1860s, played the most essential part in his discovery of the periodic law.

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Towards a Scientific Biography of Peter Griess

The evaluation of Griess' scientific work is for the first and the last time undertaken by Emil Fischer and by Heinrich Caro in the commemorative articles in the Berichte of 1891. Emil Fischer's contribution consists of an ordered summary of the publications of Griess, mainly about three important fields of investigation which the author distinguishes : the diazo-compounds, the orientation problem of benzene substitution products, and the compounds resulting from amino-benzoic acid and cyanogen, cyanamid and ureum. Heinrich Caro summarizes the work of Griess on azodyes, again starting from his published papers, but freely using information to his disposal through a lifelong personal acquaintance and an intensive correspondence.

As the modern historian is not so much interested in the scientific achievements of a person and much more in the intentions and motivations of the scientist and in the social and economic context of his research and in the contingencies of place and time determining the final result, the treatment by Emil Fischer cannot excite historical taste. Caro's contribution asks for a critical reassessment because the author is also one of the important actors in the story he tells. The availability of an important part of the correspondence between Caro and Griess and of other archival material makes such a reassessment possible.

In the case of Griess we will try to find his research program (or programs) and his research methodology, giving a rationale for his efforts and their results. In the first place we find long term, if not lifelong dedication to certain problems. Specified researches within a problem field were undertaken by different inducements and determined by particular restrictions. Sometimes a publication about the results of other chemists induced Griess to follow up his own research in a new direction. Many times his choices are determined by very practical considerations : for instance the chemicals available on the shelves in the laboratory of Griess, or because of direct encouragement from colleagues or from industry. Outside the field of azodyes, research conclusions have to be reached by careful analysis of published papers, because other entrances are not available.

Such an approach leads to a result very different from Emil Fischers report. In some respects his report will be corrected and his evaluation criticized. We hope it will contribute to a convincing scientific biography.

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Peter Griess and Kekulé's Benzene Theory

Richard Meyer (1882), Karl Graebe (1920) and E. Hjelt (1916) gave, in their first evaluations of the history of the problem of the orientation of substituted groups in benzene, Körner and Griess equal respect. Later historians gave the honor exclusively to Körner, which makes a re-evaluation meaningful.

As there are with respect to Griess' role in this question no other sources available than his published papers we have to restrict ourselves to an analysis of these papers. The immediate astonishing conclusion is that Griess still in 1872 made statements inconsistent with Kekulé's benzene theory and did not publish anything on the orientation problem until August 1874. Then, in a paper in the *Berichte*, he stated that the nitrobenzoic acid which is formed next to 'common' nitrobenzoic acid, is ortho-nitrobenzoic acid, and that three newly discovered dinitrobenzoic acids (with meltingpoints 177 °C, 179 °C, and 202 °C respectively), resulting from nitration of ortho-nitrobenzoic acid, are 1,2,5, 1,2,4, and 1,2,6 dinitrobenzoic acid. The only justification he gives is "that it will not be necessary to show that these formulae are consistent with the formation and transformations of these acids", i.e. they are *sufficient* to explain the reactions. Although a reconstruction of the probable way by which Griess came to these formulae is very well possible, we direct the attention only to the concluding remarks of the article.

Griess states : "in particular the conversion of these acids into the isomeric phenylene-diamines is an irrefutable proof of the recently.... proposed structural formulae of the last compounds". The proof consists of showing that phenylene-diamine (m.p. 63 °C) can be prepared from common dinitrobenzoic acid and from two of the new acids, the isomer (m.p. 140 °C) only from the third one, and the isomer (m.p. 99 °C) from two isomeric diamido benzoic acids *not* genetically related to the four known dinitrobenzoic acids. This leads, within Kekulé's benzene theory, to the recognition of the three phenylene-diamines as the meta-, para- and ortho-compound respectively. This reasoning takes only one page of the five page publication and makes it, if not historically equally important, then intellectually comparable with Körner's simultaneous achievement.

Why did Griess enter the discussion around the orientation problem only in 1874, and in such an utterly inobtrusive way in comparison with Körner's extensive theoretical explanation (the latter's article was summarized in a 67 page "abstract" in the Jahresberichte of 1875)? The answers to these questions lead to a discussion of the role of constitution theories in Griess' work and a re-evaluation of the traditional success story of the acceptance of Kekulé's benzene theory.

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Protagonists of High Pressure Synthesis, Fritz Haber, Friedrich Bergius, Carl Bosch

In the introducing part of the paper it is tried to fix the limits of high pressure synthesis, high pressure chemistry and high temperature chemistry and to define the proper area of high pressure synthesis.

Starting with the first work in this area at the beginning of the twentieth century the research of Fritz Haber and his team to develop the synthesis of ammonia is described in more detail. It is stated that his laboratory is the starting point for industrial high pressure synthesis.

Friedrich Bergius stayed at this laboratory for some time. His work about the synthesis of mineral oil is presented as one of the most well known process using high pressure and high temperatures.

The transfer of Habers pilot plant work and the trials, also in production scale, of Bergius are mentioned. This leads to the merits of Bosch and his coworkers at the BASF to overcome the difficulties in building up plants to produce ammonia and synthetic oil but also for other products like methanol.

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History of Quantum Chemistry in USSR

Quantum Chemistry (QC) is a foundation of the contemporary Chemistry and of the Molecular Spectroscopy too. In the QC development an important role belongs to Soviet scientists. In 1930 the member of the Soviet Academy of Sciences V.A. Fock (1898-1974) worked out many methods for properties calculation of Systems with many electrons. Fock created in Leningrad the first in USSR QC scientific school.

In 1931 professor Y.K. Syrkin (1894-1974) organized at L.Y. Karpov Physicochemical Institute (KI) a laboratory of the matter structure and the molecular spectroscopy. Syrkin became the head of the QC School in Moscow.

At KI worked the famous physicist G.B. Rumer (1901-1985), the author of an important for QC theorem. Later he was arrested and exiled to Siberia.

In 1934 at KI began his work the young German scientist H. Hellmann (1903-1938). He was the author of the first in the world monograph "Quantenchemie".

In this book Hellmann formulated his theorem which serves as a basis for the whole molecular dynamics. In 1938 Hellmann was arrested due to a false accusation on espionage and then shooted. In 1956 he was rehabilitated. The author was one of many Hellmann's disciples. He translated his book in Russian and continued to develop his ideas.

Syrkin and his nearest pupil M. E. Djatkina (1914-1972) were the authors of an original monograph "Chemical bonding and the structure of molecules" (1946) which became a textbook for many generations of physicochemists and was reedited in London. But this book is based on the Pauling's resonance theory, which was in USSR strongly criticized. The QC's development was stopped, whereas Syrkin, Djatkina and their followers were discharged.

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The Principal Stages of the Chemical Researches Formation in the Ukrainian National Academy of Sciences

There are analysed the principal stages of chemical science formation in the Ukrainian National Academy of Sciences at period of it's formation (twentieths years). It is possible to pick out two centres of development of chemical academic science in Ukraine - chemical laboratory and department of technical chemistry (Kiev), from which in future such chemical institutions as Institute of Inorganic Chemistry, Institute of Organic Chemistry, Institute of Colloid Chemistry and Chemistry of Water, Institute of Biocolloid Chemistry and others developed.

There is shown the role of academicians I.V. Vernadsky, V.A. Kistyakovsky, V.A. Plotnikov in management of the chemical laboratory. The electrochemical researches in this laboratory had a dominant role. Owing to these works V.A. Plotnikov considerably extended the concepts of the nonaqueous solutions chemistry and processes of complex formation in these solutions. V.A. Plotnikov generated Kiev's school of electrical chemists, that became the pride of Ukrainian science.

There is studied the activity of department of technical chemistry, generated in 1922 under the leadership of academician V.G. Shaposhnikov. Considerable attention at this department has been given to the questions of metallurgy development in Ukraine. The proceedings of V.G. Shaposhnikov on extraction of cellulose from linen and hempen scutch became classical, and his works devoted to the study of moisture content of flax as the test of it's standardization together with works in the field of azine and azone pigments yielded him the world publicity. For analyse of activity of this department there are used the articles of V.G.Shaposhnikov about organization of laboratory of chemical technology (1928) and Institute of Chemical Technology (1934).

The active participation in the work of scientific-research department of chemical technology, created on the base of chemical technology department, should point out the work of Prof. N.A. Tananaev in the field of methodology of analytical chemistry, that resulted afterwards to creation of one from leading scientific school in world on analytical chemistry - the school of his follower - academician A.K. Babko.

There is shown the dominant role of researches of academician A.K. Babko in the field of stepped complex formation, physical-chemical analyse of complex compounds in solution, theoretical basis of colorimetric and chemiluminescence methods of analyse.

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British Interest and the Industrial Chemical Research in India (1914-1945)

Britain's imperial interest and the development of Indian science are closely linked, as was evident among other disciplines, in industrial chemical research carried out in India between the two Great Wars. The Indian Munition Board organized European and Indian chemists during First World War for the furtherance of industrial chemicals in India; the relative backwardness in chemical industry compared to Germany forced Britain to open this front in a far colony. After the War, the British Government took some steps in industrialization including opening up Industry Departments under various Provincial Governments of British India. Industry Departments assumed the charge of industrial chemical research after the War and important researches were carried out during 'twenties and 'thirties. The industrialization venture was soon stopped for various political and economic reasons. Instead, industrial chemicals were allowed to be imported, the development of chemical industry in India became uncertain; the industrial chemists were also in the doldrums, their research lost importance. This state of affairs was continued till the advent of early multinational companies with their chemical and pharmaceutical products. Meanwhile, Second World War made England vulnerable, the story was again repeated. During 'forties Britain looked at Indian scientists with new imperial interest.

The early industrial (chemical) research in India and its dependence on Britain's imperial policy was fully elucidated and explained in the backdrop of social, political, economic and educational scenario of India in this period.

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The Delayed Development of Chemistry in Austria, Caused by Political Pressure

The study of organic chemistry, on a modern scientific basis began in Austria and the other parts of the Habsburg Empire after 1840, that is 20 to 30 years later than in comparable countries, such as Germany, France or Britain.

A reason for this delay will be presented in the paper and it will be shown that the political situation in the Habsburg Empire before the revolution of 1848 had a great influence on the slow development of chemistry.

Under the influence of the ideas of the enlightenment sciences began to develop in Austria towards the end of the 18th century. In this period Austrian chemists went to Britain and France to study modern developments. But the situation changed completely in 1792 under the rule of Francis I. Fearing revolutionary upheavals as in France, all independent thinking was suppressed. Freiherr von Stifft, who headed the Imperial Studies Commission and was one of the most influential advisers of the emperor and also his private physician, considered chemistry to be an economically important science with great practical value but he opposed any unnecessary theoretical speculations. Therefore all the chemists, who were appointed as professors at the universities of Prague and Vienna and at the polytechnical Institute of Vienna were mainly interested in practical questions and opposed to modern chemical theories.

Only after Liebig strongly criticized these professors and described chemistry in Ausria as being in a deplorable state in an article, published in the Annalen in 1838, the authorities began to recognize the necessity for changes at the chairs for chemistry at the universities and the polytechnical institutes. This gave two talented young chemists the chance to go to Gießen to study modern methods and ideas in Liebig's laboratory. One of these students of Liebig, Josef Redtenbacher, was appointed professor at Prague University in 1843 and another one, Anton Schrötter, professor at the Vienna Polytechnical Institute in 1846. When the educational system was reformed as result of the revolution of 1848, chemical departments, all headed by students of Redtenbacher, were established at all the universities. This was the beginning of modern chemistry in the Austrian Empire.

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Chemistry in the University of Coimbra in the Thirties of the Twentieth Century

Since its creation in Lisbon, in 1290, and its establishment in Coimbra, in 1308, the University of Coimbra has been the unique Higher Education School in Portugal, until the creation of the Polytechnics School of Lisbon and the Polytechnics Academy of Oporto, in 1837. In 1772, with the reform of Pombal, the teaching of chemistry was institutionalized there as a scientific and independent discipline "aiming the search for the specific properties of bodies, analyzing their principles, examining the elements of which they were composed and discovering the effects and relative properties that result from their mutual mixture and intimate application* ".

At the time of Lavoisier's chemical revolution, chemical research and important chemical applications to industry have been the subject of significant activity of the Chemical Laboratory of the University. In fact, the Chemical Laboratory has been in those years of great utility to the nation, great interest to the University and deserved credit and consideration over the world to the benefit of chemistry, medicine and all the different arts to which chemistry may help. But, during most of the nineteenth century such an activity became quite unsatisfactory in relation to the real needs of the country. The creation of the Chemical Laboratories in the Polytechnic Schools did not improve the situation, even when both of them were transformed in University Laboratories, as a part of the Faculties of Science in the Universities of Lisbon and Oporto created in 1911, having the same organization and statutes as the Chemical Laboratory of the University of Coimbra.

During the first decades of the XXth century, a period of strong political unrest following the implant of the republican system and the 1914-1918 world war, chemical activity in the Portuguese Universities had not significant links with industry; chemical research was meaningless, and the few Portuguese professors of chemistry seemed to be quite happy as being a store of foreign scientific research, feeling no necessity of any original scientific research of their own.

The development of the country, namely its industrial development, could not go ahead without drastic changes in the whole University educational system, through an adequate programme to be worked out for determining and putting into effect the best curricula in order to achieve the necessary advancement.

Such a Programme was carried out in the University Faculties of Sciences in the school year of 1929-30, leading to published legislation in June 1930. The Faculty structure defined by this Programme last for more than four decades pretending to meet the adequate attitudes and understanding of the social needs of the country.

It is our purpose, in this work, to analyse the main features of that Programme in the University of Coimbra, in chemistry training education.

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* Estatutos Pombalinos da Universidade, Liv.III, Pt.III, Tit.III, cp.IV.

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The Emergence of a Professional Identity : The Portuguese Society of Chemistry

The Sociedade Chimica Portuguesa (Portuguese Society of Chemistry) approved its statutes on the 28 December 1911, in a meeting which took place at the Laboratory of Mineral Chemistry of the Polytechnic School of Lisbon. In effect, a long time elapsed between the creation of its European counterparts and the foundation of this Portuguese institution.

This paper focuses on the leading role played by A.J. Ferreira da Silva, the first president of the Portuguese Society of Chemistry, as well as on the importance of the Revista Portuguesa de Chimica Pura e Aplicada (Portuguese Journal of Pure and Applied Chemistry) for the creation and promotion of that professional institution.

From its foundation the Society lived high moments by engaging in various activities of which we may single out the creation of the Physics Section, in 1916, and the ensuing emergence of the Sociedade Portuguesa de Química e Física (Portuguese Society of Chemistry and Physics), whose statutes were approved in 1926.

However, the biography of this institution also shows moments of stagnation and decline, as the result of the political fluctuations, which affected the country on various moments of its history, and of the emergence of cult figures, so peculiar to Portuguese science.

This paper also focuses on the role played by the scientific contributions of the various members of the Society, which were published in its journal, and on the part played by the Laboratório Chimico Municipal do Porto (Laboratory of Chemistry of Oporto) in the life of this institution. The Laboratory of Chemistry of Oporto was created by the City Council, in 1882, and aimed at developing Portuguese chemical research, which at the beginning of this century was giving its first steps towards the establishment of international contacts.

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The Industrial Connection of Science in France : The Société de Chimie Industrielle, 1917-1939

By the early twentieth century a powerful scientific system, in many cases intimately connected with industry and agriculture, had been created in France. As for chemistry, however, the absence of contact between science and industry was still considered to be a serious weakness. In fact, since the late nineteenth-century there had been a prevalent recognition of the need for a corporate body, promoting the collaboration between scientists and industrialists in chemistry. The German "model" with its large and powerful associations, meeting the professional needs of their members and defending their interests on both the national and international scene, seemed to reveal the defects of the French system.

However, nothing much happened before the First World War. The war, fostering utilitarian aims in science, brought French industrialists, scientists and politicians into rethinking and reorganizing the relationship science-industry. When the Société de Chimie Industrielle was founded in May 1917, the patriotic cause was put forward. Thus, the newly elected president of the SCI, Paul Kestner, stated : "The place occupied by chemistry in the organization of the national defence and the part it was supposed to play after the war in rebuilding the country" had induced industrialists and academics, chemists and engineers to create this association. The explicit aim was to participate in the reconstitution of the French economic power, the war having shown "the undeniable utility of chemistry". The growth of the new society was explosive : Only one year after the foundation membership had reached 2000, and the Société de Chimie Industrielle had by far surpassed its forerunner, the Société Chimique de Paris (founded in 1857).

The aim of this article is to reveal the circumstances that led to the creation of the SCI. What was the part this association was meant to play in the reconstitution of the French economic and scientific power? Who were the members, what were its activities and organizational structure? Did the SCI fulfil its intended role as a national professional organization, representing all the practitioners involved in industrial chemistry? In Britain, the Society of Chemical Industry had been founded as early as 1881, and the German equivalent, the Verein Deutscher Chemiker, was formed in 1887. What are the reasons for the deferred birth of the French counterpart, the Société de Chimie Industrielle?

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Defining Applied Chemistry in 19th Century Britain

In nineteenth century Britain, chemistry was generally adjudged the most commercially-relevant of the sciences. Indeed, it can be argued that an alleged relevance to industrial and other practicalities was the ground against which chemistry was delineated as an academic subject by university chemists in the mid-century. It was represented as a foundational "abstract" body of knowledge which could be unproblematically "applied". This was a dangerous strategy. It had a flimsy historical basis and the form of the intellectual and praxial relationship proved difficult to realize. Further, despite the academics' best efforts, many of the institutions where "pure" academic chemistry was created were forced by political and other pressures to establish courses and even departments where "applied" or "technical" chemistry was taught explicitly. This activity, particularly at Anderson's University, Glasgow (1869), Owens College Manchester (1879), and University College, London (1879), provides a useful focus for the argument, and the empirical background to the paper.

Its protagonists were compelled to address sharply, at conceptual and institutional levels, the forms of the trilateral relationship between "pure" and "applied" chemistry and the industrial practices these academic fields ostensibly served. These forms were to prove problematic. The difficulties of the courses and departments in question had their origins in the need to define stable, generic (and public) industrial knowledge in academic settings, sustain and resource departments, agree their institutional relationships with "pure" chemistry and supply industrial personnel with clear and immediate operational competencies. During the last quarter of the century most of the departments and courses of technical or applied chemistry languished and some failed entirely. The paper will also briefly contrast this with the situation in the electrical technologies.

The paper points to the contingent and emergent character of academic "applied science". In particular, redeeming the generic promises made on behalf of academic chemistry, whether pure or applied, was difficult. In the chemical sector, the creation of a working relationship between academy and industry drew hardly at all on the early models promulgated by supposedly visionary academics and was only to a limited extent a cognitive process. It involved, at the industrial level, new functionalities, personnel structures, and mediating mechanisms, and, at the academic level, new disciplinary forms.

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Chemical Decision Makers : A Profile of the Leadership of the Principal British Chemical Institutions in the First Half of the 20th Century

While the social history of British chemistry has been well studied for the nineteenth century, relatively little work has been done on the twentieth century. Yet chemistry has played a significant role: the First World War has sometimes been called 'The Chemists' War'. The chemical industry, latterly via petroleum has been one of the fundamental industries of the century, and, until after the Second World War, chemistry was in Britain the largest of science subjects both in terms of student numbers and the number of practitioners. The subject now faces a blurring of its boundaries and a softening of its core identity in a plurality of approaches in related subject areas. An understanding of the social history of these phenomena is important for a wider understanding of social and economic history, especially for such questions as the relationship between academia and industry which are of continuing concern.

Drawing on early results from a large prosopographical database being constructed at The Open University, this paper focuses on the leadership of the chemical profession as defined by participation on the Councils of major British chemical institutions. It will analyse the education and career paths of the chemical leadership with a view to understanding the backgrounds and contexts of individuals who defined themselves as chemists and took key decisions within the profession. The relationships between science, industry and government are complex. They will be illuminated by a detailed investigation of the profile of participants in them from the perspective of the chemical profession.

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Social, Economic and other Important Influences upon the Development of Science-based Industries in the London Area

In 1856, while working in his East London laboratory, the youthful W.H. Perkin discovered the first synthetic dyestuff. Against expert advice, he started a factory to exploit his discovery on a green-field site, to the west of London. Within six months, Perkin had overcome the numerous new technological problems involved, and was marketing industrial quantities of his brilliant new colour. E.C. Nicholson rapidly paralleled Perkin's achievements, and their former professor (A.W. Hofmann), confidentially predicted Britain's predominence in this exciting new industry. But it was not to be. During his 1906 visit to New York, Perkin lamented Britain's loss of the industry he had striven so hard to establish.

These extraordinary events can now be rationalised following detailed investigations by the author. Thus, Perkin and Nicholson launched their first new colours at a time of economic optimism and boom; whereas, the new colours launched in subsequent decades, were produced against increasing restriction from socially-inspired regulations, and against economics of increasing depression and gloom. These trends forced, cuts in research and development; costly relocations ever eastward away from central London; asset-stripping and eventual demise.

Similar results have now been found for the development of a number of other science-based London enterprises. These findings illustrate their educational value for evaluating the roles of social and economic factors in satisfactory marriages of science, technology and industry.

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Technological Change in the Spanish Electrolytic Chemical Industry. Solvay's Mercury Cell versus Siemens-Billiter's Diaphragm Cell

This paper deals with the history of Spanish electrolytic soda industry in the first third of the twentieth century. It tries to explain how competitiveness arose, and how Solvay, an important multinational chemical industry, established a new plant (1933-35) in its own factory with new policies concerning the raw materials, electricity purchase or production, and the technical education of the workers.

At the end of the nineteenth century, Spanish chemical industry was poorly developed. None of the three most important chemicals (sulfuric acid, alkalies and dyes) were produced in Spain, and they were imported from abroad. In the beginning of the twentieth century, the Spanish alkali industry was dependent of foreign chemical technology. The establishment of Solvay's ammonia soda process in Torrelavega (Santander), near the Basque Country (1904-1908) occurred at the same time of the birth of electrolytic soda industries through three different diaphragm cells. The only survivor was the model of the Griesheim-Elektron company (in the "Electroquímica de Flix", located in Flix, near the Ebro river in the South of Catalonia). Because of its cheaper, discontinuous process and its geographical situation near the Catalan and Valencian markets of the Mediterranean coast, it could maintain its competitiveness in relation to Solvay.

In the 1930s, the "Electroquímica de Flix" introduced the Siemens-Billiter cell, which worked in a continuous process. This cell transformed the old vertical diaphragm into the horizontal, and the company made a great amount of caustic soda, chlorine, and other important chemicals. At this moment, and probably fearing to lose the Spanish caustic soda and chlorine markets, Solvay introduced its own electrolytic process, which used a mercury cell. Thereafter, a technological competitiveness between the two companies was developed. This paper tries to explain the technological and social reasons of it.

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*La Farmacia española ante la industrialización del medicamento : el pulso por la supervivencia profesional**

El periodo que media entre las décadas centrales del siglo XIX y el primer tercio de éste constituye una de las épocas más conflictivas, desorientadoras y cambiantes por las que ha tenido que pasar la profesión farmacéutica española. El progreso científico contribuiría a una apertura del comercio farmaco-terapéutico en la que el boticario perdía su monopolio como preparador de medicamentos y como autoridad científica en esta materia. A mediados del siglo XIX la Farmacia, tal y como entonces se desarrollaba, comenzaba a ser una disciplina inútil, carente de utilidad práctica, quedando a merced de drogueros y fabricantes de productos químico-farmacéuticos, sus intermediarios y, a la vez, feroces competidores.

Sin embargo, los adelantos científicos que estuvieron a punto de causar la desaparición de la Farmacia, acabarían por posibilitar su reflote; una vez superada la etapa de furor por las especies químicas, la propia ciencia farmacodinámica volvería la mirada hacia las drogas naturales; la Química permitía el análisis de estas sustancias y la Farmacología trataba de justificar lo que antes únicamente se intuía: el mecanismo de acción de los medicamentos. Este galenismo de nuevo cuño, una vez adaptado a la exigencia tecnológica que suponían las nuevas formas farmacéuticas, se constituiría en tabla de salvación para la Farmacia y piedra angular de su reforma, al permitir el acceso al producto terapéutico industrial por excelencia : el específico.

Salvaguardado el monopolio de la especialidad farmacéutica, a través del reciclaje de las prácticas galénicas, se trataba de buscar nuevos campos de acción próximos a la Farmacia Galénica; y qué mejor elección que el control de las materias primas, la Química industrial. La implicación del boticario en este tipo de industria, en España, fue apoyada e impulsada por un núcleo de farmacéuticos de gran prestigio, entre los que podemos destacar a José Rodríguez Carracido, Obdulio Fernández o José Giral, conscientes de que el progreso industrial habría de ser el paso previo para el desarrollo y la modernización del país; su llamada no respondía al discurso corporativista clásico del colectivo farmacéutico español; lo importante era el despegue nacional, deseo que pasaba por la obligatoriedad de establecer un tejido industrial autóctono, donde los establecimientos químicos habrían de jugar un papel protagonista.

Para el farmacéutico español, la oportunidad de incorporarse a este mercado era el colofón a un largo camino, del que, finalmente, salía fortalecido. La conquista, al menos desde el punto de vista corporativo, ya se había logrado, la Farmacia se reencotraba consigo misma merced a la asimilación del elemento más consustancialmente contrario al espíritu del boticario decimonónico, la especialidad farmacéutica.

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El frío industrial y la esterilización por calor, factores de innovación tecnológica en el suministro de leche a la gran ciudad. El caso de Barcelona, 1850-1950

Durante la segunda mitad del siglo XIX se produjo un claro incremento del consumo de leche por parte de los habitantes de las grandes ciudades, a consecuencia, principalmente, del reconocimiento por la clase médica de sus virtudes alimenticias, dietéticas y aún terapéuticas. Este incremento se continuó durante la primera mitad del siglo XX, llegándose a la situación actual en la que, para España, se cifra el consumo medio por habitante y año en más de 120 litros.

La leche es, por su propia naturaleza, un producto muy fácilmente perecedero. A las pocas horas de haber sido ordeñada, las rápidas tranformaciones biológicas y químicas que sufre la hacen inservible para el consumo humano. Este rápido proceso de degradación imposibilitaba su transporte desde medianas o largas distancias en épocas en las que las técnicas de conservación de los alimentos aplicables al caso eran todavía muy elementales o inexistentes. Esto explica la presencia de los productores, es decir, las vacas de leche -ubicadas en vaquerías- dentro de la propia trama ciudadana, al lado mismo de los consumidores, en el mismísimo centro de consumo. Los problemas higiénicos y logísticos que implicaba la presencia de una cuantiosa cabaña vacuna (unas diez mil vacas en la Barcelona de los años 1940, para una población de poco más de un millón de habitantes) en el entramado ciudadano, llevaron a endurecer progresivamente las normativas legales, higiénicas y sanitarias, tanto municipales como estatales, obligando a los propietarios de vaquerías a cerrar sus establecimientos, o bien a trasladarlos fuera de los núcleos urbanos.

La necesidad de garantizar un suministro capaz de satisfacer la demanda existente y bien consolidada, obligó a adoptar, lenta pero progresivamente, los métodos de conservación por frío industrial y por calor en los procesos productivos. De este modo se hizo posible alejar de la ciudad los centros de producción, ubicándolos donde más convino por razones climáticas, de comunicaciones, etc,

En el trabajo se expone el proceso evolutivo seguido en la adopción de estos dos factores de innovación tecnológica -frío y calor- que se dió en Barcelona y su área de influencia, especialmente durante la primera mitad del siglo XX.

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How Many Routes to Cortisone? Scientific Resources and Corporate Strategy in Pharmaceutical Industry, 1949-1959

In April 1949, at a rheumatological meeting in New York, Philip S. Hench reported on the extraordinary anti-inflammatory power of a new drug produced by Merck. In a very short time Merck's product, cortisone, became a 'wonder drug' requested all over the world by millions of persons afflicted by a wide array of ailments. The pharmaceutical industry was literally shocked by the announcement, and all the available scientific resources were mobilized in an international race for the industrial production of the new drug, whose molecule was, chemically speaking, somewhat 'difficult (a hydroxyl at a particular carbon atom, the number 11 in the classical chemical structure). The lead was taken by Upjohn management that decided a crash research program trying seven routes to cortisone, at very different levels of definition in terms of research procedures: modification of the bile acid Merck process; cortisone syntheses from simple raw materials; chemical conversion of ergosterol; cortisone manufacture from jervine; cortisone manufacture from steroids with the aid of enzymes; 11-hydroxylation with the aid of micro-organisms; expedition in Africa in search of a perennial climber of the genus *Strophantus* (sec later). A great part of the present paper will follow in some details the most crowded routes chosen by Upjohn.

The route to cortisone via partial synthesis from a host of more or less available substances was explored by many research groups, and between 1951 and 1954 were reported syntheses from at least eight different substances, ranging from cholesterol to sarmentogenin. It is in this context of hectic research of new 'raw' materials as starting point for the cortisone synthesis that it is to be considered the quest for a 'lost' *Strophantus,* and other exotic plants, in Africa and in Mexico. In 1928 sarmetogenin had been indicated as the aglycone derived from the active constituent of the seed of *Strophantus sarmentosus,* and in the period here considered it was credited as a very promising starting point for the partial synthesis of cortisone. In order to confirm on authentic seeds the results of the old analyses, to find other useful plants, and to assess the possibility of the economic cultivation of the new vegetable recruits, many expeditions were sent in Africa. Among the promoters we find the British Medical Research Council, the US Public Health Service and the US Department of Agriculture, and several firms as Merck, S.B.Penik &Co, and of course Upjohn. No lasting result was obtained along these routes, while the Upjohn chemistry department scored an important success when it was discovered that a mould *(Rhizopus nigricans)* was able 'to put' a hydroxyl in the 11 -position of the progesterone molecule. Following this route Upjohn came on the market in May 1952 with cortisone obtained by fermentation, it is to be noted that the Upjohn chemistry department used the most advanced analytical methods of the time, paper chromatography and infra-red spectroscopy.

But an unexpected, fundamental development arose from the researches on the partial syntheses of cortisone, it was the preparation of cortisone analogues possessing activity greater than that of the natural hormones. This new route was opened in 1953 by chemists at Squibb who discovered that the 9-α-fluorohydrocortisone was far more potent than hydrocortisone. Actually the new route went *beyond* cortisone, and it was an usual one in pharmaceutical chemistry: to find molecular variants of any active substance. However in this case a sort of epistemological barrier had been put - mostly by the Nobel laureate E.C.Kendall - against the same existence of substances more active than cortisone. This route was at once followed by many competitors because the glucocorticoids had many serious side effects, and it was hoped to find the 'perfect' anti-inflammatory drug. Thus in 1955 the Schering Corporation marketed two new substances, prednisone and prednisolone, and finally in 1959 chemists of the same firm removed the last structural prejudice synthesizing a very active anti-inflammatory corticosteroid that had no oxygen at all in the crucial 11 position.

The paper ends with an epistemological analysis of the relationships between chemical structure theory, knowledge procedures, scientific resources and corporate strategy.

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Architecture of New Molecules in the 20th-Century - A Dynamic Survey

The development of the art of organic synthesis, since the beginning of the century, has evolved exponentially passing through several stages. In 1916, the bond dominated the field of chemistry, which finds its most suggestive mode of expression in terms of electrons. This was Lewis's view. Ten years later, Lewis's Valence appeared together with the possibility of a detailed knowledge of molecular structure, developed by molecular spectroscopists. Ingold Classification in 1925, correlating molecular structure with reactivity, allowed the explanation of several mechanisms based on molecular geometry. Then in 1932, Robert Robinson realized the need for a systematic approach to Organic Synthesis, becoming a pioneer, for the next two decades, in steroid synthesis, an important class of compounds given their uses in biological functions.

Linus Pauling resolved the alpha-helical structure of proteins in 1948, as an example of the complexity involved in the Nature of Chemical Bondings. He also worked in collaboration with Lawrence Bragg to determine approximate crystalline structures by X-rays diffraction. Nevertheless only in 1956, Herbert Hauptman and Jerome Karle made it possible to determine crystal structures directly from experimental results precisely without any approximations.

A new era of Chemistry had begun. The era of Computational Chemistry allowing modern chemists, together with their computer programmes, to elaborate perfect molecular structures and draw these on screen, prior to their synthesis in laboratory. Chemists have become Architects.

The development of chemical computer software and instrumentation, during the 60's, allowed chemists to solve various problems connected with the structure and synthesis of steroid research, highlighting the value of concepts such as : Conformational Analysis (Derek Barton-NP 1969); Stereochemistry (Prelog & Cornforth-NP 1975); Selectivity of the reactions of organic molecules (Cram, Lehn & Pedersen-NP 1987).

Later, these concepts led to the development of new methods to synthesize and produce chemical compounds. The traditional methods of drug discovery - synthetic chemistry, pharmacognosy, biological testing, and spectroscopic methods of physical and structural analyses - are strengthened rather than supplanted, by the new computer-based approaches to discovering therapeutic agents. This was accomplished by Elias Corey in 1988, being a Nobel Prize in 1990.

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The Development of Japanese Rayon Industry as a Case Study of Industry-Academy Cooperation - Its Success and Fail -

In this paper the process of the development of highly technological industry in a lately started industrial country will be discussed from the viewpoint of industry-academy cooperation. The start of Japanese rayon industry was a good example of the second stage of late industrially developing country, from labour concentrated industry, such as cotton spinning and weaving, to highly technological, such as chemical fibre industry. Many rayon manufacturing companies in Japan started based on imported technology, but at the same time some, at least one, started based on self-developed process technology. For Japanese industry, it was the time of transition from technologically import-dependent to partially independent state. Especially the effect of the establishment of new academic system must be pointed out as the social factor of the formation of this new hightech industry. About the turn of the century, Japanese academic system of science and engineering came into the second stage of industrialization by establishing many national technological high schools. Professor I. Hata, a leader in the development of rayon technology in Japan, was in one of these new technological high school established in 1910.

Japanese rayon industry developed very drastically, and in 1936 the production marked highest of the world, and export was also highest. But more important point was the level of process technology, because the substantial cost of production, for instance the consumption of cellulose raw material and so on, was the lowest of the world. There the cooperation between industry and universities should be pointed out as the factor of supporting this development. In 1924, the Cellulose Society was organized under the leadership of Professor K. Atsugi of Tokyo University, and the *Journal of Cellulose Industry* was started next year as highly research oriented journal. Even in the *Journal of Industrial Chemistry*, which was the official journal of the Society of Industrial Chemistry, the number of papers about cellulose chemistry was about 15% of total papers. In the opposite direction, the rayon industry strongly supported academic activities. The most famous example was the donation of "Research Institute of Chemical Fibre" to Kyoto University by a rayon company. That institute played very important role not only in the development of cellulose based fibre, but also the development of synthetic polymer fibre, the next stage of chemical fibre production. But at that time the world tendency of the research of chemistry was highly concentrated into the establishment of polymer science, which almost directly led to the establishment of completely new synthetic fibre industry, the best example of which was the development of Nylon by duPont Co. in 1938. Japanese chemists and chemical industry were totally out of this tendency, not due to weak cooperation between these two, but due to immature development of academic tradition in Japan.

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The Origin of Plastics Industry in Portugal

The industry of plastics in Portugal originated in the 1930s, when the country was already living under the rule of the *Estado Novo*, the dictatorship of Salazar. Its emergence is associated with two major events : on the one hand it was necessary to respond to the basic needs of the population in view of the *barefoot campaign*; and on the other, plastics were required by electrical industry.

The *barefoot campaign* was a campaign launched in the region of Leiria, but later extended to the whole country, forbidding the population to walk on barefoot within towns and cities. In fact, this was a make-up operation aiming at disguising the outer signs of an impoverished population. The less expansive response to this problem was the massive manufacture of cheap sandals. The firm Nobre & Silva, founded in 1927, began in this way the manufacture and trade of rubber-based sandals. Following this event, the same company extended its production by creating a plant for the manufacture of Bakelite stoppers and other plastic commodities.

By 1936, the electrical industry and, in particular, the Sociedade Industrial de Produtos Eléctricos (Industrial Company for the Manufacture of Electrical Material) at Carcavelos, Lisboa, began the production of Bakelite for the manufacture by moulding of low tension electrical devices and of other products for current use. This was an initiative of high repercussions in this economic sector given the perceived advantages of Bakelite over porcelain.

These industrial companies mark the beginning of plastics era in Portugal, which was launched in the context of an industrial policy based on the regime of *Condicionamento Industrial* (*Industrial Constraint*). This regime was formally implemented by law enforcement in 1931, and accordingly, the establishment of any new industry and its location, the enlargement of industrial premises, the acquisition or replacement of equipment and machinery, and the trade of industrial goods had to be sanctioned by the central government.

At the same time, another instrument of the economic policy of the *Estado Novo*, which had a major impact upon the plastics industry was the emergence of corporationism. Allegedly, this form of organization aimed at protecting the interests of each industrial sector, and accordingly, the industrialists of plastics associated in order to create a patronal organization, christened Grémio Nacional dos Industriais de Composição e Transformação de Matérias Plásticas.

The study of the emergence of plastics in Portugal has thus to be analysed taking into account not only its technological, social and econonic dimensions but also the peculiar political situation in which the country lived for almost 50 years. The economic policies implemented by *Estado Novo* shaped the evolution of the local industry of plastics, by constraining the normal dynamics of technological innovation and of markets for new commodities.

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A Battle of Giants, Multiplicity in the Industrial R&D that Produced High Strength Aramid Fibers.

There have been several long and expansive legal disputes on important results of industrial R&D. These disputes are often very destructive for all parties involved; the lawsuits are very expansive, market development for new products suffers from the uncertainty of uninterrupted supply, and the parties involved are often forced to publish technological and trade secrets, thereby helping third parties. These conflicts can hardly be explained in the rational economic terms in which large industrial holdings generally formulate their strategy.

This paper analyses the R&D, starting shortly after WW II, that lead to high strength/high tenacity aramid fibers like Kevlar, Twaron and Technora* ' in the 1970s and 80s. The development of these fibers lead to an enormous patent litigation case between the chemical giants Du Pont (US) and AKZO (Europe). Both companies sued each other starting from 1979. In 1988, they signed an agreement to stop the patent litigation cases. However, the adversaries still could not stand each other; in the 90's they started suing each other for unfair trading practices.

The paper will show that industrial research and development, especially pioneering research, is not so straightforward as is supposed in international patent law; often research findings cannot be covered easily and effectively with patents; 'inventions' are often the result of several research findings. However, not all findings are produced in the same laboratory. This confusing situation often continues after the 'invention' is patented: competitors can often improve on the product or the process, and thereby claim patent licenses. Therefore, patent rights are in practice more or less a matter of negotiation white the legal situation is often rather unclear.

This paper will briefly describe how Du Pont, Monsanto, Celanese, AKZO, Bayer, NPO Khimvolokno, VNIISV, Rhône-Poulenc, Teijin, Asahi, Hoechst all contributed to the creation of various high performance aramid fibers. It will also describe how the patent litigation struggle between AKZO and Du Pont started, and will finally evaluate this battle of giants, which cost the parties about $ 200 million only for lawyers, and probably a multiple of that amount to cover other expenses. It is suggested that there should be created more legal ways to administer justice to all researchers who contributed to an invention.

* registered trademarks of Du Pont, AKZO-Nobel and Teijin

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Putting Polymers into Paint : Explorations in Revolutions and Relations of Science, Technology and Industry

There has long been a debate on the relationship between science and technology. This intersects with various debates about the relationship between technological change and industrial need and growth. A rewarding site for research on these issues lies in the massive 20th century shift from the use of natural materials to the synthetic products created in labs and factories. Coinciding with this shift was the development and progress of organic chemistry and an industrial development which saw the production of synthetic materials grow at 12% per annum between 1913 and 1960, compared with general industrial growth of 3% per annum. Several writers have been interested in how the two were related.

It has often been noted that many of the synthetic materials of the 20th century were actually 'invented' in the 19th century, thereby implying that science had priority over technological and industrial need. Various studies of recent years have, however, revealed evidence that the opposing explanations of 'science-push' and 'demand-pull' need to be combined, either because the predominating force varies over time, or because the two forces interact. Less clear, though, are the mechanisms by which such fluctuations and interaction take place. This paper seeks to explore the nature of such mechanisms through a case which has received little historical attention - the shift from natural resins to synthetic resins as the basic vehicle for that seemingly mundane and everyday product, paint.

Paint has been used for protection and decoration for millenia and paint making technology remained virtually unchanged for centuries. But when the synthetic resins became available in the 1920s, dramatic changes followed. It was said that the new synthetic resins, and all they brought with them, had 'revolutionized' the industry, its products and its processes. The parallel debates and advances in polymer science were relevant since the synthetic resins which transformed the paint industry were also polymers. In particular, the most important class of resins, the so-called 'alkyds' were figuring strongly in debates about the nature of polymers and their formation. Indeed, the alkyds were at the nexus of the changes in the paint industry, and the developments in polymer science.

Strangely, the technological advance which made it possible to put synthetic resin polymers into paint was judged by the courts as no invention at all, but merely an obvious consequence of prior art and knowledge. We therefore ask did the introduction of polymers into paint represent a simple technological increment or a radical industrial change, linked to scientific revolutions? And what does this tell us about the relations between science, technology and industry? The answers point to the importance of the convergence of distinct but overlapping 'problems'.

Section 8.5 :

Biological and Medical Sciences in the Contemporary Period (since 1800)

Special session of section 8.5 :

Application of Science and Methodological Innovation

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Du merveilleux et de l'utile : Evolution des rhétoriques méthodologiques au XVIIIe siècle

Dans la première partie du XVIIIe siècle, l'influence de la théologie naturelle des savants anglais domine les discours méthodologiques des sciences de la vie : le merveilleux constitue une catégorie de pensée qui s'exprime à travers une terminologie déterminée, et qui remplit diverses fonctions dans la prose scientifique. L'utile y est par contre moins privilégié, quoique déjà présent dans les textes expérimentaux des anglais et des italiens de la fin du XVIIe siècle. Le renforcement d'un discours utilitaire lié à l'activité scientifique est marqué en France par les travaux de Réaumur, par ceux du premier Buffon ou de Duhamel du Monceau. Ces travaux se distinguent par un développement des méthodes pratiques inventées au XVIIe siècle, alors que des innovations importantes se trouvent au plan des discours méthodologique. De plus, le discours utilitaire se caractérise par des traits méthodologiques spécifiques, distincts de la rhétorique des merveilles. Ensuite, durant la deuxième partie du XVIIIe siècle, alors que le discours utilitaire devient partie constituante de la légitimité des travaux des savants, la rhétorique des merveilles subit d'importantes critiques sous l'influence des débats sur la génération, tant de la part des préformationistes que de celle des épigénésistes. Ces critiques ne sont pas organisées autour des mêmes problèmes, dans les écoles de Buffon et de Charles Bonnet.

Nous chercherons à décrire l'articulation et l'évolution de ces rhétoriques au milieu du XVIIIe siècle en comparant quelques passages des textes des principaux savants de cette époque.

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Les Paysans du Pays de Caux dans la controverse au XVIIIe siècle sur la transmission de la maladie chez les plantes

Charrue, traitements de semences, amendements et engrais, greffe et taille des arbres fruitiers, etc., préexistent aux théories savantes et à la mise en place de l'agronomie ; théories et agronomie qui doivent les intégrer dans leurs argumentaires et dans leurs propositions au même titre que les faits naturels. D'une certaine manière, la mise en place de l'agronomie ouvre une porte à la participation des savoirs populaires agricoles à la construction des sciences du vivant. Nous étudions ici le rôle de l'opinion explicite ou implicite des paysans du XVIIIe siècle dans les débats savants sur la transmission des maladies des plantes.

A partir des années 1730, sous l'influence de divers engagements (physiocratie, utilitarisme, science moderne), un nombre beaucoup plus important d'auteurs s'intéressent d'une manière nouvelle aux maladies des plantes, à leurs explications et à leurs remèdes. Faute de lieux savants, ces auteurs s'expriment d'abord dans des périodiques de large diffusion, ensuite dans les divers volumes du *Traité de la culture des terres* de Duhamel du Monceau, puis dans le cadre du mouvement des Sociétés d'agriculture. Ce sont des lettrés ruraux de toutes conditions et, de plus en plus, des magistrats administrateurs et membres de parlements. Après 1780, des auteurs savants, d'abord essentiellement des chimistes, puis des naturalistes, quelques médecins, s'adjoignent à ces "auteurs agriculteurs".

Tous ces auteurs, avec des équilibres variables, mêlent connaissances savantes et savoirs populaires, présentations de faits anatomiques, physiologiques ou pathologiques observés dans les champs ou au microscope et présentations des savoirs et pratiques paysannes. Toutes ces données sont intégrées au même titre dans l'argumentaire sur les causes ou les remèdes. Lorsque l'on s'oppose sur le caractère contagieux, héréditaire ou météorologique de la maladie qui noircit les grains, l'auteur doit justifier les traitements de semences pratiqués par les paysans. Ceux-ci apportent leur soutien à l'hypothèse de la transmission de la maladie par les semences. L'opinion des cultivateurs affirmant que certains types de fumier provoquent des maladies renforce l'hypothèse des auteurs qui accusent ces fumiers de transmettre le principe chimique de la maladie. La bibliographie du plus fameux traité sur les maladies des plantes du XVIIIe siècle, la *Dissertation* de Tillet (bibliographie discutée par l'auteur et sur laquelle il appuie son argumentaire et ses choix méthodologiques) présente au même niveau auteurs savants et paysans parmi lesquels les " laboureurs du Pays de Caux". Ces derniers, en accusant la semence de contenir la cause de la corruption, sont, pour Tillet, ceux qui sont le plus proche de la réalité du phénomène. Ils apparaissent, contre Théophraste et Bauhin, du côté de l'agriculture, de l'expérience et de l'utilité.

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Expérimentation physiologique et observation clinique : quelle était la nature des données tenues pour démonstratives aux débuts de la physiologie endocrinienne (1880-1920)?

La mise en évidence de la fonction endocrine des glandes dépourvues de canaux excréteurs fait suite à des observations cliniques (qui se multiplient à partir de 1850) relatives aux troubles qui accompagnent les lésions dont ces glandes peuvent être le siège. Cependant, les maladies observées par les médecins, bien quelles constituent d'après quelques-uns des meilleurs cliniciens du XIXe siècle (dont Bouillaud), de véritables expériences préparées par la nature. n'ont pas révélé d'elles-mêmes la cause des troubles constatés, pas plus que n'ont pu le faire les expériences d'ablation de glandes instituées par les physiologistes. Si l'administration d'extraits glandulaires s'est avérée un peu plus démonstrative pour suggérer que les glandes élaborent des substances actives, c'est en fait le recours à la méthode graphique, initiée par Ludwig, mise au point par Marey, considérée comme absolument objective, qui a véritablement apporté la preuve définitive de l'existence d'une sécrétion interne d'excitants fonctionnels de nature chimique auxquels Starling attribuera en 1905 le nom d'hormones. Dès 1892, Gley appliqua la méthode graphique à ses recherches sur la contraction tétanique provoquée par la thyroïdectomie. Mais l'exemple décisif a été apporté par Oliver et Schaeffer qui l'ont employée lors de leurs recherches sur l'action hypertensive des extraits surrénaliens (1895). Par la suite, lorsqu'ils établirent définitivement le paradigme hormonal en découvrant la sécrétine, Bayliss et Starling (1902) ont également eu recours à l'enregistrement graphique de la sécrétion pancréatique observée en réponse à l'injection intraveineuse d'extraits duodénaux préparés en milieu acide.

La communication analyse les rapports entre physiologistes et cliniciens, les conditions de l'emploi des appareils enregistreurs par les uns et par les autres, et les résultats fournis par la mise en oeuvre de la méthode graphique dans le domaine naissant de la physiologie endocrinienne, principalement au cours de la décennie 1893-1902 qui s'achève par la découverte de l'adrénaline, puis de la sécrétine, prototype des hormones.

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Valeur heuristique des techniques en électrophysiologie ou les métamorphoses de l'électrode

La compréhension de la science comme "pensée empirique inventive" selon l'expression de Bachelard implique non seulement l'attention portée à ses énoncés, à la charge de vérité de ses théories et à ses transformations conceptuelles mais aussi aux conditions de sa "matérialité", notamment à l'évolution des dispositifs de mesure. Si l'on se doute que les progrès de la neurophysiologie sont étroitement liés à ceux de la technologie, il reste à mieux comprendre les parts respectives des facteurs conceptuels, techniques et économiques qui ont permis le passage de cette science au niveau moléculaire, son instrumentalisation, et à clarifier les interactions entre ces facteurs.

Il s'agit là d'un programme très vaste que l'on a choisi d'aborder ici à travers quelques métamorphoses d'un objet particulier, l'électrode, lors de ses diverses utilisations, depuis son apparition dans le champ neurophysiologique jusqu'à son introduction dans une technique élégante et sophistiquée : l'enregistrement local *(patch-clamp recording).*

L'histoire de l'électrode est exemplaire en ce sens qu'elle illustre la complexité des événements nécessaires pour l'élaboration d'un objet matériel et la variété des obstacles rencontrés. Mis au point au milieu des années soixante-dix pour l'étude biophysique du neurone, l'enregistrement local est quant à lui parfois présenté comme une simple extension de la technique de voltage imposé proposée par Alan Hodgkin et Andrew Huxley au début des années cinquante, issue d'un travail artisanal sans grande évolution conceptuelle par rapport à cette dernière. Cette technique verra pourtant à partir des années quatre-vingt son champ d'investigation s'étendre à toutes sortes de cellules animales et de phénomènes bioélectriques, révolutionnant ainsi la physiologie cellulaire en débordant largement le champ neurobiologique. Actuellement, son utilisation semble, selon un de ses promoteurs francophones Alain Marty, se concentrer à nouveau sur le neurone, en particulier vers les mécanismes de communication synoptiques au niveau cérébral, l'étude des drogues interférant avec ces mécanismes, les réseaux neuronaux et les signaux intracellulaires.

La valeur heuristique considérable de cet outil très puissant valut à ses auteurs Bert Sakmann et Erwin Neher l'obtention du prix Nobel de Physiologie et de Médecine en 1991. Mais pour l'historien, le *patch-clamp* et son électrode apparaissent comme le résultat d'un difficile processus collectif entrepris depuis le début du XIXe siècle, celui de la construction d'une "chaîne de mesure" destinée à la quantification de plus en plus fine du signal nerveux, processus ayant impliqué la rencontre de disciplines, de théories et savoir-faire variés. L'intérêt de l'épistémologue n'est pas de dresser un inventaire exhaustif des développements techniques de l'enregistrement local ni un panorama complet de l'histoire des techniques électrophysiologiques. A travers l'histoire d'un dispositif précis et de ce qu'il possède de plus caractéristique, son électrode d'enregistrement, on espère simplement contribuer à une discussion sur quelques modalités concrètes possibles d'apparition, de transformation et de disparition d'outils scientifiques dans le champ des Sciences de la Vie.

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Techniques et problèmes en neuro-endocrinologie

Dans le cadre d'une discussion sur le rôle des techniques dans l'évolution des problèmes en biologie, on étudiera l'exemple de la neuro-endocrinologie et des relations hypothalamo-hypophysaires dans la première moitié du vingtième siècle. Cet exemple est particulièrement adapté pour établir plusieurs conclusions. Les techniques en biologie sont porteuses de nombreux artefacts et donnent lieu souvent à des pièges d'interprétation. Les interprétations fondées sur des erreurs techniques peuvent avoir une durée de vie étonnamment longue et gouverner pendant des décennies les discussions dans un domaine scientifique. La solution des problèmes ainsi posés ne dépend généralement pas de l'appel à une seule technique, même si l'on observe que la solution finale est atteinte par un progrès technique déterminé.

Le domaine des relations hypothalamo-hypophysaires que nous souhaitons étudier ici concerne la posthypophyse, ses relations avec les noyaux hypothalamiques supraoptique et paraventriculaire, les données histologiques concernant ces relations et le tractus hypothalamo-posthypophysaire, l'établissement du concept de neurosécrétion qui attribue à certains neurones une fonction de type hormonal. En raison de l'interprétation des "corps de Herring" observés au début du siècle dans la tige pituitaire à l'aide de certaines colorations, de nombreux chercheurs ont cru que les sécrétions posthypophysaires étaient à destination de l'hypothalamus et du troisième ventricule cérébral, où elles pouvaient réguler, par exemple, le contenu en eau de l'organisme. Dans l'approche de telles questions, plusieurs types d'expériences et de techniques ont été utilisés : physiologie expérimentale (lésions stéréotaxiques), clinique (chirurgie, opothérapie), physiologie comparée, anatomie-histologie. De nombreux modèles ont été proposés pour conceptualiser les relations hypothalamo-hypophysaires, en même temps que l'on progressait, par le rassemblement de données de divers types, dans la compréhension du rôle des divers éléments du système diencéphalo-hypophysaire dans les fonctions envisagées (essentiellement la fonction antidiurétique). Pourtant, pendant longtemps aucune technique n'a donné de solution complète du problème. Les obstacles de type conceptuel (difficulté de reconnaître la capacité sécrétrice des neurones) ont été les plus difficiles à vaincre malgré l'accumulation d' arguments expérimentaux. La solution finale n'a pu être obtenue que quelques quarante années après les observations initiales, grâce à l'introduction dans le problème d'une nouvelle technique de coloration histologique utilisée précédemment dans d'autres domaines de la physiologie. Il est frappant de constater que l'anatomie a fini par résoudre un problème qu'elle avait elle-même créé.

En reconstituant l'histoire de la fonction antidiurétique, nous souhaitons donc démontrer que l'évolution d'un problème scientifique repose sur une diversité de techniques et d'approches et que sa solution finale peut résulter d'un développement technique extérieur à son champ.

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Méthodes et techniques de l'embryologie expérimentale

Une discussion générale suivra la simple présentation d'un tableau récapitulatif qui présente une réflexion sur une histoire du développement de la pratique et de la méthode expérimentale en embryologie pendant le XIXe siècle.

Section 8.5 :

Biological and Medical Sciences in the Contemporary Period (since 1800)

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What is Life? A History of Ideas and Paradigms from Myths of Creation to Artificial Life

This paper reviews the history and milestones in the evolution of conceptions about 'living' as contrasted with 'non-living' that has intrigued mankind for millennia and received diverse explanations in mythology, religion, philosophy and science. The paper is a chronology of ideas and concepts and their discoverers and inventors structured logically and constructively according to historical conception, crystallization and development of the related beliefs, philosophical schools and paradigms of scientific explanation.

The following paradigms can be distinguished :

- mythological,
- philosophical,
- classical biological,
- physical and thermodynamical,
- chemical (including geological and molecular evolution),
- system theoretical (including cybernetics and information theory) and
- computational (including theory of self-reproducing automata and artificial life).

Prehistoric mythologies were replaced by stories of creation of literary religions which in turn were followed by explanations offered by various schools of philosophy and science. Biology grew from the traditions of natural philosophy, natural history and medicine and became a proper science in the 19th century. Classical biology was followed by modern and theoretical biology in the 20th century and other natural sciences have made their contributions but the definite answers to the enigma of life are still missing.

The reason why even modern sciences have largely failed in explaining the fundamental go-of-its of life is that they have been looking for the key from where there has been light rather than from where it was lost. Modern natural sciences have followed the classical paradigm of analysis, isolation and reduction of phenomena rather than the dimension of complexity and aspects of synthesis, integration and construction. New understanding and explanations of complex phenomena arose, however, along with the development of the system paradigm including system and model thinking, information theory and cybernetics in the second half of the 20th century.

Toward the end of the century the classical system theoretical paradigm bas been supplemented and developed further within the paradigms of irreversible nonequilibrium dynamics and thermodynamics, non-linear and complex dynamics or synergetics and discrete systems and theories of computation. The new complex and discrete system sciences, also called the <u>new system sciences</u> or simply the <u>new sciences</u>, include number of new fields such as structural stability of dynamical systems, self-organizing systems, catastrophe theory, chaos theory, discrete system theory, theories of automata and formal languages, theories of computation, theory of complexity and computability, theory of self-reproducing and self-referential systems, allo-referential systems, genetic algorithms and evolutionary computing, artificial life, artificial neural networks, artificial intelligence, computational cognition, virtual reality etc. to name a few. These fields have opened up a new paradigm of science sometimes referred to as the <u>postmodern, digital</u> or <u>computational science</u> which is revolutionizing the methodology of science and our conceptions of life, mind and culture and the culture itself.

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El estudio de las colecciones recolectadas por los naturalistas hispanos en los territorios españoles del Norte de Africa (1860-1936)

Durante los años 1860 a 1936 los naturalistas hispanos, bien como aventureros individuales o como miembros de Sociedades Científicas, intensificaron sus incursiones en los territorios españoles del Norte de Africa. Su objeto era doble, de un lado el mejor conocimiento de la fauna, flora y gea de aquellos lugares, de otro el aprovechamiento de las especies de mayor valor y de los recursos del territorio.

La mayoría de estos naturalistas, sobre todo de los primeros años, no limitaron su actividad científica al grupo biológico que constitua su especialidad. Por el contrario, capturaban animales, recolectaban plantas y cogían muestras geológicas que, a la vuelta a la metrópoli, repartían entre los especialistas oportunos o entregaban al Museo Nacional de Ciencias Naturales. En esta línea podíamos apuntar cómo los ejemplares recolectados por Francisco Quiroga, Julio Cervera y Felipe Rizzo -de los cuales tan sólo el primero era naturalista- en el transcurso de la expedición colonial que llevaron a cabo en 1886 al Sáhara occidental, fueron determinados por B. Lázaro Ibiza (plantas), J. Gogorza (equinodermos y peces), I. Bolívar (crustáceos, miriápodos, ortópteros y hemípteros), E. Simon (arácnidos), F.de P. Martínez y Saez (coleópteros, reptiles y mamíferos), J. González Hidalgo (moluscos) y M. Antón (antropologiá), además de por el propio Quiroga que formó el catálogo de minerales y rocas. Por contra, según avanza el período considerado, cada vez va siendo más frecuente que el naturalista interesado en un grupo sistemático determinado lleve a cabo sus estudios "*in situ* ".

Así pues, el estudio de las colecciones recolectadas la llevan a cabo, en ocasiones los propios viajeros, casos de los zoólogos M. Martínez de la Escalera y A. Cabrera, de los botánicos P. Font Quer y C. Pau y de los ingenieros A. del Valle y P. Fernández Iruegas, pero en otras ocasiones hubo de contarse con la colaboración de naturalistas españoles y extranjeros que no habían estado, o no llegarían a estar nunca, en esos enclaves naturales. La mayoría de estos últimos fueron zoólogos a los que, por no existir especialista en España, se les pidió auxilio desde el Museo y desde la Sociedad Española de Historia Natural. Podríamos apuntar, entre ellos, a los ingleses G.A. Boulenger, M. Burr, G. Lewis y R. Shelford, al belga H. Schouteden, a los franceses H. D'Orbigny, P. Lesne, M. Pic, A. Grouvelle, A. Fauvel y R. Martin, a los alemanes J. Bourgeois, J. Weise y H. Gebien, al suizo J. Carl y al italiano G. Nobili, entre otros.

La relación de los estudiosos ("*viajeros*" y "*especialistas*") de los materias recolectados en el Norte de Africa, así como la valoración de sus estudios, constituyen la parte central de esta comunicación.

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*Profesionales y diletantes ante la Naturaleza norte-africana : análisis de la actividad de los naturalistas españoles (1860-1936)**

En las últimas décadas del siglo XIX, coincidiendo con la corriente intervencionista hacia el territorio marroquí, plasmada, entre otras realidades, en la creación de la Sociedad de Africanistas y Colonialistas (1884), se despierta un cierto interés por el estudio del medio natural, manifestada en trabajos como los publicados por S. Calderón (1892) o L. Bescansa (1902).

Estos primeros esbozos serían utilizados por los grupos africanistas quienes inician, a partir de 1904, un movimiento colonizador hacia los territorios norte-africanos, caracterizado como una "penetración pacífica", entre cuyas actividades se encuadra el fomento de las expediciones cientificas por parte de los Centros Comerciales Hispano Marroquíes; bajo este amparo financiero, la Sociedad Española de Historia Natural crea una "Comisión para la Exploración del Noroeste de África" y en el Museo Nacional de Ciencias Naturales se organizan exposiciones de piezas de esta procedencia.

La ocupación por las tropas españolas, a comienzos de 1908, de algunas localidades norte-africanas, y el consiguiente ambiente de militarización del territorio, no detendrán las campañas de inventario de las riquezas naturales, bajo la dirección de O. De Buen se realizará una expedición, de amplias repercusiones, en la primavera de 1912; en 1915 la Junta para la Ampliación de Estudios promovió otra campaña exploratoria, esta vez supervisada por A. Caballero. Estos proyectos, subvencionados por el Estado, se superponen con una red de farmacéuticos y médicos militares, destinados en el territorio ocupado, recolectores de material natural bien para sus propios estudios bien para ser enviados a especialistas, nacionales o extranjeros, interesados en los grupos recogidos.

La pacificación del territorio, en 1927, hace desaparecer este entramado de naturalistas militares a la vez que permite la aparición de un nuevo grupo de estudiosos del medio natural, esta vez personal civil que presta sus servicios en el Protectorado, médicos y profesionales de la enseñanza. El apoyo oficial no quedará relegado, ahora será la Dirección General de Colonización quien se ocupará de explorar el medio natural, acentuando su interés por la práctica agrícola y ganadera, a través de las Granjas Agrícolas instaladas en el Protectorado. Las Sociedades Excursionistas, gestadas en esta nueva sociedad civil, colaboraran en la divulgación de los conocimientos zoológicos y botánicos, a la vez que se constituyen en centro coordinador de los aficionados. La guerra civil de 1936, destructora de tantas esperanzas, anulará estas incitativas.

En esta comunicación se presenta un panorama de los estudios realizados por los naturalistas españoles en el Norte de África.

* La realización de este trabajo ha sido posible gracias al proyecto de investigación PR 179/91-3491 de la Universidad Complutense de Madrid.

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Botanical Exploration of Central Europe Carried on under the Auspices of the Academy of Sciences and Letters (Krokow, Poland)

Cracow Scientific Society, established in 1815, was transformed in 1872-73 into Academy of Sciences and Letters, that changed its name in 1919 to Polish Academy of Sciences and Letters and continued its activity till 1952 (when communist regime made impossible any activity of the Academy). The Academy was the most important institution of Polish science in those days. In 1865, the Physiographical Commission was established within the Society. In 1867, professor Ignacy Rafal Czerwiakowski (1808-1882) worked out for the Academy the first plan of botanical exploration of Galicia (southern part of Poland under Austrian-Hungarian occupation, 1795-1918). The exploration was supported by the Academy : botanists and amateurs obtained grants for solving given problems (i.e. local floras, monographies of taxa etc.). They sent to the Commission both herbaria, and reports that were published in "Sprawozdanie Komisyi Fizyograficznej..." [report of the Physiographical Commission...'] (73 volumes). Area of investigations covered mainly northern part of the Carpathians Mts. up to the Vistula, San, and Zbrucz Rivers (till 1918). Afterwards it was spread over farther regions (i.e. Masovia, Podolia, Pomerania, Major Poland, Vilna region, Ukraine). Not only vascular plants were an object of interest, but also fungi, algae, mosses and liverworts, and lichens. The botanists did not restrict their work to floristics, but they developed other branches of botany (i.e. palaeobotany, pollen analysis, phytosociology).

Results. 1. Herbarium of Central European plants (ca. 100.000 sheets) was accumulated. 2. There were over 1000 papers published. 3. "Flora Polski" ('Flora of Poland', 1919-1995) was started and were six out of 15 volumes published. 4. "Atlas flory polskiej" ('An Illustrated Atlas of Polish Flora') - till the second world war were 6 volumes published.

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La Science Européenne au Brésil : La Géographie Zoologique de Silva Maia (1851)

Emilio Joaquim da Silva Maia (1808-1859) est l'un des personnages les plus importants des Sciences naturelles au Brésil, pendant le XIX siècle. Professeur du Musée d'Histoire Naturelle, il est membre de la plus grande partie des institutions savantes et scientifiques de l'Empire brésilien.

Diplomé en Philosophie naturelle à l'Université de Coimbra (1828) et en Médecine à la Faculté de Paris (1833), il emploie les connaissances acquises en Europe pour mettre en place des théories qui interprètent la nature brésilienne de façon à l'exalter. Il vante la flore et la faune locales, en louant leur variété et leur puissance vitale. Pour cela il n'hésite pas à inverser, par exemple, les arguments traditionnels de Buffon sur l'Amérique du Sud.

Son ouvrage théorique le plus complet s'intitule "Quelques idées sur la géographie zoologique" et date de 1851. Des commentateurs ont cru apercevoir dans ce texte des arguments en faveur de l'évolutionnisme lamarckien, mais en fait l'auteur soutient des idées proches de celles d'Etienne Geoffroy Saint-Hilaire. Au delà de ces influences, Silva Maia démontre connaître les travaux des principaux naturalistes européens de la période, notamment ceux d'Alexander von Humboldt.

L'interprétation de l'auteur à propos de la faune de l'Amérique méridionale reprend des théories déjà courantes, mais elle constitue un ensemble original. Sur un fond de romantisme patriotique, il essaye de comprendre la spécificité de la nature brésilienne et à l'insérer dans une logique organique qui met en rapport les êtres et leur milieu.

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La Matière Médicale Américaine : Le Sujet du Quinquina et les Dictionnaires d'Histoire Naturelle

L'incorporation des remèdes américains à l'arsenal thérapeutique signifia une augmentation des ressources de base que l'on avait à sa disposition pour attaquer les différents phénomènes faisant partie de la maladie.

Au cours du XVIIIe siècle, les diverses expéditions européennes en Amérique mirent tout spécialement l'accent sur l'inventaire des ressources naturelles et, à l'intérieur de ce travail, on s'attacha surtout à plusieurs produits susceptibles d'être utilisés contre les différentes maladies.

Se situant à l'intérieur d'un cadre général qui étudie la présentation au milieu européen de ces remèdes américains, notre travail utilise le quinquina comme moyen d'analyse.

Le sujet du quinquina a été abordé aussi bien du point de vue des milieux considérés comme appartenant à l'Histoire Naturelle comme de celui de ceux considérés comme appartenant à la Médecine. Les cercles naturalistes apparaissent comme la première étape pour la présentation de la plante américaine, et c'est dans ce cadre que nous portons particulièrement notre attention. Nous avons choisi les publications sous forme de *dictionnaires* étant donné que leur influence et le but généralisateur qui les guidait nous permettent d'aborder cette période initiale de la présentation de ces remèdes américains au milieu européen.

Le quinquina est un exemple significatif de la manière dont une thérapeutique peut être efficace bien avant que l'on ait pu identifier le mal véritable contre lequel elle agit et, dans son cas, cette thérapeutique est étrangère au milieu dans lequel on l'utilise, le milieu européen.

Il ne s'agit pas là d'un changement de conception -nous pouvons remarquer le lien de continuité quant au rôle que joue la Nature dans cette action-, et la relation remède/maladie, considérés comme forces opposées, ne va pas, non plus, changer. Ce qui va permettre d'introduire une différence dans la pratique thérapeutique -que l'on trouva clairement reflété par les propos tenus par les Dictionnaires d'Histoire Naturelle- sera, précisément, l'avancée dans l'individualisation d'un remède contre une maladie.

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Die botanischen Ergebnisse der Amerikareise Alexander von Humboldts

Als Alexander von Humboldt und sein Begleiter Aimé Bonpland 1804 von der Forschungsreise aus Lateinamerika zurückkehrten, brachten sie vor allem umfangreiche botanische Samlungen mit : getrocknete Pflanzen (viele davon neu) und Beschreibungen von Bonpland, bis heute erhalten in dem *Journal botanique* (Paris), ein Pendant zum Tagebuch mit den Reiseschilderungen von Alexander von Humboldt (Berlin). Verschiedene Herbarien enthalten z. T. dieselben Pflanzen, und es ist bereits bekannt, daß es deshalb zu parallelen Veröffentlichungen auch anderer Autoren (Roemer und Schultes; Lehmann) kam.

Die Publikation des 30 Folio- und Quartbände umfassenden Reisewerkes *Voyage aux régions équinoxiales* (1805 - 1839) wurde - nicht zuletzt wegen der bekannten Pflanzenmaler und Kupferstecher, die besonders die botanischen Bände kostbar illustrierten - in Paris vorgenommen.

Das vielzitierte botanische Hauptwerk der Amerikareise *Nova genera* wurde von K.S. Kunth in den Jahren 1816 bis 1826 auf der Grundlage von Bonplands Aufzeichnungen und Herbarien verfaßt, der jedoch viele Pflanzen schon in dem ebenfalls zum Reisewerk gehörenden Werk *Plantes équinoxiales* (1. Bd. 1808; 2. Bd. 1813) veröffentlicht hatte. Bonpland war wie der Berliner Botaniker C.L. Willdenow, den Humboldt zeitweise ebenfalls nach Paris geholt hatte, ein Anhänger der Linnéschen Systematik - im Gegensatz zum jungen Kunth, der neben den *Nova genera*, auch die späteren botanischen Bände *Monographie des Melatomacées* und *Révision des Graminées* verfaßte. So läßt sich am Beispiel der Publikationsgeschichte der botanischen Bände - untersucht im Zusammenhang mit der Bibliographie der Werke Alexander von Humboldts, an der die Autorin arbeitet - der Paradigmenwechsel zur postlinnéschen Botanik illustrieren. Außerdem kann durch genaue Datierung der einzelnen, jeweils einige Druckbogen umfassenden Lieferungen botanischer Bände die Autorschaft der Beschreibungen genauer festgestellt werden sowie die Einflüsse weiterer französischer Botaniker (wie Richard, Desfontaine und Jussieu), deren Herbarien mit genutzt wurden.

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Genesis of the Ukrainian School of Floristics and Systematics

The Ukrainian school of floristics and systematics poses a special position in the structure of scientific botanical school and traditions of the former USSR. It can be explained by its origin, formation, and further history of development.

During the pre-Mongolian period, the formation and development of botanical knowledge in the Kievan and Moscow Rus' developed in a convergent manner : mainly in monasteries and under protection of humanitarians of the Prince's and Church hierarchy. The botanical knowledge was based mostly on ethnobotany, principles of medicine and agriculture. The Mongol-Tatar invasion totally exterminated the initial botanical traditions of the Moscow Rus'. In Kievan Rus', however, despite some severe losses, it was possible to preserve the scientific tradition. Consequently, the development of botany in Kievan Rus' followed the traditional scheme of evolution of many botanical schools of Central and Western Europe: from Antiquity through Renaissance to the modern times.

It means that the Ukrainian botany has its own autochtonous origin, unlike the Russian botany, development of which was connected to the reforms of Peter I, foundation of the Russian Academy of Sciences and subsequent invitation of foreign botanists at the Russian service.

An important role in formation of original ideas and concepts of the Ukrainian botany played also its constant contacts with Czech and Polish botany, with many amateurs and leading Ukrainian philosophers working at the Kiev-Mohyla Academy and developing an original schemes on nature and man.

In the integrated form, it was reflected in the concept of geographical races (W. Besser, A. Rogovicz, J. Paczoski, M. Klokov) and the idea of incessant autochtonous development of flora and vegetation. The theoretical foundation of the Ukrainian botanical school was formed by J. Paczoski and M. Klokov.

The school is noted for its constant interest in evolutional history of flora and vegetation. The genesis and evolution as scientific problems come from the Bible tradition. These problems, as applied to biological problems, preserved fresh at the frontiers of the Christian world, particularly in Kievan Rus'. Kiev itself promoted and stimulated such approaches, and was the cradle of a "constellation" of outstanding biologists.

The modern Ukrainian school of floristics and systematics, even if somewhat burdened by traditions, is noted for its open-minded approach, accepting and assimilating the most suitable approaches and concepts of other schools and disciplines, such as biosystematics, comparative floristics, chorology, phytosozology (a system of concepts of conservation of the plant world). The historical and scientific analysis of some past scientific discussions and collisions between Russian and Ukrainian botanists demonstrates that these "conflicts" were based on methodological differences between these scientific schools of different origin.

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Agents and Cells : Theodor Schwann's Work in Berlin (1835-1838)

Theodor Schwann has an enigmatic role in the historiography of the cell theory; although he is traditionally considered the founder of the new scheme, it is difficult to say what his contribution exactly was; his microscopical observations offered nothing exceptionally new at the time, while his theory of free-cell formation was soon to be falsified and discarded.

During Schwann's Berlin years (1834-1839), he has worked and published on several topics, beginning with stomach digestion (discerning the enzyme pepsin), going through spontaneous generation and alcoholic fermentation, and culminating with the cell theory. Usually, these are considered to have been contributions to different fields : physiological chemistry, microbiology and microscopical anatomy, respectively. Moreover, already some of Schwann's contemporaries (e.g. Remak, Virchow) have criticized him for the seemingly inconsistency of his, on the one hand, falsification of spontaneous generation, while allowing, only one year later, free exogenous generation of cells.

In my paper I will show how those seemingly distinct investigations can all be put into a consistent investigative context. Using also Schwann's laboratory notebooks, hitherto hardly consulted by historians, I will attempt to reconstruct his investigative path, and to show how his "false" theory of cell formation actually played a central role in his project as well as in the impact his work had. It can be shown that Schwann aimed at solving a central conceptual problem of the life sciences at the time, namely that of organic agency and, indeed, that it was along this track that he arrived at the cell theory.

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La Théorie Cellulaire ès Sciences de la Vie (1824-1915)

Dans le cadre d'une enquête sur le développement historique de la théorie moléculaire, j'ai pu démontrer que les théories cellulaire et moléculaire sont congénères. Chez Henri Dutrochet, dans ses *Recherches anatomiques et physiologiques sur la structure intime des animaux et des végétaux [..]* (Paris, 1824), les "molécules organiques" de Buffon deviennent autant de "cellules vagabondes", c'est-à-dire des globules rouges du sang, qui s'agrègent pour former les tissus de l'être vivant. Le développement de cette théorie cellulaire une fois généralisée touchera, depuis Matthias Schleiden (1838) et Theodor Schwann (1839), d'un côté la classification biologique (protozoaires, métazoaires) et d'un autre côté la conception plutôt médicale de l'être vivant en tant qu'agrégat cellulaire et ses rapports avec l'environnement.

La structure de la cellule et accessoirement la reproduction (sexuée ou non; hérédité) et la formation des tissus (intussusception; multiplication) sera au coeur des préoccupations des microscopistes. L'ouvrage *Die Cellularpathologie in ihrer Begründung auf physiologische und pathologische Gewebelehre* (Berlin, 1858) de Rudolf Virchow marque une étape importante. C'est contre l'arrière-fond des travaux de Virchow que l'on peut situer l'oeuvre de Louis Pasteur. Ce dernier va chercher les vecteurs des maladies contagieuses dans des "êtres de raison", d'abord les microbes pathogènes, puis les virus. Je me propose d'esquisser les grandes lignes du développement de la cytologie jusqu'à la parution, en 1915 (New York), de l'ouvrage *The mechanism of Mendelian heredity* par Thomas Hunt Morgan et collaborateurs. Je me référerai dans ce contexte à la belle monographie de François Duchesneau intitulée *Genèse de la théorie cellulaire* (Montréal : Bellarmin; Paris : Vrin, 1987), qui domine encore l'historiographie actuelle.

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The Reception of Darwinism in Mexico. The Role of Intellectuals

The study of the introduction of evolution theories in a country is. interesting by itself. Further, its relation with biology in general allow us to learn about the development of biology itself since evolutionism synthesizes all the knowledge about living beings or, at least it claims to do so.

The existence of a general life science is the essential condition for the development of the biological notion of evolution and it is also necessary for its insertion into the wider scientific culture of a country. Studies in natural history -that do not have a general conceptualization of life- are not enough to incorporate a biological vision.

In this paper I analyze the situation of Mexican biology at the last 25 years of the XIX century - when the argument about evolution starts among scientists and intellectuals.

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L'Evolution de l'évolutionnisme : la théorie synergique

L'Histoire de l'évolutionnisme fait montre des repères successifs culminant avec cette véritable révolution de l'évolution constituée par la sélection naturelle, le noyau durable du darwinisme, qu'il s'agisse du néodarwinisme et de la théorie synthétique qui en dérive. La théorie synergique de l'évolution dont les premiers éléments remontent à une thèse soutenue en 1956 (D. Buican, L'influence des facteurs radio-électriques sur la vie, Thèse de diplôme d'ingénieur agronome, Bucarest, 1956) a été développée dans une série d'études et dans plusieurs livres*.

La théorie synergique de l'évolution prend comme point de départ la sélection multipolaire qui représente une théorie sélective généralisée qui s'exerce à tous les niveaux d'intégration, du génotype et du phénotype, dont la sélection naturelle du darwinisme reste un cas particulier mais essentiel. A la différence, donc, du darwinisme et de la théorie synthétique qui en est issue, la sélection multipolaire ne s'adresse pas seulement aux phénotypes -comme la sélection naturelle, sexuelle et artificielle- mais, aussi, aux génotypes aux niveaux moléculaire et cellulaire, la sélection multipolaire prend en considération non seulement les micromutations (géniques) mais, aussi, les macromutations (chromosomiques) qui, dans le cas de létalité, constituent une présélection génotypique -aux niveaux moléculaire et cellulaire- qui s'exerce sur le plan de la théorie synergique en rendant compte d'un orthodrome, c'est-à-dire d'une canalisation sélective initiale du processus évolutif

Ainsi, la théorie synergique permet d'élaborer une conception globale et dynamique de l'évolution dans un cadre plus adéquat aux nouvelles acquisitions de la biologie contemporaine, tout en mettant en lumière le développement du vivant au connaissant dont s'occupe la Biognoséologie, de surcroît la théorie synergique de l'évolution offre une base théorique solide à la sélection artificielle -exercée aux niveaux moléculaire et cellulaire par le génie génétique- aboutissant aux biotechnologies actuelles.

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* Denis BUICAN, *La révolution de l'évolution*, P.U.F., 1989.
Et aussi du même auteur : *Biognoséologie. Evolution et révolution de la connaissance*, ed. Kimé, 1993 (publié en même temps aux Editions All, Bucarest, 1993).

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The Mexican Society of Eugenics Influence in Health and Education

The Mexican Society of Eugenics (SME), had a prominent role in the legalization of the limitation of reproduction and in the restriction to immigration, among other sanitary measures proposed to preserve the "racial purity" and the selection of advantageous races to the improvement of local population.

Matrimonial selection with eugenic purpose remarks the prevailing conception to "bleach race" from Spanish immigration.

Further the SME was an organization with influence in the government politics of sexual education with a clear orientation to the improvement of reproductive health and prevention of venereal diseases.

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Eugenics and Politics : Spain, 1923-1939

The biological and medical thought had a special importance, from the political point of view, during the critical years of the Dictatorship of General Primo de Rivera, the Second Republic and the Civil Spanish War. Besides the actual participation of the intellectuals and professionals on politics, several conceptions about marriage, procreation, the control of "abnormals" and the control of the development and state of population, were used like ideological pennants that characterized positions of left and right. These eugenic and hygienic conceptions, could determine the establishment of certain principles in the new constitution and in the legislation that the government of Republic began to transform They were part of the liberal, socialist or anarchist ideas, but also, with their own characteristics, they were integrated in the thought of the Conservatives and "Tradicionalistas" as well as in the Fascists. In this paper I have analized, essentially, the ideas of an important Spanish physician, a psychiatrist, representative of the Catholic, "Tradicionalista" and Conservative thought, who wrote abundantly on Eugenics and Hygiene of Race, concerned for the future of the Spanish race. In spite of the fact that the eugenic ideas had been, in the Spain of the twentieth, banner of the liberal positions, the conservative Spanish thought used those ideas, although really facing to their essential principles. The Catholic positions could not accept any matrimonial control -not religious- neither much less, accept sterilizations, not even voluntary. The ideological positions in agreement with the Nazi could agree with the ideas that needed a strict control of the State, like in the case of sterilizations programs accepting, with logical limitations dependent on the situation of the own race, the essential racism of the Nazis. I will try to explain the analysis developed by the psychiatrist Antonio Vallejo Nágera, in connection with the inheritance of the physical, but fundamentally intellectual and moral characters, in order to sustain his notion that the essential factors in order to change and raise a race vas, however, the imposition of good customs, the maintenance of the traditional marriages and the education in the Catholicism, seeking support, however in Eugenics and the Hygiene of the Race. The mechanism of "scientific" interpretation he developed, using the laws of Mendelian inheritance and the concepts of genotype, phenotype and "paratype", is not only his, since I have found a similar one, with greater or lesser theoretical elaboration, in physicians of other Catholic countries, like, for example in the Portugal of the thirties, during the Dictatorship of Salazar.

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N.I. Vavilov and the Russian Geneticists - Ithaca, New York, 1932

N.I. Vavilov was the leader of the Soviet delegation of scientists to the Sixth International Congress of Genetics, in Ithaca, USA, 24-31 August 1932. His colleagues were : N. Timofeeff-Ressovsky, S. Saenko, Th. Dobzhansky, H. Timofeeff-Ressovsky, N. Dobrovolskaia-Zavadskaia, A. Romanoff. Corresponding members, who did not receive permission to go abroad, but whose papers were presented were : L. Savitsky, M. Tschernoyarow, E. KarekoSavitskaya, V. Zosimovich (Kiev); C. Frolowa, N. Dubinin, I. Svechnikova, D. Trankovski, M. Nawashin, A. Serebrovski, N. Koltzoff, G. Karpechenko (Moscow); E. Emme, N. Kuleshow, V. Pissarev, G. Lewitzki, S.Bukasov (Leningrad); A. Sapegin, T. Lysenko (Odessa); G. Meister (Saratov). Others to the Congress, from Slavic and Russian dominated countries were : S. Zarapkin, E. Grosman, G. Lebedeff, S. Bostian, R. Kamenoff, A. Marshak; E. Malinowski, M. Skalinska, B. Rosinski, X. Prziborovsky, Z. Umpolsky, V. DeBoeher, X. Bankovska, R. Mitkowski (Poland); J. Krizenecki, E. Chrobiczek, A. Brozheck, V. Ruzhichka (Czechoslovakia); G. Konstantinesku, A. Aronesku, N. Todoreanu, N. Saulesku, A. Riesku (Rumania); W. Fuchs, T. Roemer (East Germany); Yunkuei Yong, C. Chung, H. Chang, Teh Yen Chand, X. Chou, Z.Z. Feng, Z.M. Heh, Z.F. Feng, J.A. Hunter, Chia Chi Kuan, L.T. Ilik, T.H. Shen, S.T. Shen (China); D. Kostoff, M. Christoff, J. Kendall (Bulgaria).

T.H. Morgan was President of the Congress. Vavilov, who was one of 18 Vice Presidents, made what would be seen as a wonder by praising the then unknown T.D. Lysenko. This will be explained in my paper. Also to be discussed are the roles played by the geneticists named here in "communist science".

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Emergence of Renaissance Life Sciences in Eastern-Central-Europe (Austria, Hungary, Romania)

The science of renaissance humanism and that of the reformation is strongly interconnected. Conflicts between religions faith and positive knowledge resulted many still insufficiently studied controversies. *A multimedia compact disc (CD)* has been prepared with documents on scientific facts and fallacies of this period, based on the first Hungarian scientific books and manuscripts compiled in cities belonging today to Austria, Hungary and Romania. The main goal of this work was to bridge the gap between the beginnings of the first revolution of information technology *(typography)* and the second one *(electronic publication)*. The CD illustrates also the influence of some XVIth century scientists, e.g. that of Ph. Melanchton or C. Clusius on early scientific unification of Europe.

The CD entitled *"Everlasting Life of Science"* is the second in the *Bio Tár Gramma* series (the first one has been edited in 1990). It is a multimedia with databases, full texts, and graphic files regarding XVIth century Hungarian Life Sciences : medicine, (ethno) botany, zoology, (pharmaco) chemistry, etc. This science emerged first in Western Hungary, in the Sárvár School around 1530. Here the landlord T. Nadasdy invited Hungarian graduates of, famous European universities (Cracow, Wittenberg, Bologna, Padova, etc.) students of Copernicus, Melanchton, and Vesalius.

The Sárvár School was coined by the two Transylvanian humanist brothers J. and M. Sylvester (students of Cracow and Wittenberg). They had a very conscious and lasting influence on their students and colleagues : on P. Melius, S. Beythe and his son A. Beythe (born in Sárvár). The medical doctor C. Fraxinus (student of Padova and Bologna) influenced in Sárvár almost surely G. Lencsés, whose formal medical training is not documented. S. Beythe linked this *"academic circle" to European Herbals* and contributed to the emergence of the first independent ethnobotanical and mycological monographs (Clusius et Beythe 1583, Clusius 1601).

The CD demonstrates, how the first Hungarian scientific lectures published in the first Hungarian school book *Grammatica hungaro-latina* (J. Sylvester 1539) on botany, geography, mathematics, etc. contributed (quite consciously) to the emergence of a group of interconnected scientists, to the first Hungarian science handbooks. *Grammatica* is regarded here as an *origo* for *Hungarian Herbals* written by a student of M. Sylvester (Melius 1578, *Herbarium*, Colosvar, now in Romania), and the Herbal of A. Beythe *(Fives Könyv 1595*, printed in Németújvár, now Güssing in Austria). The cooperation between S. Beythe and C. Clusius yielded the first booklet on Pannonian (Austrian, Hungarian incl. Transylvanian and Slovenian) ethnobotany, *Stirpium Nomenclator Pannonicus* (Németújvár 1583), the first Central-European botanical monograph *(Stirpium per Pannoniam, Austriam*, etc., Antwerpen 1584), and contributed to the ethnobotanical foundation of mycology as a science *(Fungorum in Pannoniam* .... Antwerpen 1601).

The first medical text printed in Hungarian is attached to the first full translation of the *New Testament* (J. Sylvester 1541). This is regarded here as an origo of the *Hungarian medical literature.* The CD presents the reconstructed manuscript of a large medical monograph prepared for publication by G. Lencsés (1530-1593), a Transylvanian diplomat quite neglected in history of biology. Lencsés in his marvellously written and well edited (but never published) six volumes of his *Book on Entire Medicine or Ars Medica* followed in medical descriptions the French J. Fernelius, but was original in collecting (ethnomedical) recipes.

The compact disc edited for the 1100th celebration of the Hungarian settlement in the Carpathian Basin is the first electronic document regarding the emergence of the scientific literature in Eastern-Central Europe. The difference between the scientific and colloquial terminology is demonstrated by a database on ancient colloquial Hungarian (SZABÓ and SZABÓ 1990 : *Historical Thesaurus of the Transylvanian Hungarian. Electronic version).* The CD presents also some concise English, Germany, Romanian or/and Latin comments for about 73.000 historical records (searchable using UNESCO-Micro-ISIS). Data are of interest for botanists, specialists in zoology, anatomy, medicine, pharmacology, foods, drinks, minerals, poisonous substances, ethnography, history, linguistics and many other fields. The largely unexplored set of data may be regarded as a small electronic contribution to the study of the *History of Science in a United Europe.*

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La recherche médicale au XIXe siècle sur l'étiologie du paludisme. Liaisons avec l'histoire des mentalités concernant les marais.

Le paludisme a sévi endémiquement en Europe occidentale jusqu'au début de ce siècle. Selon la science médicale des XVIIIe et XIXe siècles, la cause de cette maladie, alors souvent mortelle, était à trouver dans des "miasmes" générés par les étendues marécageuses.

Les théories explicatives du paludisme, à l'époque, ont voulu, dans une étonnante diversité, voir à tout prix sa cause dans des agents tantôt météoriques, tantôt chimiques, tantôt biologiques qui restaient désespérément insaisissables à l'observation expérimentale, et qu'on ne pouvait désigner que sous des vocables du langage commun ("effluves marécageux", "exhalaisons miasmatiques", etc.) L'idée dominante était que le complexe "marais" était producteur des agents infectieux occasionnant le paludisme, par l'interférence du sol, de l'eau, de l'atmosphère et des populations animales et végétales, notamment au cours de la décomposition des matières organiques dans les eaux stagnantes.

Les théories miasmatiques se sont succédé en vain et en grand nombre jusqu'à ce qu'enfin elles fissent naufrage lorsque Laveran, en 1880, eût mis en évidence la véritable cause infectieuse, un protozoaire appartenant au genre Plasmodium, parasite du sang.

Or, droit public, économie politique et sciences médicales ont pris appui pendant 200 ans (XVIIIe et XIXe siècles) sur ces théories miasmatiques fausses, pour lesquelles on n'a jamais pu effectuer la moindre vérification expérimentale, et s'en sont servis pour justifier pendant tout ce temps la destruction forcenée des marais par assèchement. Pourquoi?

Ce discours d'ordre scientifique n'était que le prolongement caché et implicite d'un discours d'ordre mythique de phobie des marais tenu par l
es traditions populaires orales (contes et légendes) depuis au moins deux millénaires ainsi que par les littératures occidentales. L'imaginaire des populations a en effet toujours assimilé, depuis la nuit des temps, les marais au malheur et aux puissances de la mort.

La conjonction de ces deux types de discours (scientifique et mythique, ennemis en théorie, mais historiquement convergents dans le cas des marais) explique l'acharnement séculaire mis à détruire les marais. Il y a là, sur le très long terme, une illustration du poids des mentalités dans un problème majeur d'environnement.

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Contribution française (XIXEe siècle) à la notion de spécificité et contagiosité des maladies bactériennes

1. Tuberculose : Bayle (1810) pressentit pour cette maladie une entité nosologique spéciale, confirmée par Laennec (1819) et Louis (1825). Villemin (1865) la transmit au lapin et en déduisit qu'elle était due à un agent inoculable, tandis que Grancher (1873) établit son unité. Mais c'est en Allemagne que sera isolé le bacille (Koch, 1882).

2. Typhoïde : décrite par Petit & Serres (1813), elle est individualisée par Bretonneau (1819 à 1829, année où Louis lui donne son nom actuel). Ce sont encore des Allemands (Eberth, 1880, Klebs, 1881) qui isoleront le bacille.

3. Diphtérie : son unité, sa spécificité et sa contagiosité furent établies par Bretonneau (1826), et ici encore, le bacille sera décrit outre-Rhin (Klebs, 1883 ; Löffler, 1884).

4. Panaris, furoncles, anthrax : leur épidémicité et contagiosité dans les garnisons avaient été reconnues par des médecins militaires (Bégin, Martin, et surtout Tholozan, 1841). Les staphylocoques responsables seront découverts par Pasteur (1879) et nommés par Ogston (1880).

5. Zoonoses : ces maladies animales transmissibles à l'homme constituent un chapitre négligé de l'histoire de la pathologie infectieuse. Dès 1837, Rayer démontra la transmissibilité de la morve des Equidés à l'homme et vice-versa. Il découvrit avec Davaine (1850) la bactéridie charbonneuse, première bactérie pathogène individualisée, dont Davaine, à partir de 1863, démontra le rôle pathogène.

L'Ecole de Paris, illustrée par Bayle, Laennec, Louis, Bretonneau, Villemin, etc., a joué un rôle fondamental en reconnaissant la spécificité et contagiosité des principales maladies bactériennes, tandis que les "éclectiques", Rayer et Davaine, ont établi l'importance des zoonoses (morve, charbon) en pathologie humaine et découvert la bactéridie charbonneuse.

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Uneasy Bedfellows: Science and Politics in the Refutation of Koch's Bacterial Theory of Cholera

In the history of science there have been many controversies, Newton versus Leibniz, Huxley versus Wilberforce, and Galileo versus the Church; but it is very unusual for a committee whose members occupy very important positions in one country to refute an individual of another country. I happened to find a paper on this very topic, which has the title, "The Official Refutation of Dr Robert Koch's Theory of Cholera and Commas." (1886) Why did a British committee convened by the Secretary of State for India refute Koch's theory of germs? Why in this period? Why in this journal? I would like to elucidate the social background and the reasons why a paper like this was published.

In 1883 Cholera broke out in Egypt. The British Empire Authorities, France, and Germany, who had feared its spread and landing in Europe, each dispatched a commission to Egypt. The British delegates arrived in Cairo first of all. The next was the French commission, arriving in Alexandria in August, funded with 50000 Frs by the French government. The last was the German commission, led by Koch, with governmental research resources of 6000 Marks. Research was done on the suspicion that Cholera in Egypt had been brought by ships from India. Britain wanted to deny this, Germany to affirm it. If the cause of Cholera were a microbiological entity, it could certainly have been carried by ships and therefore the quarantine restrictions agreed upon at the Constantinople and Vienna Conferences had to be strengthened. Severe restrictions could not fail to exert a great influence on British trade with India through the Suez Canal.

The germ theory, which insisted Cholera was not endemic but epidemic, was deeply bound-up with the quarantine problem. Britain, which had acquired the Suez Canal in 1875, wanted to abolish quarantine and make do only with medical inspections. In a famous paper, Ackerknecht discussed "Anticontagionism between 1821 and 1861". In the case of the British Empire, however, this period should be extended by more than 20 years. The German medical commission proceeded to India in order to continue their research and make sure of their theory. Refuting Koch's theory scientifically was an urgent object of the British government, so it may have seemed essential that data collected by Klein and Gibbes in India which was antithetical to Koch's hypothesis be endorsed by the official committee.

At the same time in Germany the controversy between Virchow, who had been the mentor of Koch, and Pettenkofer was being noised throughout the scientific world. This controversy was being recapitulated between Germany and the British Empire. Rarely can there have been a more striking example of the degree to which "scientific truth" may be moulded by social and political forces.

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Mythos and Penicillin

My paper will examine the story of penicillin as 'myth'. Now losing its negative association, the 'mythical' function of stories about technology is to give meaning to history. In German there is a strong tradition of history as 'mythos'. This paper explores the mythical function of historical accounts. It lays out the historiography both in English and German, and explores its implications through the case study of the 'the 'antibiotic age'. This will focus upon the mythic importance of penicillin after the Second World War.

Long run trends in the decline of infections disease from the mid-19th century have seemed to undermine the special significance attributed to antibiotics as the solution to the threat of disease after World War II. This contradiction was used by René Dubos and Thomas McKeown to criticize excessive claims for modern medicine. Yet while they were able to dismember demographic assumptions, they did not engage with the enduring appeal of penicillin which went even beyond its particular therapeutic value.

I explore the meaning of the promise of carefree healthiness that antibiotics seemed to give, in contrast to the more rigid discipline of prewar preventive medicine with its threats of incurable illness punishing the careless. The story of penicillin with its human roots and beneficial outcome seemed to resonate particularly for a post-war generation wishing to express change from prewar, and wartime, anxiety. The special use of the drug to cure the diseases of children was specially important. For the British the story of penicillin served too to express the relationship with the United States which had taken the discovery and exploited it to the advantage of American business.

This study is important for understanding historical change but also for finding ways of interpreting history for a wider audience interested in finding the meaning of its own past, and present, rather than in abstractions or facts. I shall explain finally the special importance of this perspective for a museum interpretation of the history of antibiotics.

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The Role of XIX Century Ukrainian Scientific Societies in Development of Microbiology

The emergence of microbiology, a new branch of natural sciences, was one of the brightest achievements of XIX century scholarly life. Due to joint efforts of the scientists from different countries, within a short historic period (from the 60 to the 80th of XIX century), an essentially new science, with its peculiar methodology and specific experimental basis, came to existence. Immediately, various applications thereof were found in different spheres of social life. Among the founders of this new science were L.S. Tsenkovski, I.I. Mechnikov, V.K. Vyskovich who worked at Kiev, Kharkov and Novorossijsk Universities.

However, to broadly spread the concepts of the new science and to promptly implement its practical applications, it was necessary to have a certain number of microbiologists, assisted in their work by the other specialists, and to secure a positive reaction of the various circles of society. University sciences, tied by a strict state bureaucratic regulations, would not have succeeded in resolving these issues without the assistance from public scientific societies.

Indeed, some profound microbiological theories, as well as practical applications, related to the vital functions of micro-organisms, were being developed by naturalist societies that existed under the auspices of universities in the cities of Kiev, Kharkov, Odessa, as well as in medical societies. Many agencies initiated by these societies such as laboratories, walk-in clinics, biological and Pasteur stations, later acquired the status of state institutions which until now deal with microbiology related issues.

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Biochemistry in Moscow Medical Faculty Clinics

At the medical Faculty of Moscow University (now Sechenov Moscow Medical Academy), teaching of all medico-chemical disciplines -ranging from pharmaceutical sciences to medical chemistry- started at the end of 18th century (including the episode of the attempt of clinical chemistry diagnosis during cholera epidemic in 1830). Russian biochemistry has been developing according to the "German model" until the turn of this century when, owing to the authority enjoyed by I.P. Pavlov, the holistic concept became predominant over the reductionist one. During that period, however, biochemical methods were used in clinics in accordance with the classical structure of medical biochemistry. This was particularly evident at the Medical Chemistry Institute of Moscow University's medical Faculty owing to the works of V.S. Gulevich who began reading the first special course of lectures on clinical biochemical analyses and who founded the best laboratory of clinical biochemistry where equipment and the procedures used were not inferior to those in the best clinical laboratories of Europe (materials of the Central State Historical Archive, Stock 418). After the death of Gulevich in 1933, this process came to standstill, and it is only when Ya.O. Parnas came to live in Moscow in 1941 and an Institute of Medical and Biological Chemistry was founded under the Academy of Medical Sciences that a new attempt was made to complete the construction of classical biochemistry in the Soviet Union but without Moscow University and Moscow Medical Institute.

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The Emergence of Biochemistry in Twentieth-Century Portugal

Biochemistry emerged as an independent scientific discipline in the 20th-century. Its first steps were given at the beginning of this century, a stage which may be considered as preparadigmatic, to use Kuhn's terminology. The first investigations in this emerging area date from 1850, but they were carried out in the context of either organic chemistry or physiology, despite certain difficulties in accommodating biochemistry in these established specialities.

The first attempts at an emancipation emerged in Germany in the framework of the existing research schools of chemistry and physiology. In the first case, we may single out the schools of Tübingen, led by Julius Schossberger (1845-1861), Fribourg, and the Institute created by Felix Hoppe-Seyler (1861-1872), in Strasbourg, France. In the latter, the schools led by Willy Kühne at Heidelberg, that of Albrecht Kossel at Marburg and Emil Fisher's in Berlin are mentioned as the most relevant.

From 1870-1880 onwards, England followed the German pattern, absorbing the tradition associated with the emancipation of physiological chemistry from physiology, which at the time was the leading tendency in the German States. At the beginning of this century, we find as followers of William Sharpey, key figures of British physiology such as Michael Foster, Francis Gotch or Edward Shäfer. The leading research schools were those of Cambridge and Liverpool, to which were associated Frederick Gowland Hopkins and Benjamin Moore.

In the Portuguese context the first attempts began in 1897 when Marck Athias, a physiologist and histologist trained in France by Mathias Duval, arrived in Portugal. Athias implemented a new mentality by changing the research practices of the Portuguese medical community and established proper research facilities and libraries. Following his example, other leading figures emerged, who marked decisively the path of biochemistry in Portugal from the 1920s onwards. In 1922, a private research institute was established, the Rocha Cabral Institute, over which presided Ferreira de Mira, a former disciple of Mark Athias. For almost half a century Ferreira de Mira engaged in fundamental biochemical research. At this Institute four sections were created, one of them devoted to biological chemistry. Kurt Jacobsohn, a former disciple of Carl Neuberg, at Berlin, was appointed supervisor of this section. He developed a research programme based on the German tradition linked to organic chemistry.

The Portuguese model followed closely the German, but from the mid 20th-century the scientific relationships with other European countries produced major changes : biochemistry became part of the *curricula* of the Faculties of Medicine, Pharmacy and Science of Lisbon, Oporto and Coimbra.

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Origin and Development of Biochemical Researches in Ukraine

Ukrain biochemistry origin was proceeding simultaneously with its formation in other European countries in the University Centres - Kharkov, Kiev, Odessa. The special role in biochemistry advancing within Ukraine was played by the scientists of Kharkov University, working at the Medical Chemistry and Physics Chair created as early as in 1863, among which the world-famous Professor Alexander Danilevsky. Here also some of the first manuals were issued (A.I. Khodnev-1847, D.I. Kurayev-1911), as well as some first practical guide-books (D.L. Davydov-1888) on Physiological Chemistry. Among the most famous initial researches, to them should be related the works carried out by A. Danilevsky in the field of protein substances (existence of peptide bounds, adsorption technique of enzymes isolation) and their functions (in the life processes manifestation - mobility, nutrition, growth, reproduction, sensibility, psychics). By means of P. Petrovsky's investigations the metabolism dependence on the central nerve system functional status was proved. V. Gulevich found *carnozin* and further on - *carnithin*, as well as tested the muscular extractive substances. In 1863, was opened the Medical Chemistry and Physics Chair at Kiev University, whose collaborators (A.I. Shcheffer, V. Kistyakovsky, A. Sadoven, S. Salazkin, B. Koldayev, M. Petrunkin) worked over the problems of blood biochemistry, nutrition, metabolism at starvation and thyreoidectomy. In 1901-1902, the Medical Chemistry Chair was established at the Odessky University, where the items of ammonia formation in the animal organism tissues were considered. In 1921 Alexander Palladin founded at the Kharkov Medical Institute the Physiological Chemistry Chair, and in 1925 - the Institute of Biochemistry which in 1931 left Kharkov for Kiev. A. Palladin, as well as his friends-in-arm and disciples - V. Belitser, R. Chagovets, D. Ferdman, M. Guliy laid down the following trends of science - Muscular Biochemistry, Nerve System Biochemistry, Vitamins Biochemistry, proceeding to be developed both in the Institute and other Ukraine biochemical laboratories. The Ukrainian scientists achievements in the field of the Functional Biochemistry, studying the process of proteins self-assembling on the model fibrinogen-fibrin, nerve system chemical topography and neurospecific proteins relate to the level of the fundamental ones, and brought to these persons the international acknowledgement, while their leader Alexander Palladin at the 1st International Congress of Neurochemists held in Strasbourg in 1967 was called as a Patriarch of the world Neurochemistry and in Milan at the IInd International Neurochemical Congress, held in 1969, was awarded by the Gold Medal "Provincia di Milano" for the especial honours in the advance of the Neurochemical Science.

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Between Chemistry and Physiology : Introducing Enzymology in Spain in the 1960's

Biochemistry as a field provided by physiological background and chemical tools was introduced in Spanish academia during the sixties through enzyme research. Training abroad of the scientists with academic and science policy support offered to them are the basis of the introduction of enzymology in Spain, at its beginnings mainly in research institutes rather than in the universities.

New tools and experimental systems were introduced through a process of which the main challenge was to establish biochemistry as an independent discipline in both medical schools and science faculties. Chemical and physical tools such as ultracentrifuge, and animal tissues and bacteria as experimental systems mixed the physiological vision of life processes with the study of chemical reactions of cell products.

Research at the bench was closely related to negotiations towards the creation of new research units and university chairs. Thus, scientists developed a twofold strategy, through both actions in favour of the development of the field and research result closely linked to their foreign mentors' cognitive concerns.

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From "Technical Biochelistry" to Bio-Technology (Russian Model of the Interaction of Science and Technology)

1. Until the early 20th century, Russian biochemistry was developing according to the "German model" (the major orientation toward meetings the needs of medicine). Since 1918 the situation had changed drastically : after a Biochemical Institute was established under the People's Commissariat of Health, the ideological basis for the development of biochemistry became the formula "immediate practical result". A.N. Bach introduced a concept of "technical biochemistry", and the program for its development became the basis for activities of the Institute of Biochemistry under the Academy of Science (second Soviet Biochemical Institute).

2. The second phase of evolution of Russian biochemistry was governed by the same ideological principles as the first, but biochemistry developed in a setting of smashing attacks on genetics in the Soviet Union. In this process, biochemistry (especially in teaching) played an important role in the preparation of specialists who made possible, in the 50th, the development of physico-chemical biology in the institutes newly organized at the Academy of Sciences and Moscow University the Institute of Bioorganic Chemistry (M.M. Shemyakin and Yu.A. Ovchinnikov), The Institute of Molecular Biology and Bioorganic Chemistry (A.N. Belozersky), and the Institute of Molecular Biology (V.A. Engelhardt).

3. The third phase (60s-80s) was associated with increasing of investments in new lines of research, with the construction of large biochemical centers, and with emergence of new themes for molecular-biological and biotechnological studies. The new structure of research was undergoing tests during a number of large conferences and symposia held in the Soviet Union with participation of outstanding scientists (including about 20 Nobel prizewinners) from many countries. It was recognized at these meetings that a set of sciences designated collectively as "physicochemical biology" was arising in Russia (TV debates held in Tashkent and Moscow in 1978).

This stage was also accompanied by the development of engineering enzymology and by the creation in Russia of modern biotechnologies.

The present study is based on analyses of the whole body of scientific literature in bioorganic chemistry and on examination of archival material.

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Biomechanics, Domain of Interactions among Natural and Technical Science

A pure science and an applied one, biomechanics studies fundamental aspects of mechanical phenomena in living matter, physiological implication and their applications in medicine and industry.

Now, the development of biomechanics is rapidly increasing and we can see that from number of publications concerning this field.

This paper tries to analyze moments of history of this discipline through works of engineers, physicians , mathematicians.

Beginnings of this interdisciplinary domain is related to great achievements of exact sciences. So we can mention works of Galilei, Descartes, Bernoulli, Euler, Coulomb, Young, Poiseuille. From Romanian scientists, there are important contributions of Fr.L. Rainer, V. Popa, E. Juvara.

The field of biomechanics is a large one, with a great number of base problems and a lot of applications in medical diagnoses and treatment, in sports, aeronautics, survival and adaptive behaviour at changes of environment of animals and plants, prothetic devices, some of these are science anticipation problems. Its development is correlated to progress of other pure sciences, but the implications are in both directions.

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Establishment of Clinical Teaching at the Medical Faculty of Moscow University

Clinical teaching at the Medical Faculty of Moscow University (now - Moscow Medical Academy) covers the first half of the 19th century, starting with 1804 when University's Statute was approved.

The first step was based on van Swieten-Stoerck's reform of university medical education in Austria. Moscow University's Medical Faculty was reoriented to prepare internists with the right to practice medicine. Three clinical institutes were organized with instruction in surgery, midwiferey, and internal medicine at patient's bedside. The development of a methodology for teaching internal medicine at patient's bedside and the implementation of this methodology at Moscow University's Medical Faculty are mainly associated with Professor M.Ya. Mudrov.

A major determinant of the transition from practical teaching to clinical teaching proper was the gradual introduction, between 1804 and 1845, of instruction in pathological anatomy which was at that time not only a mainstay of clinical medicine, but also made it possible to enlist data from other natural sciences in order to study diseases and search for ways and means of their diagnosis.

A distinctive feature of teaching pathological anatomy regardless of wether it was taught in the anatomy course (Ch. Loder, L.S. Sevruk) or in the courses in internal medicine and surgery (Mudrov, G.Ph. Sokolsky, A.I. Auvert, F.I. Inozemtsev), was emphasis on close links of the studied and demonstrated pathological changes with clinical manifestations of disease.

The wide introduction into the teaching process, in the 20s-40s of the 19th century, both of data obtained with the method clinical-anatomical correlation and of this method itself in the teaching of practical medical disciplines in the University clinics led to a substantial revision of the content of the courses for these disciplines, with progressive displacement of speculative theoretical constructs by new ideas built on the principles of natural science. The existence of a sound natural-science basis for the courses in practical medical disciplines in conjunction with the teaching of this disciplines at patient's bedside represent, in our view, the two principal criteria characterizing clinical teaching.

The year making termination of the period of establishing clinical teaching at Moscow University's Medical Faculty should be considered 1846 - the year when the faculty and hospital therapeutic and surgical clinics were opened at the University.

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A Journey through the Medical Literature of 19th Century India

This paper attempt to present a broad history of western medicine in nineteenth century India through the writings and works of some seventy five medical men - both European and Indian - of that century. Its aim is twofold; first to bring to the notice of scholars the richness of Indian medical literature of that period and its value for the study of social, political and economic history. History of medicine in India has been mainly the concern of medical men and the studies have been individualistic whereas the present paper tries to present a holistic view of the various facets of the medicine over a century.

Two major changes characterize the development of medicine in 19th century India (i). The medical pluralism of the earlier centuries gives way to the assertions of the western medicine (ii). Transformation of the early shipboard or shore based and ill trained medical man into highly literate medical practitioners/scientists. The medical literature too mirrors these changes.

How did the western medical men look at Indian medicine? How did they counteract the influence of homeopathy? How did they popularize western medicine? How did tropical medicine become a specialized study in Britain. These are some of the questions for which answers have been sought.

A survey of the medical literature shows that the early writings were concerned with the health of the soldiers.

As the century progresses and the influx of both medical men and European civilians increases, popular writings in a variety of forms appear. When an understanding of local diseases and finding local remedies became a necessity we find in the writings of medical men records of diseases prevalent in the country, their recognition and management mainly for the benefit of the new arrivals trained in Britain but unfamiliar with local conditions. The search for local remedies have resulted in the appearance of a number of materia medicas.

An excursion into the contributions of medical men to natural history, forestry, jail management, state of sanitation, medical topography, etc. makes a fascinating study.

While the rise of specialized societies and journals is one aspect of development of medicine another is the increasing participation of government resulting in formations of various commissions and committees. The scholarship of the authors of these reports is amazing. In short, this paper builds up the Chronicle of medicine in 19th century India by examining the literature grouped under the following heads : (i) Literature pertaining to Army (ii) Popular writings - for Mothers; instructions to Europeans in India, guide to Domestic chest etc... (iii) Hindu medicine - Books translated, commentaries on these; (iv) Materia Medica; (v) Reports and Manuals on Jails and Lunatic Asylums; (vi) Reports Medical Topography; (vii) Medical lectures delivered by men of medicine both in India and abroad to various societies; (viiii) Journal; (ix) Committee and Commission reports.

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Medical Discourse in Colonial Context : Public Health Care Policies in British India

In recent literature on "colonial" science, scientific discourse and practices in the periphery are often viewed as components of metropolitan knowledge and power or devices of control and subordination. Medicine and medical discourse in particular, are assumed to form important sets of those "grids" within which "colonialism" went about measuring, comprehending, and ordering the unfamiliar world of India. It is generally believed that Western medicine in India broke away from its enclavist origins and became a hegemonic project from the 1900s onwards. The basic premise underlying this kind of assumption is that "colonial" science represented a monolithic, homogeneous and efficacious project. Any analysis based on this notion of uniformity of ideological function of colonial discourse fails to grasp the dispersed and heterogeneous character of "colonial" science.

In this study, an attempt is made to highlight the conflicting perceptions regarding disease causation and evolution of health care measures in British India to bring out the heterogeneity of colonial scientific projects. It is traced how the environmental paradigm or the belief that uncongenial surroundings played an active role in the incidence and etiology of specific disease like malaria continued to find its adherents among researchers and public health workers in India in the first half of the 20th century. It is also shown how this theory was confronted by a new paradigm, the germ theory of disease. It became a powerful force in shaping ideas about the spread of tropical diseases in India from the late 19th century onwards and remained an essential comportment of colonial medical discourse in the 20th century as well. According to another view, undernourishment and illbalanced diet were the major causes of chronic ill health as well as high rates of infant and maternal mortality. The discovery of vitamins as well as importance of minerals provided the immediate context for development of dietetics and nutritional studies in the colonies. By the mid-1930s the Indian Research Fund Association sanctioned annual grant of one lakh rupees for nutrition research et Coonoor and the All India Institute of Hygiene and Public Health established in Calcutta in the early 1930s. A number of field surveys were carried out in Bengal during the 1930s and 1940s to investigate the general causes of morbidity. It seems reasonable to argue that the existence of different and often contradictory paradigmatic articulations on disease-causation at least partially explain the chequered growth of health care facilities in some provinces of British India including Bengal. A detailed analysis of the health care system as it evolved in this colony from the late 19th century onwards is presented here and finally it is shown how the failures of the health care department to tackle the severe famine-borne epidemics during 1943-44 led to a traumatic mortality experience in Bengal et the fag end of the British rule.

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Peruvian Bark Revisited : A Critique of British Cinchona Policy in Colonial India

The unfolding of British medical science in colonial India was, as recent studies indicate, gradualist in approach involving a cautious interference with indigenous cultures, gathering of epidemiological data, preventive measures mainly to protect military troops and European settlements, promotion of Western medical institutions and finally concentration on therapeutic intervention rather than an all-round health care undertaking to preserve public health. Reinforced by the emerging medical theories (i.e. bacteriology) and related industrial technologies, this medical science sought to create its own domain of control and authority despite occasional resistance from autochthonous societies. In so doing, this medical authority not only ignored traditional Indian treatise on health, diseases and remedies, but rejected as well the early European researches on the efficacies of Indian medicinal plants which had enriched Europe Pharmacopoeia considerably.

A case in point is the British propagation of the Cinchona plant in colonial India, the source of the wonder drug, once considered a panacea for malaria. Introduced with much fanfare in the 1860s in different parts of India, the success of this enterprise was conspicuously limited. Not only were traditional Indian disease-perceptions formulated in the *Ayurveda* regarding various conditions of fevers and their remedies contravened, but the authority took to notice of the studies of Indian medicinal plants done by the European scientists which were effective in the treatment of several diseases including malaria. The home authority, even, did not pay any attention to the appeal of the Agri-Horticultural Society of India for a trial of *Atibisha* (*Aconitum heterophyllum*) in the 1850s as an antidote for malaria.

The whole amalgam of the issues involved was not considered adequately in the recent literature of Cinchona cultivation in British India, nor was the failure of the enterprise properly examined. The writers highlighted the initial Anglo-Dutch rivalry over the transfer of the plant from the Andes to India and Java, the role of quinine in the European penetration in Africa and Asia, the cartel of Dutch, British, German and French companies to control the market and that the effort was mainly "to protect the health of troops and civil administrators". It has also been suggested that the British fiasco in India was due to the cultivation of the 'red bark variety of Cinchona (*C.succirubra*), whereas the Dutch captured the world market because of superior yield of quinine from the Ledger species (*C. Ledgeriana*). What is missing in even these recent writings is the fact that the best quinine-yielding variety of Cinchona (*C. Ledgeriana*) not only thrived in the Darjeeling region but its cultivation could be carried on to any extent in that area. However, the private planters ware more interested to grow tea than this Cinchona, a comparatively new crop which was also expensive to grow. Nor did the Government take serious measures to increase the supply of quinine in India through extensive cultivation of this variety of Cinchona. Quinine became a more and more expensive drug, "mostly beyond the purse of the common people". Thus, the British Cinchona policy in India remained an addition to the imperialist civilizing persona than a sincere effort to protect public health.

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Development of Nutrition Science in India and its Interaction with Agriculture and Food Science and Technology

Development of Nutrition Science and research in India dates back to the beginning of this century. In view of the widespread prevalence of malnutrition and nutritional deficiency diseases among its population, nutrition has formed an important component of medical research in India since 1918. Food and Nutrition related health problems of the country were closely studied over the past 9 decades by its medical and bioscientists with a view to understanding their etiology and to develop appropriate strategies to combat them. Attempt to combat malnutrition and undernutrition amongst the vast majority of the country's poor population has largely shaped its agricultural and cropping policy. Development of Food Science and Food Processing industry has also been largely geared to solve the country's nutrition problems. Historical perspective of linkages between Nutrition-Agriculture and Food Science and Technology over the past nine decades will be discussed in this paper.

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The Modern Chinese Biology and the Rockfeller Foundation

The Rockefeller Foundation, established in 1913 by John D. Rockefeller, had made over 30 years philanthropic endowment to China on a large scale with a large amount of money from its earliest years to 1951, when the PUMC (Peking Union Medical College), a model medical school in Asia, founded and administered by the CMB (China Medical Board after 1928, CMB, Inc.), was taken by the China government. Although beginning its activities in China with medical care and medical education, and the main objective of the RF was not aimed at the natural science, it had really made an indelible role on the transfer and early development of the modern biology in China.

Due to the speciality of biology and the RF's policy to China, biology in China had got comparatively stronger financial support from the RF than that in other fields of natural science. With the RF's grants and fellowships, departments of biology in some leading universities were equipped with nice plants and excellent teachers who returned after finishing their professional training abroad and really had played important roles in both biological teaching and research in China. On the other hand, the unique superior conditions and high standard of the PUMC made some first rate researches related to biology be carried on prominently there. The financial support to the Chinese agriculture colleges and relative projects which coincided with the RF's China Program in 1930's made applied biology develop rapidly as well. Furthermore, the RF's coordinations with the China Foundation for Promotion of Education and Culture, founded in 1924 with the indemnity money, had enabled both basic and applied biology to get necessary financial support which was critical to their maintenance and development in China.

Though the aid of the RF had to be reduced during the World War II and suspended by historical reasons later, its role and influence to the modern Chinese biology should not be neglected, at least when we consider such two facts that many of the Chinese biologists who had relationship with the RF in the past have taken the leading roles in the Chinese science after 1949, and that the RF has resumed its financial aid to China since 1980's.

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Genetic Laws of Nature Published by I. Festetics (Brünn, 1819). Antecedents of the Mendelian Revolution (Brünn 1865-1900)

The former director of Mendelianum, Moravian Musem, Brno, identified around 1988 a document of interest for the history of genetics (V. Orel, Personal Communication). The *New Explanations of Count Emmerich Festetics Connected with Inbreeding, 61. Discussions. Sheep Breeding* has been publisbed in Oekonomische Neuigkeiten und Verhandlungen, 1819, vol. 22., Brünn.

Imre (Emerich) Festetics (1764-1847), was the brother of George Festetics who organised the agricultural science education in Hungary. The family was famous in animal breeding. The above mentioned paper belongs to a series of articles published by I. Festetics in the local *Economical News and Proccedings*, a scientific periodical edited in German by a French free thinker. The journal was a forum for the society of natural scientists from Brünn (now Brno, Czech Republic), where I. Festetics was still a member, when the young G. Mendel arrived there.

Festetics formulated clearly in his paper a passage entitled *The Genetic Laws of Nature*, as follows :

a. "*Animals with a strong and healthy constitution transmit their specific characters to their offspring's*",

b. "*Those characters of the grandparents, which differ from that of their direct offspring's will reappear in the next generation*",

c. "*Among the animals which are in possession of specific characters for generations, may emerge individuals with contrasting characters. These are varieties (sports),* lusus naturae *not suited for further reproduction, if the goal is the transmission of specific characters required for breeding*".

d. "*In the case inbreeding a condition is the most careful selection of the animals kept for breeding*".

The paper also deals with inbreeding and pair selection among animals and humans (phenomena termed now *inbreeding depression* and *heterosis*), the complexity of the hereditary phenomena especially if behavioural characters are also considered (e.g. in horse breeding), differences and similarities between *artificial and natural selection* with examples of Hungarian traditional cattle breeding practice. Finally argues briefly on difficulties in case of plant reproduction and plant breeding. So Festetics anticipated roughly some of the *Mendelian Principles* almost half a century, without mentioning, of course, the factorial inheritance, but dealing with *mutations (sports), natural and artificial selection, inbreeding*, and even what we term now *dominance, heterosis, evolution* and *eugenics*.

The concepts of Festetics were related both with post-Lamarckism and pre-Darwinism. His thoughts fitted in the series of pragmatic ideas circulating among animal and plant breeders of the time, such as Knight, Vilmorin, Galesio and many others. He was also dealing with complex characters and meditating about "blending inheritance".

What makes the position of I. Festetics quite peculiar is his close contact with the Mendelian scientific circles. It seems that Festetics was among the firsts, if not the very first in this circle, who :

1. anticipated clearly and termed first as *Genetic Laws of Nature* the hereditary phenomena observed in consequent generations (47 years before Mendel),

2. used first the term *Genetic* for the scientific designation of heredity (about 80 years before Johannsen and Bateson),

3. argued for the *importance of genetic laws for selection* (*and implicitly in evolution*) of the different groups of interbreeding (inbreeding, outbreeding) organisms.

It is still an open question, why Mendel (a very clever scientist, interested also in evolution) did not mention Festetics at all. There are many possible reasons ranging from scientific rigidity of a pea breeder up to antipathy and/or fear quite characteristic for the period following the oppression of the Hungarian Revolution (1849).

Section 8.6 :

Technology and Engineering in the Contemporary Period (since 1800)

Special session of section 8.6 :

Scientists, Soldiers and Manufacturers

Zimmerman D.

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Responding to the 19th Century : The Royal Navy and Technical Change

There is an enduring myth that the world's navies were reactionary, or a best unduly conservative in their handling of technical change in the nineteenth century. This, it is argued, was symptomatic of a large hierarchically structured bureaucracy which was opposed to change in any area, from uniform regulations to weapons systems.

This view is reflected in the work of historians of the liberal progressive school, for whom conservatism in technology, as in politics is the mark of an unthinking and bigoted reactionary. They contend that, had the world's navies been more adventurous, progress would have been more rapid, and more economical.

It is argued that in the long nineteenth century (1815-1914) the Royal Navy was the most conservative of all the major navies. allowing France, the United States, and even Russia to take the lead in applying new technology to warship design. Clear cases are made for Admiralty failure to deal with steam power, the screw propeller, iron ships, armour plate, turrets and a host of other issues. France is usually cited as a nation with a far sighted and technically positive approach.

The core argument against this approach will be provided by a case study of the Royal Navy's adept handling of the development and introduction in front line service of the screw propeller between 1837 and 1852. The Admiralty pushed the private sector to develop and demonstrate the system, then starved it of funds, bankrupted the patentees and secured full patent rights to the system just as the technology matured, and only months in advance of the transition to an all screw powered navy in 1852. Far from attacking the Admiralty for undue conservatism Isambard Kingdom Brunel was convinced the Admiralty had defrauded the patentees.

In Conclusion : the self serving, politically naive and technologically determinist accounts left by nineteenth century engineers, who wished to portray themselves as high minded servants of humanity, have been taken at face value for too long. There is no evidence to support their contention, the Admiralty was technologically dynamic. adopted a professional approach and handled the massive change in the nature of naval technology between 1815 and 1914 with a sure touch. There were few examples of failure, and the most significant of those, the Captain disaster of 1870, was brought about by politicians deciding override the professional advice provided by the Admiralty in favour of a visionary project. France, by contrast, started four technically based arms races, and lost every one within five years. Because the Royal Navy was central to British Strategy the Admiralty had to be certain that it could meet its commitments, and to do this it could not afford to take any risks with the core of the navy, the battlefleet. Britain won the naval races because it had secure long time finance, superior industrial resources and above all, stable political support.

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Reflections on the Interaction of Military, Scientific and Industrial Institutions

Innovations in military technology have had profound sociopolitical consequences throughout history. Recent controversies over the early modern military revolution have tended to focus on the precise nature and timing of military change. But the thesis has another side often neglected, the great transformations in the Western social, economic and political order that flowed from changing military technique. Relatively narrow technical changes in weapons and tactics on early modern European battlefields not only transformed armed forces but ultimately demanded that reorganization of Western society, economy and polity. This essay centers on part of that reorganization : aspects of the interaction of military concerns, values and attitudes with scientific and industrial institutions in the 17th, 18th and 19th centuries.

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The Radar Defence System and British Manufacturing, 1935-41

In the Battle of Britain the radar defence system allowed the Royal Air Force to detect attacking Luftwaffe bombers and vector in fighters to intercept them. It was the most technologically sophisticated defence system in the world up to that time, and it played a crucial role in the British victory. Although the significance of the radar system has long been noted, there has been little examination of its construction. It was a remarkable accomplishment, in five years British scientists and engineers created the technology, designed the system and supervised the construction of over 60 different radar stations, plus numerous ancillary operations. Yet, the relationship between the scientists and British Industry was perhaps the least satisfactory of all aspects of the program. In the end, the failure to fully cooperate with industry lead to the most significant deficiency of the defence system - the inability to intercept night bombers.

Until late 1939, most of the development work for radar was done in government laboratories, the most famous being the Bawdsey research station. Industry was simply contracted to build individual components, and was not informed of their eventual use. Bawdsey was particularly weak in industrial development expertise and the performance of certain equipment such as transmitters for the Chain Home Low Radar, suffered as a result. One technology that foiled the Bawdsey scientists was the manufacture of an effective Airborne Interception radar. Only when it became clear that the government team had failed to find a workable solution to numerous technological shortcomings in their first generation AI sets was the problem turned over to a private electronics company - EMI.

EMI began work on AI in December 1939 and had perfected a practical AI radar by July 1940. Unfortunately, the nighttime Blitz started before more then a few of these sets were operational and British cities laid open to attack. It was only in the late spring that sufficient number of the EMI AI raiders were in service that German bombers began to be shot down in appreciable numbers. This paper will examine this complex and controversial relationship.

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Making Missiles and Making them Work : The Electronic Analogue Computer, an Instrument of Science and War

In missile science, a largely forgotten computing technology - the electronic analogue computer - played a significant role in redefining the possible. In the USA and Britain, military funded programs drove forward the development of electronic analogue computers. In the USA in the late 1940s, the Office of Naval Research (ONR) funded, via project Cyclone, the development of the first commercial electronic analogue computing system. By the late-1950s almost every major military aircraft and missile R&D facility, as well as every major commercial aero-space company, had its own electronic analogue computer installation.

The cold-war raced to make missiles and space rocket that worked, pushed against the boundaries of science and technology. The missile science of the 1950s and 1960s was largely experimental and empirical. Electronic analogue computers enabled complex aero-dynamic systems to be simulated. They took abstract mathematical statements and transformed them into physical experimental tools, in which parameters could be easily and rapidly varied and the results observed immediately. They reflected, and appealed to, an empirical tradition in science and engineering. In a circular manner they helped bridge the gap between theory and practice, extending the limits of both.

Economics and safety were also important consideration. The test-firing of real missiles and rockets was expensive and hazardous. Computer modeling meant that missiles could be launched hundreds, even thousands, of times in simulated space, with relatively low costs and with no risk to personnel.

Section 8.6.1 :

Technology Transfers, Metallurgy, Electricity and Information Technologies in the Contemporary Period (since 1800)

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Un enfoque actual de la tecnologia

La ponencia postula la definición de la tecnología como una "fuerza productiva social". Esboza las diferencias entre esta caracterización y los enfoques propuestos por otras corrientes. Analiza la doble finalidad de la tecnología, su componente universal y sus rasgos derivados de las leyes del capital. Explica porqué la factibilidad técnica y la viabilidad económica de la innovación dependen del proceso de valorización. Distingue la tecnología de la técnica por el uso de procedimientos científicos y la incidencia del criterio de rentabilidad. Considera que la tecnología está más directamente configurada que la ciencia por los requisitos de la acumulación. Partiendo de estas definiciones, señala cómo las culturas tecnológicas están configuradas por la ideología de las clases dominantes y propone analizar el significado social de la innovación en relación a los conflictos de clase. Formula una propuesta de utilización social provechosa de la tecnología partiendo de un proyecto emancipatorio. Finalmente el autor plantea una hipótesis sobre el lugar de los estudios de la tecnología en las ciencias sociales y naturales.

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La "science industrielle" selon Henry Le Chatelier (1850-1936) : un modèle français d'organisation rationnelle des relations entre la science et l'industrie?

Les sociétés occidentales voient au tournant du siècle s'accélérer ce que Max Weber décrit comme un processus incessant et inéluctable de rationalisation. Mais c'est l'organisation sur le mode scientifique des relations entre la science et l'économie industrielle qui tient indéniablement le premier rang des schémas envisagés.

Au milieu du foisonnement des modèles proposés, Henry Le Chatelier, un ingénieur français et polytechnicien au corps des mines, figure emblématique, élabore son projet intellectuel visant à associer les deux entités. L'adjectif intellectuel annonce que l'accent est mis sur le développement de sa pensée et que seules sont mobilisées les données susceptibles de l'éclairer.

Henry Le Chatelier est en effet un militant très actif qui voue intégralement sa carrière à un tel projet. En outre, son implication dans le contexte économique et social est totale : il est, en accord avec son modèle, le divulgateur en France et la caution scientifique auprès des industriels du taylorisme.

Sa proposition d'organisation rationnelle de la production, tant technico-scientifique qu'industrielle, qu'il désigne lui-même par "science industrielle", s'élabore au fil des années, rythmée par chacune des étapes de sa carrière. L'exploitation des archives privées de Henry Le Chatelier récemment mises à la disposition des historiens permet d'expliciter avec toute la précision requise l'évolution de sa pensée.

Pour autant, la communication sera synthétique, c'est-à-dire qu'elle proposera une définition. Il s'agira de préciser les six éléments principaux constitutifs de la science industrielle :

1. L'élaboration de discours types, traduction des représentations que se forge Henry Le Chatelier des relations nécessaires entre la science et l'industrie.
2. Ses objets et les matériaux mobilisés pour constituer un ensemble de connaissances, de méthodes et de savoirs spécifiques.
3. Les acteurs désignés pour les accueillir et les mettre en oeuvre dans le cadre de la production.
4. L'enseignement de la science industrielle.
5. Les lieux indiqués où elle peut et doit être mobilisée.
6. Enfin, les mécanismes d'organisation entre eux de ces éléments qui permet de déterminer la science industrielle comme une science à part entière.

En dernière instance, la science industrielle exigera une mise en perspective avec les modèles existants. On posera donc la question : dans quelle mesure la science industrielle est-elle l'écho d'un modèle français d'organisation des relations entre la science et l'industrie, ou au contraire n'est-elle que l'expression tout juste personnalisée d'un modèle qui se prétend universel?

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Industry and Industrial Relations within the Laboratory

The relationship between science and technology is often seen solely as one concerning either the transfer of ideas and concepts or as one of a general availability of techniques and instruments without specifying the process of transmission in detail. In the science of thermodynamics this kind of relationship is usually condensed into the phrase that "Science owes more to the existence of the steam-engine than the steam-engine does to science". In this paper I will try to show that this sentence can be extended to express a deeper meaning than that generally acknowledged. The joint experiments of James Joule and William Thomson (Lord Kelvin) done in the 1850s will be used to illustrate the close relationship between science and technology/industry in Victorian England. Then and there, the steam-engine - the very symbol of the industrial revolution - enters (for the first time) the laboratory, not as an object for investigation but as a central part of an experimental apparatus used to study important property of gases. The experimental apparatus as a whole, and not only the highly sophisticated instrument (thermometer), reveals that (still in the 1850s) "there was much coming and going between the laboratory and the workshop" (Ashton, The Industrial Revolution, 1948). But the reasons why the steam-engine was introduced into the laboratory were not purely material ones. As in industry it had also much to do with the role and status of manual work within the production process; in the laboratory: the production of scientific facts. I will therefore consider in detail the role of unknown "helping hands" in those experiments. These insights presented in this paper and their consequences for our view of "science as practice" are results gained by a "replication" of the experiments i.e. a re-performance of the original experiments. Thus, I will also attempt to explain the relationship between the results obtained and the method used.

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Gilles Holst Stimuled Technology Oriented Physics, how?

Holst was director of the Philips Research Laboratories, the so-called "Nat. Lab." (Natuurkundig Laboratorium) from 1916 till 1946. During these decennia the Nat. Lab. was successful in many fields: for instance in tv-technology and in the field of the semi-conductors. At the same time, the Nat. Lab. had a strong attraction on physicists and other scientists of high level (Van der Pol, Tellegen, Dorgelo, Postumus, Bouwkamp, Bremmer are examples from the time before WW II). During a long time, they preferred to do science in the context of the Nat. Lab. to working at a university.

Therefore, it is an interesting question how Holst succeeded in fascinating those scientists of high level and at the same time making them do useful work for Philips. My paper focuses on Holst's effort for tv-technology. From my analysis it will become clear that Holst's judgement followed three levels. (a) First of all, he decided about the question whether or not a new technology would fit with Philips as a company. Crucial was, that form the beginning of our century Philips tried to become a mega-concern. (b) He also wondered, if and how society would accept the technology. While this acceptation was still unclear, he kept considering alternative technologies. (c) In the third place he wondered, what aspects of the new technology could be developed further in a competent way due to his division of labour in the Nat. Lab.

Indeed we can recognize these levels of Holst's consideration in the context of the tv-technology: in 1929 the television did not yet fit into the scope of the company. In 1936 this has become the case, but Holst remains doubtful with respect to the realization of the required impact (the broadcasting of programs by non-industrial organizations). That is why he still held the home cineac for feasible. Chemists like Dippel worked on this. But at the same time he kept an army of scientists working on the various detailed parts of the tv-equipment. The relevance of their work was made visible by gifted engineers (like Rinia), who demonstrated with practical designs what technology possibilities had to be improved. Holst himself guarded the issue of the selection that society was making.

However, favourable circumstances were, that a lot of money was available for expensive experiments and that the organization was not very bureaucratic.

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The Modernization of China's Mechanical Engineering under the Influence of the West (1581-1985)

From 1581 onwards, Jesuit missionaries introduced the European technology into China. Since the 17th century, European style clocks were made in China, but the Western mechanics was hardly adopted.

After China had lost the Second Opium War in 1860, the government had to permit pro-western officers to import machines and technology from the West to establish factories engaged in weapons' and steamships' manufacture although conservatives strongly opposed it. Later, small privately-run factories emerged. They learned how to produce modern machines. From 1872, some young people were sent to the USA and Europe to study modern technology.

In 1895, Zhongxi University in Tianjin initiated its department of mechanical engineering. By 1936, 17 universities had opened a mechanical course. China Mechanical Engineering Society was founded in 1936. Engineers could make experiments on machines in simple laboratories since the 1930s. The establishment of higher-learning and academic institutions was a sign that modern mechanical engineering was initially systemized in China.

Since 1914, official factories continued making or assembling ships, trucks and machinery. Encouraged by the government of the R. China, privately-owned factories also improved their copying technology.

After 1931, the government decided to import technology and set up state-owned fundamental industry. Unfortunately, the plan mostly failed to materialize because of the Japanese invasion against China and the civil war. In 1950, China could only make some ordinary machines.

In the 1950s, China imported technology from the former Soviet Union and followed the Soviet model to set up systems in research designing, manufacture and education, so that it was able to produce major machines. The government of the P.R. China focused on development of state-owned factories and gradually transformed private businesses to state-owned assets. In the 1960s, China depended on itself to improve its technology. Its research centred on large sets of equipment. But such political movements as the Cultural Revolution delayed technical improvement.

Even since China practised reform and opening-up policies, it has introduced technology from the West again and started new research to improve crucial equipment. The most of China's mechanical products had been made domestically so far. But on the whole, the introduction of technology is still in the stage where it copies foreign technology. Compared with advanced countries, Chinese products are less admired.

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Social Structure of Technology-transfer from Bergakademie Freiberg to Meiji-Japan

1. Foreign Engineers in the Service of Meiji-Government

As it is well known, many foreign engineers were hired by Japanese government during the earley Meiji Era. Their roles in the introduction of modern technology and science to Japan have been well recognized. H. Dyer set up the Koobu-daigakko (Koobu Technische Hochshule) with one of the most idealistic technical education program at that time. Many excellent engineers and instructors, for example, W.E. Airton, J. Condor, J. Milne, J.A. Ewing, E. Divers, C. Netto, E. Naumann, B.S. Lymann etc... contributed to the establishment of advanced technological education .

Foreign engineer did not only teach but also took active part in construction and production processes. R.H. Brunton built many lighthouses, H.S. Palmer constructed watersupply-system et Yokohama, E. Morell designed and constructed the first railroad in Japan, and so on. The number of these foreign experts during the Meiji era exceeds 1000. Koobusho, Ministry of Industry, alone employed 588 foreign engineers by 1885.

2. Bergakademie Freiberg (BAF) and Making the Meiji Professoriate

Situation in the fields of mining and metallurgy was not different. After being taught by the foreign instructors at the Koobu-daigakko and Tokyo University, graduate students went abroad, first to England, then to Bergakademie Freiberg to further their studies. They became professors after returning. To visit Freiberg became a precondition to become professor. The number of Japanese students at Freiberg reached 45 before WW II. The curricula of the mining and metallurgy courses at Tokyo University were based on the Freibergs, while Akita Mining Hochshule was founded after the model of BAF.

3. Social Context and Technology

Japanese students who visited Freiberg stood at the top of the educational hierarchy and played leading roles in the technological development of mining and metallurgy in Japan. Their research tendencies and interest were shaped by social and political contexts of their period. They had little interest in the mining hazards, which presented a big social problem. They could study this issue at BAF, if they had wanted. In Freiberg, hazards constituted a big problem, and Prof. Winkler was doing research on this problem. There were Japanese who were taught by him, but they did not study this problem. We can see here the side of social construction of technology. Koobu-daigakko itself was absorbed by Tokyo University in 1886, then lost its practical feature. H Dyer, then in Britain, regretted for this absorption. Further, Koobu-ministry, which founded Koobu-daigakko and oriented, it was a product of political conflicts within the Meiji government.

4. Shaping of Technology

The sect composed by Satuma and Choshu within the Meiji government, which founded Koobusho, had close connection with Britain, therefore the instructors at Koobu-daigakko were mainly from Britain, and the graduate visited there first. Afterwards the destination was changed; in mining to Freiberg. In the civil engineering , most engineers came from Britain, and they had close connection with political lobbies. R.H. Brunton had to compete with C.J. van Doorn from Netherlands, who got supports of another political lobbies. Doorn succeeded in spite of weaker political support for him, as his techniques proved to be more efficient.

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The Life and Creation of Russian General of Flemish Origin P.A. Huysmans (1853-1919)

General Platon Hussman (Huysmans) was descended from the family Huysmans, which lived near Antwerpen until 18th century. His great-great-grandfather Iva Huysmans (1738-1772) was prime major in Duke Golshteensky forces; then passed in Russian army.

Platon Huysmans was born in Moghilev in I853. He has finished Kishinev classic school with gold medal in 1870. He took part in the Serbia-Turkey war and Russia-Turkey war (1876 - 1878). He finished S.-Petersburg Military College in 1881. Became Professor of this College in 1892, Professor Emeritus in I902, General officer, member of Military Council in 1915. Service man, military historian, theorist of the army, Platon Huysmans had more of 100 scientific works - articles, monographies, manuals of forces tactic, history of Slavo - Turkey fight, history of the art of war, history of Russian General Staff.

After the October 1917 revolution in Russia he was in resignation then lectured in Petrograd University, but a long time did'nt receive his pension. He died at one's post in January 1919.

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La influencia de las Escuelas de Armeria de Liège y Saint Etienne en la creación y posterior desarrollo de la Escuela de Armería de Eibar

Durante la primera década del siglo XIX, en la ciudad armera de Eibar, se sintió la necesidad de establecer la Prueba Oficial de Armas y a su vez crear un Centro en el que se impartieran enseñanzas profesionales que, acordes con su industria, fueran más allá de las que ofertaba la Escuela de Artes y Oficios que había sido creada en 1902.

El ingeniero P. Alzola, en un discurso pronunciado en Eibar en 1908 abogó por "una Escuela de Armería como en Bélgica", algo que se haría realidad cuando el industrial y concejal de Eibar P. Goenaga, al que se considera como "iniciador de la Escuela", conoció la Escuela de Armería de Liège. En efecto, Goenaga, tras visitar varias Escuelas profesionales (entre ellas, la Escuela de Artes y Oficios de Barcelona y la Escuela de la fábrica de maquinaria de Loeme en Berlín), el 7 de junio de 1911, asistió a un Congreso de Banco de Pruebas en Liège, visitando la Escuela de Armería de esta ciudad; este Centro, según sus propias palabras, "llamó poderosamente su atención" de modo que a los pocos días de su regreso a Eibar, el 23 de junio, hizo saber a un grupo de eibarreses, en presencia del entonces Ministro de Fomento Fermín Calbetón, que la Escuela de Liège era sin duda el modelo que había estado buscando.

Según las fuentes del Archivo Municipal de Eibar, en sesión del 1 de julio de 1912, Goenaga, apoyado por otros miembros del Ayuntamiento, presentó una moción en la que se pedía la creación de una Escuela y un Museo de Armería. La Escuela empezó su andadura el 6 de enero de 1913, y el Museo de Armas se inauguró el 24 de junio de 1914. La redacción del Reglamento, y los Estatutos asi como la elaboración del primer plan docente se llevó a cabo teniendo en cuenta los de la Escuelas de Liège y Saint Etienne. Durante los años sucesivos, la Escuela de Armeria de Liège siguió siendo un referente importante en la toma de decisiones que afectaban al desarrollo de la de Eibar.

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Science, Technology and the Armaments Industry, 1850-1914

This paper examines the science and technology of naval armaments, and the growth of the naval-industrial complex in Britain between 1850 and 1914. The development of modern industrial naval armaments took place in two stages : between 1840 and 1880, when sail and wood gave way to steam and iron in ships while smooth-bore, muzzle-loaders were replaced by rifled, breech-loaded ordnance; and from 1880 to 1914, when developments in chemistry, electricity, metallurgy and machine engineering raised naval power to unprecedented heights.

The Industrial Revolution in armaments was carried out mainly by private entrepreneurs; government arsenals contributed relatively little to the major innovations. Hence, when demand for naval armaments rose sharply after 1880, private armaments businesses grew rapidly into vast industrial enterprises of great economic and strategic importance.

The technological and financial realities of the armaments production demanded a new relationship between the state and private armaments companies. In Britain a naval-industrial complex emerged in the 1880s whereby private firms, once ignored or abused by state arsenals, now had to be incorporated into a general state-private system of armaments production and innovation. This was resisted the War Office arsenals. At the same time international competition prompted the British government to establish a "political-industrial complex" with private armament firms, in which the Foreign Office became more directly involved in selling naval armaments abroad both as a matter of grand strategy and to maintain armaments production and industrial research at home.

The paper is based on research into the armaments company of Sir William Armstrong, a British entrepreneur of exceptional technological virtuosity, business ingenuity and political acumen, who played a leading role in the militarization of science and technology, and who transformed his small engineering firm into a major armaments company with sales around the world.

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Portuguese Engineering and the Colonial Project (1870-1914)

When colonial nations do effectively want to take possession of their territories they sent overseas their engineers.

Revista de Obras Públicas e Minas, 1899

This paper aims at re-thinking the identification of the Portuguese project of modernization within the European context, and the concept of a *mission civilisatrice* underlying the effective occupation of African colonial territories, as voiced by the *Revista de Obras Públicas e Minas*, the journal of the Associação dos Engenheiros Civis Portugueses (Portuguese Association of Civil Engineers).

The new redistribution of colonial territories, which had been anticipated since the 1870s, and culminated with the Berlin Conference (1885) was an attempt at imposing the effective occupation of those territories based on a right to possess instead of the traditional historical right. This situation led to the formulation of a project of real consolidation of the Portuguese presence in Africa. The key element of this project was the identification of the process of occupation with the concept of a civilizing mission, based on the transfer of national science and technology to African possessions. The territorial occupation was crucial and the privileged means were the expeditions and engineering works.

Throughout the 1870 decade, the interest of the great European powers in their overseas territories grew; the Portuguese missions reach their peak with the campaign of Capelo and Ivens (1877-1880), within the framework of the recently created Sociedade de Geografia (Geography Society) (1876). In this way the process of effective occupation takes form.

In this context already in 1882, the first article on railways to be built in the Portuguese African colonies is published in the *Revista de Obras Públicas e Minas*. Authored by Joaquim Machado the article was entitled "Memória acerca do caminho de ferro de Lourenço Marques a fronteira do Transvaal" ("Memoir on the railway from Lourenço Marques (Mozambique) to the Transvaal border") and its first chapter had the suggestive heading "Necessidade de Construção dos caminhos de ferro para a civilização de África" ("The need to build up railways in order to civilize Africa")

Following the Berlin Conference, and in particular the failure of the Pink Map (1886) which led to the British Ultimatum (1890), the articles focusing on the need to intervene through engineering, especially through the construction of railways in the Portuguese colonies in Africa, proliferated. The technological dimension was revised within a patriotic and civilizing matrix, where the project of modernizing the nation mingled with the effective possession of colonial territories.

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The Contribution of the Civil and Military Engineers in the Development of the Machines' Mechanics in the 19th Century in Russia

The arising of machines' mechanics (applied mechanics) as a science is closely connected with the high technical schools, in the first term with the Petersburg Institute of Means of Communication, founded in 1809. Then it was connected with Petersburg Technological Institute, Sea Academy and the other Petersburg and Moscow institutes. The development of this science began from working out (designing) the theory of steam engine. The new areas of this field started with applying the steam engine on the transport, first on vessels, further on railway. The engineers P. Melnikov, N. Jastrgembskij, N. Sokolov, A. Dobronravov, N. Bogerjanov and others have made the vast investigation in this field. Their work has led to creating the kinematics of mechanisms. This subject was introduced as a compulsory item in the curriculum.

In the second half of 19th century, the analytic and graphic methods of investigation penetrated into the machine science. The differentiation of this subject was being started. The theory of machine was being developed not only owing to the university graduates such as A. Ershov, P. Chebyshov and others, but also owing to the civil and military engineers. Many engineers including N. Brashman, I. Vyshnegradskij, N. Petrov and others worked over the problems concerning the structure of mechanisms, the theory of friction, the details of machine.

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Patents and Licenses in Interwar Czechoslovakia (1918-1938)

Statistical data on the number of patents and licenses applied for and granted, and on the purchase and sale of patents and licenses in the balance of payments, can to a certain extent serve as an indicator of the overall level of the technical-economic potential of interwar Czechoslovakia. For the most part, however, this data is fragmentary and not very precise, as well as often exceedingly difficult to obtain. The preponderance of German applications and patents at the Patent Office in Prague, was the result not only of the geographical proximity of Germany, the place of the German economy in the European and world economies, its research base and previous development including its ties to the former Austro-Hungarian monarchy, but also of the attention devoted by German firms to patent protection. The large-scale participation of foreign applicants for patenting in the CSR also shows foreign interest in patenting results guaranteeing profitability and profits, and therefore in the protection of generally binding and useful patents, and likeside integration of the CSR into the world community. In some important branches of modern technology inseparable from the development of such areas as electrotechnology and measuring technology, Czechoslovak research did not achieve results comparable with those gained abroad, or achieved them only in the initial phase (electrotechnology), and did not have the financial resources for further research development. The passive balance of the trade in patents and licenses was linked to the efforts of Czechoslovak economic experts to acquire foreign technical knowledge and technology. Only some partial aspects of technical level and progress are reflected in patents, since not everything can be patented and the maintenance of secrets in production technology also plays its part.

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Inventivité technique et naissance d'industrie innovante en Belgique, 1860-1910

Notre contribution porte principalement sur la ville de Huy, située le long de la Meuse à quelque 30 km de Liège, mais nous nous efforçons de dégager des leçons générales de cette étude de cas. Une localité comme Huy, fleuron de la vieille sidérurgie wallonne d'ancien régime, a été marginalisée de manière radicale par le développement du bassin de Liège durant la première révolution industrielle. Pourtant, elle est un des lieux où se construit ce qui, malgré divers débats, est couramment qualifié de "deuxième révolution industrielle". Nous la définissons par la production relativement massive et à moindre coût de produits manufacturés "finis", directement destinés à la consommation des ménages.

Dans ce processus, l'inventivité technique est une composante fondamentale, dans l'ensemble bien connue grâce aux volumineux registres qui collationnent les brevets. Cette documentation identifie les auteurs et décrit leurs outils de base aussi bien que leurs apports. Nous en proposons une typologie et une analyse d'où ressort le portrait en apparence confus d'une multitude de petites innovations qui, généralement, n'ont rien de bouleversant. Pourtant, ce sont elles qui permettent à un artisanat au départ classique, d'accroître sa production et de diminuer ses coûts tout en rencontrant une demande bourgeoise certes croissante, mais aussi très exigeante. L'introduction continuelle de nouveautés se réalise en outre avec la complicité -le mot n'est pas trop fort- d'une main-d'oeuvre d'élite qui s'en trouve d'autant plus valorisée.

Comme historien de l'économie et de la société, nous nous efforçons de recomposer la genèse complexe, à la fois familiale, socio-économique et culturelle, d'une structure nouvelle, fondée sur une inventivité intégrée et non imposée, qui fut admirable par sa cohérence et son harmonie. Mais qui n'a cependant constitué qu'un intermède fragile, un stade transitoire dont les succès tant techniques que économiques ont été la cause évidente de sa propre destruction. Quand les petites et moyennes entreprises dynamiques et innovantes se sont transformées en véritables industries, elles sont entrées dans un système de production de masse et ont introduit une distanciation beaucoup plus grande entre dirigeants et ouvriers. Cette double prolétarisation des travailleurs fut toujours très mal perçue et a produit assez souvent des conflits sociaux suicidaires.

Edmund N. Todd
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Coalition Technology : Implementing Purification and Power on the Ruhr, 1920-1930

Building large-scale technological systems in Germany during the 1920s involved resolving political and technical problems. Combining functions was common. Water purification companies, like the Ruhrverband (Ruhr association), built coalitions to make purification pay for itself. They sold by-products like sludge and methane. If they built settling basins in rivers, they promoted other uses of the facility like bathing, fishing, and electric generation. Successful power companies like the Rheinisch-Westfälisches Elektrizitätswerk (RWE) in the Ruhr combined town and county systems into ever larger regional systems. During the 1920s, the RWE expanded out of the Rhineland to connect hydropower in the Alps with coal-based systems in northern Germany. To make this larger system work, the RWE formed coalitions with state power systems between the Rhineland and the Alps. To improve efficiency and reliability, it looked for a location to build a pump-storage station, which could use hydroelectricity generated during the night in the Alps to pump water into a storage basin. The water could then drive turbines to cover peaks or sudden breakdowns in the system. After several failures, the RWE formed a coalition with the Ruhrverband which was trying to build a settling basin on the Ruhr. Their coalition provided solutions to their different problems. In 1928, the Ruhrverband completed a settling basin whose water the RWE could use in its pump-storage station completed in 1930. The Ruhrverband and the RWE took several years to learn how to operate their systems together.

Anne-Catherine Robert-Hauglustaine
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La métallurgie du soudage en France dans les années trente, vers une approche théorique et scientifique

En France, dans les années trente, les procédés de soudage s'étaient développés dans les grands secteurs de l'industrie du pays. Leurs utilisations multiples imposèrent alors une compréhension scientifique des phénomènes métallurgiques présents dans les soudures afin de dépasser le stade antérieur, celui de leurs emplois empiriques. Le soudage des métaux, défini par le Professeur Albert Portevin comme une opération métallurgique, passa progressivement du stade empirique à la connaissance théorique grâce aux travaux des métallurgistes. Des études sur la nature du métal à souder et sur la composition des flux et des métaux d'apport utilisés dans les différentes techniques de soudage se basèrent sur les récents progrès de la métallographie et de la métallurgie. En outre, les travaux de Henry Le Chatelier sur les flammes et les hautes températures avaient permis une meilleure compréhension des phénomènes chimiques présents dans les soudures et lors de l'opération de soudage.

La notion de soudabilité des métaux, définie en 1930 par le Professeur Albert Portevin, contribua à une meilleure compréhension des phénomènes internes lors de l'opération de soudage. Outre une recherche scientifique des phénomènes métallurgiques, le contrôle non destructif des pièces soudées apporta une réponse à la demande de la part des industriels d'une réelle assurance qualité. Le développement des différentes techniques de contrôle des soudures dans les grandes usines et dans les divers ateliers du pays a joué un rôle très important dans la confiance que les industriels apportèrent à ces nouveaux procédés. Nous analyserons les étapes de ces recherches et le passage d'une utilisation empirique à une connaissance théorique du soudage. Nous présenterons également une courte biographie d'Albert Portevin, dont le rôle fut essentiel dans l'essor de la métallurgie française à la veille de la Seconde Guerre mondiale.

Florence Hachez-Leroy
Chargée de Recherche à l'Institut pour l'histoire de l'aluminium Pechiney-Balzac, Paris, France

Aluminium et développement, le rôle original d'un cartel : l'aluminium français

Imposer l'utilisation d'un nouveau matériau à la fin du 19e siècle fut un défi pour les industriels de l'aluminium. Il s'agissait à la fois de développer la connaissance scientifique et technique du métal et de ses alliages, de constituer une nouvelle filière industrielle et de mettre en oeuvre des conditions favorables pour créer un marché.

De 1888 à 1910, les différents producteurs français tentèrent de trouver des applications à l'aluminium par des initiatives individuelles, à la portée limitée. Ils se heurtèrent à des difficultés techniques, faute d'une connaissance suffisante du métal, et à une résistance des transformateurs. L'exportation restait la façon la plus sûre d'écouler la production nationale. En 1911, ils s'en remirent à un cartel de vente, l'Aluminium Français (L'AF). Sous la forme d'une société commerciale, L'AF fut chargée aussi de promouvoir, par tous les moyens, la diffusion de ce métal léger. La tâche fut ardue : il fallait à la fois créer des alliages adaptés à chaque utilisation et en améliorer les connaissances mécanique, chimique et technique, élaborer de nouvelles techniques de transformation ou adapter celles existantes, démarcher les entreprises susceptibles d'être intéressées, répondre aux demandes de conseil ou mener des campagnes de sensibilisation auprès d'un public très divers. De fait, de 1911 à 1945, L'AF élabora progressivement des outils de développement et une structure pour tenter d'amorcer et d'accompagner les processus d'innovation en cours. En même temps, elle trouvait sa place au sein d'une entreprise en pleine évolution, la société Alais Froges et Camargue (AFC), constituée en 1921 par fusion des deux plus gros producteurs français qui unissaient ainsi leur capacités de production et de recherche. L'AF intervint activement sur le marché français, au niveau de la recherche technique - en relation étroite avec les laboratoires de recherche fondamentale d'AFC -, de la propagande et de la formation. Secteur par secteur, L'AF initia des projets de recherche ou soutint financièrement et techniquement des initiatives extérieures. Sa mission fut donc celle d'un organisme de recherche et de développement et dépassa largement le rôle de cartel qui était le sien à sa création. Cette orientation fut donnée en deux temps : la période de 1911 à 1929 fut celle où de multiples initiatives et projets furent développés sans réelle stratégie. L'expérience et la connaissance accumulées furent néanmoins déterminantes lorsqu'un nouveau dirigeant, Jean Dupin, orienta L'AF dans une démarche plus stratégique, de 1930 à 1945. A la fin de la guerre, L'AF avait organisé une structure de recherche technologique, de formation et de communication et obtenu des résultats qui furent fondamentaux dans le processus de développement du métal dans l'Après-guerre.

Anne-Françoise Garçon
Prof. Ag. de l'Univ., Dr de l'EHESS (option Hist. des Techniques), chercheur associé au CRHISCO (Centre de Recherche Historique sur les Sociétés et Cultures de l'ouest, UPRES - CNRS, Rennes, France

Un métal, trois procédés, deux filières. (La métallurgie du zinc en Europe continentale, des années 1790 aux années 1820)

Inhabituelle au regard du système technique européen, puisqu'elle nécessite le recours au creuset, la métallurgie du zinc s'est implantée en Europe continentale plus tardivement encore qu'en Angleterre. Donnons pour date de cette implantation, les années 1790, et pour moment de sa mise en forme technique, la période 1800-1820.

La paternité en est le plus souvent attribuée à l'abbé Dony, titulaire de la concession de Moresnet. Force est de constater qu'il ne fut pas le seul, et même qu'il ne fut pas le premier. Plusieurs autres le précédèrent, qui travaillèrent dans deux zones, géographiques bien éloignées l'une de l'autre : Dillinger en Carinthie, Ruberg et Freytag en Silésie. Ce furent donc trois procédés distincts de fabrication directe du zinc qui virent le jour entre 1800 et 1810. Deux d'entre eux firent école, le silésien et le liégeois.

Cette communication s'intéressera au cheminement de la pensée technique. Délaissant volontairement le pourquoi, c'est-à-dire la recherche des raisons qui prévalurent à l'apparition de cette métallurgie nouvelle en ces divers lieux, nous présenterons les supports mis en oeuvre dans chacun des cas (four à réverbère, four de verrerie, four de cémentation) et la manière dont ils furent adaptés. Ce faisant, nous chercherons à comprendre le rôle joué, dans cette triple élaboration, par les pratiques antérieures (Inde, Goslar, Bristol); nous poserons la question du contact science/savoir-faire; enfin, nous nous interrogerons sur les conditions techniques, locales et/ou générales qui ont aidé, voire contraint, les innovateurs dans leurs choix.

Fumikazu Yoshida
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Itai-Itai Disease and the History of Mining Pollution

Itai-Itai Disease, renal osteomalacia, mostly attacks multiparous women over the age of 40. The patients can neither walk, stand nor talk. In the final stage of the disease they cry out constantly "Itai-Itai (It hurts, it hurts)", hence the common name of this disease. Itai-Itai Disease occurred in a typical Japanese rice farming area, Fuchu City, Toyama Prefecture, situated in the lower middle reaches of the Jinzu River on the Japan sea side of the main inland, Honshu. Heavy metal such as cadmium, zinc and lead from the Kamioka Mine of the Mitsui Mining and Smelting Co. Ltd., located about 50 km from the mouth of the Jinzu River, had polluted the river, the rice farming areas, and finally damaged to human health.

While metal-mining industry has played an important role in the modernization of Japan, its development has at the same time caused many cases of environmental impairment. In general, the mining industry consists of three stages : (1) the mining process, (2) the ore dressing process, (3) the refinery process. After the Meiji Restoration, the Mitsui Corporation bought out the Kamioka Mine and then introduced modern technology. Since 1905 zinc ore has been the main mining target. In 1911, Mitsui constructed the first preferential flotation system in its ore dressing process. This, however, resulted in a finer particle size of the tailing; the tailing slurry was thrown into the Jinzu River and then precipitated into the rice fields in the Toyama district. At the same time, patients suffering from Itai-Itai Disease were first seen. In 1927, a bulk differential flotation process was introduced into the ore dressing process. Although the recovery and production of metal were improved, the particle size of the tailing became finer and the amount of tailing became larger; consequently the damage caused by the slurry grew worse and covered a wider area. During the period from 1930-1945, when Japan was engaged in various wars, the production increased four fold. At the same time, the area of contaminated land along the Jinzu River in the Toyama district grew more extensive.

In 1968, the patients and their families filed a suit against the Mitsui Mining and Smelting Co., Ltd. In 1972, the victims won the final decision. As a consequence of the decision, the subsequent negotiations between the victims and Mitsui resulted in three agreements : (1) Compensation for Itai-Itai Disease, (2) Compensation for polluted fields and crops as well as for the recovery of contaminated farm soil, (3) The installation of a pollution prevention system in the Kamioka Mine and Refinery, on the basis of agreement for pollution prevention, every year from 1972 to 1996 the sufferers, lawyers and scientists have carried out an inspection of the Kamioka Mine & Refinery.

Philippe Tomsin
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Calling into Question the Current Knowledge about Zénobe Gramme and his Inventions

Since the end of the 19th century, Zénobe Gramme is the topic of a lot of articles and biographical summaries. Even today, these documents are copied one another. The original informations source would be Oscar Colson's book *Zénobe Gramme, sa vie et ses oeuvres* published at Liege in 1903.

In the end of the 19th century, Belgium was disturbed by political quarrels. In order to demonstrate that an union between the Flemish and the Walloons in the same country is impossible, some separatists tried to elaborate a political, economic and scientific history of the Walloon region. Oscar Colson, leader of the review *Wallonia*, known for his radical opinions, built the Gramme myth. He does of Zénobe Gramme a person who is pleasant, brilliant, rebellious and self-taught. Gramme's dynamo is also described as an exceptional and original invention in the history of sciences and technology. After the First World War, a Gramme worship grew in the Walloon region. Statues appeared, crystals were engraved with Gramme's face, and even barrels, made in Damas steel, were engraved with his name and were sold. Legends about him and his work began to spread.

About fifteen years ago, Maurice Daumas questioned himself about Gramme's personality. First, he noticed many biographical uncertainties about Zénobe Gramme, and showed that his life is still unknown. Daumas also noticed that the importance of the dynamo is relative; for him, it is rather a technological steep that arrived at the right time.

How is our exact knowledge about Gramme and his work? What is its impact in the field of history of technology? Must we demystify Gramme and his inventions? Was Gramme a brilliant self-taught, like the people say, or was rather the intellectual context in his native city decisive? During this lecture, I shall try to answer these questions, with the help of some unexpected sources : rare or unpublished archives, and papers contemporary with Gramme himself.

Konstantin Severinov
St-Petersburg, Russia

Importance of Montefiore Institute for Voinarovsky Activities

The Electrical engineering Institute of Montefiore produced a number of specialists. Among them there was a Russian engineer Pavel Dmitrievich Voinarovsky. At the time of entering (1894) he already possessed a "Diplôme de Licencié ès Sciences Mathématiques".

At Montefiore Institute he listened to the Prof. Eric Gérard lectures on electrical measurements, which he was the first to publish (in 1898 in Russia) under his supervision.

Voinarovsky was the best student of Prof. Gérard. He graduated from Montefiore Electrical Engineering Institute with distinction and was awarded with the Belgium diploma of electrical engineer. He also became a life member of the "Association des ingénieurs électriciens sortis de l'Institut Montefiore". Developing the knowledge he gained at the Montefiore Institute, Voinarovsky prepared the project of the longest (at the time) telephone line in Europe St-Petersburg-Moscow (1896) and produced a fundamental book on the theory of cables (1912) which was subsequently republished (in 1921).

The importance of Voinarovsky's contribution to both research and organization of electric engineering in Russia, which was really enormous, also dues to his studies in Montefiore Institute.

As a director of the Electrotechnical Institute (St-Petersburg, Russia) he produced many electric engineers; as a gifted engineer he was a project leader of numerous successful projects in Russia. The basis of his successful work was his links with European science and ability to communicate.

Marc J. de Vries
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A Preliminary Study for the History of the Philips Research Laboratories

In the period 1997-1999 a historical research study into the history of the Philips Research Laboratories will be carried out by the Eindhoven University of Technology in cooperation with Philips. In order to assess the feasibility for such a study and to determine its nature a preliminary study was done in advance. This study comprised :

- a survey of the written history of similar research laboratories (like Bell Labs, GE Labs, Dupont Labs). It became evident that the nature of those studies varies considerably : some are very much focused on a description of the technical content of the research program, others are more concentrated on the management issues;
- a survey of the available sources for the history of the Philips Research Laboratories. In the Philips Company Archive we find primary sources for the period 1914-1950 (during which dr Gilles Holst served as the first director) that are well accessible (they have been used already for the overall history of the company as well as for an unpublished history on this first period). There are also sources for the later periods, but those are more difficult to access.

The major decisions that were based on the preliminary study are :

- the history will include descriptions of both the content of the main research program lines and of the management issues that guided the program,
- the history will be divided into the periods 1914-1950, 1950-1970 and 1970-1990. These periods were chosen on the basis of the first responsible persons and the different economic and social circumstances under which they operated,
- the main point of focus for the research will be the scientific rote of the laboratory, its rote within in the company (the relationships with the Main Industry Groups, a source of patents and a source of new personnel for the rest of the company), and its relationships with other social actors.

Gildo Magalhães dos Santos
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Electrification and the Idea of Progress during Brazil's First Republic

Worldwide, electricity was a cornerstone of the new "Industrial Revolution" which took place in the second half of the XIXth century. Likewise, in Brazil during the so-called "Old" (or first, 1889-1930) Republic, the increasing diffusion of electricity contributed a great deal to the country's forthcoming industrial surge. The new ideology of progress in a land where slavery had just been abolished, was heavily tinted by positivism and the effects became most conspicuous through the implantation of coffee export-oriented railways, civil construction and iron forgeries.

Soon, electricity developed from its initial use in illumination and streetcar traction to a full energy source for industry. Conditions ripened then to leave traditional energy fuels behind such a wood, coal and gas in favor of the new electric alternative. Thus was the road paved to a more intensive development effort - which occurred in the next "New" Republic (after 1930).

Taking a closer look at the flow of ideas that circulated behind this scene, a research was conducted in an often overlooked source : academic magazines. During the Old Republic, two engineering colleges were created in São Paulo, the Brazilian industrial hub, respectively the Polytechnical and Mackenzie Schools. Both colleges published academic magazines, which although primarily intended to divulgate technical information, were also vehicles to expose the discussion on the subject theme of electricity and the idea of progress. A selection of articles in the time span of the Old Republic provides an interesting sample of such an idea forum.

Ludovít Hallon
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Systematic Electrification in Germany and in Central Europe States in Interwar Period

Formation of systematic large-scale plenary electrification as one key assumption for economical and social development in 20th century run in Germany sooner than in other Central Europe countries. Systematic electrification of Germany in the first half of 20th century in the same time represented a sample for the whole Central Europe. This paper aims to compare the German process of electrification, with the situation in the interwar Czechoslovak Republic respectively in the Czech countries and in Slovakia, in Austria, Poland and Hungary, or also in the adjacent countries of the South-east Europe, in Yugoslavia and Rumania. By means of this comparison it is possible to create simultaneously an approximate picture about reached level of the whole economical development of the named countries in the same period.

Ante Sekso-Telento
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Science, Technology and Industry in the Example of the First Electric Power System in Croatia

Two years ago was celebrated the hundredth anniversary of the first modern electric power system in Croatia as the precursor of the modern system named "Hrvatska elektroprivreda" (Croatian Electric Power Industry). In 1895, near town Sibenik in Dalmatia was built the first Croatian hydroelectric power station, the first transmission line and the first distribution network so representing all three components of electric power system : generation, transmission and distribution. The system was modern because it was based on polyphase alterning current generator. It was one of the first in the world two-phase systems as a transition from single phase to contemporary three phase systems. Two-phase system was used in the first great hydroelectric power plant on the Niagara Falls too, which is one of the symbol of modern America. Starting in the same year and even in the same month (August 1895) both systems had the great influence on the formation of the electric power systems in their countries and much broader. In comparison with for that time huge American system (5000 HP) built on the Niagara Falls (National Park) small Croatian System (320 HP) built on the Krka Waterfalls (National park, too) even had few technical advantages.

In the development of modern electric power systems Croatia played an important role not only because of one of the first polyphase systems in the world. Two inventors born in Croatia eliminated from the practical usage two main contributions in this field of the great inventor T. A. Edison. Croatian emigrant in USA famous Nikola Tesla was among the most meritorious in the discovery of the rotating electric field and in the invention of asynchronous motor. It is not so known that Croatian university professor Franjo Haneman was "father of the wolfram (tungsten) lamp" in the beginning of the XXth century. Due to these inventions in two main applications of electric energy (power and light) old inventions (direct current system and coal filament lamp) were replaced by better solutions.

The reasons for such and other contributions in the early introduction of the new technology may be found in a good school system, in a talent for scientific work, in good reception of new knowledge etc. E.g. the greatest Croatian scientist and at the same time one of the most neglected scientists in the history of physics Joseph Rugjer Bošković anticipated the discovery of the concept of field of Michael Faraday, the first Croatian engineer and polyhistorian Faust Vrančić is compared with Leonardo da Vinci etc. Living in such intellectual environment the behavior of the first Croatian system builders in the new field of electricity industry is not the unexpected case. One of them civil engineer Vjekoslav Meichsner and the Mayor of Šibenik Ante Šupuk played the main role in the early acceptance of the polyphase alternating current systems immediately after the Frankfurt exhibition in 1891, in which all advantages of polyphase transmission have been firstly presented. So the small Sibenik (the first Croatian town on the eastern Adriatic shore) took one of the leading roles in the field of new technology before much bigger towns (Rome, London, Budapest and even Frankfurt).

As a result of early acceptance of the modem polyphase electric power systems the town of Šibenik soon became the industrialized town in Croatia changing its profile from the undeveloped centre of Mediterranean agriculture to s.c. "Croatian Manchester' (metallurgy, textile, food industry, etc). Paradox is that just in the year of hundredth anniversary of its first power system the industry rapidly disappeared under the pressure of recent war and new tendencies for making "quick" money (trade, tourism services). But it is now more and more clear that like in the past the combination of new science and technology and new modern industry combined with local resources will give an economic growth to the region. The examples from the history of early electrification may help today in understanding the connections between science, technology and its application through industry into everyday life and the economic growth of the society.

Krishan D. Mathur
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India's Nuclear Technology : Prospects and Problems

India is one of the few developing countries which has carried on nuclear research since the 1950s. This enabled India to become a member of The United Nations Committee on the Effects of Atomic Radiation in 1954, and of the Working Level Meeting of International Atomic Energy Agency in 1956. India has manufactured Heavy Water and built Research reactors. However, India opposed nuclear testing, and advocated destruction of weapons of mass destruction.

The development of nuclear power in China in the 1960s, followed by the invasion of Tibet, and the occupation of Indian territory in the Northeast, resulted in a change of attitude among Indian rulers. India detonated a nuclear test in 1971, which brought forth condemnation from various parts of the world. India relinquished nuclear testing altogether. However, India has been experimenting in the production of Missiles (Agni). At present it is said that India has 12-15 Atomic bombs, and Pakistan has 8-10. Any use of atomic weapons between India and Pakistan could be disastrous to both.

India's opposition to the Comprehensive Test Ban Treaty is partially in response to China's tremendous progress in nuclear energy. In case of a conflict between India and Pakistan, China can easily transport weapons to Kashmir, through a road built recently.

It is estimated that China has amassed $160 billion in foreign reserves, probably used to fund an arsenal, and establish a strong industrial base. In addition, China is obtaining the latest military technology from Russia. It is doubtful that India's nuclear technology will ever catch up with China.

This paper attempts to investigate India's emerging problems in the field of nuclear technology, and the danger she might face in the future.

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The Study of Controlled Nuclear Fusion in Japan. Concerning Arguments about the Policies of Research Organizations

The study of controlled nuclear fusion in Japan began in 1955. The Atomic Energy Commission of Japan, established in 1956, took up the study of controlled fusion and set up the Nuclear Fusion Reaction Discussion Group (with Hideki Yukawa as chairman). It was dissolved, however, about a year later. The Commission then established the Nuclear Fusion Working Committee (again with Yukawa as chairman) in April 1958 and discussed Plan B. In March 1958, the Working Committee submitted its recommendation to the government that both Plans A and B be acted upon. Plan A was to promote basic research to foster new ideas and Plan B was to build a middle-sized fusion reactor capable of maintaining a temperature of about ten million degrees Celsius.

The recommendation raised a debate about the policy of the research organization, the so-called AB argument, among researchers who were to begin the study of nuclear fusion. This argument was greatly significant as the starting point of controlled fusion studies in Japan. To anticipate the conclusion, Japan decided to promote only Plan A and established the Institute of Plasma Physics at Nagoya University.

This talk focuses on the understanding of those researchers who were looking toward the study of nuclear fusion. Wanting the sound promotion of basic research in general, many of them had an antipathy to excessive power belonging to a particular governmental organization such as the Atomic Energy Commission or the Atomic Energy Bureau within the Science and Technology Agency. As a result, researchers rejected any idea of the Atomic Energy Bureau supporting the study of controlled fusion, having already negatively experienced government initiated and promoted study of nuclear fission. Consequently, they dissolved the Nuclear Fusion Reaction Discussion Group within the Atomic Energy Commission and organized their own democratic society, a nuclear fusion discussion group (chaired by Yukawa).

In this environment, Plan B was reconsidered in terms of its theoretical basis as well as its proposed planning and funding, and was finally abandoned by the Nuclear Fusion Working Committee of the Atomic Energy Commission in the summer of 1959. As a result, the Ministry of Education alone budgeted for the study of nuclear fusion. Thereafter until 1966, the Atomic Energy Commission took no action on any study of nuclear fusion.

Bruce R. Wheaton
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Hiroshima and Berkeley : Sister Cities

Enriched uranium 235 destroyed the center of Hiroshima, Japan in August of 1945. In its natural form, pure uranium metal consists of several isotopes, two of which are fissionable. But about 99% of it is U238, quite a stable stuff. Separating the less than 1% fissionable isotope 235 from the rest is something of a challenge since no chemical operation will do it, all the isotopes behave the same in any such reaction. It is as much a challenge to Saddam Hussein today as it was to Ernest Lawrence in 1943.

Several methods were tried by what became the famous Manhattan Project to separate the isotopes of uranium: centrifuge whirling, hoping that the tiny mass difference could thus be amplified; by membrane diffusion through calculated pores, with similar false hopes; with proto-microwave electron dances, too early to work as it turned out; feeble academic mass-spectrographs, that would have taken centuries. But what worked was administered by the seemingly indefatigable Lawrence, who became, among many other things, the "Peter Rabbit" of Knoxville Tennessee.

The successful wartime method was none of the above, but rather a blunt instrument driven 24-hours a day by otherwise non-war-needed women. It used 200 million dollars-worth of silver, requisitioned from Fort Knox, to electrify magnets that directed a beam of uranium hexafluoride into parabolic receptor slits. I leave it to the reader to figure out why parabolic.

The diffusion didn't work in time: there was too much "crud" (a term of art) in the works. The centrifuge only produced feed material for the Berkeley approach. Berkeley was then cloned to go from about 20% up to weapons-grade of close to 80% U235. Each week the small package of yield went by courier through Chicago then by train to about nowhere in northern New Mexico. He was picked up, usually by a Ford, and disappeared into the desert plateaus west of Santa Fe. The citizens of Hiroshima knew nothing about it; but soon they would.

Wading through the arcane written terminology of the effort is a challenge. Everything is done in letters of the alphabet. If you thought the alphabet-soup of government agencies was a trial, try the Lawrence papers at the University of California, Berkeley. I can personally assure you that you will be rewarded by finding some non-declassified documents!

V.M. Tchesnov[1], **M.G. Yarochevsky**[2], **M.A. Ostrovsky**[3]
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Histoire, interaction et union de la technique électronique et de l'optique physiologique (histoire et logique de la science moderne)

Aujourd'hui nous pouvons bien voir la naissance d'unions imprévues entre sciences et techniques. L'optique physiologique et la technique électronique nous en donnent un exemple très intéressant. Cette union de deux branches assez différentes de l'activité intellectuelle humaine est obtenue comme un des résultats possibles de leur interaction. Nous pouvons déterminer les caratéristiques essentielles et les directions principales de ce processus.

1. Interaction au niveau auxiliaire. Des installations électroniques exercent des fonctions auxiliaires dans les expérimentations des physiologistes. Parfois leur rôle détermine le succès d'une recherche biologique.

2. Interaction au niveau de système. Un objet biologique ou une de ses parties sont considérés comme système indépendant. Les principes de son fonctionnement et de son organisation forment le fondement de l'élaboration de techniques électroniques.

3. Interaction au niveau technologique. L'interaction peut suivre deux voies : 1) utiliser en électronique des composants biologiques "vivants" ou au contraire 2) construire des installations électroniques analogues d'après leur destination aux "organes" optiques biologiques.

La première voie est plus intéressante parce qu'elle permet d'obtenir des succès tout à fait inattendus. C'est la voie des décisions techniques extraordinaires. D'habitude le point terminal et le résultat de l'interaction à ce niveau ne peuvent pas être déterminés d'avance. Tout de même il est possible de les prévoir en prenant pour base l'analyse historique du développement de la physiologie de la vue, de l'optique physiologique et de la technique électronique.

Le progrès de la dernière a toujours été déterminé par la perfection de ses éléments proprement dits électroniques : tubes, transistors, circuits intégrés et autres. Le "moteur" qui assurerait la jonction semi-conductrice dans l'immédiat n'est pas encore choisi. Mais il est bien probable que sa place pourrait être occupée par la molécule photosensible d'albumen. Les réalisations de la biologie physique et chimique proposaient les molécules de *rhodopsine* ou de *bactériorhodopsine* qui pouvaient se trouver dans un des deux états stables conformément à la fréquence du faisceau lumineux de commande. A cet effet, la technique binaire d'ordinateurs avait la plus grande importance.

Le moment du fusionnement de la science biologique et de la technique est précédé par l'histoire demi-séculaire des ordinateurs électroniques, par un siècle de recherches sur l'albumen de la rétine et par deux décennies d'étude des propriétés de la *bactériorhodopsine*, albumen de photosynthèse sans chlorophylle. Le fondement de ces recherches biologiques, biophysiques et biochimiques sur l'optique physiologique fut posé par des savants russes. Les premiers travaux furent faits dans les années vingt et trente de notre siècle. Les académiciens de l'Académie des Science de l'U.R.S.S. L.A. Orbeli et S.I. Vavilov sont devenus "pères" de la physiologie moléculaire de la vue en Russie. Au commencement des années soixante-dix, les recherches dans ce domaine furent intensifiées par une puissante impulsion donnée par le programme d'Etat spécial *"Rhodopsine"* dirigé par l'académicien Yu.A. Ovtchinnikov. Lui et ses collègues découvrirent la structure primaire de la *bactériorhodopsine* en 1978 et trois ans plus tard, en 1981, la structure de la *rhodopsine* optique fut déchiffrée. Les premiers films photosensibles qui contenaient des molécules de bactériorhodopsine furent conçus. Ce succès permit d'utiliser ces molécules dans les techniques électroniques. Ce ne fut pas en Russie - Union Soviétique, mais aux Etats-Unis, en Allemagne et au Japon, que, dans les années soixante-dix, quatre-vingts, se déroulèrent les premiers travaux pratiques et les expériences qui maintenant nous font penser aux ordinateurs "biologiques".

Andiy J. Gundar
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History of Computer Science in the Ukraine

Computer science is one of the youngest and most dynamic daughters of modern applied mathematics, electronics, cybernetics, physics, engineering and automation sciences. The inventions and ideas of many mathematicians and scientists from Ukraine led it to the great development. Such names as Glushkov, Lebedev, Ioffe, Popov are well known in the world, others are not well known, but all of them from Ukraine.

Let us point out some global steps on the Computer Science in the Ukrainian.

In the Ukraine the first Computer Engineering Department was founded and organized in the Kyiv Polytechnic Institute (KPI), in March 1960. It has a deep background in computer system design, development and teaching, actively engaged in computer system and software research at the Ukraine and the exUSSR. It is an experienced consultant in the areas of computer hardware, software and applications for number of research and development institutions.

Practically Computer Engineering Department establishment was begun in 1956 when lectures in "Computer and their units" as well as laboratory work in this subject were conducted for the first time. The Ministry of High and Special Education gave permission to train two groups of students in the new field (speciality 0608). Department of Information Science helped the newly organized Department in scheduling, selection of staff, training first specialists, etc. That very year 10 students from Chinese People's Republic began to study the Computer Science. A group of the Kyiv Polytechnic Institute graduates from Radio and Electric Engineering Faculties was invited to work out new subjects and organized two laboratories in analog and digital computers.

1960 - the following courses of lectures were delivered : "Programming technique", "Digital Computers", "Analog Computers", etc.

1961 - the first group of specialists in the "Computer and their units" graduated from the Kyiv Polytechnic Institute Computer Engineering Department.

1969 - training specialists in Applied Mathematics was begun.

1973 - Applied Mathematics Department became a part of new faculty.

Now the Computer Engineering Department of the Institute is modern and one of the well-known in our country. It trains day-time, part-time and extra-mural students for the Ukraine and foreign countries. More then 54 lecturers (12 professors of Computer Science, 31 senior lecturers - Candidates of Science, 11 lecturers), 72 research workers and 128 postgraduate students (14 from foreign countries) are working at the Department now. It makes fundamental scientific theoretical investigations, successfully conducts experimental and design work, raises scientific and engineering training of specialists, many postgraduates having become well known scientists in Computer Science.

About 80-90 scientific certificates are received by the Computer Engineering Department annually, more then 50 Candidates of Science and 400 engineers from 30 countries as well had been trained at the Department.

The KPI Computer Engineering Department since its first days is headed by Samofalov Konstantin G., a well known scientist, State prize laureate of the Ukraine Republic, corresponding member of the Ukrainian Academy of Sciences, and professor of Computer Science.

Khatskel Ioffe[(1)], **Leonid Kryzhanovsky**[(2)]
[(1)]Head of Dept. (retired), [(2)]Freelance Researcher, The Popov Central Communications Museum, St. Petersburg, Russia

Alexander Popov and Eugène Ducretet : a Fruitful Cooperation and the Rise of Wireless in Russia and France

The paper commemorates the centennial of the beginning of the cooperation between Russian physicist and teacher Alexander Popov (1859-1906) and French engineer and entrepreneur Eugène Ducretet (1844-1915). This cooperation led to the birth and development of practical wireless communication in both Russia and France.

In the spring of 1895, Popov built an instrument which turned out to be identical with Marconi's receiver disclosed in 1897. Popov's early wireless experiments were not as successful as those Marconi demonstrated in England in 1896 (to some officials) and 1897 (publicly), a transmitting antenna tuned to the receiving one, both provided with a ground connections constituting essential advantages of Marconi's wireless telegraph system over Popov's setup. However, summaries of Popov's article describing his instrument originally published in Russia early in 1896 appeared shortly afterwards in some foreign periodicals. Great interest in Popov's work was expressed by Ducretet. He initiated a correspondence with Popov of several years' duration. In 1898, Ducretet began to manufacture wireless telegraph stations of the Popov-Ducretet system. In the same year, Ducretet performed wireless transmission from the Eiffel Tower to the Panthéon, 4 km away. Between 1898 and 1904, the Ducretet Company filled orders of the Russian Navy. In June 1899, Popov's coworkers discovered sound reading of wireless telegraph messages. The development of wireless receivers for sound reading was an important result of the Popov-Ducretet cooperation. Ducretet began to manufacture wireless receivers for sound reading of the Popov-Ducretet system in 1901. Sound reading considerably enhanced the range of wireless.

The paper is illustrated by pictures of some original equipment kept at the Popov Central Communications Museum.

Katalin Tihanyi Glass
Independent Scholar, Budapest, Hungary

Patents and Practices. The Influence of Kalman Tihanyi on Television's Development in Europe and America

One of the most prodigiously gifted inventors active in the first half of the 20th Century was the Hungarian physicist and electrical engineer, Kalman Tihanyi.

The fact that his fundamental contribution to television remained relatively unknown can be attributed to Kalman Tihanyi's death at the age of 49, shortly after WWII, just as, based on his inventions, television's commercial development was resumed in Europe and America.

The myths about the origin of modern television based on storage principle were born in parallel with the practical development of Tihanyi's inventions and, by virtue of sheer repetition, came to dominate the popular, semi-popular and technical literature on both sides of the Atlantic. The recognition that Kalman Tihanyi had received in the press and in the technical literature of the 30s and 40s was gradually overwhelmed by the myth, until the early 70s, when he was rediscovered.

It seems that this year, when Kalman Tihanyi is being celebrated in Hungary on the occasion of the centennial of his birth, is a highly appropriate time to speak about his life and work, so intimately connected with that other celebrant of 1997, the electron.

Vasily P. Borisov
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Russian Technology in a Context of the World Development. An Outlook in the End of the XXth Century

The reforms of to-day in Russia have led to considerable reduction in the output of new machinery. Search of a strategy for further development of technology is now a vital issue for the country.

An analysis of how Technology has been developing in Russia in the XXth century is of interest. Author used the History of radioelectronics as an object for the investigation.

Since its birth in the beginning of the XXth century the radio industry in Russia has been forming in competition with western firms. During the World War I the Russian Navy had been completed with wireless stations made in the Kronstadt workshop and also at the "Ducretet", "Marconi", "Telefunken". On organizing the first Soviet Plant of electronic devices (1922) the Government had introduced a ban on import of foreign radio valves. Nevertheless the Russian industry used repeatedly in the 20th and 30th a technological help from abroad ("Compagnie Gen. de la TSF", the RCA etc.).

Works on the Soviet Atomic Project (40th-50th) had stimulated technical progress in many branches of industry. Then the priority investment in research and development of technology related to war industry contributed to the USSR becoming a world leader in many aspects of aircraft and space technology, nuclear energetics etc. The adopted strategy demanded for manufacturing a vast list of components without normal competition and cooperation with western firms.

The situation in the beginning of the 1990th has revealed the inability of most of production to compete on the world market. Some examples of renewed cooperation with firms of Germany, the USA, France give evidence of possibility to take advantage of the Russian intellectual and technological potential in the future.

Liviu Sofonea
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A Historical and Epistemological Analysis of the Significance of the Work of the Engineer-Physicist Alexandru Proca (1897-1955)

The basical items of the contributed paper are the following :

1. Main characteristics of the Romanian schools where Alexandru Proca was educated : Liceul Gheorghe Lazar in Bucuresti, Faculty of Science of University of Bucuresti, Scoala de Poduri si Sosele which in 1920 became Scoala Politechnica din Bucuresti, Scoala de Ofiteri de Geniu : activity in Buletinul de Matematica/Bull. Math. pure et appl. de l'Ecole Polytechique de Bucarest.

2. Main characteristics of the industries where Alexandru Proca has worked : the Society Electra in Câmpina, the oil industry; the volume of Alexandru Proca entitled *Intrebuintarea electricitatii in industria de petrol* (1924; first Romanian work in this field).

3. Main contributions in theoretical physics : publications, scientifical milieux, relevant contacts, problems and topics, ideas, the Proca's vectorial relativist fields : physical, mathematical, and epistemological-historical aspects (interpretations given in the period 1933-1955 and after).

4. Some researches made in Romania on Alexandru Proca's work by the members of The Committee for History and Philosophy of Science and Technics of Romanian Academy, committee affiliated to U.H.P.S.

A preprint will be delivered at the occasion of the Congress.

Claude Dubois *
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La flottation des minerais : une révolution scientifique, technique, économique et écologique au début du XXe siècle

De l'Antiquité au début du XXe siècle, la séparation des minerais métalliques de leurs gangues était basée sur les lois naturelles de la densité et de la gravité. Des plus primitifs aux plus perfectionnés, les appareils de triage et d'enrichissement utilisaient les vitesses de chute différentielles des matériaux pour classer et piéger les minéraux métalliques denses, tandis qu'un courant d'eau entrainait les stériles. Les sulfures mixtes, Pb-Zn par exemple, et les très faibles granulométries issues du broyage constituaient les principales limites de ce procédé multiséculaire dont le meilleur rendement ne dépassait guère 70%.

Au tout début de notre siècle le principe physico-chimique de la flottation fut adapté, en Australie, à la minéralurgie. Par adjonction d'huiles et réactifs à un bain qui peut être aéré par agitation, les particules de métaux denses flottent à la surface de la solution où ils sont écrémés, au contraire des stériles. Les progrès dans le domaine du broyage assurent une production de fines qui sont parfaitement adaptées à ce procédé. L'usage de produits spécifiques permet de dissocier les minerais mixtes, principalement les sulfures, et les rendements peuvent dépasser les 90%.

La flottation fut rapidement appliquée à des minerais très divers tels que l'anthracite, le molybdène etc... D'abord perfectionné et développé en Australie et aux U.S.A., le nouveau procédé gagna l'Europe après la première guerre mondiale. En 1924 on ne trouve que deux ateliers de flottation dans les mines métalliques de France, mais les houillères du Nord ont déjà largement accueilli ce mode de séparation.

Les anciens stériles des laveries gravimétriques ont fréquemment été retraités par la flottation. Moins riches en métaux utiles que leurs prédécesseurs, les nouveaux résidus peuvent poser des problèmes écologiques à long terme. En effet leur granulométrie très fine les rend plus accessibles chimiquement, tandis que leur composition peut être affectée par la présence de certains réactifs.

Ces changements radicaux sont notamment illustrés par la mine de blende et galène de Sentein, dans les Pyrénées ariégeoises. Les Anglais y installèrent une laverie gravimétrique à la pointe du progrès en 1879 et 1880. Après plusieurs modernisations, une récupération de 65% des métaux contenus dans les minerais constituait le meilleur rendement. En 1923 un atelier de flottation fut installé en suivant l'exemple des mines du Val d'Aran en Espagne. Il était associé à la laverie classique dont il récupérait les mixtes et les stériles. On adopta également le broyeur à boulets qui permettait d'obtenir des fines inférieures à 0,210 mm. En quelques mois on parvint ainsi à atteindre un taux de production de 98% de métaux.

Section 8.6.2 :

Building, Transportation, Agro-alimentary in the Contemporary Period (since 1800)

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Centre Interuniversitaire de recherche sur la science et la technologie, Université du Québec, Montréal, Canada

Une problématique pour une histoire des infrastructures urbaines

Cette communication présente un programme de recherche pour réaliser une étude de trois infrastructures urbaines à Montréal, la mise en place du réseau d'égouts, celle du système d'aqueduc et la construction du métro.

Bien que nos objets d'étude soient éminemment techniques, notre problématique refuse de l'appréhender dans le cadre étroit d'une histoire internaliste de la technologie. Nous voulons avant tout rendre compte de la multiplicité et de la diversité des facteurs à la fois politiques, scientifiques, techniques et sociaux qui, souvent indissociables, ont donné à ces infrastructures urbaines leurs caractéristiques particulières. C'est pourquoi nous proposons d'analyser l'espace social extrêmement hétérogène et métissé dans lequel se sont prises les décisions relatives à la construction de ces infrastructures. Il s'agira donc de cerner les forces et les faiblesses des différents acteurs et examiner l'ensemble des stratégies qu'ils mettent en oeuvre pour convaincre les différentes instances décisionnelles.

Michael Schimek
Museumdorf Cloppenburg, Cloppenburg, Germany

Modern Influences on Rural Building in Northwest Germany 1880-1930

Between the 1880s and 1930s many developments influenced rural building : Modern ideas of dwelling especially in hygienic matters created new demands on rural houses and other buildings while agricultural production got more and more intensified. At the same time modern building materials as Portland Cement, iron or steel became easily available because of new built railways and improved roads. Against his historical background the report will describe a further development which was able to change rural building. Increasingly apprentices of the building profession attended special schools and academies - so-called Baugewerkschulen - conveying scientific knowledge of engineering constructions. Some examples will show how and to what extent these craftsmen could turn their modern knowledge into reality. The statement will concentrate on the rural parts of Northwest Germany, particularly on the north of Oldenburg, and is to be understood as an intermediate result of a research project carried out at the open air museum Cloppenburg.

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Structures métalliques dans l'architecture russe et les ingénieurs métallurgistes

Dans la communication, on examine la période initiale de l'application des métaux dans les constructions civiles et industrielles en Russie à la fin du XVIIIe siècle et au début du XIXe siècle. Dans cette période, qui a exercé une influence immense sur l'évolution suivante de l'architecture et de la technique de construction, quelques tendances sont observées :

- tout d'abord, des essais épisodiques de remplacement des éléments en bois ou en pierres par des éléments métalliques, dans des bâtiments et des ouvrages d'art immédiatement liés aux usines métallurgiques. Ces essais poursuivaient le but utilitaire d'augmenter la longévité et l'ignifugation des structures, et ils ne se basaient que sur la pratique du travail des métaux;
- ensuite, l'imitation des ouvrages étrangers (en premier lieu - des ponts anglais et américains) par les architectes, auxquels la fonte et le fer forgé offraient de nouvelles possibilités plastiques. Mais souvent ce n'était que l'intervention des métallurgistes fabriquant des structures qui les rendait rationnelles ou au moins viables;
- enfin, l'assimilation de l'expérience d'avant-garde mondiale sur la base de recherches théoriques et expérimentales. En Russie, dans la première moitié du XIXe siècle, cette tendance était représentée, avant tout, par les ingénieurs des voies de communication qui suivaient les traditions de l'Ecole Polytechnique parisienne.

Le bond en avant a été fait lors de la réunion de toutes ces tendances dans les oeuvres des dirigeants de l'industrie métallurgique. Parmi eux, les ingénieurs des Mines russes, d'origine anglaise, se distinguaient : Charles Baird (1766-1843) et Francis Baird (1802-1864), propriétaires de la fonderie à St-Pétersbourg; Alexandre Wilson (1776-1866), directeur de l'usine d'Amirauté, et Matew Clark (1776-1846), directeur de la fonderie d'Etat nommée l'usine d'Alexandre.

La fonderie de Baird a fabriqué les structures d'un des premiers ponts en fonte à St-Pétersbourg (1806), l'ossature en fer forgé de la coupole de la cathédrale Kazansky (1810), plus tard la coupole métallique de la cathédrale de St. Isaak (1838-40).

A. Wilson projetait et construisait de nombreux bâtiments industriels, en employant des structures portantes métalliques.

M. Clark a créé, avec l'architecte V. Stassov, les couvertures des grandes portées pour des édifices publics et des palais privés, sur la base des structures nouvelles, des poutres en tôle rivée et des fermes à sous-tendeur qui sont connues comme "les fermes de Polonceau". Les oeuvres de M.E. Clark ont fait une époque entière dans l'évolution de l'architecture métallique. De nombreuses commandes d'Etat, très variées et importantes, lui permettaient de montrer son beau talent d'inventeur hardi. Rien que pour les planchers et les toitures du Palais Impérial d'Hiver, restauré après l'incendie de 1837, il a élaboré à peu près une dizaine de nouveaux types de structures métalliques. Et outre cela, parmi ses travaux il y avait une coupole d'église et des toitures du théâtre, des constructions d'usines et de ponts, des ouvrages hydrauliques et commémoratifs. La collaboration avec les spécialistes principaux de son époque; la connaissance d'une expérience étrangère; les essais scrupuleux des structures sur modèle réduit et les essais témoins des éléments des constructions mêmes, qui étaient faits pour la première fois à l'échelle si vaste; l'analyse des causes des écroulements de quelques constructions considérables érigées d'après ses projets - tout cela compensait un manque de méthodes théoriques de calcul des constructions et lui permit de faire à bref délai -pendant dix ans, en tout- le chemin de constructions assez primitives jusqu'aux structures presque parfaites.

Plus tard, les travaux de F.K. San-Galli (1824-1908), propriétaire d'usines mécaniques et de fonderies à St-Pétersbourg et à Moscou, d'origine allemande, sont devenus une sorte de prolongement des oeuvres de M.E. Clark. Un de ses ouvrages les plus marquants est la coupole vitrée du Musée baron Chtiglitz (St-Pb., 1885-95) dont l'ossature en acier se compose de fermes à sous-tendeur réunies en construction spatiale.

Dans la communication, on utilise les documents connus ainsi que ceux découverts par les auteurs. Il révèlent les changements et les perfectionnements, que les structures subissaient, parfois en cours de la conception, de la projection et de l'érection d'un ouvrage, et le rôle que les ingénieurs métallurgistes jouaient là. Ce sont eux justement qui asseyaient des fondements techniques de l'architecture métallique du XIXe siècle.

Dominique Theile
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Le poteau et le voile : essor et apogée du béton armé dans le logement collectif en France

Malgré quelques avancées significatives, l'histoire des techniques de la construction reste encore largement à écrire, tout au moins en France. Plus particulièrement, la diffusion de l'emploi du béton armé dans la construction de bâtiments résidentiels y reste encore mal connue. Alors même que la France se distingue actuellement de ses voisins européens par l'emploi massif et monolithique de béton armé dans le logement collectif.

Comment est-on parvenu à cette domination du voile de béton armé dans le logement en France? Posée telle quelle la question n'est pas nouvelle. En quoi consiste notre apport?

A vérifier l'hypothèse que le béton armé s'est d'abord diffusé dans le logement collectif sous la forme poteau porteur, dès les années 1920, avant de s'imposer progressivement sous la forme voile porteur dès les années 1960. Mais s'intéresser au voile de béton c'est s'intéresser aussi à la banche, de la banche à pisé employée dans la première moitié du XIXe, au triomphe de la banche-outil dès les années 1970, en passant par le coffrage-tunnel des années 1960. C'est s'intéresser enfin au rapport offre de technique/commande de logements, en particulier au rapport ingénieurs/architectes.

Cette rétrospective historique nous amènera, en conclusion, à nous interroger sur les conditions de l'actuelle perpétuation de la domination du voile banché, ainsi que sur. les perspectives des constructions à poteau porteur dans ce contexte. Ce sera aussi une occasion de s'interroger sur l'originalité de la France par rapport à ses voisins à cet égard. Ainsi que de revoir certaines idées quant au rapport entre techniques de construction et milieu naturel.

La présente communication est issue d'une recherche menée pour le compte du ministère français du logement, qui allie la synthèse bibliographique à l'analyse d'entretiens.

Dominique Barjot
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Le rôle de l'entreprise et de l'entrepreneur dans l'introduction du béton précontraint : le cas des entreprises Campenon Bernard (1920-1962)

Nées en 1820, les entreprises Campenon Bernard-ECB- ont joué un rôle prépondérant dans l'introduction du béton précontraint comme matériau de construction. Le point de départ e a été la rencontre d'un entrepreneur ayant le goût du risque, mais efficace gestionnaire, Edmé Campenon (1872-1962) et l'un des ingénieurs les plus doués de sa génération, Eugène Freyssinet (1879-1962). En optant plus massivement qu'aucun de ses concurrents en faveur du béton précontraint, les ECB se sont imposés, dès les années 1930, comme l'un des deux ou trois leaders français de l'entreprise des travaux publics. Dès cette époque aussi, les procédés Freyssinet connurent un succès certain hors de leurs frontières, notamment en Allemagne, où se trouvaient pourtant les principaux concurrents des ECB. Grâce à Wayss und Freyrtag, leur principal licencié, ces procédés Freyssinet prirent l'ascendant sur ceux développés à la même époque par Dyckerhoff und Widmann.

Durant la seconde guerre mondiale, les ECB et Freyssinet s'associèrent pour créer une société d'ingénierie , la société Technique pour l'utilisation de la Précontrainte -STUP- devenue aujourd'hui Freyssinet International, filiale des ECB. La STUP en soutint puissamment l'essor, les ECB devenant l'une des entreprises les plus actives dans la reconstruction de la France après la seconde guerre mondiale, mais aussi l'un des leaders français à l'exportation. Elles réalisèrent des ouvrages de première importance au Brésil, en Colombie et au Venezuela (les trois viaducs de Caracas), mais aussi des barrages exceptionnels en Algérie, en Tunisie et surtout en Iran. Elles introduisirent aussi, à l'instigation des élèves les plus doués de Freyssinet, comme Jean Müller, des procédés tout à fait nouveaux de construction (voussoirs conjugués collés). De son côté, la STUP ne cessait d'innover tant dans le domaine des procédés (vers 1960, 70% des procédés de précontrainte utilisés dans le monde dérivaient des procédés Freyssinet) que des ouvrages (Basilique de Lourdes, pont en béton et en arc de Sydney), promouvant le concept de précontrainte généralisé (piste d'Orly, cuves de centrales nucléaires, etc...).

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The Presence of Cuban Students at the Agronomic Institute of Gembloux in the Nineteenth Century

In the sixties of the nineteenth century, the Royal Economic Society of the Country's Friends of Havana carried out an extraordinary effort in order to develop in Europe the first Cuban agronomic engineers due to the existing limitations in the colonial context of Cuba.

The Belgian agronomic science -represented by the Agronomic Institute of Gembloux- was entrusted with guaranteeing, between 1864 and 1868, the professional quality of Cuban students as an essential factor in the developmental plans of a Cuban agronomic science.

The correspondence of Cuban students and the Cuban press itself situated the teaching of the Agronomic Institute of Gembloux at the same level which the famous Agronomic Institute of Grignon in France, had.

Douglas Helms
Senior Historian, USDA, Natural Resources Conservation Service, Washington, USA

The Parallel Development of Soil Science and Soil Surveys. A Historical Study of Science in Government

For nearly 100 years the Federal Government of the United States has supported the mapping and description of soils through the U.S. Department of Agriculture (USDA), state universities, and state agricultural experiment stations. USDA's capabilities in agricultural sciences expanded greatly in the 1890s. Soil scientists in USDA, along with university-based scientists, led the development of the discipline.

USDA was charged with using scientific research to assist agricultural development in the United States. Mapping and surveying soils were a means of relating scientific information about the soils to particular locations so that farmers might then use the information in crop production.

Soil surveying was created at a time when the discipline was just being born. Thus the activities undertaken to support the surveys serve as a locus for examining the development of soil science. New soil classification systems were created and then abandoned in order to organize the information collected in soil surveys. Theories of soil genesis were applied to explain soils distribution.

The value of the survey rested on the assumption that it would provide useful information, especially as it related to plant growth. But many basic scientific questions about the soil characteristics important to plant growth remained unanswered. The ability to describe characteristics depended upon understanding the characteristics important to plant growth processes. Thus soil surveying had to grow apace with the broader field of soil science. The history of the early decades of soil surveying reveals the stresses, missteps, and successes of trying to promote soils knowledge in a climate where the basic knowledge was only beginning to be accumulated.

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Colonial Techniques and Scientific Research : a Parallel Progression in Brazilian Agriculture of the XIXth Century

Since 1840, Coffee has been the most important product in the increase of Brazilian GNP. From 1889 on, with the establishment of the Republic, the political supremacy of the land oligarchy, linked to coffee production and exportation, is established - the first phase of the republican period is know as the "Coffee Republic".

The wealth produced by coffee and the coffee growers' power created conditions for the development of a real agricultural research pole. As an off-spring of Positivism, the research pursuing excellence and aiming to enlarge fundamental knowledge, did not have an important impact on coffee production itself. The gap between scientific development and the field techniques remained without changing the profile of an "extractivist" or "mining" agriculture. Such agriculture had its bases rather on the availability of land extension and cheap labor force, than on changes in production techniques. However the scientific pole "grafted" on modernist ideologies, for a long time detached from its social context, supported subsequently the creation of the Brazilian agricultural research system.

Anatoly V. Guterts
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N.V. Verescaguin (1839-1907), founder of butter manufacturing and cheese-making in Russia

1. Genealogy, education, service in the fleet, public activity (1865).
2. Mastering cheese-making in Switzerland; study of the work of artels.
3. Spreading of artel cheese-making in Russia. Reaction of government circles, of D.I. Mendeleev and public organizations. Insinuations.
4. Financing when money-market in Russia is exhausted and credit establishments are coming into being. Cooperation with A.I. Vassilchikov, "prince-cooperator" in the field of setting up of loan associations. Loans and financial aid of the Free Economic Society. Sponsors.
5. A number of expeditions to survey Russian dairy cattle; overcoming of prejudices in theory and practice. Elected President of the Cattle-breeding Committee of the Moscow Agricultural Society during five 3-year periods. Introducing a practice of district exhibitions of local cattle. Popularity of the exhibitions with the peasants.
6. Model plant producing equipment for butter manufacturers and cheese-makers. Further experiments to adapt foreign technologies to the conditions of Russia. Taking part in exhibitions abroad.
7. Warehouses of finished products in Moscow and St-Petersburg to stop the monopoly of the capital traders. Foundation of two big firms for dairy products trade headed by Verescaguin's followers. Geography of the new industry, problems and difficulties of its development.
8. Direction of the school of artisans and of the laboratory, training of highly-qualified specialists for ministries. Secret police supervision.
9. Organization of dairy products transportation with special tariffs and invoices in special trains. Special trains and steamers for exporting butter.
10. Reduction to practice of microbiology and technical advances (Lavale separator, physico-chemical methods of butter control). Falsification control.
11. Organization of dairy products exhibitions in capitals and in province as well as of stands at all agricultural and industrial All-Russia exhibitions. Participation in the organization of the International exhibition in Paris (1902).
12 Founding of periodical newspapers for covering dairy industry problems. Publication of 150 articles on the subject. Publication of his followers' papers.
13. Followers of Vererscaguin. Statistics 1910-1912 : export of Siberian butter provides Russia with more gold than all Siberian gold mines.
14. Verescaguin as a phenomenon. Founder of a new industry without personal capital and administrative authority.

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United States Car Industry, Technology and Society (1950-90)

Every technology has its impact on the society within it functions. This influence will not remain restricted to the desired effects but it comes with others which might be considered harmful by people in that society. As a consequence, internal social forces will try to counter *(contain)* what is seen as harmful, That means that the society as a whole has to find an equilibrium between the positive and negative aspects of the technology in question. How this gets done depends on many factors; too many to discuss here.

To this general "*law*" the introduction of automotive vehicles has been no exception. No one doubts that their impact on our society has been enormous, not only quantitatively but also qualitatively. This success also brought several shadow sides to the surface one of which will be the focus of this paper. the *environmental degradation.* It will study the efforts made to contain the damage to the environment in the country where the invasion of automobiles has been the most pervasive, the U.S.A.

In the years after the second World War the American car industry has been extremely successful. Regularly new production records were realized by the industry with its main center in the Detroit area.

However, the ever rising number of cars also brought an ever increasing level of pollution of the air (ground and water). One of its consequences, the smog formation, started to worry people, in particular in the Los Angeles area. Not so much the reduced visibility or the increasing smell in the air upset people, but the risks for their own health.

The automotive industry was not very apprehensive. So to counter this inter-state problem, to find ways to reduce the pollution by exhaust gases the federal government took the initiative in 1954. The U.S. Congress agreed on a public law (84-159) in 1955 which authorized, amongst others, financial support for car manufacturers to study, develop and produce less polluting vehicles.

However, this form of pressure on the automotive industry did not appear very effective, so that people turned to their local government for some real action. Not surprisingly, California was the first state to act. In 1966 it formulated strict regulations for the exhaust gases of cars. The federal government was forced to follow because after several "polite" laws the U. S. House and Senate got irritated by the non-responsive behaviour of the industry. They issued in 1970 the *Clean Air Amendment* (91-604) which set strict norms for 1975 and following years.

This political landmark dominates the relation between the federal government and the car industry for many years to come. The history of this "interaction", this exercise in mutual containment, will form the core of the presentation.

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Changes in the Concepts of Flight in the First Decade of the 20th Century : The pioneering Work of Alberto Santos Dumont

In its beginnings, heavier-than-air flight tackled fundamental questions related to stability in the 3 axes (involving aircraft configuration), power required for flight (engines) and speed (which allows for controllability and lift). Two approaches were round feasible : the use of small scale models and direct experimentation with prototypes. However, lack of knowledge of the basic principles of flight led to the adoption of inadequate formulas such as unstable canard configurations, thin wing sections and horizontal attitude on the ground (hampering take-off). Successful take-off requires an understanding of the transition between the acceleration run on the ground and flight proper. This knowledge was not supplied by experiments in gliding flight. Around 1900, it was considered that, in order to be recognized, controlled flight should satisfy the following criteria : it should occur. a) in the presence of officials from homologation bodies, b) in calm weather, c) over horizontal and controlled terrain, d) with unassisted take-off from a previously determined location, e) carrying aboard a man and the required energy source. Additionally, the machine should, f) leave the ground, g) manoeuvre in flight and h) return to the take-off point, i) performing all this without accidents. Distance, altitude and duration were not specified. According to these criteria, Santos Dumont achieved the first speed and distance world records in Nov. 12, 1906 with the no 14-bis. During 1907, Santos Dumont built 5 prototypes. In the each he tried new solutions to the fundamental questions, he abandoned the canard configuration (S.D. n°15), experimented with a dirigible-aircraft combination to ease take-off (S.D. n°16), increased power and allowed for a higher wing incidence in take-off (S.D. n°17), tested controllability with a water-borne craft. (S. D. n°18) and flew the first successful monoplane in November (S.D. n°19, the Demoiselle). From 1909 the definition of flight was dramatically altered-altitude and duration becoming the main criteria with take-off losing relevance. From this point on, retrospectively, the Dec. 17, 1903 flight by Wilbur Wright in Kitty Hawk came gradually to be recognized as the first flight by a heavier than air machine, even if it did not satisfy criteria a), b), c) and d) prevailing at the beginning of the century.

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Ein Beitrag zur Luftfahrtgeschichte. Der Flugtechniker Dr. Ing. h. c. Igo Etrich (1879-1967)

In der nordwestböhmischen Kreisstadt Trutnov geboren (am 25.12.1879) und beheimatet wandte sich Igo Etrich vor 100 Jahren der Entwicklung von Flugzeugen schwerer als Luft. Zuerst unter dem Einfluss Otto Lilienthals, bald jedoch durch die Arbeiten des Hamburger Prof. Ahlborn auf die hervorragenden Flugeigenschaften des Pflanzensamens Zanonia macrocarpa aufmerksam gemacht beschritt er seinen eigenen Weg. Er modellierte das eigenstabile Zanonia-Gebilde, im 1903 mit dem österreichischen Flugtechniker Franz X. Wels alliiert, bis 1905-1906 der manntragende Flugapparat Zanonia entworfen und in Österreich sowie anderswo patentiert wurde (öst. Pat.-Nr. 23465). Doch erst im Oktober1907 führte Wels damit in Trutnov die ersten bemannten Gleitflüge in Österreich-Ungarn aus. Um das ersehene Ziel, ein manntragendes Motorflugzeug, besser zu erreichen, wurde das Konstruieren nach Wien, später nach Wiener Neustadt verlegt. Im Sommer 1909 trennten sich allerdings Etrich und Wels, dessen Platz der Geschichte, auch aus Böhmen stammende Werkführer und Pilot Karl Illner einnahm. Gleich danach wurde in Wr. Neustadt das Motorflugzeug Etrich I-Experimental ausprobiert. Eine umgebildete Tragfläche (öst.Pat.Nr. 51064) kam beim 2. Etrich-Monoplan, wegen seines äusseren Aussehens TAUBE genannt, zur Geltung. Von Illner meisterhaft in zahlreichen spektakulären Flügen geführt setzte sich die Etrich II-Taube als Typenmuster insbesondere in Deutschland und Österreich durch und erlangte fur ihren Schöpfer den Weltruf. Fabrikationslizenzen für Österreich, Deutschland, Frankreich wurden erteilt, in Deutschland gründete Etrich sogar eine eigene Flugzeugfabrik, wobei in Trutnov die Typen-Entwicklung weiterging (z.B. die Type Schwalbe, Limousine). Die Tauben flogen in allen Weltteilen ausser Australien, fanden als Schul-, Sport-, Rennmaschinen, nicht zuletzt als Militärflugzeuge Verwendung. Bis zum 1.Weltkrieg, wo sich Etrich aus der Flugzeugindustrie zurückzog, waren verschiedene Tauben-Formen die meist gebauten Type in Österreich-Ungarn und Deutschland. - In den J. 1929-1930 konstruierte Etrich in Trutnov noch einen 2-sitzigen Kabinen-Hochdekker mit modernisierter Tragfläche, der aber zu keinem Serienbau mehr führte. Der Prototyp ist nun ein Prachstück des Tech. Museums in Prag. Wertvolle historische Original-Tauben werden in Berlin, München, Wien, Oslo ausgestellt, eine neugebaute Etrich-F/1912 fliegt erfolgreich in den USA. Seit jeher sind die Tauben-Muster im Modellbau stark vertreten. - Igo Etrich wurde 1944 für seine flugtechnischen Pionierleistungen von der Technischen Universität in Wien die Doktor-Ingenieur-Würde honoris causa verliehen. Hochbetagt starb er am 5. Feber 1967 in Salzburg und ruht dort in einem Ehrengrab.

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Creation and Development of the First Multiengine Aeroplanes

The famous Russian-American aviation designer I. Sikorsky built the first multiengine aeroplane and transoceanic airliner in the world. He was also the founder of helicopter industry. Sikorsky made a great contribution to the Russian prerevolutionary aviation development. He built "Russky Vitiaz", the world's first multiengine aeroplane in 1913. The airliner "Ilya Muromets" (1913) was a further development of the "Russky Vitiaz" and the first serial heavy bomber. A detailed investigation of the archives and old periodicals has permitted to consider all the types of this plane, to find out the number of the "Muromets" planes built and to make analysis of the first air giant creation and development.

The construction of the "Ilya Muromets" was carried out according to the orders for 76 bombers placed by the Main Military Technical Department of the Russian Army on May 12 and October 2, 1914, as well as on June 21 and December 16, 1915. Besides, another order for 40 aircrafts was expected to be placed in 1917. The Russian Navy ordered 1 plane. The total number of the "Muromets" aircraft put into construction was 142. The construction of 85 machines was completed, 15 aircrafts remained unfinished. The rest of them were not even assembled.

From 1913 to 1919 the following types of the "Muromets" bombers were munufactured : A, B, V1, V2, G1, G2, G2bis, G3, G3bis, G4, D1, D2, D3, E1 and E2. Type Zh remained unfinished. Each type had many modifications. For example, type V2 had 9 modifications, and type G2 more than ten modifications, etc. This paper highlights the specific features inherent to the design of each type and modification, as well as the history of their development and production. The paper describes how design, production and test stages were organized at Russian Sikorsky plant.

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The Sonicity and its Applications in Aviation Transportation Energetics and Oil-drilling

Ing. Gogu Constantinescu is one of the greatest inventors of the XX century, quoted by the English magazines "The Grafic" of 16 January 1926 a long side with Edison, Einstein, Rutherford, Marie-Curie, Graham Bell, Kelvin, Marconi, Ramsay and others.

Gogu Constantinescu owes his fame to the creation of a new science-sonicity and to his inventions which apply sonicity. The sonicity is a science that deals with a propagation of energy with the help of mechanical vibrations. Starting with the theories of musical harmonies, Gogu Constantinescu discovered the laws of the mechanical energy propagation at a distance with the help of oscillations that are transmitted in continuous environments of liquids, gas, solids, due to their resilience. Actually, the sonicity is based on the compressibility phenomenon of the liquids. The Romanian inventor discovers the similarity between the electric power and sonic currents obtained from a sonic generator (all the physics measurements defined in electricity have an equivalent in sonicity). The results of the researches were published in his paper work "The theory of sonics" in a limited number of copies meant to be secret until 1918 due to application of this invention to a "sonic device of automatic shooting" through the propeller of an airplane, an invention with the help of which The British Air Forces preserved their supremacy in the First World War.

At the Romanian Academy Conference in 1919, G.C. draws a parallel between the usage of the sonic energy and the electric one at different means of transport (locomotives, tracks), showing that sonicity opens new horizons in problems of drive. At Wembley exhibition, in 1922 and at the Paris exhibition in 1926, G.C. had a stall where there were showed sonic engines, the automobile and the locomotive with sonic convertor. Between 1931-1933 G.C. experiments the convertor couple at the Malaxa plants in Romania on a railway engine (automotor) on the Bucharest - Oltenita route. A spectacular application of sonicity was made in oil-drilling, due to Ion Basgan (1902 - 1981). Ion Basgan, with his license no. 22789/1934 in Romania and license n°2103137/1937 in USA based on the principle of sonicity, revolutioned oil industry. In scientific paper works and the American, French, German and Russian university lessons (Prof. Moore, Prof. Wolf, Prof. Evscenkp, Prof. Siscenko) specified the priority of the Romanian inventor Ion Basgan.

Today, the researches regarding the application of sonicity are continued and though the last word in this field was not said, there are stipulated new utilisations of the achievements of the inventions of G.C. specially regarding the sonic convertor . In a more favourable economic condition for Romania, the sonicity will impose itself much more.

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The Role of Mathematical Education in St.Petersburg School of Maritime Engineering in XIXth and XXth Centuries

It is well known that the dawn of scientific and engineering activity in Russia was associated with the name of Peter the Great. He was impressed by the achievements of the western technology and realized that without bringing the western experience on the Russian ground it would be impossible for Russia to incorporate into Europe. The problems of defence and exploration of the unknown lands, and also development of trade required to start building the new Russian fleet. This task could be only solved in conjunction with the development of the whole block of sciences such as physics and mathematics. In other words, the dawn of technology in Russia was closely connected with a creation of the scientific infrastructure in the country i.e. with foundation of the Russian Academy of Science with the base in St. Petersburg and setting up new universities and technical institutions in St. Petersburg and Moscow.

The needs of the newly created maritime industry required to put a lot of efforts in developing of mechanics and hydrodynamics. We will discuss the role of three important figures in mathematics, namely of Euler, Ostrogradsky and Krylov who considerably contributed into this program. Euler was developing the theoretical structure of mechanics which was later used by Ostrogradsky in his applications of the Gauss Ostrogradsky theorem to hydrodynamics. Ostrogradsky was a professor of St. Petersburg University who created the school of scientists and engineers who worked later in different companies and institutions of the Navy Ministry. The outstanding role of the Russian scientist Krylov can not be overestimated. He created a special topic in an educational program for navy engineers which was called a "theory of ship". This theory was based on his achievements in theory of differential equations and the problems of stability of their solutions. This led also to creating a special educational subtopic on "stability of ship".

The culmination point in developing an educational infrastructure of Maritime and Navy industry was the establishing of the St. Petersburg State Marine Technical University (in the past the Leningrad Maritime Institute). It was the first institution which has been given a systematic education in fundamental sciences as well as in engineering enabling its graduates to work in both civil and military industry associated with human activity in the sea. In the report a systematic account will be given on the evolution of mathematical education during the last decades at this university. We base our report on a research of one of the veterans of this university, professor Holodilin, who wrote an extended historical review of the scientific and educational activity at this university.

The main idea of the report is to demonstrate the link between the engineering and mathematical education at the St. Petersburg State Marine Technical University which was so important in order to achieve success in building a powerful fleet which celebrated its 300's anniversary in 1996. The report also intends to outline the whole spectrum of the research activity in the University, including history of science and technology as one of the subjects among the human sciences taught at the College of Human Sciences.

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Le développement du système de la formation des cadres des ingénieurs du génie maritime en Russie : Historique d'une question

1. Après la conquête de la forteresse de la mer Azov, qui est devenue possible grâce à l'utilisation des navires, le 20 octobre 1696 la Douma des boyards adopta un important décret sur la construction de la Marine de guerre. Ainsi, à l'initiative de Pierre le Grand, commença la construction de la marine de guerre régulière.

En 1996, la Fédération de Russie a solennellement célébré le tricentenaire du jour de sa fondation.

2. Le 18 janvier 1724, le Sénat adopta le Décret sur l'institution de l'Académie des Sciences de Saint-Pétersbourg. Dès le début de l'activité de l'Académie, des études scientifiques des problèmes du génie maritime et de la marche des navires furent organisées par D. Bernoulli (1700-1782), Léonard Euler (1707-1783) et d'autres. Sous Paul Ier, un Comité spécial a été créé auprès de l'Amirauté, transformé plus tard en Comité de formation de la Marine.

3. Vers la fin du XIXe siècle, la Russie éprouvait une grande insuffisance de cadres des ingénieurs du génie maritime ayant une formation profonde. C'est à l'école supérieure technique qu'on pouvait réaliser cette idée. L'initiative de l'institution des écoles supérieures polytechniques appartient à un homme d'état éminent S. Vitté (1849-1915).

Le 2 décembre 1902 à Saint-Pétersbourg eut lieu l'inauguration de l'école supérieure polytechnique Pierre le Grand, qui incluait la faculté du génie maritime. Le premier doyen de cette faculté, qui est devenue plus tard l'Institut de la construction navale de Léningrad, était le remarquable savant russe K. Boklevsky (1862-1928). Depuis 1992, cet établissement d'enseignement supérieur s'appelle Université technique maritime d'Etat à Saint-Pétersbourg.

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Organization and Activity of the Academic and Technical (Machinery) Committees of the Russian Marine Ministry in XIXth and in the Beginning of the XXth Century

The Marine Academic Committee organized in 1827 and the Marine Technical Committee established in 1885 were the organs for management and control of science at the Marine Ministry in Russia and the educational institutions in this department as well. Their tasks, functions and structures were the same as those of the similar institutions of other Russian ministries.

The Marine Academic Committee examined the drafts of new statutes and regulations of higher educational institutions of the Marine Ministry, drew up directions and reports, issued a magazine and training appliances for educational process and distributed special literature.

The Marine Technical Committee supervised the technical aspect of shipbuilding, mechanics, artillery and mining and also had to keep an eye on all inventions in Marine Machinery.

The Structures of Marine Academic and Marine Technical Committee were similar : a chairman responsible to the Marine Ministry and a staff of 3 or 5 elected acknowledged scientists. The Marine Academic Committee also included national and foreign honorary members and Associate Members.

The Marine Academic and Marine Technical Committee played an important role in training of specialists for the Russian Navy and in supplying it with new-type machinery.

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An Unknown Naval Accident and the Development Trajectory of the Kanpon Type Turbine in Prewar Japan

The marine steam turbine was invented in Britain in 1894 and was first transferred to Japan in the early 20th century. Since then, surprisingly within a short period, Japan assimilated multiple types of the marine steam turbine which had been invented by different Western countries (e.g., Parsons turbine in Britain, Curtis turbine in the US, Zoelly turbine in Germany, Rateau turbine in France, Escher Wyss turbine in Switzerland etc.). The purpose of such multiple assimilation was to carefully examine the relative advantages of respective type in view of establishing its own type, the Kanpon type turbine that was developed by the Imperial Japanese Navy. This paper examines the implications of an unknown but serious subsequent accident of the Kanpon type turbine that took place just before the outbreak of the World War II. Focus is placed upon the accident's relation to the development trajectory of the Kanpon type turbine.

The accident was called the Rinkicho incident but was kept secret during the wartime and afterwards. The detailed study of the incident now enables us to look at much more complex development trajectory of technology in Japan than is usually supposed by a success story. This is due to the fact that a turbine blade vibration with multiple nodes caused the accident, which was beyond the standard of turbine design of the days. Generally, such problem is supposed not to have been recognized until postwar period. But the Imperial Japanese Navy had detected it in prewar period after serious technological and organizational errors in the Rinkicho incident. And the Kanpon type turbine, thus unexpectedly coming into question in the incident, held the technological key to the opening of war against the US and Britain by the Imperial Japanese Navy in 1941. Based upon the analyses of that accident within the development trajectory of the Kanpon type turbine, its implications for the Navy's international policy shall be suggested.

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Evolution of Vessel Use in Romanian Oceanographic Research Activities (1893-1997)

Development of oceanography logically depended upon the progress achieved in naval transportation, navigation, and underwater equipment.

The starting point of Romanian marine research is best represented by the scientific cruises organized and conducted over the entire Black Sea by Grigore Antipa (1867-1944) on board the RRN cruiser "Elisabeta" during 1893, 1894 and 1895.

In addition, another activity contributing to the birth of Romanian oceanography was the extraordinary activity conducted by Emil Racovitza (1868-1947) during the Antarctic expedition on board the vessel "BELGICA" in 1896.

Research vessels used over recent times, particularly since the 1930's, on the continental shelf of the Black Sea by marine research stations established along the Romanian coast were "Emil Racovita", "Gilortul", "Nisetrul", "Marea", "Palamida", "Ariesul", "Vostok" and "Chefalul".

The Romanian Marine Research Institute (RMRI), created in 1970 by the fusion of several smaller research units, has at its disposal the R/V "PALAMIDA" and the R/V "Steaua De Mare 1" -these vessels are used for coastal research and experimental fishing.

During the last 25 years RMRI has also used, or periodically leased for research purposes, vessels belonging to the Maritime Hydrographic Department ("Hidrograful"), and the Diving Center ("Emil Racovita II", "Grigore Antipa") of the Romanian Navy, several fishery enterprises from Constantza, the Romanian Oceanic Fishing Company from Tulcea ("Delta Dunarii", "Sinoe", "Tarnava", etc.), and the commercial fleet ("MANGALIA").

Efforts now are being made in a sustained manner, to refit the trawler "Somes", belonging to the Romanian Center of Marine Geology and Geoecology, into an adequate R/V for geophysics, oceanography and fishing activities for both the Black Sea and in certain other ocean areas.

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Oceanography, Fishery Science and Fishing Industry on Russian Northern Seas, 1898-1934

My research is focused on the relationships between oceanography as a pure science, applied fishery science and fishing industry in the Russian North (Barents and White seas). This region was central in Russia for both the development of new trends in research and the building of fishing industry.

The beginning of the complex oceanographic and fishery research in this area at the very end of the last century was marked by the activity of the first appeared permanent Murman Expedition. During ten years of its work high quality oceanographic researches were provided. The main part of them were made in the close connection with the program established by the International Council for the Exploration of the Seas (ICES). In my paper I discuss different strategies which the leaders of expedition employed to bridge the gap between the aims of oceanographic research and the goals of development of local fishery.

The 1917 Revolution and the subsequent changes enabled entrepreneurial scientists to organize several new institutions for marine biological research. Their activity was connected to the strategic interests of the Soviet state in the Arctic. Later because of the drastic food shortages the authorities shifted their attention to more immediate problems - the quick development of fishing industry. The centralized system of research institutions subjugated to the fishing industry was built. Oceanographic research became the part of this system totally subordinated to the interests of fishing industry. The main concern in the North was the development of trawl fleet and herring fishery. The catches of herring turned out to be quite unpredictable. This unpredictability together with the principal unpredictability of the marine research practice in comparison with the laboratory practices leads to the tension between scientists and authorities. From the other side the similarity of scientific practice with the actual fishing allowed political and industrial bosses to meddle into fishery sciences. This situation slowed down the development of marine research in Russia, the revival of them began only after the Second World War in other political situation.

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The Interaction of Science and Economics in Fishery Management, 1941 to the Present

The history of fisheries management theory and policy in the last thirty years has been marked by tension between advocates of the objective of exploiting the resources under regimes that will assure maximum sustainable yield (MSY), principally championed by fisheries biologists and managers, and advocates (mainly economists at first) of market-oriented efficiency that will maximize social income from the fishery enterprise. Although the origin of the maximizing concept is generally dated from the mid-1950s, when it was advanced in the writings of Scott, Gordon, and others, in fact the concept had emerged as early as 1941 and formed the subject of a nearly-forgotten debate between prominent biologists that would later have a great influence on the writings of economists. Immediately after World War II, American fisheries scientists, drawing upon the heritage of ecological marine research in Northern European and British scholarship, developed the theory of MSY management in connection with ecosystem research designs. In the 1950s and 1960s, the objective of achieving MSY came to a focus upon "limited entry" as the instrument for constaining fishing effort and sustaining stocks. Then, a group American economists launched a wholesale critique of management policies, including the MSY objective, and set in motion a debate which in recent years-encouraged by the general movement toward enshrinement of free-market policy ideals in the West has resulted in a pervasive interest in limitation of entry through the privatization of fishery rights and the use of transferable quotas in the context of scientifically determined "allowable catch". Most recently, anthropologists have entered the debate with still another perspective on the objectives of fishery management, stressing community rights and maintenance of social traditions and structures.

Section 8.7 :

Geography and Cartography in the Contemporary Period (since 1800)

Under the auspices of the Commission on History of Geographical Thought

Wardenga U., Berdoulay V.

Ute Wardenga
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Historiography and Technics - New Results of German Historiography

Historiographical research concerning geography can be discussed along three types of texts which at the same time can be regarded as steps of development of historiographical research. The oldest publications (e.g. Peschel 1865, Günther 1904 and Hettner 1927) defined geography in a very broad sense, describing the development of geographical knowledge from antiquity to the present. These descriptions included general history, history of discoveries, history of technics, cartography and natural science as well. Since the beginning of the 20th century however, new aspects of historiography developed against the background of a slowly formed *scientific community of geographers.* At this stage authors focused on specific aspects such as special parts of the discipline, their methods and aims of research. At the same time historians characterized the history of institutions or choose a biographical approach of outstanding geographers. A third phase of research started after World War II when a group of specialists gave up the close relationship to the proper discipline and began to orient themselves at the standards and problems of historical science.

A critical view on the three types of historiography mentioned leads to an astonishing fact : There is a clearly visible decline in the importance of *technics.* The presentation will analyse the reasons and investigate how it came that an originally positive attitude towards technics and civilization - which were broadly accepted during the 19th century - slowly but definitely vanished in the 20th century.

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Concepts of the Progress and Geographical Thought

The concept of *progress* as an opposition to conservative thinking has been one of the main tenets of the Modern Age. Numerous expressions of the belief in progress can be round in Western thinkers' writings since the Renaissance. In some contemporary interpretations however, it is just considered to be a "myth", or "unexamined presupposition". The aim of the paper is to find an answer to the question, how should the concept of progress be understood in relation to geography.

By the most of its history, modern geography could not be a good model of *progressiveness.* Contrary to the general tendencies toward the specialization of thought, geography remained truly conservative, trying to combine its physical and human branches, to preserve its philosophical unity. The history of geographical thought constitutes an opposition to the progress both in its ideological, scientific, technological, and colloquial understanding. Nevertheless it does not mean stagnation or recession.

The history of geographical thought can be expressed best by the idea *of development,* defined in the field of biology. For biologists the term *progressive changes* denotes pathological processes, e.g. the neoplasm growth, while the correct changes are referred to as *development.* Development denotes then the process of change which leads to the creation of a functional whole, in which the information capacity (complexity) is growing, and where exists the integrative agent. On the contrary, the progress in science could be compared to the pathological growth of a tumor with its chaotic and growing jumble of separate tissues and organs. Geography appears to be the field, which could have a chance to avoid degeneration of this kind.

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Technique, milieu et culture dans la pensée géographique

Comment les géographes définissent-ils la technique? Si les définitions sont rares, les travaux de géographie expriment tout de même des dimensions de la technique. Ils ont certainement le mérite d'exprimer très tôt les implications spatiales de cette technique, des techniques de production plus précisément. Avec Max Sorre les géographes prennent en compte non plus seulement ces techniques de production mais aussi ce qu'il appelle les "techniques de la vie sociale". Cette proposition nouvelle met en lumière les aspects immatériels de la technique. Pourtant prometteuse, cette voie ne va pas susciter d'intérêt marqué ou faire couler beaucoup d'encre. Il faut attendre les travaux de Gourou pour que cette idée reprenne vie et qu'elle devienne le centre d'une géographie tropicale. La technique s'inscrit alors dans un nouveau cadre spatial, celui des civilisations et de leur efficacité paysagiste. Plusieurs travaux contemporains de géographie s'inscrivent dans cette perspective civilisationnelle et historique. En résumé, en géographie, la technique reste pour l'essentiel perçue d'abord dans sa matérialité apparente (techniques de production). Elle reste peu questionnée en elle-même, et rarement met-on en lumière le fait qu'elle se trouve être une création de l'homme, un produit culturel. Ce qui, on en conviendra, pose des problèmes d'un autre ordre, à savoir comment penser la technique en dehors de l'homme. C'est la question incontournable du sujet et de l'objet qui se trouve alors posée. En géographie, ce problème est évacué dès le départ, en fait, il ne se pose même pas. La technique reste généralement pensée en dehors de l'homme et de la culture. Des raisonnements simples de causalité sont proposés pour montrer les impacts de la technique sur les sociétés et leurs espaces. A la limite, on opte pour un certain "déterminisme technique", si doux soit-il. Cette approche conduit dans une impasse ou tout le moins ne permet pas de rendre compte de tout le spectre de la technique.

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Geographic Integration : From Holism to Systems

Substantial changes in a core idea of geography, integration, have occurred since Alexander von Humboldt published *Kosmos* (1845-1862). These changes are part of a larger shift in Western thinking to mechanistic reasoning. This shift, central to the strengthening of system-based analysis, central to the development of geographic information systems (GIS). The duality of holism and the systems approach has also led to an apparent contradiction in geography. R. Hartshorne described this contradiction in *The Nature of Geography,* but as did Alfred Hettner and Emil Wisotzki before, continued the move to partial systems as the core concept for geographic integration. Hartshorne's concept of vertical integration is in fact the antecedent for the ubiquitous GIS layer model. The reduction of geographic relationships and processes to mechanistic components (i.e. layers) enables the systematic approach, but may lessen geographic understanding of a place's interrelationships. Although the partiality of systems approaches was already acknowledged by Finch and Hartshorne in the 1930s, the tension between holistic and systems approaches in geography remains unresolved.

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The Transformation of the Idea of Spatiality in the XX th Century Geography

The aim of the paper is to analyse the transformation of the idea of spatiality throughout the XXth century geography. The idea of spatiality is chosen since it has an outstanding importance for this discipline. The extreme importance of the idea of spatiality particularly for geography is caused by the fact that, on the one hand, it holistically grasps the object of geographical study in the form of spatial singularity ("geospace") and, on the other, determines the basis of its research method ("spatial approach").

Now, geography revises its previous research program which was connected mainly with the Earth description. The previous research program found its most distinct and intelligible form in the so-called chronological conception by Alfred Hettner at the turn of the XIXth century. Since the very spirit of geography was to encompass the whole set of the processes concentrated in one place, this program urged to consider things and processes on the earth surface as filling of space (space *as a reservoir).* On the eve of the XXth century geography rested upon the vision of a single and homogeneous space, which was dominating in culture and science. Nevertheless, soon this dominating idea was subjected to substantial revision initiated by physics but most profoundly by philosophy (Husserl, Heidegger).

In the late 1950s parallel with an idea of space as a reservoir the idea of space as *a structure* appeared. It stems from the conception of *isomorphism* of different spheres of reality brought with the system analysis. If space is understood as a structure, it means that space belongs not to the object (as in the case of space as a reservoir) but to an object-subject link. This logic was extremely important as it began to bridge the Cartesian break between consciousness and physical world.

The third mode of spatial understanding views space *as an image* (space in that case belongs to an object). This mode of understanding was born in the 1970s together with a humanistic stream in science, emphasizing that a human being is both a maker and a keeper of images.

The paper also elucidates the evolution of the idea of spatiality in the light of Steven Pepper's theory (1942) of World Hypotheses (organicism, formism, mechanism and contextualism). According to Pepper, only these four basic hypotheses (better to say - generating structures) give relatively adequate explanations of reality. The correlation of these generating structures with the evolution of the idea of spatiality in geography is tested. The paper shows the deep coherence of these four generating structures with four basic categories in which the idea of spatiality manifests itself in geography (space, place, territory, and region).

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The History of Cartography as a Science and it's Role in the Contemporary Society

As we are approaching the end of the 20th century, it is of great importance to evaluate the role played by the history of science in the current modern society.

The history of cartography, which is a subsidiary science of cartography, geography and history, deals with old maps. Being a visual and documentary model of the past, they greatly differ from modern geographic maps. However, the function of old maps as documents of the past is of great significance in the countries which have recently regained their independence. Here mention should be made of the Baltic states - Latvia, Lithuania and Estonia, the territories of which were shown on old maps already seven centuries ago. But it is only now possible to make an impartial study of the history of cartography of these states.

One of the most vital problem of the history of cartography is the impact of the totalitarian regime on the development of cartography, which has not been thoroughly studied so far. To make it possible to reveal the informative value of old maps, it is advisable to include illustrations of old maps and town plans in school geography and history textbooks, as well as to publish such illustrations together with modern maps or town plans on the same sheet. It will be also allow to evaluate the layout and design of the modern map.

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The Theory of Economic Landscape on the 20th Century Scene

The theory of economic landscape created by August Lösch (1906-1945), glittering German economist and liberal thinker, is still the cornerstone for those branches of economics and geography which study the problems of location. Apart from having made an indispensable contribution to the conceptualization of those problems, Lösch is also meritorious for having anticipated certain ideas considered as key-note in the late 20th-century science. In particular, his work dealt with the problems of self-organization in non equilibrium systems, which are nowadays being intensely elaborated, especially after the works of I. Prigogine. The tragically short life of Lösch can be viewed as an example of fortitude in defending the highest standards of scientific research, as well as upholding the principles of freedom and responsibility, and intellectual resistance to the totalitarian regime. We can consider Lösch at the end of the century to be Hayek of the spatial economy.

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La "Géographie du Moyen Age" de Joachim Lelewel et sa valeur documentaire pour l'histoire de la cartographie

"*Joachim Lelewel à Bruxelles*" est un ouvrage collectif publié en 1987 à Bruxelles, qui décrit le lieu et la période de création de la "Géographie du Moyen Age", vol. 1-4, *1852, Epilogue 1857, Atlas* 1858. La spécificité et les limites des études historiques, mais avant tout l'accès aux sources ont déterminé le fait que les cartes, les itinéraires cartographiques et les commentaires n'y apparaissent pas dans l'ordre chronologique. Certains sujets s'y répètent plusieurs fois et par conséquent cet ouvrage devient plutôt un choix de documents pour l'étude de l'histoire de la géographie qu'une description cohérente de l'histoire de cette discipline.

C'est pourquoi j'ai décidé de suivre l'ordre chronologique dans mon étude sur l'oeuvre de Lelewel et d'observer la règle de chercher le contexte historique aussi bien dans l'analyse d'une carte donnée que par rapport a un sujet tout entier : p-ex. le thème des cartes arabes, de leurs auteurs et de leurs itinéraires, l'image du monde sur les cartes médiévales (aussi bien latines que celles d'origine arabe); les cartes du bas Moyen Age et celles de la Renaissance; les navigations du Moyen Age et les cartes nautiques. Conformément au principe de la recherche du contexte historique, je décris les relations entre le livre de Lelewel et -entre autres- un ouvrage comparable, similaire d'Edmond Jomard, *Les Monuments de la Géographie*, 1842-1862.

Tout en partant du principe de l'historisme posé au début, je présenterai une analyse et une appréciation de trois ouvrages, monuments de la géographie provenant d'époques différentes, dont il est question dans l'oeuvre de Lelewel : la *mappa mundi* médiévale, les *Tabulae Novae* de Germanus qui datent du début de la Renaissance et la carte dite de Zeno.

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Lucas Mallada and the Debate over the Image of Spain

In 1882, Lucas Mallada, a Spanish geologist, mining engineer, and publicist, presented an extraordinary series of lectures on Spain's environment to the Sociedad Geográfica de Madrid (Geographic Society of Madrid). He sought to persuade the Society's members, most of whom adhered to the idea that their country was blessed by nature, that Spain had severe environmental limitations. There was an accumulating body of fact and opinion to support Mallada's attack on the Leyenda de oro (Legend of Gold) : meteorological studies of the 1850s, more recent field reports of the Comisión del Mapa Geológico (Commission of the Geologic Map), and an 1880 address to a Madrid farmers' convention by Joaquín Costa, the great Spanish reformer.

Mallada's ideas appear to have been widely disseminated and considered in 1882. His lectures were published in the Society's bulletin, as well as in the Madrid liberal daily, *El Progreso*, and the bulletin of the Institución Libre de Enseñanza (Free Institute of Learning). The lectures were greeted with reactionary criticism by key members of the Geographic Society. As editor of the Free Institute's bulletin, Costa pared Mallada's bitter criticism of the Spanish race and published Federico de Botella's scathing commentary on Mallada's articles without including Mallada's reply. Both Costa and Botella were members of the Geographic Society.

When Mallada republished the essays toward the end of the 1880s, his ideas were already entering the mainstream of opinions over the Spanish environment and agriculture. Although not the first to attack the Leyenda de oro, Mallada was the first to effect an important and lasting revision of the image that Spaniards hold of their land.

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Nouvelles du Brésil : l'Institut Historique de Paris
et le projet de l'écriture de l'Histoire de l'Instituto Histórico e Geográfico Brasileiro

Pendant le XIXe siècle, une quantité considérable de voyageurs et savants ont enregistré dans leurs journaux, rapports, tableaux et dessins leur vision du Brésil. Ce sont des registres qui révèlent comment le Brésil a été vu et pensé par ceux qui ont participé aux voyages exploratoires: un pays exubérant, exotique, mais sans tradition et sans histoire.

Je prétends, dans cette étude, reconnaître la vision et le discours civilisateur des rapports de voyageurs français qui ont été au Brésil entre 1810 et 1870, et leur place dans le projet d'écriture de l'histoire du Brésil de l'Instituto Histórico e Geográfico Brasileiro. L'un des objectifs de l'IHGB était de stimuler et de promouvoir des voyages exploratoires ayant pour but de prendre des données qui puissent aider à l'écriture de l'histoire du pays et de chercher dans les archives étrangères des "Nouvelles du Brésil", pour utiliser le titre d'une section du Journal de l'Institut Historique de Paris. Les liens entre l'IHGB et l'Institut Historique de Paris peuvent être repérés par l'intense échange de textes et de documents entre les deux instituts.

On prétend comprendre comment la tradition française héritée de l'Institut Historique de Paris se trouve dans les discours de ceux qui ont eu la tâche d'écrire l'histoire du Brésil -l'IHGB- et les rapports de ce projet intellectuel avec la construction d'un Empire aux tropiques.

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The Influence of Scientists on Public Policy Regarding Rottnest Island and Garden Island, Western Australia. Two reserves - Two Different Approaches

Islands have long been of interest to the earth and life scientists, and less than 20 kilometres off the coast of metropolitan Perth, the capital of Western Australia, two publicly owned Islands and their biota have been used by different scientific disciplines for research. Located in a Mediterranean climate, Rottnest Island and Garden Island are both used for recreation and nature conservation. The settlement on Rottnest is devoted to management of the island as a recreation and conservation reserve. In contrast, the settlement on Garden Island is a naval base, yet this also manages, but with stricter controls, recreation and conservation on the island.

Over the last 50 years scientists have contributed to management policy, and consequently have affected the ecology and cultural landscape of the islands. On Rottnest, zoologists, physiologists and medical researchers have leased a portion of the island as a research station since the late 1940s. These, and other specialists have also occupied positions on the government-appointed board of management for Rottnest. On Garden Island, only 20 kilometres to the south of Rottnest, geographers have played a different research role, and for different political reasons. In 1969, when the Commonwealth Government of Australia proposed to connect the island to the mainland and build a naval base, geographers were called upon to investigate the environmental impacts of construction. This investigation led to the development of a management policy for the whole island by a geographer for the Royal Australian Navy.

As the disciplinary biases have produced contrasting impacts on policy and the island landscapes, it is concluded that the contrasts are the result of the differences between the reductionist approach of the specialists, and the more holistic approach taken by generalist geographers. The lessons from these Australian cases contribute to the appreciation of the power and influence of the universally held tenets of reductionist science. However, the cases also illustrate the rising influence of holistic science and point to the future of this approach.

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La science forestière vue par les géographes français, ou la confrontation de deux sciences "diagonales" (1800-1940)

La Science forestière et la Géographie présentent de nombreux points communs. A l'exemple de l'agronomie ou de l'écologie, toutes les deux peuvent être assimilées à des sciences "diagonales", empruntant aux autres corps scientifiques (tels la botanique ou la géologie) une partie de leur contenu. De même, à l'état dispersé dans les travaux des naturalistes du XVIIIe siècle, elles connaîtront une formidable évolution au cours du XIXe. Il en résulta une véritable reconnaissance scientifique de la part des autres domaines scientifiques, au tournant de ce même siècle.

Toutefois, elles différent considérablement quant à la prise en compte de la technique dans leur corpus. Bernard Lorentz, le fondateur de l'école moderne de sylviculture française (1824), introduit un très fort contenu technique dans l'enseignement forestier. Aux sciences traditionnelles, mathématique, physique, chimie, histoire naturelle, droit, économie politique, s'ajoute tout un panel d'enseignements spécifiques, tels la dendrométrie, la statistique forestière, la sylviculture, ou encore l'aménagement forestier; ces matières reposent sur la synthèse d'une multitude d'observations accumulées depuis trois siècles par les membres de l'ancienne Maîtrise des Eaux et Forêts et par les grands naturalistes du XVIIIe, comme Buffon ou Duhamel du Monceau. Aussi, le contenu de l'enseignement forestier, appelé à l'époque l'*Economie forestière,* confère à cette nouvelle discipline un caractère très utilitaire, à contre-courant de l'idéal de la science naturaliste du début du XIXe siècle. Cette particularité concourra à isoler la science forestière, assimilée par le monde scientifique français à une simple "pratique vulgaire" (de Sahune, 1852).

Aux lendemains des désastres de 1870, le formidable essor de l'enseignement français, du primaire au supérieur, combiné à la mobilisation des ressources naturelles, engendra entre autres la constitution d'une Ecole française de Géographie autour de Vidal de la Blache et la vulgarisation des actions entreprises par le Corps forestier français. Géographes et forestiers se retrouvèrent au sein d'une multitude d'associations nouvellement créées afin d'aider au relèvement moral et matériel du pays. Curieusement, il en découlera très peu de travaux géographiques consacrés au domaine forestier, l'ouvrage de Pierre Deffontaines, *L'Homme et la forêt* (1933), marquant l'interruption jusqu'au milieu des années 70 des recherches forestières réalisées par les géographes français.

Aussi, notre communication s'attachera à démontrer que la raison principale de ce rejet découle directement de divergences fondamentales quant à l'aménagement forestier et pastoral des montagnes, soit une remise en cause par les géographes vidaliens d'un pan important des concepts techniques de l'enseignement forestier français.

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Capitalizing on the Information Technology "Revolution" to promote regional equality.Reflections on a Malaysian Experience

Malaysia is fast identifying itself with the rise of global Information and Telecommunication Technologies (ITT) as the recently conceived government plan to build a comprehensive Multimedia SuperCorridor (MSC) south of the capital, Kuala Lumpur testifies. At a lesser regional level, this writer has headed a consultancy team commissioned by the Malaysian Town and Country Planning Department to propose a development plan involving three states in the northern part of Peninsular Malaysia. The result was a regional development plan which was to transform the entire socio-economic base of the study area using ITT industries as its main instrument. This paper seeks to highlight the articulation of the idealism of regional equity behind the ITT instrumentalism of the plan and the mixed reactions it had triggered from the respective state governments.

Section 8.8 :

Sciences of Man and Society in the Contemporary Period (since 1800)

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Historiography of History : Modern Instruments and Tendencies in the Study

Historiography of history (history of historical science) takes particular place in the historian's consciousness of soviet and postsoviet time. Interest to the intellectual history, spiritual life of society is regarded as a mental feature of knowledge, mode of thought of a Russian scholar, a philosopher. Marginal position of Russia between West and East aggravated the sense of self-consciousness of Russian intellectual, his philosophical and scientific reflection. Hence, special attention to history of thought, consciousness, science. Under the totalitarian regime's conditions with severe regulation of historian's activity, the history of historical science was the space where reduction of innovations, contemporary achievements of philosophy, history and sociology of science took place. This assimilation was a reason for creation of modern language of science according to world's standards.

Studies of the history of historical science were considered prestigeous among soviet historians. It was prerogative of the elect. In the course of time it turned into an elite field of research. Historiography represented itself as "demarcation line" between ordinary historians and theorists, methodologists of history.

At the same time disciplinary institution of historiography with its scientific apparatus, personnel, organized structures testified to the crisis of scientific consciousness of the epoch.

This crisis is connected not only with the crash of marxist paradigm of science, but in a broad sense with the search for new methods of investigation, formation of a modern historical gnoseology (social history, cultural anthropology, Microhistory, Postmodernism).

Contemporary research apparatus of historiography (history of historical science) is supplemented and improved at the account of notions, concepts, ideas borrowed from such spheres as philosophy, history of literature, linguistics, study of culture and science, psychology of creation. Modern historiographical research uses elements of theory of reflection, such notions as "image of science", "ideal of learning", "axiological space", social and intellectual history of science, Baroque, Enlightenment, Postmodernism.

New and promising tendencies in the study of the history of science are connected with the process of finalization and anthropologization of knowledge and with arising of situation of "theoretical eukimenism".

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History of Ethnological Study of the Pamir Peoples

Ethnological study of the Pamir peoples is a very important in connection with processes of their assimilation by Tadjiks on the one hand and their consolidation in the new ethnical society "pomiri" on the other hand. At present these nationalities call themselves : Vakhan, Ishkashim, Shugnan, Bartang, Rushan and Yazgulem. They are descendents of the oldest settled agricultural population of central Asia which have preserved archaic survivals in economy, material culture, social and family relations. Their languages belong to the East Iranian group and their religions belong to the Ismaelites, one of the Shiah sects of Islam. In the Russian Empire and in the USSR they lived in isolated, almost inaccessible canyons or valleys of the West Pamirs - a part of the Gorno-Badakhshan Autonomous Region of the Tadjik Republic.

History of ethnological study of this region can be divided in two periods : the first - from the last quarter of XIXth century to time of establishing of Soviet power (1918-1920) and the second - from the time of establishing of soviet power to the time of destruction of the USSR. Each of these periods is subdivided on smaller parts. In the contemporary period (since 1991) any investigation in the region is practically impossible due to the war. Moreover during the whole second period the investigations of Pamirs for the researchers from abroad were impossible for political reasons. Only during the first period were made some few investigations by western travellers as *Journey to the source of the river Oxus* by A. Hood (1872), *The Roof of the World...* by T.E. Gordon (1876), *Through Asia* by Sven Hedin (1898), *Through the Unknown Pamirs* by O. Olufsen (1904) and *Die Pamirtadshik* by A. Schultz (1914). In this connection the presented paper should help to make the first step toward the more detailed acquaintance of international audience with unique scientific materials.

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'Tripping in the Desert' : Spencer and Gillen, the Invention of the "Dreamtime" and the Emergence of Australian Anthropology

Since the late 19th Century the dominant image of the Indigenous (Aboriginal) peoples of Australia has been an image of desert dwellers. This image has been shaped by many people, but particularly by two men - Baldwin Spencer and F.J. Gillen, two 'men of science' who travelled throughout Central Australia during the early years of the Australian Commonwealth. I shall argue that the observations, deductions, interpretations and conclusions that these men made have defined ideas and attitudes toward Indigenous Australians until recent times.

Importantly, Central Australia is an extreme physical environment characterized by great distances, scant vegetation, oppressive heat and a scarcity of water. The indigenous peoples of the region have developed lifeways that embrace and yet transcend that environment, but which are in many ways distinct from those of Aboriginal people in other parts of Australia. Not surprisingly, many mainstream Australians regard the Aborigines of Central Australia as the 'real' Aborigines. At the same time, Aboriginal people in the largely wet and fertile East and South are often seen as less 'authentic' and less Aboriginal. I shall argue that these views owe much to the orientations and interpretations of Spencer and Gillen and their many disciples.

Today, the 'Dreamtime' or 'Dreaming' is understood as a system of beliefs shared by Aboriginal people throughout Australia. This is not the case. In fact, beliefs and values vary significantly from one region to another and even within regions and communities there are sometimes major differences. Yet in the popular (non-Indigenous) imagination it is the Central Australian archetype which commands attention. This is significant because in Australia the discipline of Anthropology has enjoyed considerable success. In recent times, which the advent of Native Title, anthropologists have been in great demand as 'expert' witnesses whose views often determine the outcomes of claims and thus shape the futures of Aboriginal communities and individuals. The expertise of many Australian anthropologists is more problematic than is generally assumed. As far as the courts are concerned, their views are generally held to be based on technical expertise beyond the capacity of Aboriginal people. I shall argue that this may well be an extreme example of the mis-alignment between a western academic discipline - based on late 19th century concepts of Science and of Man - and a framework of inquiry based on English and Australian legal doctrines and precedents. In this context, the distinct, complex and at times secret and sacred claims and counter-claims of Aboriginal people cannot be expected to prevail or even survive.

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St.Petersburg (Leningrad) Research School in the Sociology of Science : History, Characteristics, Trends in Research

The formation of the School is associated first of all with the names of I.A. Majzel, S.A. Kugel, Yu.S. Meleschenko, I.I. Lejman. Each of these scientists had his own way to the sociology of science, each of them has his own specific scientific interests. They were united by the interest in social studies of science and common paradigms. This creative union of theoretically and practically oriented scientists exists more than 30 years.

The main characteristics of the school are :

1. Orientation on fundamental large scale empirical researches. Study of adaptation of young scientists and engineers (whole city survey) in 1960s, study of activity of chemists (in the USSR) in 1970s, study of Leningrad academy scientists mobility in 1980s, complex study of intellectual elite of St.Petersburg in 1990s.

2. Openness, orientation on international contacts and comparative studies. Even in the socialist period joins studies were carried on not only with scientists from socialist states; and the collaboration in the field of scientific policy studies was held as well.

3. Continuity of research : through the period of school's existence power structure has changed, the structure of science and the attitudes toward the sociology of science have changed as well; nevertheless intensive studies were continued in the same way;

4. The appearance of new methods : in the 1990s experts in bibliometrics were united in the research group and bibliometrics became the integral part of school's research program

5. Orientation on practical needs of scientists and engineers : members of the school tried to help practitioners of science and develop better social relations in science. Unfortunately the results were not implemented and nowadays such approach seems more and more utopic.

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Les rapports médecin/societé et la proposition d'une sociologie de la médecine-analyse des textes de Bernhard Joseph Stern

Le présent travail fait partie d'un ensemble de textes que l'auteur élabore afin de reconstituer les origines de la sociologie médicale. Ce travail prend comme point de départ les auteurs et les textes qui se tournent vers cette thématique. Dans ce cas, l'auteur est Bernhard Joseph Stern, l'auteur d'un vaste et important ouvrage sociologique et anthropologique, tant par l'analyse théorique réalisée que par la reconstitution historique, auquel s'associent des travaux de champ de grande évidence. Par rapport au domaine de la sociologie médicale, sa production s'étend sur sept livres et dix articles, dans lesquels ont été selectionnés deux qui seront analysés dans ce travail : "The physician and society", 1948 et "Toward a Sociology of Medicine", 1951.

Dans la première partie du travail est présentée une rapide biographie de Stern (né en 1894, et décédé en 1956). Les deux textes sont analysés en détail, des extraits sont cités intégralement, et à la fin des commentaires soulignent l'insertion de Stern en tant qu'intellectuel dans la réalité nord-américaine et le caractère théorique sur lequel est basé son travail dans l'école marxiste qui a comme priorité les forces productives. De nombreux analystes pensent que les tendances de gauche de Stern lui firent obstacle pour atteindre des grades académiques plus élevés, et auraient isolé sa production scientifique. Ses études sur les rapports santé/médicine/societé mettent en évidence la présence de concepts comme le progrès et la résistance. Pour lui, si les forces productives affectent le progrès médical, celui-ci de son côté, pousse les forces productives. De la même façon que le développement de la science est lié aux transformations économiques, la morbimortalité doit être comprise dans le cadre le plus ample du développement des forces productives, sans oublier le rôle accompli par l'action médicale. Quand il s'agit du rôle du médecin, il affirme que celui-ci est socio-historiquement déterminé. Pour Stern aussi, la sociologie médicale ne se confond pas avec la médecine sociale et révèle la totalité sociale ainsi qu'un point de repère. La conclusion, indique l'intérêt de son ouvrage, signalé inclusivement par Merton, comme un pionnier de la sociologie médicale.

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L'émergence des sciences cognitives en France

L'étude de la construction des sciences cognitives est abordée par le biais de l'analyse des moyens littéraires et rhétoriques qu'utilisent les chercheurs pour orienter un nouveau domaine. Une comparaison entre les États-Unis et la France permet de dégager les traits originaux du cas français. L'évolution institutionnelle appréhendée via l'analyse des rapports demandés à des experts par des instances officielles révèle deux types de construction; l'une centrée sur les neurosciences, l'autre sur les pratiques en intelligence artificielle. En France, deux types de groupes fondateurs peuvent être distingués. le premier rassemble essentiellement informaticiens, psychologues, linguistes qui cherchent à produire des simulacres informatiques du raisonnement, le deuxième implique des scientifiques et des hommes politiques qui ont fait partie du Groupe des Dix (1969-1976). A l'aide d'archives et d'entretiens, l'histoire de ce groupe est retracée : théorie de l'information, cybernétique, informatique, fonctionnement du cerveau, théories de l'auto-organisation et de la complexité sont autant de thèmes abordés lors de réunions mensuelles. Certains membres de ce groupe ont été directement impliqués dans la création du CESTA (Centre d'étude des systèmes et technologies avancées), organisateur du premier colloque en sciences cognitives en 1985. Fonctionnant de 1982 à 1987, ce centre a favorisé la mise en place d'une coopération technologique européenne et a participé à définir les sciences cognitives comme un domaine orienté vers les pratiques en intelligence artificielle.

Héritière de la théorie des jeux, l'approche qui consiste à redéfinir un objet d'étude pour qu'il puisse être traité par le biais de la simulation sur ordinateur est privilégiée dans les sciences cognitives. Est-ce une révolution scientifique comme aiment à l'affirmer certains? Ce n'est pas une révolution au sens que lui attribue Thomas Kuhn : ce n'est pas une crise déclenchée par une anomalie mais un combat pour imposer une approche et une nouvelle conception du monde : ce qui importe, ce n'est plus de découvrir les mécanismes de la nature mais d'inventer la nature. Si la biologie moléculaire a imposé une nouvelle façon de concevoir la vie, les sciences cognitives semblent poursuivre le même objectif de raisonner en termes d'échanges d'informations, elles rajoutent toutefois une composante : assimiler le vivant à l'artificiel et inversement.

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La naissance de la criminalistique et la notion d'identité

à la mémoire du Dr. E. Stockis

Les premiers apports scientifiques systématiques et décisifs dans le domaine judiciaire (*"sub specie iuris"*) remontent seulement à la deuxième moitié du XIXe siècle, non pas tant à cause de l'insuffisance des connaissances et procédés relatifs à ce domaine que à cause de la persistance d'un paradigme - d'abord interprété comme principe, puis comme préjudice - sur la nature de la preuve, lequel ne prend en considération que la preuve du témoignage, ignorant la preuve de l'indice considérée sans importance; c'est d'ailleurs seulement à partir de ce moment-là que le savoir juridique commence progressivement à assimiler l'importance du discours scientifique (il est significatif que c'est presque au même moment que commence à se développer aussi la *"detective story"*).

Ces apports concernent essentiellement la constatation de l'**identité** de l'individu, c'est-à-dire, l'équivalent logique de son unité ontologique (*"indivisum in se et divisum a quolibet alio"*). Ce procédé d'**identification** qui consiste à extraire de l'individu dans son ensemble des éléments biologiques discrets qui lui soient propres, s'adresse à l'origine uniquement aux criminels et est affronté à cette époque-là de deux façons différentes par l'**anthropométrie** (A. Bertillon : mesurage de 11 parties invariables du corps humain [1879], intégrée par la suite par la photographie signalétique [1882] et par le portrait parlé [1888], et par la **dactyloscopie** (les *"faux précurseurs"*; W.J. Herschel: individualité des empreintes digitales et leur importance comme instrument d'identification [1877]; H. Faulds : leur valeur comme élément de preuve [1880]; F. Galton, J. Vucetich, E. Henry : critères de classification et enregistrement [1891, 1892, 1896]). En réalité, plus que leur différent degré d'efficacité et de fiabilité, il faut remarquer tout d'abord le fait qu'elles se rapportent à deux formes différentes de l'identité : l'anthropométrie, sans vouloir mettre en doute son caractère innovant dû à une approche rigoureusement quantitative du problème au moyen du système métrique, même si ce dernier présente des limites intrinsèques et des inconvénients d'ordre pratique (validité circonscrite à l'individu adulte, complexité et difficulté, avec par conséquent des marges d'erreur dans le mesurage et donc dans l'identification : des faux positifs et des faux négatifs) appartient à la re-connaissance directe traditionnelle et simple de l'**identité absolue** d'un individu déjà connu; au contraire, la dactyloscopie, qui se sert de l'arithmétique élémentaire, marque une rupture, une discontinuité épistémique de très grande importance criminalistique puisqu'elle fait appel à la notion d'**identité relative** : ce renvoi au critère de la **provenance** des éléments structurels uniques, immuables et inaltérables laissés par un individu, permet en effet aussi - et surtout - en plus de servir d'instrument d'identification, d'établir une corrélation précise entre le susnommé indice et un individu déterminé, laquelle a une valeur probatoire de caractère positif et non seulement négatif.

Par rapport à l'intérêt uniquement historique de l'anthropométrie, paradoxalement déjà dépassée au moment où on l'adopte, la supériorité intrinsèque de la dactyloscopie, aussitôt célébrée aussi dans le roman (M. Twain [1883 et 1894]), est confirmée par l'application de ses principes lors de l'examen d'autres genres d'empreintes (balistiques, vocales, génétiques, etc).

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L'évolution historique de l'analyse multicritère

L'objectif de cette brève communication est de faire un résumé historique de l'évolution de l'Analyse Multicritère, appelée par les anglophones Multiple Criteria Decision Making (MCDM) ou Multiple Criteria Decision Aid (MCDA).

Les idées sur la prise de décisions où les critères sont simultanés (c'est-à-dire pour préférer entre diverses alternatives) ne sont pas récentes. Nous pouvons trouver des analogies chez certains philosophes grecs, mais les méthodes pour structurer quantitativement les préférences sont récentes.

Nous devons attendre la fin du XVIIIe siècle pour trouver les antécédants les plus proches au traitement du problème actuel de la décision multicritère, et en outre, avec des phrases, et non avec une formulation mathématique.

Le problème de la subjectivité aux diverses possibilités ouvertes a fait que la science a pris ces méthodes comme de simples formules et pas comme de vraies méthodes scientifiques.

Jusqu'au XXe siècle, il n'a pas été possible de modeliser mathématiquement ces questions. Et c'est seulement dans le second tiers du XXème siècle que les scientifiques ont commencé à établir les principes généraux de cette nouvelle discipline. Mais on doit attendre jusqu'aux années cinquante pour obtenir des définitions et des structures précises.

Dans dans la seconde moitié du XXème siècle, la nouvelle science a eu un développement spectaculaire. On ouvre de nouveaux champs de recherche avec une application précise et pratique dans les sciences sociales, en particulier l'Économie, en plus des ambiances déjà classiques comme les Mathématiques, le Génie Industriel et de Systèmes, la Recherche Opérationnelle.

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Literary Responses to Technology at the Century's End : Virtual Reality and E. M Forster's "The Machine Stops"

This paper is part of a larger study proposing to compare literary responses to technology at the last turn of the century with literary responses today. By way of indicating some parameters of this subject, the paper will compare E.M. Forsters short novella, *The Machine Stops* (1908) with one of its immediate antecedents, H.G. Wells's *The Time Machine* (1898) and also with a contemporary text, which depicts the workaday life of employees in a modern corporation, who "commute" to work each day via home computers, Pruitt and Barrett's *Corporate Virtual Workspace* in Michael Benedikt's anthology, *Cyberspace* (MIT Press). Pruitt and Barrett's text is not a work of fiction, of course, but a narrative illustration of the sort of working conditions among managerial employees soon to be enabled (in the view of these authors) by the development of Virtual Reality. Nonetheless, it serves handily to illuminate the central aspect of Forster's story, which depicts a world in which human relations are entirely managed through the interposition of machinery.

The point of comparing Forster's text with Wells's is to show how thoroughly it is a *fin-de-siècle* document, sharing with Wells's story a concern with the theme of degeneracy-degeneracy consequent upon the technical conquest of nature. The comparison with Pruitt and Barrett captures a more significant aspect of the story-the alteration in human relationships consequent upon the technical management of society. Here commentary has gone somewhat astray, concentrating upon the usual anti-utopian elements-the Central Committee, the flattening or evisceration of private life, the conformities of thinking and expression insisted upon in a system aimed at preserving the stability of a materialistic utopia. What this approach misses is the way in which Forsters presentation of the future overtly catches a central feature of modem civic life-the extent to which social relations between people have been subjected to what Anthony Giddens calls a process of "disembedding", whereby they are lifted out of local contexts of interaction and restructured in forms admitting of digital and hence mechanical representation. Forster's provision of a world in which people communicate only and entirely by means of video screens, astonishing enough for 1908, was not meant as a dystopian prophecy but as an image of what social relations had become in his own time. A comparison of Forster's text with Pruitt and Barrett's recent essay on Virtual Reality in the corporate workspace offers an chance to compare hopes and fears about the impact of technology at the end of the last century with those of our own time.

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Ukrainian Archeology in XVIII-XX c.c.

Being rich in antiquities originating from various epochs, the territory of Ukraine is one of the regions of the S-W Europe most thoroughly explored by archaeologists. Interest to the relics of the past dates back as far as times of the Kievian Rus. Notably at the end of the XI c., the Kiev chronicler Nikon Pecherski gave description of the city, its fortifications and architectural constructions, as well as ancient settlements and burial mounds in its vicinities.

First special archaeological explorations in the Ukrainian territory were started in the second half of the XVIII c. with the excavation of the Melgunov scythian burial mound in 1763. During the XIX c. and the beginning of the XX c. numerous archaeological relics were discovered and partially explored yielding valuable material for scientific studies. In that stage, studies of the relics of the Palaeolithic period (Volcov, Merezhkovski), Tripolean culture (Gamchenko, Shtern, Khvoiko), eneolithic and bronze period burial mounds Gorodtsov, Zabebelin, Samokvasov) were initiated.

In 1830, J. Stempkovski excavated the Kul-Oba burial mound, the tomb of a Scythian tsar, in the suburb of Kerch. From this time on, were started systematic explorations of the ancient settlements in the regions adjacent to the northern coastline of the Black Sea, specifically settlements of the kingdom of Bosphorus, Khersones, Olvia, Tira (Uvarov, Farmakovski, Zabelin).

Earlier iron period settlements (Gorodtsov, Spitsyn) scythian mound in Chertomlyk and Solokha (Zabelin, Veselovski) Slavic and Russian relics (Antonovich, Samokvasov, Beleshevski) were also studied.

In the XIX c. various associations (Society of History and Antiquities in Odessa, Shevchenko Scientific Society in Lvov), Liberal Arts departments in Universities (Kiev, Kharkov, Odessa), historical-archaeological museums (Nikolajev, Kerch, Kherson), provincial Archives Commissions (Ekaterinoslav, Chernigov) conducted studies of the archaeological relics. Archaeological Commission in Kiev, Chronicler Nester Historical Society at the Kiev University actively participated in excavation works.

Of the 15 all-Russian archaeological congresses, 6 were held in Ukraine. Scientific findings of the excavation undertaken were regularly published in the *Archaeological Chronicles of the Southern Russia, Notes of the Society of History and Antiquities in Odessa, Transcripts of the archaeological congress*. However, a significant part of the accumulated archaeological material had not been published.

Within the period in question, all explorations were limited to the artefacts studies conducted by a small number of scientists. The explorations of ancient relics were conducted with a special bias towards the hunt for valuable artefacts which later either went into museum collections or became part of the private treasure stocks of some maecenes. Simultaneously, the whole mass of non-precious material had been completely ignored.

It should be noted through that a number of positive features in the development of archaeology as science during the period can be observed, such as the tendency on the part of the scientists to study cultural complexes, implement the method of the comparative analysis or reach for archaeological material when doing historical evaluation and drawing conclusions.