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(vgl. auch: Juan Martinez-Alier, **Ecological Economics**, Oxford, Blackwell, 1987, Chapter V. Der nachfolgende Text lieferte seinerzeit das Diskussions- und Ausgangsmaterial. S. gegebenenfalls auch die Voarbeiten "Preussisches (Stettiner) 'Geistesleben' (/geistesleben/), und weiter unten im Anschluss Bermerkungen zu Zürich)

Preface

This text originated in a discussion on natural resources and productive forces and its first purpose was to expose the case of a scientist and "thermodynamician" of the nineteenth century who explicitely payed attention to the scarcity problem. The methodological impossibility to free the discussion of those days aswell as nowadays of the subject's ideological connotations led to a formal approach to the problem of "semiotization" of the natural (and technological) sciences. The ideological connotations are considered as integral part of the properly formulated (historical) question. The approach is outlined in this text, it however demands further study. Another methodological demand arose from the question of the meaning of biographical data and their analysis: a "scientific worker" of those days and today, motivation, fascination, alienation. The biographical pitfall and how to avoid it: "open" biography, "sociobiography". In front of the background of an extended discussion on an "ethnopsychanalytical" approach to the matter. The approach is neither systematized nor consequently applied, however in the end it should throw light on alienation mechanisms at work, on the constitution and variations of a "social unconsciousnes" (Mario Erdheim). The "sociobiographical" method should disclose the link between individually acting alienation processes and the cultural semiotization tendencies and "projects". The point is to understand and express our own possibilities and preconditions in this respect by means of a sufficiently precise historical case study.

KS 1985:

Progress without revolution. Rudolf Clausius on "The Energy Stocks in Nature".

I. The making of a scientist.

Rudolf Clausius (1822-1888) is known to specialists for his contribution to our principles in understanding thermodynamic and electromagnetic phenomena. In 1850 he elaborated the fundamental observation known as the "Entropy Law" or "second law of thermodynamics".

Clausius was born and brought up in Pommerania (Cöslin and Ückermünde) in a parson's and schoolinspector's house, where he was the seventh of thirteen children. He went to school at Szeszin (Stettin), to an extraordinary school indeed, where physics was taught by Justus Grassmann, history and theology by Ludwig Giesebrecht, music by Carl Löwe, german literature by Franz Albert Wellmann, french and english by Ferdinand Calow: each of these men had a name in public as either scholar, scientist, artist, writer and/or - politician .¹⁾ (/rclausius/#sd1sym)

2) Clausius studies continued his Berlin University and according to his biographers at (/rclausius/#sdendnote2sym), he was fascinated by history and the lectures given by Leopold Ranke. However, he became a scientist and wrote a PhD-thesis on meteorological optics and the blue colour of the sky (Halle 1848). He worked as educator in a bankers family (1843-44), as schoolteacher (Friedrich-Werder-Gymnasium Berlin 1844-50), as an instructor at the Berlin Artillery and Engineering School (1850-55) and as a university teacher at Zürich (1855-67), Würzburg (1867-69) and Bonn (1869-1888), where he declined offers to work at Strassbourg or Göttingen (1883). He was married (1857) to Adelheid Rimpau (1833-1875) and (1886) to Sophie Sack (1856 -1941). The Rimpau were a Braunschweig family, Adelheid lost her parents when she was

twelf and lived with her relatives, the Henneberg silk-house at Zürich. The Sack were a family of prussian civil servants (Glogau, Bensberg), a cousin of Sophie, the Marburg theologian Karl Budde, was married to Helene Clausius, the eldest daughter of Adelheid and Rudolf. Thus, throughout his life, Clausius,the scientist moves in or inbetween two spheres: one is the world of bourgois trade and the other is the civil servant, clerical and military complex.³⁾ (/rclausius/#sdendnote3sym)

He kept a lasting friendship with his teacher in science and technology, Gustav Magnus (18O2-187O)⁴⁾ (/rclausius/#sdendnote4sym) and with John Tyndall (182O-1893)⁵⁾ (/rclausius/#sdendnote5sym), the "carlylian victorian" and natural philosopher of the London Royal Institution. Magnus' carreer was liberal jewish and grand bourgois before and during prussian confessionalism and it hints the way to professionalism, to political abstentionism and specialisation in science. Tyndall on the other hand got involved politically and as a scientist in the ideological debate on clericalism in victorian England ⁶⁾ (/rclausius/#sdendnote6sym). Questions of belief indeed served for political differenciations in England aswell as in Germany. If a document from school time:"Professor Giesebrecht on Religion" ⁷⁾ (/rclausius/#sdendnote7sym) is considered to be a key,evidence may be found that Clausius was guided throughout his life by the teaching in religious science(that was the term in use at his school) at Stettin, by a hegelian rationalist view, where however it was specified, as Giesebrecht once put it, that religion neither has its root and place essentially ouside of rational thought, as others have stated, nor is feeling, as Hegel said, the animal side and only thinking the divine part of our lifes.

It is interesting to state that Clausius, if he had such views, may have had a particular "german" intellectual solution to a question concerning the historical role of a scientist in the 19th century, in "class war", or ideological struggle, and concerning the scientists perception of this role, in other words (and in hegelian terms) his "alienation" of thought. If in this sense Rudolf Clausius expressed a "style" in comparison to other scientists, an interest, which may be called "sociobiographical" arises from this very fact and includes an interest for the collegues around him, for Emile Du Bois-Reymond, for Werner Siemens, for Hermann Helmholtz and others ⁸⁾ (/rclausius/#sdendnote8sym). Was there a difference? A difference in consciousness of the social function of scientific work, a selfconsciousness or awareness of historical alienation mechanisms at work, or simply a temptation to metaphysically "semioticize" or not, scientific work. A century after his death, all the people who knew Clausius are dead. Oral history nevertheless continues to contribute to our studies: "I allways wondered wether my grandfather was'nt a democrate", Dr. Elizabeth Hagemann told me (K.S.) in 1983, and: "like my grandfather, I strongly dislike haring", said Dr. Otto Budde and explained to me, how he imagined the numerous mouths of the parson's family at Ückermünde being stuffed with that (at the time) cheepest (protein-) food ⁹⁾ (/rclausius/#sdendnote9sym).

II. Citizen C's style and duty.

Professor (Geheimrat) Clausius' outstanding scientific fame is based on his fondamental treatise of 1850 "On the moving force of heat and the laws which consequently can be deduced for the teaching on heat in itself". The steamengine had caught his interest allmost certainly allready at Stettin, but surely in listening to Gustav Magnus and Johann Christian Poggendorf (1792-1877). The study of earlier work by Sadi Carnot and Benoit Clapeyron then lead him to formulate the "second law" of thermodynamics (the first being the law of energy conservation, expressed by Robert Julius Mayer and others some 8 years before), which implies a "theoretical" efficiency factor for the transformation of carburant into mechanical force by a thermodynamical machine.

Thirty five years later, in 1885, when Rudolf Clausius was rector of the University at Bonn, he published a small booklet "On the energy stocks in nature and their valorization and use for the benefit of mankind" (Bonn(Bouvier)1885). By that time, he had written plenty of scientific articles but as far as I know only one, just published (1885),for a broader public: "On the connection between the principal agents (today we would say forces) in nature". ^{ix} (/rclausius/#sdendnote9sym)

By office, the rector had to deliver speaches and apparently Clausius chose subjects for which indeed he was a specialist, once a subject concerning the understanding in terms of physics of a part of the material world, and this time a theme concerning the future planning of an important material part of community life. Subject and form reveal the double concern of the author: On the one hand we may suppose a consciousness of the way a scientific worker takes part in social life and is tied to a "whole", hence we may suppose a struggle with identity or alienation expressed by his personal approach and "style", on the other hand we see the author worried about the material base of the social "totality" and about the future destiny of its present means of reproduction, whereby the present mode of reproduction is questioned as a whole. No "metaphysical" view, neither of the scientist's role nor of the social whole.

Once published, nothing apart from a subtitel "Eine akademische Festrede" and a phrase in the foreword indicates that indeed, "On the energy stocks..." had been a speach, pronounced at the occasion of the annual celebration of the emperors anniversary. The manuscript had been carefully revised: an element of style, none of the panegyrical phrases stayed over. Was it by accident, that a handwritten draft survived and thus allowes a glance at a transient ideological production?(cf. section IX)

Let me summarize quickly what the booklet has to say: Over five pages, Clausius tells the history of steam engines, as he had done in his lectures many times and in terms similar to those his teacher Poggendorf had been using. He than remarks that electricity - an uneconomic form of force insofar as zinc batteries were used - was beginning to compete with steam, since "our countryman Siemens, a true genius", had invented the dynamo, which represents a great advantage not with respect to the generation of force but with respect to its transfer. Only now, the forces of water and wind can easily be transferred elsewhere and thereby be fully exploited. However, do we really need the energy of waterfalls? Clausius is led to consider once more the "coal question"^x (/rclausius/#sdendnote10sym) :

"With repect to the consumption of mechanical energy we are living today in a marvellous age. In economics there is the general rule that consumption in one period of any good should not exceed its production in the same period. Therefore, we should consume only the fuel that is reproduced through the growth of forests, although in practice we go about things in a completely different way.

We realize that there are coal stocks under the earth from ancient times, massively accumulated through the growth of plants then existing on Earth, during such long periods of time that, compared to them, historical time appears as infinitely short. We are now consuming such stocks, behaving as happy heirs. So much is taken from the earth as human strength and technical means allow, and it is consumed as if it were inexaustibel. The number of railways, steam boats and factories equipped with steam engines increases astonishingly so that when we look at the future, the question inevitably arises of what will happen once coal reserves are exhausted.

This is not a superfluous question despite the abundance of coal deposits. There are certainly very large stocks in the planet which up to now have not been measured, but we may estimate the magnitude of reserves in particular countries and we may guess how long they will last. William Siemens (Inaugural Adress at the General Meeting of the Iron and Steel Institute, March 1877, p.7) reckoned that, should extraction of coal in England continue at the same rate, the coal fields would last 1100 years more, but should the annual rate of extraction increase as in the last twenty years, then coal reserves would last only 250 years more. Although such figures are not exact, they show however the beginning of a crisis. We are dealing with periods of time which are relatively short compared to the life of nations."

This is a clearly stated conservationist view in matters of energy, not unlike the earlier considerations of this kind by Mary Somerville (1780-1872) and more so by George Perkins Marsh (1801-1882, Man and Nature 1864), Clausius may well have been aware of this literature. A digression on the physisist view concerning the dreams of a perpetuum mobile, prepares a warning statement at the end:

"With perfect assurance we can distinguish the possible from the impossible. All creation of energy without a corresponding expenditure of Energy is impossible. The stock of potential energy in the coal fields is due to the energy, which the sun during long periods of time long before men existed, has sent to the earth in form of

radiating heat, needed to feed the plants. If this stock will be exhausted, science by no means at its most advanced stage will be able to open up a new source of energy, but men will have to get along with what the sun still will deliver by radiation in the course of these far away times".

Science soon proved Rudolf Clausius wrong, (let alone that he forgot to mention oilfields): not even twenty years later Frederic Soddy could speculate on the social consequences of the use of nuclear energy and another forty years later their "crime", the nuclear bomb had given proof to the physicist-successors of Clausius, that the realm of science was still as ill controlled by socially constructive forces as it was in his time. Only the risk and the dimension of actual misuse changed scale and still changes scale. While so many people favour positive decisions for a technology of nuclear power, of fast breeder reactors, eventually of nuclear fusion, some do not, and to them, as to ourselves, the "coal question" or more generally the question of exhaustible energy resources is as topical, as it was for Clausius.

"Solar energy is offered to us on the one hand in the form of matter which can be oxydated and which has come into being by the growth of plants, and on the other hand in the movement of water. which can produce so much energy that waterfalls could substitute large coal mines"

"Such forces of nature should be efficiently used on a great scale as soon as possible in order to protect coal reserves against quick depletion. Coal reserves will not deteriorate if kept under the earth."

Hydroelectricity is our future? Ecological consequences have to be delt with, life quality is to be seen in perspective:

"A lover of nature will find it ugly that waterfalls, the foaming savagery of which constitutes the main source of beauty of alpine landscapes, be captured and harnessed to machines, but this is their inevitable destiny. The active industrial life that will develop near each waterfall will have to substitute for the forsaken beauty"

A century ago, an author could conclude like authors on this subject often still conclude, by urging the need for action and by calling for a concerted decision. One century has gone by since Clausius wrote:

"Due to the invention and improvement of machines such as the steam engine, the century which is now ending has been characterized by the use of the natural sources of energy to an extent never known before. The next centuries will have as their main task that of introducing a wise economy in the consumption of natural resources, mainly those we have found as a heritage of past ages and which we should not waste because they cannot be restituted. The quicker the change comes, the better. The most civilized nations should act in concert in order to control the extraction of coal in a manner alike to the control of forest exploitation in well organized states."^{xi} (/rclausius/#sdendnote11sym)

Although Clausius' text merits attention, a critical reader cannot but admit that it sometimes pathetically misses the proposed task and practically becomes absurd, in particular when the author based his hope for international cooperation on the experience with the International Post Office or even more ridiculous, on the creation of "a great neutral state of Congo". Social group and environment determine the horizon and the examples show how far away from actual political decision making a university teacher wrote and presumably still is bound to write. And those who decide do not produce the kind of texts needed.

III. The electrical revolution. The author of the little booklet on "The stocks of energy" definitely had a taste for machinery, or say for the epochal significance of some machinery: he worked successfully since 185O on a fundamental law governing the performance of the steam engine, he seemed equally motivated, when in his later days he worked with less success on the principles of the dynamo. After thermodynamics, electrodynamics. James Clerk Maxwell (1831-1879) had left a stumbling stone to his scientific community with the Treatise on Electricity and Magnetism of 1872. Electromagnetic phenomena as implied by the dynamomachine were under discussion long since (Schweigger, Oersted, Faraday, Wilhelm Weber) and gave rise to a scientific controversy of lasting repercussion. Todays common understanding of electromagnetic phenomena in terms of "fluids", in terms of a mathematical description borrowed from fluid mechanics was much debated before versus an "atomistic" description, versus a picture in terms of centers of the forces and their action at a distance, familiar from gravitation and electrostatics.

A continuus field of action with curls, springs and sinks obviously depended on the presence of a medium, called the "ether" for which there was no direct experimental evidence. Only with the experiments (1887/89) by Heinrich Hertz (1857-1894) on "wireless waves",the description in terms of Maxwells formalism seemed convincing and was more generally accepted. ^{xii} (/rclausius/#sdendnote12sym)

Rudolf Clausius entered the controversy in 1875 with a paper on "A fundamental law of electrodynamics" in which he attempted to retain some of the ideas developed in 1846 by Wilhelm Weber (1804-1891), who was by now a "grand old man" of the exact sciences and was remembered for his constitutionalism in 1837(the "Göttingen Seven" ^{xiii} (/rclausius/#sdendnote13sym)). For Clausius he had been a mentor, he had once given a very favorable judgement on demand of the young man's future swiss employers.

It was a delicate detail of the controversy that besides Maxwell and other partners of discussion and besides Hermann Grassmann from Stettin, Clausius once more encountered his old adversary Hermann Helmholtz (1821-1894) ^{xiv} (/rclausius/#sdendnote14sym). I think it would be of interest for german intellectual history to elucidate the opposition of these two men. Their different way of thinking certainly shines forth in their scientific manifestations. Moreover, we may observe a marked difference in "style", as far as "public relations" are concerned, inspite of common friends and interests.

If we attribute this difference to an adherence to different programms of "semiotization", ("cultural programms") we are lead to consider the social groups behind such programms, in our case no doubt fractions of the power elite: the question is, were to draw the separating line. If the fundamental structure is given by landed gentry, military and civil servants, clergy, professional class, bourgois trade and industry, especially the (protestant)clergy had an abiguous role and fractioned in various ways for or against paternalist-protectivist rule, mostly for (Prussia:"Junker und Pfaffen"). Some however sided with more advanced politico-cultural interests of trade and industry, of the professional and "middle" class(tendencies later on towards a "Volkskirche"). The (new) scientifico-technical elite, including the medical profession faced ideological integration problems not necessarily solved by "old style" religeous semiotisation, nor in Germany, by a "nationalist" cultural program as in England or France, nor for the time being by a "technocrat" culture. The resulting ambiguity finds expression in "alienated" forms of thought: scientists who feel obliged to go along with and express programs without fully understanding the implications or the alternatives, or worse, without caring. This, I think is the case for Hermann Helmholtz whereas Rudolf Clausius as we shall see, keeps his distance with respect to such temptations. His (religious) education (Giesebrecht), experience (Zürich) and insight are unseparable from his family background: protestant clergy. So is Helmholtz' or Werner Siemens': prussian military and (small) landed gentry.

This largely speculative thought may serve to indicate a difference between the two men which is not just individual. Helmholtz may appear as the more "modern" style of a man of his position, Clausius as the antiquated. There is however a rationalist component in the antiquated, which is more advanced than apparent modernism. A corresponding study would have to refer in more detail to of prussia's social development between pre-1848 and post-1871 and to it's perspectives. When he spoke about the importance of electrical transmission of force and the significance of the dynamo for energy economics in 1885, Clausius had not ceased to publish scientific articles on electrodynamics and the dynamo and he is certainly an expert on fundamental principals in this do.pamain. He realized, that the impressive characteristics of electrical power is its transportability and since the costs of transport are an integral part of the (energy) costs of energy, electrification offered a technically promising outlook: electrification and "white coal" versus steam and fossil fuel, all the more so, as in 19th century Gernany the energy consumption was not that incompatible with the potential supply of hydroelectricity, as it soon became (and in Britain presumably allready was), and lacking exact figures, one could belief, that fuel could be substituted.

In 1885, promotion of the new technology was well underway: "Electrical Exhibitions" had become a glamourous fashion: Paris 1881, Munich 1882, Vienna 1883. In Vienna there was an "orgy of voltaic arcs" as reported by "Die Neue Zeit" (Karl Kautsky ed.) and " in order to make such magic even mor complete, there now arrive the enormous clouds from the chimney of the boilers house, where steam performs the work of 2000 horses". In 1885, Berlin had seen the first electric plant of 540 kW supplying the theater and the

Deutsche Bank, in 1883 Emil Rathenau started the German Edison Company which four years later became the AEG, the chief competitor of Siemens. The town of Basel had undertaken the construction of an electric plant on the rhine, a fact which Clausius mentioned with enthousiasm.

Marcel Deprez demonstrated the transmission of electric power at the Munich exhibition: a vehicle moved, driven by a stationary generator, up to 60 kilometers away. In 1862, a young engineer had deposited a memoir with the Viennese Academy, to be published in 20 years, and when at the time of the Munich exhibition, the memoir was published, evidence was given, that the principles of power transmission by means of electricity had been correctly explained. The author was Joseph Popper-Lynkeus (1838-1921) who started off by constructing steam boilers, became known as a pioneer of aerodynamics and much more so as a writer and philosopher, pacifist and promoter of a concept for civil duty in a general "food army", a sympathetic utopist, a "Voltairian", as he called himself and Ernst Mach, Richard Mises, Theodor Karman, Albert Einstein appreciated him and joined in on his enterprise for social reform^{xv} (/rclausius/#sdendnote15sym). This innovator in technical aswell as social engineering wrote (autobiography, posthumously published in 1924) that by his memoir of 1862 he had no claims whatsoever on the achievements of a Deprez or a Siemens, that his interest had been to hint at the ethical and socio-economic implications of technical change, that very early, he had realized, that electricity would offer the means "to develop regions, which still suffered from pauperism", and that nations, nature left unfavoured by coal fields or oil, might profit from other resources through electricity.

If the "enormous clouds from the boiler of the chimney house" at Munich in 1882 were but a symbol, it soon became all the more clear: electricity, instead of economising fossil fuel, opened unprecedented possibilities to spend it, the electrical revolution led to another qualitative step in consumption of unrenewable resources, conservationist hopes were radically disappointed, and another hope aswell: especially in Britain plans for a municipal, decentralised kind of socialism had been based on the possibilities of electrification, very much in the sense of Joseph Poppers claims for a more just distribution of chances for development. Its true, a spiderweb of electric lines was put on the country but a glance at these strategically designed networks (Oscar Miller and others) not only teaches where the spiders sit, it makes us realize how decentralisation and socialism can be hampered by the actual mode of electrification.

By the time of the russian revolution, electrification was synonymous for progress, which kind of progress? "Soviet power plus electrification" - was the actual mode of electrification given sufficient attention? certainly not, the magic formula by no means substitutes consciousness of the dialectics of productive forces and production relations. Certainly, electrification is not but a means, and in todays soviet russia, the power question is not solved, neither technically nor socially.

What is the lesson? More justice through technology? Joseph Poppers dream? Nuclear energy was promoted by protagonists like Robert Oppenheimer and Frederic Joliot with much the same dream. Dream or ideology: never in itself will technology cause social progress, more likely it causes social regression.

Dnjprprostroy, Tenessey valley, barrages in Switzerland and Sauerland in our "atomic age" do little more than remind us of another dream, the conservationist's, which is the dream developed in the booklet by Rudolf Clausius.

IV. Entropical paradigms.

In his fundamental treatise of 1850, "On the motive force of heat", Rudolf Clausius starts off as follows:

"Since by the help of the steam engine, heat is used as motive power and, based upon this, it has been practically noticed that a certain amount of energy may be considered equivalent to the heat required to produce it, it was rather obvious that a fixed theoretical relation could be determined between the amount of heat and the work produced by it, and from this relation conclusions could be drawn on the nature and the laws of heat."

Hence, the declared and achieved purpose was twofold: to elaborate the efficiency of the steam engine, to discover the nature and the laws of heat. In fact, the principal finding of the latter kind had to be inferred from "nature", that is from experiment and observation, and was stated axiomatically by simply saying that "heat by itself does not move from a cold to a warm body". This is a classical formulation given to the "second law of thermodynamics". Ever since students learn to deduce from this assumption and from the assumption of energy conservation a theoretical efficiency of the steam engine in terms of the two "absolute" operating temperatures of the machine.^{xvi} (/rclausius/#sdendnote16sym)

Practitioners, constructing engineers like Gustav Zeuner, collegue of Clausius at Zürich and teacher of generations of steam experts and locomotivists, had'nt but a smile for Clausius theoretical efficiency factor or even doubted the justification of such a two temperature quantity: practical technical efficiencies differed too much from the thermodynamical optimum value. Still in the 1880th, Clausius had to debate the critizism of the Alsatian engineer, entrepreneur, experimenter and energeticist Gustave Adolphe Hirn with respect to the practical result of his work.^{xvii} (/rclausius/#sdendnote17sym)

Concerning the "nature and the laws of heat", together with the thermodynamical approach, Clausius and many of his contemporaries pursued another way of thinking the "nature of heat" in terms of a molecular kinetic theory of matter (gases). The stochastical movement of the molecules should explain the functional quantities defined by thermodynamics within the framework of (quantum-)mechanical calculus. In this context the "second law" became an enigm, since it was considered derivable from other principals. But indeed, since the first attempt by Ludwig Boltzmann in 1866, all such trials, including Clausius', failed: the second law of thermodynamics remained an axiomatic principle to be included in one of its many forms in any attempt to describe the phenomena. In particular in kinetic theory one had to live with the seeming paradoxon, that the mathematics used to describe the individual statistical event, the impact of two molecules, results in no asymmetry at all, whereas the statistical ensemble does show the asymmetry of the heat flow according to the model character or "semanticity" of description in modern physics as opposed to a "naive realism" becomes evident, and was in fact detectable long before quantum mechanics was developed.

The asymmetry of heat flow with respect to the time variable, its unidirectional character, in a sens the "timepointer" which it represents, is an observation of far reaching consequences indeed. A machine driven by heat is not a watermill. The latter is able, in its idealized abstract form, apart from losses by friction etc., to lift a quantity of water back up to the level from where it fell when it drove the machine, this observation is merely a confirmation of energy conservation. A heat engine, however cannot, according to the observation of the second law, transport a quantity of heat by which it was driven, back to the original temperature level without additional work. And why should it? Heat is not moving matter, like water. It is, in the picture drawn by kinetic theory, yes, energy of molecules, but it is also a characteristics of the emsemble of a large number of molecules, the temperature of which indicates a potential of "rearrangements", of "changing order", where order is an instantanious attribution of energy and location to each molecule.

This potential of rearranging possibilities increases with temperature (and number of molecules, and also depends on their kind), its change is negligible in the case of the water mill and it was given a name by Rudolf Clausius in 1865, in the sense that "entropy" increases with the decrease of this rearrangement potential.

Hence, heat scientifically is allways referred to by two functions: energy and entropy. The Jena Physicist Felix Auerbach in 19O2 published a book on "The Mistress of the World and her Shadow". The title is expressive enough. Not so much for the optimistic popular connotations of the mistress energy as for the pessimistic ones of its "shadow" entropy. Men's work however, can be "ektropic" (Felix Auerbachs verbal creation), can decrease the entropy of a partial system. Of course it can. ^{xviii} (/rclausius/#sdendnote18sym)

Another way of stating Clausius' law is by saying, that entropy in a closed system cannot but increase: "entropical" thus became synonimous with irreversible. To repeat once more the practical conclusion: any use of heat to produce work is accompanied by an irrecoverable loss of energy, to be seen as an increase in entropy. So far the physicists contribution, the technically worthwhile finding of natural scientists, the "solid fact" devoied of any symbolism.

Irreversibility is an attribute which equally applies to an irrevocable progress and to the sad aspects of aging and death, to solid construction and to fatal decay, there is in general no need to take reference to thermodynamics. However, within the framework of a social and natural philosophy which tries to exploit scientific principles semantically and politically, the second law of thermodynamics may have considerable significance. It eventually became "semioticezed". As if irreversibility had gained a higher dignity with the "Carnotian revolution" to use a metaphor employed by Michel Serres. Yes, there is metaphorically speaking a watershed between the theoretical attention Lazare Carnot, the father, the organizer of the Revolutionary Army had given to hydraulic power and the attention, with which the son, Sadi Carnot (1796-1832) devoted his short life to the steam engine, there is the "watershed" between preindustrial life and the post-revolutionary industrialisation period.

The treatise by Sadi Carnot in 1824:"On the motive power of fire",on which Clausius explicitely built his research (Carnot's law) was indeed a valuable attempt to semioticize mathematically and in terms of fundamental analysis the legendary invention for which an equally legendary James Watt (1736-1819) was to be granted symbolically. Epocal times of James Watt, of Sadi Carnot? Steps of human progress? machine age for a better world (see the american "Technocrates" at the beginning of our century, the "American Comitee for Urban Planning (Lewis Mumford et al.), see Stuart Chase on James Watt ^{xix} (/rclausius/#sdendnote19sym),see the "futurists" in art and literature)? What is the ideological importance of a scientific concept of irreversibility, "overlooked" for many years, as Michel Serres observed? We remember another paradigm of unidirectionality: Joseph Fourier 1816 on heat conduction. Paradigms of unidirectionality of time, paradigms of irreversibility in search of what? To be used by whome?

Nicholas Georgescu-Roegen in 1971 tried to"marry" thermodynamics and economy in his book "The Entropy Law and the Economic Process". Ivo Rens and Jacques Grinevald comment:

"By demonstration of the relevance of well understood thermodynamics for the study of economical activities, the author of "The Entropy Law and the Economic Process" integrates the "irrevocable time" of irreversible physical degradation of our world and unveiles the enthropical historicity common to biological and economic processes which constitute the material base of men's life." ^{xx} (/rclausius/#sdendnote20sym)

Georgescu-Roegens philosophical and in many other ways interesting chef d'oeuvre, the author a former student of Emile Borel, Karl Pearson and Joseph Schumpeter, who was himself a specialist in econometry before he became the "bioeconomical" dissident, remains unsatisfactory however in one point: it assumes rather than demonstrates a connection between economical irreversibility and thermodynamical entropy The analogy is really without consequences, except for ideology. Of course, the energy efficiency of thermodynamical machines eventually appears in an economical calculation, in precisely this sens Sadi Carnot aswell as Rudolf Clausius allready thought of it. However, the observation that "the time in economy is not any more the reversible variable of celestial mechanics, but the irreversible time of the science of heat" (Grinevald/Rens) implies little for a possible connection between two fields of knowledge.

It is perhaps worth noting, that Rudolf Clausius while he writes on the vaste of energy and the irreversibility of coal extraction and steam engine performance, and after so many years of life with the economic coefficient and the entropy law, in all his pamphlet never connected the irreversibilities he talks about to the second law he had discovered.

A significant extension however, of the thermodynamical concept of entropy happened to occur with the mathematics of "information" due to work by Marian Smoluchowski in 1917, by Leo Szillard in 1929 and definitely by Leon Brioullin in 1950. Negentropy, the negative equivalent of entropy is a measure for information in its purely statistical sens. We are familiar today to information kept in terms of binary numbers: hence to calculate entropy or negentropy as the number of potential rearrangements, as we have said above, is merely a matter of combinatorics. A human brain has about 10 to the 10th cells, (and humanity alltogether disposes of 10 to the 20th), which are incessantly in use, that is a considerable potential of negentropy. It is however by many orders of magnitude smaller than the entropy production of cobustion machines and thus apriori "economically" quite insignificant: different kinds of heat, different kinds of entropy, economy indeed is a matter of decisions on quality.

V. The cultural project: three realms of semiotisation.

"Semiotisation" of natural science in general or of particular findings of experiment and research, the attribution of "social" signification exceeding the inherent scientifico-technical value, the valorisation of concepts and methods in itself and independant of their particular field of application of their subject of investigation is and was a common, often politically motivated phenomenon. Typically today the "exact" sciences provide a paradigm for "exactitude" even if an event, a subject, a situation, a process demand a very different kind of "accuracy" or adequacy in description, analysis, or action. Gaston Bachelard has suggested that this attitude reaches the level of libidinous conditioning. Typically, the science of "Nature" in an earlier stade of the division of labour provided essential elements for common sense and class ideology of the revolutionary bourgois class.

Scientists in the 19th century love to "discover the laws of nature". That task is not just practical and for many, subconsciously or consciously, a rousseauian ring accompanies the expression of feelings about social order, the harmonies of personal "Weltanschauung". Often enough, such constructions are derived from "nature", or projected into the realm of science in order to reappear, linguistically more or less transmutet, as "scientifically" or "objectively" founded. Social Darwinism is the most well known example, biologistic simplifications still are common practice today.

During the second half of the 19th century, the evocation of "nature" is conventional, the connotation of "Natural right" and "Nature" as legitimation power for human rights fades and barely survives as a phantom for clerical circles fighting the secularizing tendencies of industrialisation and modernisation. However, with the rise of technical elites, the natural sciences become re-semioticised as the supposed foundation of technical progress, as "pure science", as "fundamental research". First to discriminate between a few "real scientists" and the growing mass of technicians, in order to hamper the formation of the new elite. Finally in oder to provide the ideological elements for technocratic domination. In the name of science.

The Kantian metaphor for the ethical essentials:"the stared sky above us and the moral law in us", a natural and a social law, indicates the kind of individualistic mystification, to which the scientists of the 19th century are likely to succomb. However, action and behaviour are not to be determined by opaque ethical or moral legitimation on the one hand and the truth of scientific results on the other, but rather by science as far as it provides for the material wellbeing and by a choice in social decisions, demanding intimate knowledge of realities and possibilities, hence science and human capacity of communication, understanding and successfull readjustment of civil society. It is to be determined by rational processes in which moral and ethical rules are but dangerous shortforms for complex human qualifications. A newly arising "socialist collectivism" ("communist anarchism") in the 19th century obviously does not demand less personal "independance" and personal judgement than ana-chronistic kantian or smithian liberal individualism, but more.

In the course of the 19th century we distinguish three cultural projects, indeed three projects of domination aswell: the clerically determined "ancien regime", bourgois nationalism and emerging technocracy. The three semioticize science, administer a specific cultural role to scientific work and scientific results.

"Religion" mediates symbolically and ritually an explicitly unquestioned scheme of social reproduction: veiled and stuffed with ideology, it has a social function directed to the future, it implies a teleology of the social process, a "concrete transcendency", a way to deal with society's "draft" of itself. Adolf von Grunebaum described and analysed the case of Islam ^{xxi} (/rclausius/#sdendnote21sym).Religion,in particular in modern Europe stands for other things ("opium for the people"), it also stands or stood for a mode of social reproduction.

A closed world oriented towards its future grew into an open world oriented towards history. This is the seemingly paradoxical formulation by the Moscow-Tartu school of semioticians and culturologists (Juri Lotman, Boris Uspenskij et al. ^{xxii} (/rclausius/#sdendnote22sym): a closing "eternal" "text" "transcends" the present whereas the "open society" activates history into a "futuroloy". The two cultural formations put unequal importance on "text" and function. Text determines the closed, function the open formation. A textual, highly

ritualised social life with the belief in "eternal" constructions perceives history at most in terms of catastrophies. With the overwhelming experience of change, conventional "texts" become questionable, culture is explicitely functionalized and history is the source of "experience", of "drafts", in particular in capitalism it serves as a quarry for ideological needs. Capitalism is not able to handle the future of society as a whole, every time the question rises, it is deflected into contradictory private interests. Is'nt Rosa Luxembourg's analysis of 1912 still valid in this point?

VI. The nationalist semiotisation project: Thomas Henry Buckle.

Around 1860 Henry Thomas Buckle (1822-1862), the liberal, the traveller and amateur historian, wrote and published his scientific, naturalist, positivist History of Civilisation, a book of "tremendous resonance" (Meyers Lexikon 1905) not only in England ^{xxiii} (/rclausius/#sdendnote23sym). For Buckle the "nation" is a modern concept to replace anachronist religions. He developed the consequences with the horizon of british colonialist experience. He made pertinent remarks on the german case, on medievalism, holy imperium, tradition and "myth" in Germany. Thomas Henry Buckle and the many scientists who approvingly read his historiography welcomed an evolving future:

"indeed our resources are now so great, that we could, at worst, suffer from a slight and temporary scarcity".

No "teleology", no "planification": the future appears causally related to history:

"Fortunately, however, for the object of this work, the believer in the possibility of a science of history is not called upon to hold either the doctrine of predestined events, or that of freedom of the will; and the only positions which, in this stage of inquiry, I shall expect him to concede are the following: That when we perform an action, we perform it in consequence of some motive or motives; that those motives are the results of some antecedents; and that, therefore, if we were acquainted with the whole of the antecedents, and with all the laws of their movements, we could with unerring certainty predict the whole of their immediate results. This, unless I am greatly mistaken, is the view which must be held by every man whose mind is unbiased by system, and who forms his opinions according to the evidence actually before him."

Buckle heroworships Adam Smith ("probably the most important book that has ever been written") and it is interesting to observe how far reaching he perceives a concept against any "protective spirit":

"Even the best of the German governments are constantly interfering with the people; never leaving them to themselves, always looking after their interests and meddling in the commonest affaires of dayly life."... "...and the world has been made familiar with the great thruth, that one main condition of the prosperity of a people is, that its rulers shall have little power, that they shall exercise that power very sparingly, and that they shall by no means presume to raise themselves into supreme judges of the national interests, or deem themselves authorized to defeat the wishes of those for whose benefit alone they occupy the post entrusted to them."

Buckles eurocentric, evolutionist, nationalist even racist views allways appear rather sceptically cautious, neither absolute nor fanatic:

"we cannot safely assume, that there has been any permanent improvement in the moral or intellectual faculties of man, nor have we any decisive ground for saying that those faculties are likely to be greater in an infant born in the most civilized part of Europe, than in one born in the wildest region of a barbarous country."

There is however no doubt where progress can certainly be detected:

"The discoveries of genius alone remain: it is to them we owe all that we now have, they are for all ages and all times; never young, and never old, they bear the seeds of their own life; they flow on in a perennial and undying stream, they are essentially cumulative, and, giving birth to the additions which tey subsequently receive, they thus influence the most distant posterity, and after the lapse of centuries produce more effect than they were able to do even at the moment of their promulgation."

Yet this apology of genius, of cumulative progress of discovery does not entail unlimited elitism:

"The german intellect, stimulated by the French into a sudden growth, has been irregularly developed, and thus hurried into an activity greater than the average civilization of the country requires. the consequence is, that there is no nation in Europe in which we find so wide an interval between the highest minds and the lowest minds."

Buckles belief in firm - as opposed to conventional - "moral" (i.e. social) and natural laws, his liberal conviction that good and evil are balanced by nature and as accessible to (scientific) knowledge and enquiry as any fact, is the precondition of ecomomic liberalism, of laissez faire, it determined the nationalist project of semiotisation and was a determining factor in politics not only for Britain.

VII."Protectivism" as a systemic quality: the german case.

The bourgois nationalist semiotisation project never was in good shape in Germany, it was belated and when in the years before 1914 a breakthrough is going to happen, the situation was destructively rearranged by war, by Prussias "Griff nach der Weltmacht". Various attempts of cultural revolution culminated in the efforts of the first republic until National Socialism provided a destructive semiotisation project with still lasting consequences.

How comes? Scarcity of resources and capital and later on the unequal development of colonies are ambiguous facts. 1805, 1815, 1830, 1848 and 1871 are crucial dates: defeat in peoples struggle for participation and steps in "modernisation" to the detriment of peoples emancipation. The prussian cameralist socio-economic system was efficiently modernised with concepts of classical political economy (Christian Jakob Kraus 1753-1807) but the continuity in government, in "corporatist" organisation of social life led to a particular "prussian model" of cultural semiotisation: autoritarian "protectivism" and paternalism are characteristic features of a culture which owed and perhaps still owes more to an absolutist and clerical than to a nationalist mode of semiotisation. In paranthesis: all these modes of semiotisation acting by great unifying concepts and opaque notions like god or church or nation are structurally conservative and in practice profoundly violated human rights, though nationalism in the 19th century also tended towards an emancipation of the masses.

Adolf Fick (1829-19O1) physiologist at Zürich and Würzburg, collegue and admirer of Rudolf Clausius, a liberal, democrate, nationalist, outspoken rationalist and versatile pamphletist had similar ideas to those of Thomas Henry Buckle and yet they differed characteristically. Fick was a christian moralist and cultural pessimist (Schopenhauer's philosophy) ^{xxiv} (/rclausius/#sdendnote24sym) and the cardinal virtues of the citizen in 1878 looked much less "natural" to him, as they had looked to Buckle:

"...cultural progress has never been threatened as much as in our times. A great number of the people called to stand at the head of this progress, by wicked delusion chose the struggle for existence to be the moral principle, hence chose the principle of evil. It is obvious, that such conversion of ethics is much more of a danger to culture than the most terrible struggle for existence by mere instinct. How to meet the danger? Sure, the clergy of the court is right if unisono they shout "the belief in a transcendental world must be strengthened in everybody". Only the way they think they can strengthen this belief is easily shown to be absurd by the poorest idiot of a communist agitator."

And what leads to transcendental belief? According to professor Fick this belief must be stimulated by a simple fact, that everybody can observe. This simple fact, surprisingly enough for us today, is "commonsense". The commonsense which for Buckle (some 18 years before) was selfevident and natural, now is for Fick a "mystery": the "simple fact"

"in reality is given in the sens of responsibility for ones own will. The sens for responsibility for ones own will and action corresponds much more to the notion of a mysterium, or if you like of a miracle, than a man's walk over a lake or the feeding of ten thousand people with five loafs of bred and two fishes... Because this

responsibility comprises as an essential part - a fact which to our knowledge is not yet really illuminated - the idea of an unbreakable causal interdependence of all phenomena. How for instance could a murder feel responsible, if he would not be convinced, that putting a dagger into man's heart, is necessarily causing his death?"

Knowledge is a presupposition of commonsense and "responsibility" for ones actions ("Bildungspolitiker"in Niedersachsen in cutting down on funds for universities in 1987 seam to have forgotten to what extend this is the case or do they think that television provides what is needed?). If Buckle can be affirmative and generous, Fick cannot, the german situation demands opposition and critizism. It is not clear to me at all, wether his critizism had an appropriate platform: the german forum was traditionally split and various "discourses" coexisted (and still coexist) without taking notice of each other. A shortsighted view, that the stronger has not to take notice of the weaker.

When Karl Marx wrote on "historical materialism" he had in mind to leave a frustrating ideological battle ground which was religion (where Hegelianism, left and right,had made an influential contribution). He proposed a distinction between a need for an "ideology" of material social reproduction, hence the need for a "materialistic ideology" and the talk about reproduction of the existing "culture". In a capitalist cultural formation social reproduction is but implicitely dealt with, a multitude of more or less totalising and competing ideologies with more or less alienating consequences for the individual mind (and body) are the expression of this situation. While analysing this kind of a "whole", Marx did not intend to add another holism to the existing multitude,but to unveil a need and a possibility to deal explicitely with social reproduction. Marx intention continues to be valid. The totalizing religions are still alive and there is still no public space to simply negotiate social reproduction, the relevant questions in general remain veiled by particular interests dressed up in declinist, optimist, conservationist secular or religious fashion, and a public space remains to be gained. Marx' propositions and analysis need amendment and adjustment ^{xxv} (/rclausius/#sdendnote25sym), may in particular need linguistic and semiotic studies.

VIII. Clubs of Ideologists.

Jacob Moleschott (1822-1893), Feuerbachian, physiologist at Heidelberg, a case of "Berufsverbot" and afterwards university teacher in Zürich, Torino and Rome represents german "scientific materialism". For several years Moleschott and Clausius shared house in Zürich and the former towards the end of his life spoke of the latter as of his "true and lasting friend". "Scientific materialism" as manifested by Moleschott's "The Cycle of Life" (1852), by Carl Vogt's "Physiological Letters" (1845/46), by Ludwig Büchners "Force and Matter" (1855) caused noisy conflicts with the defenders of religion (Rudolph Wagner) and was rejected by the scientific establishment, e.g. by Justus Liebig and Johannes Müller).

In the socially less agressiv, apolitical form of a "New Reductionism" (Everett Mendelson) however, it served as a vehicle to professionalize old and new branches of science, anatomy, physiology, physics and chemistry.

In the 1880s arguments from sience not against but in favour of theology became a fashion. Emil DuBois-Reymond (1818-1896) physiologist at Berlin and a commom friend of Clausius and Hermann Helmholtz (and of the imperial family), talked in 1872 about "On the limits of knowledge on nature": "ignorabimus" - we shall never know. The dark spots, the outside, the background of science: free space for belief?

"we recommend this reading to all our friends, who, other than the Büchner, Vogt and now even Strauss, detest all confusion of knowledge and belief",was a comment by Alfred Dove, historian and editor of "Im Neuen Reich".

Belief is meant to be a human need in itself? xxvi (/rclausius/#sdendnote26sym)

The second law of thermodynamics was not free from ideological connotations. Allready in 1851 William Thomson (1824-1896) at Glasgow (later Lord Kelvin) had spoken of the "death of heat" as the destiny of our world, and Clausius himself in 1864 had a dubious formulation printed wich was:

"energy in the world is constant, the entropy of the world tends to a maximum value".

The world? what is a "world" in this context? Today we speak of a closed system, no one knows, wether "the world" is a closed thermodynamical system, and certainly we do not know about the entropy of "the world".

Hence, the second law became a credo of (christian) declinists and cultural pessimists, however, as Erwin Hiebert wrote in an essay on "Uses and Abuses of Thermodynamics in Religion" (1966):

"The essential substance of this phase of the history of thermodynamics or religion is, therefore, not what happened, but, what was thought or said about what happened."

In other words: the transfer of ideology from science into socio-political ideology florished. On various sides in political and social struggle, science began to serve as a quarry for arguments. And science claims a cultural territory greater than ever before. This is well shown by the "Belfast Adress" of John Tyndall at the meeting of the British Association in August 1874. This speach of Clausius' close friend and godfather of his son, had been "written among the glaciers and the solitudes of the Swiss mountains" it appeared all the more production"xxvii to clerical it hurried, objectionable circles as was "no hasty, crude (/rclausius/#sdendnote27sym). It comprises 50 pages in print and is full of belief, belief in the emancipative power of science, and in its beauty:

"I should look upon the mild light of science breaking in upon the minds of the youth of Ireland, and strengthening gradually to the perfect day, as a surer check to any intellectual or spirtual tyranny which may threaten this island, than the laws of princes and the swords of emperors."

"It has been said by its opponents that science divorces itself from literature; but the statement, like so many others arises from lack of knowledge. a glance at the less technical writings of its leaders - of its Helmholtz, its Huxley, and its Du Bois-Reymond - would show what breadth of literary culture they command. Where among modern writers can you find their superiors in clearness and vigor of literary style?"

I find no such "vigor of literary style" in Hermann Helmholtz, in particular not in the final phrase of an adress to students by the rector of Berlin University in 1877:

"You are supposed to demonstrate, that a conviction, worked out by on's own effort is a fertile seed of insights and a better orientation of conduct than the best thought of orientation by authority. Germany, which in the 16th century first rose for the right of such conviction and suffered as a martyr for it, in the first place continues this fight. She has got a sublime historical task for the whole world and you are now asked to collaborate."

A pathetically unreflected mixture of oppositional semantics (individualism against authority), of historical myth (Germany the martyr) and imperialist megalomania.

Pangerman nationalist semiotisation eight years before in an adress to the "Naturforscherversammlung" at Innsbruck:

"In science, I think, we need not ask where the political borders are, our mother(Vater-)land reaches as far, as the sound of german tongue, as german industry (Fleiss) and german audacity find appreciation..."

Hermann Helmholtz unlike Adolf Fick is not an independent writer in "cultural" matters, his formulations are conventional, commonplace and devote (der "ehrwürdige" Kaiser): an example of german nationalist alienation.

A couple of years later a "science of history" served to Heinrich Treitschke to fabricate antisemitic conclusions: Adolf Fick sarcastically stated (dec.12, 188O): "The Jews are a desaster for Germany, however not because of the bad qualities of the Jews, but of the Germans."

Inspite of the prolific writers surrounding him, of collegues and friends, Rudolf Clausius did not join any of the "clubs of ideologists". He may have considered himself as "ungifted", (allthough he once had envisaged to become a historiographer). More probably, as I have indicated above, "rational theology" is the reason for which he saw no need to produce the kind of "Weltanschauung", John Tyndall imagined nor the semiotisation Hermann Helmholtz or Emil Du Bois pursued. He may have had technical sensibilities for writing which were

difficult to satisfy and he may have had demands for accuracy analogous to his scientific ones. These are projections. It remains a fact, that indeed Rudolf Clausius, allthough today seen as one of the "leading" figures of this period of "resemiotisation" of science and scientific results is practically absent on the ideological stage. This is, what makes the "boring" interesting. Yet it is impossible to put Clausius next to the habitual type of a "scientific worker" ("tecnocrat" program of semiotization?), though he undoubtedly was a "specialist": the social status of Herr Geheimrat forbids such a juxtaposition.

Clausius is absent on the ideological stage, he is very present wherever his work is questioned: he meticulously analyses the arguments of his adversary and the fact that he published the refutations as integral part of his monographies indicates a methodological and formal signification. The point is to extend a notion of "accuracy" behond its stricly scientific field of application:

"I cannot explain the tune in Mr. Taits polemic but by an eager temperament, which makes him unable, once he feels offended, to read and to examine the parts in question, but pushes him to answer in a most passionate way following a first and superficial impression"

In this case, Clausius had written with respect to Taits "Sketch of Thermodynamics":

"...aus Scheu vor persönlichen Erörterungen...unterliess ich es, obwohl jenes sehr geschickt abgefasste Buch nicht bloss in England grosse Verbreitung fand, sondern auch ins Französische übersetzt wurde"

Whereupon Tait replied:

"Professor Clausius adds that my book is ,sehr geschickt abgefasst'. Read by the light of the context this can only mean that it is skilled special pleading."

Clausius insisted:

"Ich muss mich aber bestimmt dagegen verwahren, dass meinen Worten etwas anderes unterstellt wird, als was sie wirklich enthalten. Ich bin gewohnt, mich immer offen auszusprechen, und denke nie daran, etwas, was ich nicht wirklich sagen will, doch andeutungsweise durchblicken zu lassen. Jene Worte "sehr geschickt abgefasst" sind von mir einfach als ein auf die gewandte, leicht fassliche Darstellungsweise bezügliches Lob gebraucht, und weiter kann man auch aus dem Zusammenhange nichts schliessen, da sie offenbar dazu dienen sollen, die grosse Verbreitung des Buches in England und seine Übersetzung ins Französische zu erklären."

At another occasion: "With respect to the book published by Tait:"Skech of Thermodynamics"...I expressed my conviction in 1872 in my article "On the History of the Mechanical Theory of Heat and in the first volume of this work p.387, that it owes its existence to the intention to claim as much as possible of the mechanical theory of heat for the english nation."

Clausius wrote refutations, demands for correction or claims for priority to a number of collegues: to Helmholtz, Holtzmann, Thomson, Zeuner, Maxwell, Boltzmann, Zöllner, Hirn and others. Tait and Eugen Dühring violated an explicit rule of scientific controversy, they published "persönliche Erörterungen". The scientific activity is meant to vehicule standards for human intercourse.

In contrast to controversial buisiness in public the private letters to friends show a more relaxed mood and carry a host of personal information : lively letters from Rudolf Clausius to Gustav Magnus (Preussische Staatsbibliothek) tell news from Zurich in the 1850s and in a letter from Berlin in 1851 to his Brother Robert (collection Reinhard Budde) he reported on a visit to the "cinema" of those days, he had seen a moving panorama ("grossartige Kunstwerke")representing a trip on Ohio and Missisipi, and on Poggendorfs anniversary he had dansed until two o'clock in the morning and Dubois had been elected by the Academy ("anstatt vielleicht alte, abgelebte Individuen...zu wählen"). Rudolf complains to Robert, that he has to do every publication at least twice, however "one of our most famous mathematicians told me, that he reworked every treatise up to five times".

IX. The scientist and the emperor.

. The occasion to which we owe Clausius' pamphlet "On the Energy Stocks", was the Emperors eighty eightth birthday. Yes, the monsters demanded to be worshipped. Who was Wilhelm I.? Clausius was'nt yet born, when the son of Luise, reactionary mother-of-the-nation-symbol, had his baptism of blood. And when in 1826 the "raison d'etat"(ou de famille?) forbade to Hohenzollern love and passion for Elisa Radziwill, the child amongst the children in the parsons house at Ückermünde was four years old. Wilhelm married Augusta(1811-1890),who knew how to compose march music, and the brother of Elisa afterwards became the favorite imperial adjutant. Yes, in 1830 Poland indeed was lost and when the "hermaphrodite" (dr. Hufeland) and with him the preference for christian romanticism was crowned in 1840, the younger brother became crownprince, residing at Koblenz (Friedrich Wilhelm had had his residence at Stettin) Clausius now at Berlin had to decide what to study: history or natural sciences. In 1848 the absolutist prince dropped the mask, he marched, now the "Kartätschenprinz", in Baden in 49: "victorious". Clausius by that time taught at a state school on Friedrichs Werder, in a gymnasium atmosphere which the young Henry Adams some 15 years later sensed as poorish. The physicist soon changed to become a teacher at the Berlin engeneering and artillery school. The industrial "boom" started in Prussia and Werner Siemens profited by Wilhelms grace and favour. Clausius lived the "Neuenburg-Krise" at Zürich in hostile Switzerland and reported in friendly astonished terms his observations of democratic order. The later "Bismarckkaiser", master of the grand lodge yes indeed, was a more liberal figure: he had abandoned the style of a government which, when he was 21 had decorated the first rector of Berlin University with the order of the great eagle for a polemic against "free macon revolutionaries". Had he really abandoned this style? As soon as he took to power in the crisis of 1858 he started to work on prussian hegemonia also by developing a more modern style of government within the orthodox regime."Protective spirit" (Buckle) was never questioned and remained a leading figure of thought. The royal "profession" was now given support by military and economic management, both pushed towards efficiency and the nation remained belated. Reform of the army: no hesitation to violate the constitution and with the "success" of the war against Austria in 1866/7 the Liberals became corrupted to prussian-paternalist politics for power, military and economical growth. In 67 Clausius came to Würzburg and two years later he joined a University which had been the last piece of a reform programm for Prussias unfortunate start to the age of nations. He was enough of a patriot to leed a medical support group of Bonn University students into war, got injured so that henceforth he was seen on horseback. When Adelheid Rimpau had died in 1875 - of scarlatine fever (Otto Budde) -- he stayed alone with the children for 11 years, enyoyed his second marriage for two years and died half a year after Hohenzollern, whose nephew and successor he had instructed privatissime(cf.scriptum Nachlass Clausius Deutsches Museum) in physics in 1877/8. His friend Gustav Kirchhof (b.1824) had died the year before.

The emperors anniversary. Schooldirectors, clergy, university professors were trained in panegyrical production of speeches. Let me call it the irony of history that we can have a look at such a speech by Rudolf Clausius: two pages of introductory panegyrics to the "Energy Stocks..." kept in the "Nachlass". The man of the jubilee, the reactionary national symbol is given the attributes endurant, moderate, peaceful:in revolution and reaction he tried to do justice to everyman and he kept his distance aswell from too much youthfull enthousiasm as from the contact with the Nemesis (the dictionary:godess of revenge,punishing wantonness...often carrying a branche of montaign-ash or apple tree), 1848 and 1871 were the epochal dates. Indeed these were decisive dates - did Clausius really think that Hohenzollern reacted in a "balanced" way in 1848? - and the Bonn rector in 1885 puts his emphasis on a quotation from the emperors proclamation in 1871:

"May God always grant to us and to our successors in the crown to be promoters of the German Empire, not by war and conquest..."

"not by war and conquest" is underlined and Clausius states that the emporer for nearly one and a half decade "sincerely kept his promise". Peace and the feeling of security favoured industry and commerce to the benefit of mankind and to the benefit of mankind the natural forces serve aswell. Whereby the physicist has reached his subject:"Über die Energievorräte..." A scientist for peace one hundred years ago and in the spirit of his time.

X. Forced Industrialisation or Civil War.

We may ask how the conservationist attitude expressed by Rudolf Clausius in his pamphlet in 1885 fits into the general social and economical climate. In 1871 the german economy went into a period which inspite of "Reparation" investment, inspite of the "Gründerboom" and various phases of at least partial prosperity has been looked at as "the Great Depression". A structural crisis lasting about 20 years. The pending question of reorganisation of political, economical and social relations was dominated by the "Soziale Frage", to which however it cannot be reduced. The situaton finally demanded a decision "for or against civil war". The way to avoid civil war was forced industrialisation against the interests of a considerable and in particular of an agrarian part of the powerelite. On the long way to this decision we first remark a particular enthousiasm for governmental activity, according to Helmut Böhme 1968 "the economical reorganisation of the prussian-german state in 1879 signified a refoundation of the state on the base of preindustrial autocratic and corporative principles, on loyalty to the king and to the state, on protection by the king and by the state". The "protective spirit". Practically this meant, following Böhme:

"the liberal state secretaries who had been kept in the first "purge" were now replaced by rigorous conservatives, the burocratic organisation was shaped for conservative demands and the administration was "totaly purified" of freetraders. Bismarck even tried, allthough without success to replace parliament by a corporative (state-) council for economy. Thereby he thought to round up his reforms with the intention to organise the community life (Volksleben) in corporations and associations (Korporationen und Genossenschaften) protected by the state (unter staatlichem Schutz). This plan was avorted, but Bismarck had obtained the loyalty of leaders in industry and trade,had linked them to the state and its traditional supporters, to landowners and administrators."

Foreign policy took on traits of splendour and show buisiness with the Berlin congress after the turkish war in 1878, with the "distribution of the (colonial) world" in 1885. It is no surprise that inner policy and "cultural life" stimulate new periodicals in addition to the ones existing since the 1850s like "Die Grenzboten" or "Die Gartenlaube". New for instance "Kosmos" (1877,Stuttgart,Ernst Krause (Carus) ed.), a periodical to promote Darwinism, or "Im neuen Reich" (1871,Leipzig,Alfred Dove ed.) (protestant,liberal-conservative), or "Die Gegenwart" (1872,Berlin, Paul Lindau ed.) or "Deutsche Revue" (1877,Berlin, Richard Fleischer ed.) (national-liberal) or "Deutsche Rundschau" (1874,Berlin, Julius Rodenberg ed.)(Literature) or "Nord und Süd" (1877,Berlin, Paul Lindau ed.) or "Vom Fels zum Meer" (1881,Stuttgart,Wilhelm Spemann ed.). The influential and traditionally liberal weekly "Das Ausland" (Friedrich Hellwald ed.) changed under the new direction of Friedrich Ratzel to become more specialized in "Anthropogeography".

The new periodicals reflect a growing "need" for ideology of politically evasive and repressive nature, inner policy indeed was repressive as demonstrated by the antisocialist law 1878-1890. The russian opposition had at least had the satisfaction of a successfull action when the repression increased after 1881, whereas the two attempts of regicide in Germany in 1878 by Hödel and Nobiling failed. Hermann Helmholtz commented on "terorism" in a widely noted and also printed speech entitled "The facts of perception":

"How things have changed! We may exclaim in circumstances where the ideal goods of mankind are cynically depreciated by the street and by the press, a depreciation which culminated in two abominable crimes which apparently headed at our emperor only because he symbolizes what mankind sofar considered worth of honor and gratitude."

Apparently without relevance to this political perception of his the professor of physics then goes on to discuss his subject with great precision and scholarship.

The development of the "Social Question" became not less but more conflictual, inspite of repression, inspite of evasive manoeuvring: neither theatralic foreign politics, nor colonial splendour diminished the potential of conflict. Nor the real social improvements: health insurance 1883, professional security insurance 1884 and a

social security law in 1889. In 1883-1885 Germany counted more emigrants than ever before, more than one million in a couple of years. Things headed for confrontation: Bismarck envisaged a "bloodbath", i.e. civil war and acted in order to win.

The political decision however turned out to be different: a kind of "illuminated" conservative spirit won: the decision was to force the efforts in industrialisation, the agrarian fraction lost and its alliance with the grand bourgois fraction became less and less tight in the 90s. The bourgois fraction became more powerfull, though never as strong as it was in England and France.

In 1885 german coal extraction amounted to 73 million tons, whereas the United States extracted 97 and Great Britain 162 million tons. Germany extracted as much as Britain had extracted in 1860, industrialisation was still delayed.

But with the industrialization fever of the 90s the extraction of coal grew by a factor of two and a half between 1892 and 1912 and steel production increased by a factor of three. The first world war finally showed the destructive face of forced industrialisation and put a questionmark behind the political decision of the 1880s.

We have tried to show in this section, that the initiating forces for industrialisation where not exactly those of industrial "optimism" guided by the anticipation of industrial profits but at least in part those of neutral or even hostile interests for industry, guided by political calcul for power conservation. An unholy alliance suggested itself.

Clausius "conservationist" pamphlet effectively was a votum against forced industrialisation. As in 1885 the decision for or against it was still pending this votum is perfectly up to date for the ruling class, it supports one of its strategical political tendencies.

XI. Rudolf Clausius and the "Coal Question". Coal extraction may be seen as an indicator for the advancement of industrialisation. In 1885 Germany in this respect ressembled Britain in the 1860s. The conservationist - optimist question by then was going to be settled. Discussion of coal extraction by economists had begun in Britain in the 1830s. As Paul Christensen has indicated, J.R. McCulloch, in reviewing Charles Babbage's, the "declinist's" arguments for the Edingburgh Review 1833, had to admit that given the importance of steam "as a moving power, an abundant supply of coal has become quite essential to distinction in manufacture". Two years later the same author reviewed Ure's Philosophy of Manufactures for the Edinburgh Review and drew attention to the physical "causes" of industrial progress, the causes being the possession of abundant resources for iron, brass and steel and extended available coal mines. In her treatise "On the Connexion of the Physical Sciences" (London 1835) Mary Sommerhill discussed the geological timescale though not with respect to the formation of coal mines, she rather mentiones "those tropical plants preserved in the coal measures" to point out their age and the slowness of geological change in general, a fact which cannot simply have escaped the attention of economists: coal embodies sun energy of infinitely greater periods than mankinds period of coal extraction. The social implications of the latter became terrifying: more than 1000 dead miners per year in the 1860s. Memorable strikes as in 1864 in Staffordshire. People in 1860 had condamned exportation of coal to France and advocated a protectionist policy. The victorian clerical mass periodical "Good Words", a mouthpiece of the establishment wrote in 1864:

"Few questions can be more interesting than that of the duration of our coal fields, on which so much of the comfort an prosperity of the world depends"

Henry D. Rogers, professor for natural philosophy at Glasgow discusses the coal question. Different authors give different estimates: William Armstrong told the British Association in a speech that mining would be a question of 2-300 years. E. Hull estimated the total yield to one hundred million tons which would garantee the actual consumtion for eight centuries. Will we succeed to extract the deep lying resources?

The establishment is looking for a final word in the coal question and Stanley Jevons book "On the Coal Question" in 1865 is enthousiastically wellcomed as such for instance by John Herschel, doyen of naturalists whose expert knowledge counted for government. For William Stanley Jevons the book gave the initial push to his carreer. Immediately tutor at Owen College Manchester, later on Cobden Professor. The book recommended short spur of internal use of coal for industry in order to achieve a durable base for Britain's lead amongst the nations. Hans Peter Sieferle has recently summarized Jevon's challenge to British entrepreneurial talent: we must choose between greatness in the short run or continuous mediocrity.

An expansionist industrial policy could still be connected by argument to social welfare. However the authors later book, the Theory of Political Economy of 1871, a founding treatise for the subjective theory of value is far from any connection to the social intentions and hopes for the future of a Robert Owen. Nor was it any longer concerned with the historical perspective of the use of physical matter and energy. Instead it studies the formal rules of economic equilibrium: Mathematisation as the key to scientific reputation and professionalization. Complex human relations formalized in terms of the mathematics of mechanics: an example of the reductionist physicalist approach. Heinrich Gossen had started this attempt with his book of 1854 on "The development of human relations" and the statistical reductionism started even earlier.

Whereas in England the Coal Question for a while was settled, the political situation in Germany was different and Rudolf Clausius could "go back" behind Stanley Jevons conclusion and venture a conservationist approach by saying that "in economics there is the general rule that consumption in one period of any good should not exceed its production in the same period". In contrast to Jevons. The english debate of the 1860s can barely have escaped to him. He had friends in Britain, he travelled to Britain several times and in 1879 he had received the Copley Medal of the Royal Society. And he quoted William Siemens, who participated in the English discussion. His critique of the current practice in coal extraction, precisely the opposite view to Jevons' twenty years earlier, fits into an atmosphere of hesitation with repect to capital investment in industry and stabilisation of power relations. I doubt that Clausius pushed the question as far as we can push it, as to whether social change can be postponed further and further.

The "Coal Question" or more generally the "Question of resources" comes up again and again. It has of course a "technical" aspect, related directly to a socio-economical model for the use of resources, and it has a "natural history" in the sense, that scientific progress has been made, and more knowledge has become available to approach the technical part of the question, the prospective research on natural ressources. It is in part a question of natural and technological science, and in part a question of a socio-economical model. But only in part. Books like Daniel Fords "The Cult of the Atom" show that there is more to it: the scientific and technical knowledge is put into a context, into a "cultural" project, is "semioticized" or not according to interests and projects and intentions. The "talk" about scientific facts may not be entirely separable of their technical use, but the historian of science realizes that it has a signification of its own and often a use of no small importance on another level. It was our intention to study the energy question in history in its scientifico-technical development as well as in its semiotic historical dimension. The awareness for the latter and for present day semiotization processes may serve to put our "subjective" accents to our work and enable us to question its political tendency, this makes the difference between conventional "natural history" of the question in its scientifico-technical dimension and the more advanced concepts of social history of science. Part of this work is meant to exemplify a sociobiographical approach, which is pursued by a working group at Osnabrück University.

Notes & Literature.

1) (/rclausius/#sdendnote1anc) With regard to Stettin, School and teachers:

M.Wehrmann, Festschrift zum 350jährigen Jubiläum des kgln. Marienstifts-Gymnasiums zu Stettin am 24.u.25.Sept.1894, Stettin 1894

Nachrichten über das Schuljahr von Michaelis 1836/7 in: Karl Friedrich Wilhelm Hasselbach, Einladung zu der öffentlichen Redeübung, Stettin 1837. With a Contribution of Justus Günther Graßmann on acoustics.

F.H.G.Graßmann, Guther Rat für Schulaufseher und Schullehrer auf dem Lande, Stettin 1838. F.H.G.Graßmann was a brother of Justus Günther Graßmann.

August Zapp, Aus meinem Leben. Ein Beitrag zur Reform des deutschen Schulwesens. Zürich 1888 For Zapp Giesebrecht's teaching was "determining for the whole life".

Hermann Günther Graßmann, Ges.math.u.phys.Werke,Leipzig 1894

R.Graßmann, Das Weltleben oder die Metaphysik,Stettin 1881. "Der Verfasser wird es sich selbst zuschreiben müssen, wenn es ihm geht, wie es seinem Vater und seinem Bruder gegangen ist, deren Werke zu wenig Anerkennung fanden." (a "linguistic" question, an inclination for neologisms) "the Graßmann family disease (Familienübel)"(Comment Kosmos 9,1881)

Carl Loewe, Selbstbiographie, Berlin 1870. Loewe kept a close friendship with Ludwig Giesebrecht and with Justus Graßmann.

H.Bulthaupt, Carl Löwe, Berlin 1898

F.Kern, Ludwig Giesebrecht als Dichter, Gelehrter, und Schulmann, Stettin 1875

Ludwig Giesebrecht, Ferdinand Calos Leben, Anhang in F.Kern, loc.cit.

Ludwig Giesebrecht, Damaris, eine Zeitschrift, Stettin 1860-65

M.Runze, Ludwig Giesebrecht und Carl Loewe, Berlin 1884

H.Kircher, Robert Prutz, eine biographische Skizze in: R. Prutz, Zwischen Vaterland und Freiheit, eine Werkauswahl, Köln 1975. Robert Prutz(1816-1872) was a friend of Arnold Ruge and of Georg Herwegh, Friedrich Wilhelm IV made him professor at Halle University in 1848,he returned to Stettin in 1858.1851-1867 editor of "Deutsches Museum".

Georg Büttner, Robert Prutz, Ein Beitrag zu seinem Leben und Schaffen von 1816 bis 1842, Leipzig 1913:"Während über Hasselbach, Giesebrecht, Schmidt, Graßmann,Loewe die ADB mancherlei zu sagen weiß, wäre Wellmann ganz vergessen, wenn ihm nicht sein bedeutenster Schüler Robert Prutz im Deutschen Museum 1861,II,s.620-626, ein Blatt der Erinnerung gewidmet hätte". Prutz recalls Wellmann as a "maitre camerade" in his paedagogical method and as an expert for comparative language studies,including slavic languages. Wellmann was a collaborator of Grimm's Dictionary.

Hans Prutz, Jugenderinnerungen eines Dankbaren in Nord und Süd 150(38)1914-160(41)1917. Hans Prutz was the son of Robert.

G.Uhlig in A. Graf, Schülerjahre, Erlebnisse und Urteile namhafter Zeitgenossen, Berlin 1912. For Uhlig the philological and linguistic teaching of Karl Ernst August Schmidt was influential. The Clausius papers at Munich contain a Manuscript "Logik bei Prof. Schmidt."

C.L.Schleich, Besonnte Vergangenheit, Lebenserinnerungen 1859-1919, Berlin 1920

2) (/rclausius/#sdendnote2anc) Biographical writings on Clausius:

Eduard Riecke, Rudolf Clausius (Nekrolog+Schriftenverzeichnis) Göttingen 1888

J.Willard Gibbs, Rudolf Emanuel Clausius (Orbituary) Proc. A.A.A.Sc, 16, 458-65, 1889

G.F.Fitzgerald, Rudolf Julius Emanuel Clausius (Orbituary) Proc.Roy.Soc.48,1888

F.Folie, R.Clauius, sa vie, ses traveaux et leur portee metaphysique, Bruxelles 1890 (Extrait de la Revue des questions scientifiques, avril 1890)

Max Reinganum, Rudolf Clausius, ADB 55, 1905. Max Reinganum(1876-1914 was professor of physics at Freiburg/Baden (1907)(cf.Phys.Z.16,1915)

Walther Nernst, Rudolf Clausius, Gedenkvortrag 1922 in:150 Jahre Rheinische Friedrich-Wilhelm-Universität Bonn 1818- 1968, Bonn 1970 vgl. dort Beitrag Barbara Jaeckel, Wolfgang Paul zur Geschichte der Physik in Bonn.

Rudolf Clausius in: Pommersche Lebensbilder I,208-211,1934

Grete Ronge, Die Züricher Jahre des Physikers Rudolf Clausius, Gesnerus 12,73,1955

Max v.Laue, Rudolf Clausius NDB 3 1965

Edward E.Daub, Rudolf Clausius in Dict.Sc.Biogr.

Autobiographical fragments:Anschreiben Breslau(Stelle Nachfolge Pohl) 25.7.49:"1844 Oberlehrexamen,seitdem... Friedrich Werderschen Gymnasium...obwohl von jeher meine Absicht war, eine Stelle als Lehrer an einer Universität zu suchen" (Nachl. Gustav Magnus Preuss. Staatsbibliothek).(His references were Dove,Poggendorf, Magnus,Dirichlet,Steiner). A letter 1880 (Nachl.D.M. München):"Was meinen Lebenslauf anbetrifft,so ist er kurz folgender. Geboren bin ich, Rudolph Joh.Em.Clausius am 2ten Januar 1822 zu Cöslin in Pommern. 1840-44 studierte ich zu Berlin. 1850 erhielt ich die Lehrstelle der Physik an der Artillerie- und Ingenieurschule zu Berlin und habilitierte mich zugleich an der dortigen Universität. 1855 wurde ich Professor der Physik am eidgenössischen Polytechnikum und zugleich auch an der Universität zu Zürich. 1867 wurde ich an die Würzburger und 1869 an die Bonner Universität berufen. Hochachtungsvoll ergebenst Rudolf Clausius.

72 letters Clausius-Tyndall, Copies: Tyndall papers RI London, cf.below. Letters Clausius-Magnus, Clausius-Dubois (Preuss. Staatsbibliothek Berlin, Samml.Darmstädter).Letters Marie Sochatzy,Mathilde Selasinsky to Karl Budde (Family archive Reinhard Budde Geneva).

3) (/rclausius/#sdendnote3anc) The Clausius family:

Father Carl Ernst Gottlieb Clausius (1781-1855) born in Woldenburg/Mark,(son of Charlotte Wilhelmine Diemann (1753-1823 Cöslin), daughter of the parson at Sonnenberg and of Ernst Gottlieb Clausius (1745-1791), parson. 2nd marriage of Charlotte 1793 with Franz v. Zemari(?),captain) First marriage 1804 with ? Michaelis (1784- 1808),daughter of a military councillor, 2 children(the first d.1842, the second (1808-1873) was a prussian Generalmajor), second marriage 1809 with Wilhelmine Bliesener (d.1810), 1 son(d. 1853), third marriage with Charlotte Wilhelmine Schultze (Schulz?)(1793-1840), daughter of the parson in Glasow/ Brandenburg and his wife, Wilhelmine Senft (Charlottes eight brothers and sisters were or were married to parsons and officers, one brother emigrated to America, two others died in the war 1870/71),13 children: Minna,(b. 1811,married Willigmann),Herrmann, forester (d.1891),Concordie(married Wilde,d.1884), Robert (1817-1891), garnison parson Mainz, Theodor, forester (d.1877),Rudolf, Mathilde (married Selasinsky),Carl (1827-1844), Marie(b.1829,married Sochatzy), Max,forester (d.1881),Ida (married Merzet,d.1895), two more children died early. Rudolf was the eigth. Sources: copy by Anna Clausius, 2nd wife of Robert from handwritten notes by Marie Sochatzy 1894 (family archive,courtesy Reinhard Budde/CERN), Interview with Dr Otto Budde (b.1898) October 1983, family documents.

Marie Sochatzy tells, that Rudolf cared very much about her when she was young, especially when their mother had died (1840):"he sacrified his 4th year of study so that I could be send to board at Stettin. Since our father had to keep so many sons away from home the means were missing. My brother Rudolf took a job as educator of two sons in a bankers family at Berlin while continuing his studies: this was a big sacrifice, in view of his eagerness for research."

Adelheid Rimpau's father was Justus Johann Christian (1782- 1840), merchant in Braunschweig. Her mother died when she was 12. Clausius to Dubois 12.8.59: "Meine Braut ist eine Braunschweigerin, ihr Schwager Henneberg..."; to Magnus same day:"...independent of my engagement: my position here is very much recognized. Children of Adelheid and Rudolf: Mathilde(b.1859, married Zimmer), Helene(b.1863, married Budde), John (b.1864, judge), Hedwig,(b.1866), Alfred (b.1868), Else(1872-1954, married Hagemann). Adelheid died of scarlatine fever (Dr.Otto Budde).F. Folie: "une apres midi, Mme Clausius ouvre le piano et fait chanter ses enfants en les accompagnant, ils etaient la trois ou quatre, ages de six a douze ans. Sur un ordre de la mere, ils tiennent tous les mains jointes, afin,sans doute,d'etre exempts des distractions auxquelles le jeu de leur petits doigts eut pu les exposer, et chantent, avec un ensemble parfait, quelques Liedchen. "Savez vous, me dit Madame, quelles sont ces petites chansons que les enfants viennent de dire?" Et me montrant un recueil manuscrit:"Les voici, ajouta-t-elle, elles ont ete composees, paroles et musique par Kirchhoff, l'un de nos meilleurs amis de Zürich".

Mathildes husband was a theologian, Helene married the Marburg professor for Old Testament theology Karl Budde (cf.Kautzsch-Bertholet, Die Heilig Schrift, Tübingen 1922). Elses husband was a merchant. PhD thesis of John Clausius Bonn,1890: "Das Merkmal der Macht im Begriff des subjektiven Rechts." Sabine Clausius (wife of John?) published novels: "Aug um Auge, Novelle aus einer deutschen Seestadt", Köln 1905.Alfred Clausius became director of "Wagons lits" and lived in Geneva.

Rudolf had a son with Sophie Sack: Walther (1887-1895).

4) (/rclausius/#sdendnote4anc)With regard to Heinz Gustav Magnus:

His influence on the devolopment of physics in Germany can barely be overestimated. He came from a wealthy Berlin jewish merchant family, friends of the Mendelsohns (Gustav and his brother Eduard grew up with the Mendelssohn children Rebecka (married Lejeune-Dirichlet), Fanny (married Hensel) and Felix. Felix in a letter about a walk to Brocken/Harz 1827:"Heydemann stellte sich auf einen Stein mitten in dem Bach und plätscherte mit der Hand im vorbeirieselnden Wasser, hob dann einen Kiesel auf und zeigte mir, wie nun das Wasser anders flösse, und alles drückten wir in Ritterschen Phrasen aus; Magnus ging voran, pfiff und äußerte: das gefiele ihm" cf. Sebastian Hensel, Die Familie Mendelssohn 1729-1847, Freiburg München 1959.

Magnus got his PhD in September 1827 with a thesis"De tellurio", went to Stockholm for a year, then to Paris, returned to Berlin in 1829, begann to lecture on technology in 1831, taught at the Artillerieschule (1.11.1832:"jetzt nun waren Liebig und der junge Gay-Lussac vier Wochen hindurch hier und haben bei mir gewohnt"..."Sie schreiben meinem Schweigen Verliebtheit zu, aber davon ist nichts zu spüren, alles Frühere ist verschwunden, ich bin wieder heiter und froh"), took the succession of Sigismund Friedrich Hermbstädt in 1833 and became a full professor in 1845. In 1840 he bought a house with a lecture room near to the University and was married to Bertha Humblot (b.1820, Berlin Hugenot family, booksellers). She initiated the "Gustav Magnus Stiftung der Akademie" after Magnus' death and was still alive in 1900 (Hjelt) 1831.

Hermann von Helmholtz, Gedächtnisrede auf Gustav Magnus Abh. Berliner Akad.1871, p. 1-17

A.W.Hofmann, Gustav Magnus, ADB cf.A.W.Hofmann,"Erinnerungen an vorangegangene Freunde".

Aus Jacob Berzelius' und Gustav Magnus' Briefwechsel, 1828- 1847, Edv. Hjelt ed. Braunschweig 19OO. Magnus to Berzelius, 2.11.1831:"Daß die Cholera sich auch an die Philosophie gemacht hat und Hegel daran gestorben, ist Ihnen wohl aus den Zeitungen bekannt geworden, wiewohl diese andere Krankheiten als Todesursache anführen und er mit allen Ceremonien, und nicht wie andere Choleraleichen,beerdigt worden ist.Mit ihm wird hoffentlich wohl auch die Naturphilosophie in Deutschland zu Grabe gehen".

Peter Pringsheim, Gustav Magnus, Die Naturw. 1925,49 - a case of ahistorical semiotisation of facts for the benefit of the scientific community

cf.Bruno Meyer,Eduard Magnus und die Magnus-Ausstellung in Berlin, Beiblatt Z.bild.Kunst 8,522,1873.Alfred Dove, Die Polychromie, zur Erinnerung an Eduard Magnus. Im neuen Reich,1872,p.522

From John Tyndall Nature 1, April 1870, Death of Prof. Magnus:" I first saw Prof. Magnus on his own doorsteps in Berlin. His aspect won my immediate regard which was strengthened to affection by our subsequentintercourse. He gave me a working place in his laboratory and it was there, I carried out the investigation on diamagnetism and magnetocristallic action which is published in the Phil. Mag. for Sept.1851. In 1853 I was again in Berlin and found under his roof the same ready help and sympathy. Prof Hirst and myself payed him a visit last summer...When I bade him goodbye in 1851 his last words to me were:" If you should meet any really able young fellow, willing to work, and to whom such assistance as I can render would be valuable, send him to me!"

Rudolf Clausius relation to Gustav Magnus is reflected by his letters to "Hochgeehrter Herr Professor" (1855/ 59), "Lieber Herr Professor"(1862/66)(13.11.64:"Durch Frau Poggendorf haben wir erfahren, daß Sie bei guter Laune sind und mit Vergnügen Reutersche Schriften lesen. Das letztere ist allerdings ein vortreffliches Mittel, die gute Laune aufzufrischen. An Sie und die lieben Ihrigen einschließI. Quinke (Magnus' son in law K.S.), und mit der Bitte auch Herrn Louis Rieß und seine Familie freundlich von mir zu grüßen...")

5) (/rclausius/#sdendnote5anc) With regard to John Tyndall:

John Tyndall, Erinnerungen aus meinem Leben, Deutsche Revue 10,218,1885

A.S. Eve, C.H.Creasey, Life and Work of John Tyndall, London 1945

James R.Friday, Roy M.MacLeod, Philippa Speherd, John Tyndall Natural Philosopher 1820.1893. Catalogue of Correspondence, Journals and Collected Papers, Mansell/ London 1974: "Despite his research into spontaneous generation (fermentation K.S.), he was never credited with a profound theoretical advance (like Faraday, Darwin or Kelvin), or with the invention of a new device (like Dewar), nor was he the architect of a system of instruction (like Huxley or Armstrong). Yet Tyndall was in many ways their equal and more." - "Three facets: the mathematical, the visual and the literary".

cf. J.S. Rowlinson, The Theory of Glaciers Notes and Records of the Roy. Soc.26,189-204,1971

R.M.MacLeod, The X-Club, A Social Network of Science in Late Victorian England. Notes and Records of the Roy. Soc. 24,305-322,1970

German education: On leave from Queenwood College (an Owenist foundation)he went to Marburg with Edward Frankland in 1848, they met Robert Bunsen (and Ludwig, the physiologist). From Berlin (where he worked with Magnus) in 1851:" I like Dubois, there is a healthy streightforwardness about him."

Lifelong friendship with Archer Hirst: Letter to him 9.3.1848 discusses cooperation vs. individual competition: "I don't like their motto liberty and equality - as long as society is composed of such heterogeneous particles, we shall now and then want some vigorous heel to tramp it into order..." Letter 24.12.53: "I don't want you to love anybody but me and your wife if you ever get one."

Lifelong friendship with Karl Debus (Queenwood, later Kassel) letter from Debus 9.6.51 discusses Hegel and world spirit. Letter to Debus 10.8.70: Germanys action in the war is "truly wonderful and beyond all expectations." Letter to Tyndall 9.9.1890 "The spirit of Germany is now running more and more in the military line than I have ever known it to do before. Where will it end?", letter Debus to Tyndall 17.3.1893: "Europe is very fast becoming a great military camp...the millenium is certainly not yet near."

Ssientific controversy opposes Tyndall and on his side Huxley, Hooker, Frankland, Spottiswoode, Lubbok and Spencer to Forbes, Whewell, Thomson, Joule, Tait, and Darwin joins in with them. X-Club founded by Tyndall in 1864.

Tyndall the "Carlylean": Since 1849 he was in correspondance with Carlyle, stimulated by Archer Hirst: German students mad with democracy? Tyndalls "generalized antiorthodoxy"? "Most dogmatic individualism", sided in "antisocialism" with Herbert Spencer who proclaimed: "The advent of Socialism is inevitable. It will be the greatest disaster the world has ever seen, It will end in military despotism." Tyndall in a letter to Spencer in 1892 deplores" Panama and all its scandal in France, Army Bills and Antisemitism in Germany, mad Gladstonianism in England and Ireland."

John Tyndall on Rudolf Clausius: to Adelheid Rimpau 31.12. 64: "Among my many friends there is not one, whose friendship I rate higher thean his"; Letter to Hirst 2.9.88: "For no other German man - Bunsen alone exepted - had I a greater regard".

Herbert Spencer on Tyndall: "Men of Science may be divided into two classes, of which the one, well exemplified by Faraday, keeping their science and their religion absolutely separate...and the other, occupying themselves exclusively with the facts of science, never ask, what implications they have (like Peter Bell and the primrose) Tyndall did not belong to either class, and of the last, I have heard him speak with implied scorn."

6) (/rclausius/#sdendnote6anc) Clericalism in Victorian England:

Geoffrey Best, Mid-Victorian Britain 1851-75, Frogmore St. Albans 1973:p.194:" Parliament daily opened busines with prayers, and the beginnings and ends of sessions were solemn and splendid with religious ceremonies. Some members certainly believed not a word of it, and many presumably were no more willing than Lord Melbourne had been to let religion "interfere with private life"; it is nevertheless a fact that Gladstone's administration in the early eithies was never more seriously embarrassed or endangered than by its attempts to help an honest and uncompromising atheist take the seat in the Commons to which the men of Nothampton had elected him. As things were with national representatives, so were they all down the line. I doubt if any noble family did not own at least one clergyman. Clergyman were called upon to add religious seriousness to every sort of public occasion, from prize-givings and cattle-showes to ratepayers' meetings and political protests. Urban clergymen were no longer, so far as I can judge, liable as in the twenties and early thirties to be met with menace and abuse from working-class secularists and radicals."

"The consensus omnium as to the being of a Power superior to Nature is a fact" said Rev. William J. Irons of The Victoria Institution (founded 1865 ad maiorem Gloriam dei),"Will Mr. Herbert Spencers admission, that religion is, per se, a fact not to be ignored, satisfy Prof. Tyndall? Or will Max Müllers painful Science of Religion?"

In this context the writings of Hariet Martineau ("Maid of all work": Abolitionist, mesmerism, Auguste Comte) and her brother James, Professor for mental and moral philosophy and political economy (!) Manchester New College. "The seat of authority in religion believed in the state rather than in the sanctity and sainty of the church".

cf. Joseph Needham ed., Science, Religion and Reality, London 1925 esp. Antonio Aliotta/Naples Science and Religion in the Nineteenth Century:"religions energies operating in the world of history"?

To victorian clericalism correponds Prussian Confessionalism in Germany, "positive christianism". Robert Prutz commented on the religious landscape in 1846 (cf. note Nr.8):"Theologie - siehe da die wahre große Angelegenheit des Tages! das Zentrum des deutschen Lebens! die Losung der Parteien!Was England und Frankreich? Wir haben Uhlich und Hengstenberg! Was Rußland und die polinische Grenzsperre? Wir haben Ronge und den Bischof Arnoldi von Trier! Was spanische Heirat und englischer Zolltarif? Wir haben Lichtfreunde und Deutschkatholiken! Deutsche Verfassungsfrage? Wir beschicken die Synode. Handelskongresse? Wir gehen nach Köthen (Versammlungsort der Lichtfreunde K.S.). Interessen der Kunst und Literatur? Wir disputieren über die Dreieinigkeit, erörtern die Glaubhaftigkeit des Evangelisten Lukas, und schreiben Bücher darüber, ob der Weg in den Himmel links geht oder rechts, ob man zu Pferde oder zu Esel sicherer dahin gelangt, und ob die Hölle eine Treppe tief liegt oder zwei. Da haben wir in Summa die

Nationalinteressen des deutschen Volkes von Anno vierzig bis sechsundvierzig: der rote Faden, der sich durch das Gewirre dieser Jahre hinzieht, er ist aus geistlicher Wolle gezupft, die Dogmatik ist unser contrat social, Geistliche sind unsere Volkshelden, theologische Streitfragen die Fragen der Gegenwart, die Fragen der Nation!"

7) (/rclausius/#sdendnote7anc) The Munich Collection of Clausius' papers contains this valuable document. I discussed it elsewhere ("Von Zinzendorf zu Hegel","Workshop-papers"Oldenburg 1983).Ludwig Giesebrecht (1792-1873)is of interest as poet and writer, as historian and theologian. In 48/49 he was a Frankfurt deputy (conservative constitutionalist). He quarrelled with prussian confessionalism and called himself a "heretical subjectivist". He had been emotionally attracted by Zinzendorf's Pietism, he had struggled with antiintellectualism in those circles and had "discovered" Hegel in 1832/33. For his friend Carl Löwe (1796-1869) Giesebrecht was "created to write poetry for oratoria".

8) (/rclausius/#sdendnote8anc) The question of a "difference in style"

is neither easy nor simple. It is the question as to wether different social groups "semioticized" science in different ways, because of different "cultural projects" or -programms. I understand that "Prussian confessionalism" or "Victorian clericalism" indicate such projects. Both revive or maintain older anthropological and political concepts. At the same time, industrialization, social change put in question any kind of "totalizing" ideological scheme, and the discussion florishes.

Who were the "collegues around him"? (State-)controlled industrialization, reforms of the educational system, professional specialisation, a higher degree in the division of labour (the academic paradigma of the "german philological seminar"), a deep change in the medical profession towards "scientific medicine". Gustav Magnus taught courses in innovative "technology" (he and his family were prussian capitalists) including "field"excursions into workshops and factories. He also taught the foundations and fundamental methods in chemistry and physics. Besides the young capitalists his academic public were teacher students and medical students. Some of them joined in a "Physikalische Gesellschaft" in 1844 in order to promote a professional called "New Reductionism"(Everett programm, todav Mendelssohn) documented bv а periodical:"Abhandlungen der Berliner Physikalischen Gesellschaft", and a year book:"Fortschritte der Physik".

cf.: Emil Warburg, Zur Geschichte der Physikalischen Gesellschaft, Die Naturw.1925, Heft 3, p.35

Among the 53 members in 1845 (including 6 leutenants and 6 technicians): Beetz, Brücke, Clausius, Du Bois, Halske, Helmholtz, Karsten, Kirchhoff, Knoblauch, König, Siemens. Some of them professionally successful indeed. Some must have felt a need for ideological reorientation. Werner Siemens recalls: "It was a period of great religious and political movement all over Europe. In Germany the first expression was the free religious mouvement, directed against catholicism as well as against the dominant rigorous protestantism. Johannes Ronge came to Berlin and everybody went to his Tivoli-speeches, which created great enthousiasm. Specially the young officers and officials - nearly all of them carried liberal thoughts - were enthousiastic about Johannes Ronge." Johannes Ronge (1813-1887) was a catholic priest, dissident, excommunicated in 1844, leader of a politico-religious reformmovement ("German-catholic"), important until 1849(50 000 members in Prussia in 1845(Meyers 5th)), less so afterwards(Prussia:6400 in 1861). It promoted fundamentalist together with rationalist thoughts(cf.Gervinus, Die Mission der Deutschkatholiken, Heidelberg 1846). Associated with the "Lichtfreunde", the protestant opposition of 1840 against "prussian confessionalism" and pietism: Gustav Adolf Wislicenus (1803-1875)("Ob Schrift, ob Geist"1845, "Die Bibel, für denkende Leser betrachtet", Leipzig 1863/4) parson at Halle, lost his position in 1846, was a member of the Frankfurt Parliament, went to America in 1853 to avoid emprisonment and lived near Zürich from 1856 on. His son was Johannes Wislicenus (1835-1902), chemist at Zürich 1861, Würzburg 1872, Leipzig 1885 (cf.Sonne Erinnerungen, Leipzig 1907), who worked with Adolf Fick cf.below.

Two oppositional religious "cultural programms" represented by Ronge and Wislicenus. The above mentioned Ludwig Giesebrecht represents a third. A fourth would be the spencerian or the entirely laicistic alternative for which Ludwig Börne, Heinrich Heine or Karl Marx can be named today. Each of these "frames of reference" attributed a signification to science.

The question of differences in "style" apart from personal factors leads to the question of such frames of "semiotiza- tion". I am tempted to think that Rudolf Clausius due to his education (Stettin, Giesebrecht) and personal contacts (Halle?Wislicenus?) and in contrast to Du Bois, Helmholtz and Siemens had an awareness on a different level for instance for the "Lichtfreunde" or John Tyndalls approach, an awareness which led to a difference in "style".

In this context cf: Albert C.Lewis, F.Schleiermacher's Influence on H.Graßmann's Mathematics in: Herbert Mehrtens, Henk Ros, Ivo Schneider eds. Social history of nineteenth century mathematics:papers from a workshop TU Berlin 1979, Boston Basel Stuttgart 1981 and: Albert C.Lewis, H.Grassmann's Ausdehnungslehre and Schleiermacher's Dialektik, Ann. Sc.34, 103-162. Hermann Graßmann (1809-1877), son of Justus Günther(d.1852) and brother of Robert Graßmann (1815-19??), studied and taught at the Stettin gymnasium: a younger collegue of Ludwig Giesebrecht, engaged in Sanskrit studies by the time Giesebrecht publishes "Damaris".(cf.Schlegel, H. Graßmann, Leipzig 1878). (cf. "Stettiner Zeitung", "Pommersche Zeitung" edited by Robert Graßmann 1848-?)

9) (/rclausius/#sdendnote9anc) To both I am very greatful for the hours they talked and listened to me: to Otto Budde, the country doctor of the Markgräflerland whom I visited in October 1983 in a small private room which belonged to a large hospital and where he had kept furniture which his grandfather Rudolf Clausius had used and pictures showing his parents and his grandparents. And to Dr. Elizabeth Hagemann the highschoolteacher at Essen - my grandfather before 1919 was a teacher at her school, she and my aunt had met while both studied natural sciences at Bonn University in the 1930s. The feelings and the facts which were transmitted to me contributed to my understanding of german history in a perspective reaching from the lifetime of Rudolf Clausius to our present days.

10) Before going on, I wish to refer to the following literature on the historical and social background:

Eckart Kehr, Der Primat der Innenpolitik, Gesammelte Aufsätze, Berlin 1965

Helmut Böhme, Prolegomena zu einer Sozial und Wirtschaftsgeschichte Deutschlands im 19. und 20. Jahrhundert, Frankfurt 1968

Klaus Epstein, Vom Kaiserreich zum Dritten Reich (Review articles on Kehr and Böhme therein), Frankfurt,Berlin,Wien 1972

Hans Uwe Wehler, Das deutsche Kaiserreich 1871-1918, Göttingen 1973

Reinhard Koselleck, Preußen zwischen Reform und Revolution, Stuttgart 1967

Knut Borchardt, Die Industrielle Revolution in Deutschland, München, 1972,

Jürgen Kocka, Unternehmer in der deutschen Industrialisierung, Göttingen 1975

E.J.Hobsbawm, Industry and Empire, An Economic History of Britain since 1750, London 1968

E.J.Hobsbawm, The Age of Revolution, Europe 1789-1848, London 1972

E.J.Hobsbawm, The Age of Capital, 1848-1875, London 1975

U.K. Preuß: Bildung und Bürokratie - Sozialhistorische Bedingungen in der ersten Hälfte des 19. Jahrhunderts, Der Staat 14,371-196,1975

Peter Lundgren, Techniker in Preußen während der frühen Industrialisierung, Berlin 1975

C.Varrentrapp, Johannes Schulze und das Preussische Unterrichtswesen in seiner Zeit, Leipzig 1889

Hermann Rösch-Sondermann, Gottfried Kinkel als Ästhetiker, Politiker und Dichter, Bonn 1982

S.F.Cannon, Science in Culture: the Early Victorian Period, New York, 1978

Steven Turner, The Growth of Professorial Research in Prussia 1818-1848 - Causes and Context, Hist.Stud.Phys.Sci.3, 137-182,1971

Christa Jungnickel, Teaching and Research in the Physical Sciences and Mathematics in Saxony, 1820-1850, Hist.Stud. Phys.Sci,10,3,1979

Frederick Gregory, Scientific Materialism in Ninetheenth Century Germany, Dordrecht-Boston 1977

Herbert Mehrtens, Die Naturwissenschaften und die preussische Politik 1806-1871 in: Friedrich Rapp und Hans-Werner Schütte eds. Philosophie und Wissenschaft in Preußen, Kolloquium TU Berlin WS. 1981/82

Hans Querner und Heinrich Schipperges, Wege der Naturforschung 1822-1972 im Spiegel der Versammlungen Deutscher Naturforscher und Ärzte, Berlin-Heidelberg-New York 1972

Michel Biezunski ed. La Recherche en histoire des sciences, Paris 1983, contributions by M.Crosland, D.S.L. Cardwell, I.Toth

11) List of selected publications of Rudolf Clausius with respect to different subjects and controversies.

Über die Lichtzerstreuung in der Atmosphäre und die Intensität des durch die Atmosphäre reflectierten Sonnenlichtes Pogg.Ann.72,1847 and: PhD thesis Halle 1847

Lichtmenge, welche die Erde durch Reflexion des Sonnenlichtes in der Atmosphäre erhält.Monatsb.d.Berliner Akad.1847, 2p.

Über die Intensität des durch die Atmophäre reflectierten Sonnenlichtes, J.r.u.a.Math.36,1848,31p.

Übersichtliche Darstellung der in das Gebiet der Optik gehörenden Erscheinungen. Grunerts Meteorologische Optik Bd.I.1850

Über die relativen Intensitäten des directen und zerstreuten Sonnenlichtes, Pogg.Ann.129,1866,7p.

Über die bewegende Kraft der Wärme und die Gesetze, welche sich daraus ableiten lassen, Pogg.Ann.79,1850

Über einige Stellen der Schrift von Helmholtz über die Erhaltung der Kraft Pogg.Ann.89,1853,cf.Pogg.Ann.91, 1854

On the discovery of the true form of Carnots function Phil. Mag.4,1856,2p-

Über die Art der Bewegung, welche wir Wärme nennen, Pogg. Ann.100,1857

Über das Wesen der Wärme verglichen mit Licht und Schall, Zürich 1857

Über die mittlere Länge der Wege,welche bei der Molecularbewegung gasförmiger Körper von den einzelnen Molecülen zurückgelegt werden, nebst einigen anderen Bemerkungen über die mechanische Wärmetheorie, Pogg.Ann.105, 1858,16p.

Über den Unterschied zwischen activem und gewöhnlichem Sauerstoff Vjs.nat.forsch.Ges.Zürich,8,1863,22p.

The Mechanical Theory of Heat. With ists applications to the steamengine and to physical properties of bodies. Edited by T.Archer Hirst FRS, professor of mathematics in University College London. With an Introduction by Professor Tyndall, London 1867. Tyndall wrote: "Nearly 17 years ago I translated the first of this series of memoirs by prof. Clausius on the Mechanical Theory of Heat. A short time afterwards the essay by prof. Helmholtz, Über die Erhaltung der Kraft, was placed in my hands: I translated it and had it published in the continuation of "Taylors Scientific Memoirs". It was thus my fortune to introduce to the scientific public of England the earliest writings of two of the most celebrated contributors to the great theory in question."

Introduction a la theorie mathematique de l'electricite Ann. Genie civ.6,1867,28p

Über die von Gauss angeregte neue Auffassung der elektrischen Erscheinungen.Pogg.Ann.135,1868

Über ein neues Grundgesetz der Electrodynamik Pogg.Ann.156, 1875

Über die Behandlung der zwischen linearen Strömen und Leitern stattfindenden ponderomotorischen und electromotorischen Kräfte nach dem electrodynamischen Grundgesetz.Wiedem. Ann.1,1877

Über das Graßmannsche Gesetz der ponderomotorischen Kraft. J.r.u.a.Math.83,1877,1p

Über einige Bemerkungen des Hrn Carl Neumann in Bezug auf Elektrodynamik, Wiedem. Ann. 12, 1881, 5p.

Zur Theorie der Kraftübertragung durch dynamoelectrische Maschinen. Wiedem. Ann. 21, 1882, 13p.

Bemerkungen zu den Prioritätsreklamationen des Herrn Boltzmann, Pogg. Ann. 144, 1871, 9p.

A necessary correction of one of Mr.Taits remarks.Phil.Mag. 44,1872,1p.

Erwiderung auf die von Zöllner gegen meine electrodynamischen Betrachtungen erhobenen Einwände.Wied.Ann.2, 1877,13p.

Über einige neue von Hrn. Zöllner gegen meine electrodynamischen Betrachtungen erhobenen Einwände.Wiedem.Ann.4,1878,9p.

Über das Bekanntwerden der Schriften Robert Mayers.Wiedem. Ann.8,1879,12p.

Examen des objections faites par M.Hirn a la theorie cinetique des gaz. Bull.Acad.Belgique 11,1886,20p.

12) With regard to the "electromagnetic controversy":

John L. Heilbron in: The Dictionary of the History of Science (W.F.Bynum,E.J.Browne,R.Porter ed.,London 1983):"While the Cambridge School furthered field theory several continental physicists, particularly Wilhelm Weber(1804-1891), F.E.Neumann (1798-1895) and Rudolf Clausius (1822-88), developed Amperes approach. They introduced a force explicitly dependent on the relative velocities adn accelerations of interacting current elements. Propagation with velocity c was accounted for formally by retarded potentials: the force at point P at time t is obtained by integrating the contributions of all sources at distances r according to their strengths, velocities and accelerations at the earlier time t-r/c. Both the English and the continental formulations gave the same results, except for certain unrealizable cases emphasized particularly by Hermann von Helmholtz(1821-94). The detection of electromagnetic waves by Heinrich Hertz(1857-94) in 1887/8 brought Maxwell's formulation into prominence in continental Europe."

J.C.Maxwell, On physical lines of force.Part 1, Phil. Mag.21 161,1861,Part 2,ibid.21,281,1861,Part 3,ibid,22,12,1863,Part 4,ibid,23,85,1862

J.C.Maxwell, A treatise on Electricity and Magnetism,Oxford 1873:"In a very interesting letter of Gauss to W.Weber (March 19,1845) he refers to the electrodynamic speculations with which he had been occupied long before, and which he would have published if he could then have established that which he considered the real keystone of electrodynamics, namely, the deduction of the force acting between electric particles in motion from the consideration of an action between them, not instantaneous, but propagated in time, in a similar manner to that of light... Three eminent mathematicians have endeavoured to supply this keystone of electrodynamics." - Maxwell continues by a short account of these attempts by Bernhard Riemann, Rudolf Clausius and Carl Neumann and he concludes by saying: "There appears to be, in the minds of these eminent men, some prejudice, or a priori objection, against the hypothesis of a medium in which the phenomena of radiation of light and heat and the electric actions at a distance take place. It is true that at one time those who speculated as to the causes of physical phenomena were in the habit of accounting for each kind of action at a distance by means of a special aethereal fluid, whose function and property it was to produce these

actions...Hence the undulatory theory of light has met with much opposition, directed not against its failure to explain the phenomena, but against its asumption of the existence of a medium in which light is propagated...But in all these theories the question naturally occurs:-If something is transmitted from one particle to another at a distance, what is its condition after it has left the one particle and before it has reached the other?...Hence all these theories lead to the conception of a medium in which propagation takes place, and if we admit this medium as an hypothesis, I think it ought to occupy a prominent place in our investigations, and that we ought to endeavour to construct a mental representation of all the details of its action and this has been my constant aim in this treatise." - This, the "medium as a hypothesis" signifies in nuce the "axiomatic" (as opposed to an "inductivist") conceptualization.

Max Planck 1899(Vortrag "Die Maxwellsche Theorie der Elektrizität von der mathematischen Seite betrachtet", Phys.Abh. u. Vortr. I, 601: "Alles zusammengefaßt möchte ich also sagen: die Maxwellsche Theorie zeichnet sich vor den älteren Theorien aus nicht durch größere Richtigkeit, sondern durch größere Einfachheit, oder mit anderen Worten: es ist im letzten Grunde nichts anderes als das Prinzip der konomie im Sinne von Mach gesprochen, welches in der Durchführung der Maxwellschen Elektrizitätstheorie einen seiner schönsten Triumphe feiert."-Res Jost (cf. below) has shown that this approval of Ernst Mach's idea for Planck is transitory and is going to be replaced by what Jost calls an "idealistic romantic concept of the roots for progress in physics".

H.Grassmann, Neue Theorie der Elektrodynamik, Pogg.Ann.64, 1,1845

G.Th.Fechner, Über die Verknüpfung der Faradayschen Induktionserscheinungen mt den Ampereschen elektro-dynamischen Erscheinungen.Pogg.Ann.64,337,1845

Franz E.Neumann, Allgemeine Gesetze der induzierten elektrischen Ströme, Berliner Abh. 1845,p.1, Pogg.Ann.67,31,1846

Wilhelm Weber, Elektrodynamische Maßbestimmungen, Abh. Jablon. Ges. Leipzig 1846, Pogg. Ann. 73, 193, 1848

Hermann Helmholtz, Über die Bewegungsgleichungen der Elektrizität für ruhende leitende Körper, Crelles J. 72,57,1870

Bernhard Riemann, Pogg.Ann.131,237,1867 (1858) ("schon 1954 in der 31.Naturforscherversammlung ausgesprochen"(Carl Neumann,cf.below)

Carl Neumann, Elektrodynamische Untersuchungen mit besonderer Rücksicht auf das Prinzip der Energie.Ber.k.sächs.Ges. Wiss.Math.-phys.Cl.22,386,1871

Heinrich Hertz, Beziehungen zwischen den Maxwellschen elektrodynamischen Grundgleichungen und den Grundgleichungen der gegnerischen Elektrodynamik, Wied.Ann.23,84,1884

Ferdinand Rosenberger, Die Geschichte der Physik, Braunschweig 1882

Emil Wiechert, Grundlagen der Elektrodynamik, Leipzig 1899

Paul Drude, Physik des Äthers, Stuttgart 1894

Henri Poincare, Electricite et optique, la lumiere et les theories electrodynamiques. Lecons professees a la Sorbonne en 1888.1890 et 1899.

Ludwig Boltzmann, Vorlesungen über Maxwell's Theorie der Elektrizität und des Lichtes, Leipzig 1908

Franz Richarz, Entwicklung der Elektrizitätslehre bis zum Siege der Faradayschen Anschauungen, Ernst Lecher, Die Entdeckungen von Maxwell und Hertz, H.A.Lorentz, Die Maxwellsche Theorie und die Elektronentheorie, R.Gans, Ältere und Neuere Theorien des Magnetismus, all in: Emil Warburg ed. Physik (Paul Hinneberg ed., Die Kultur der Gegenwart), Leipzig und Berlin 1915

C.W.F.Everitt, James Clerk Maxwell, NY 1975 and: Dict.Sci. Biogr.9,1974

Norton Wise, The Maxwell literature and British dynamical theory, Hist.Stud.Phys.Sci.13,175,1982

B.G.Kuznetsov, Evoliutsiia osnovnykh idei elektrodinamiki, Moscow 1963 (especially for the contributions to electrodynamics of the 1870/80s by Aleksandr G.Stoletov(1839-1896) and Nikolai A.Umov(1846-1915)

A recent book by an Oldenburg-Munich group on the history of eletromagnetic theory.

13) The "Göttingen Seven": cf. Winfried Löschberg, Es begann in Göttingen, Berlin/DDR 1964, a "novellistic" account and a parallel to the 1957 "Göttinger Erklärung der Atomphysiker".

E.Ippel ed., Briefwechsel zwischen Jacob und Wilhelm Grimm, Dahlmann und Gervinus, Berlin 1885/86

14) Clausius in:" "Über das mechanische ÄÄquivalent einer elektrischen Entladung und die dabei stattfindende Erwärmung des Leitungsdrahtes" (Pogg.Ann.86,337,1852) with respect to Hermann Helmholtz' "ÜÜber die Erhaltung der Kraft, eine physikalische Abhandlung", Berlin 1847:" Es ist zu bedauern, daß der Verfasser dieser sinnreichen Schrift den Gegenstand nicht mehr ins Einzelne verarbeitet hat. Dadurch ist es gekommen, daß einige Stellen, wie es mir scheint, ungenau, und andere, wenigstens für mich, schwer verständlich geworden sind, was übrigens bei dem Gedankenreichthume, welchen er in einen engen Raum zusammengedrängt hat, leicht möglich war." Then in Rudolf Clausius, über einige Stellen der Schrift von Helmholtz, Pogg. Ann.89,568,1853. Hermann Helmholtz, Erwiderung auf die Bemerkungen von Hrn.Clausius, Pogg.Ann.91,241,1854:"...ist seine Polemik durch ein vollständiges Mißverständnis dessen, was ich gemeint und ausgesprochen habe, bedingt." "Da Clausius eine Arbeit über dies Kapitel ankündigt, will ich ihm nicht vorgreifen...Ich kann es nur für einen Gewinn halten, wenn die Ideenverbindungen, welche ich in meiner Schrift damals zu einer Zeit, wo sie noch wenig Anklang unter den Physikern fanden, darzulegen suchte, jetzt von einem Andern in anderer Form wieder aufgenommen, und in so vollständiger und kriti scher Weise durchgearbeitet werden, wie es bisher bei anderen Kapiteln der Theorie von der Erhaltung der Kraft durch Herrn Clausius geschehen ist." Rudolf Clausius, Über einige Stellen der Schrift von Helmholtz..., zweite Notiz, Pogg. Ann.91,601,1854: Clausius shows that as to the "Mißverständnis" Helmholtz had arrived at the correct result by a double mistake, he insists, that Helmholtz had not proven the "Zerlegbarkeit aller Naturkräfte in Zentralkräfte" (important in later discussions on "field theory"), and he concludes:"...glaube ich, daß Herr Helmholtz, welcher selbst für die neue, auch hierbei angewandte theoretische Betrachtungsweise zuerst die Bahn gebrochen hat, überhaupt keinen Grund hat, um irgend eines Anderen willen die Veröffentlichung seiner eigenen Arbeiten zu verzögern." Letter from Karl Ludwig at Zürich to Emil Du Bois-Reymond at Berlin, May 26th, 1854:" Helmholtz and Clausius balgen sich aber gut; aber wie mir scheint ist Helmholtz im Übergewicht, ich schließe dies nicht aus dem Inhalt der Helmholtzschen Erwiderung, sondern nur aus der zahmen formellosen Erwiderung, welche der Griesgram Clausius von sich gegeben. Von Helmholtz erhalte ich öfter Briefe, die immer heiter und belehrend sind. Er hat Zeit zu allem und so auch dazu mir bogenlange Antworten zu schreiben. Du kannst Dir denken, daß ich ihm dankbar dafür bin. Und doch erfährt man niemals ganz, was er treibt. Denn neulich schreibt mir Donders, daß sich Helmholtz mit einem Werk über physiologische Optik geschäftigt, wovon ich bis dahin noch nichts gehört hatte." Estelle Du Bois-Reymond, Zwei große Naturforscher, Briefwechsel Emil Du Bois-Reymond, Karl Ludwig.

15) Joseph Popper represents an important study case for the semiotization of science and technique. He opens the way to a "modernist", laicistic, "posistivist" eventually to a technocrat programm.

cf.Joseph Popper, Physikalische Grundsätze der elektrischen Kraftübertragung, Wien 1884.

Theodor v.Karman, Lynkeus als Ingenieur und Naturwissenschaftler, Die Naturwissenschaften 6,457-463,1918: Joseph Popper-Lynkeus, the "philosopher of technical progress": "Die technischen Fortschritte nach ihrer ästhetischen und kulturellen Bedeutung", Dresden 1886,1901(2nd ed.): "und was haben denn die meisten Menschen davon, daß man von Europa nach Amerika telegraphieren kann? Die reine Sache für sich ist es, ein ganz und gar abstraktes, sozusagen theoretisches ästhetisches Vergnügen." "So ist es auch mit dem Interesse, was man der Luftschiffahrt entgegenbringt. Von Ausnahmen, z.B. den Kriegsverwaltungen

abgesehen (man beachte, daß dies im Jahre 1901 geschrieben wurde) empfindet niemand eigentlich ein reales Bedürfnis danach, durch die Luft zu fliegen, die ganze Sehnsucht danach ist eine rein ästhetische, ebenso die Betrachtung der einzelnen kleinen Schritte der Flugtechniker, und niemand wird behaupten wollen, daß das Vergnügen und das Interesse an jedem Geschwindigkeitsgewinn, welcher bei einem Luftballon erreicht wird, darin seinen Grund hat, daß man dabei die Absicht im Sinne hat, selbst davon einen Gebrauch zu machen." Early Semiotics. Karman concludes: "Die Abhandlung liefert gewissermaßen durch Analyse der durch die technischen Fortschritte geweckten Gefühle einen Beitrag zur Ästhetik, indem er das Kantsche Kriterium des Schönen, das "interesselose Wohlgefallen" auf die Freude anwendet, die wir bei Betrachtung technischer Leistungen, ganz unabhängig von einer Nutzanwendung, empfinden." No sign of vested interests alienation of the scientist-technician? Karman quotes Poppers interesting criteria for technology asessment:"1) Garanty for the life essentials for every individual. 2) Presence of means and institutions to create as much as possible comfort and happyness for everyman. 3) Absence of factors which tend to force the individual to feel happyness not according to his own scale but according to the judgement of others."

cf.also Joseph Popper, Flugtechnik, Wien 1889 and: Maschinen und Vogelflug, Berlin 1911

Philipp Frank, Joseph Popper-Lynkeus. Zu seinem achtzigsten Geburtstag, Phys.Z.19,58,1918: Joseph Popper as"entschiedener Vertreter des Phänomenalismus".

Otto Neurath, Joseph Popper-Lynkeus, seine Bedeutung als Zeitgenosse, Neues Frauenleben 20,33-38,1918:"Die Erfahrungen des Weltkrieges waren dazu angetan, seiner "Allgemeinen Nährpflicht" (Die allgemeine Nährplicht als Lösung der sozialen Frage, Dresden 1912 K.S.) eine gewisse Anerkennung zu sichern und auch seinen Betrachtungen über die Wehrpflicht und über internationales Leben (Das Recht zu leben und die Pflicht zu sterben,1st ed. 1878,3d ed.,Dresden 1903 K.S.)erhöhte Aufmerksamkeit zu verschaffen.Der Name Poppers war übrigens schon einmal weiteren Kreisen bekannt geworden, als nämlich seine Phantasien eines Realisten (Dresden 1899 K.S.) 1899 unter dem Pseudonym "Lynkeus" erschienen und - konfisziert wurden...Popper gehört zu den wenigen noch lebenden Zeitgenossen, welche im Prager Ghetto die volle jüdische Jugendausbildung genossen haben. In langsamer Wandlung legte er den Weg vom Mitglied einer zusammengepreßten Gemeinde zum Weltbürger zurück...Popper Lynkeus ist im Grunde genommen nur ein Eiferer für Güte und Glück, alles andere beurteilt er milde und zurückhaltend...Er schildert die Liebe als eine sonderbare Erscheinung, die sich in das menschliche Leben eindrängt, während man ohne sie auch ein freundlich-heiteres Dasein führen, ja den Geschlechtsgenuß ganz unbefangen als ungemein erfreulich dem gesamten Leben einfügen könne...Ihm ging es darum, eine Lebensordnung auszudenken,welche unter der Annahme, daß die Menschen im großen und ganzen in ihrem Charakter unverändert bleiben, die Lebenslage jedes einzelnen sichert. Er kam zu dem Ergebnis, daß man den Notbedarft aller Menschen decken könnte, wenn jeder Mann 13 Jahre lang, jede Frau 8 Jahre lang etwa 7 Stunden täglich arbeiten würde. Wie man sich zu Poppers Vorschlägen im ganzen und im einzelnen verhalten mag, ihm kommt das große Verdienst zu, die Utopie bis ins einzelne durchgerechnet zu haben. Er stellte fest, wieviel Rohstoffe, Arbeitskräfte usw. erforderlich seien, um Lebensmittel, Kleider, Häuser herzustellen. Er führt eine Art Naturalrechnung durch, welche in Gegensatz zu der heute verbreiteten Geldrechnung tritt... Wissenschaftlich strenger wäre es gewesen, wenn er den Nachweis erbracht hätte, daß die überlieferte Verkehrswirtschaft grundsätzlich unfähig sei die Sicherung der Lebenslagen in Poppers Sinn zu ermöglichen." cf. Friedrich Stadler (see below):"Das Sozialisierungsprogramm von Popper-Lynkeus wurde innerhalb der Sozialdemokratie heftig und kontroversiell u.a. von Wilhelm Ellenbogen, Otto Bauer, Karl Renner, Engelbert Pernerstorfer, Käthe Leichter und Otto Neurath debattiert. Vor allem Neurath war, wie bereits angedeutet, ein Anhänger von Popper-Lynkeus und seines ratinalistischen Wirtschaftsplanes, sodaß er sich sogar Anfang 1919 als Leiter des zentralen Planungsamtes in München in einem euphorischen Telegramm an sein Vorbild in Wien (Ihr Werk wird Wirklichkeit, wir machen Vollsozialisierung") zu Unrecht auf das Halbsozialisierungskonzept der Allgemeinen Nährpflicht berief."

Helene Stöcker, Zu Joseph Popper-Lynkeus 80.Geburtstag, Die Neue Generation 1918,p.97 and: Menschenschutz (Zu Joseph Popper-Lynkeus 80.Geburtstag) von Dr.phil. Helene Stöcker, Die Neue Generation 1918,p.132-144: She quotes Lynkeus' reference to Moses (book 3,19,34) "Wie ein Einheimischer unter Euch soll auch der Fremdling sein, der bei Euch wohnt, und sollst ihn lieben, wie Dich selbst" and

Goethe."Wie hätte ich, dem nur Kultur und Barbarei Dinge von Bedeutung sind, die Franzosen hassen können..." and she concludes:"Kultur und Barbarei - erst wenn die Menschheit erkennt, daß dies die einigen "Gegenstände von Bedeutung" sind,wird es möglich sein, den Selbstmord der Menschheit aufzuhalten, dem sie jetzt fast sehenden Auges entgegenzugehen scheint."

Adolf Gelber, Joseph Popper-Lynkeus, Sein Leben und Sein Wirken, Wien Berlin Leipzig New York (Interterritorialer Verlag "Renaissance" (Lucian Frank Erdtracht) o.J. (1923)

Richard Schwarz, Rathenau, Goldscheid, Popper-Lynkeus und ihre Systeme zusammengefaßt zu einem Wirtschaftsprogramm, Wien 1919

Walther Marcus ed., Nach dem Kriege! Ein Auszug aus dem Werke "Die allgemeine Nährpflicht...", Dreden 1919(?):"Bellamy,Popper-Lynkeus und Prof. Köppen brauchen den starken Staat zur Durchführung ihrer Systeme, Rathenau und Goldscheid geben ihm die Stärke."

Richard von Mises, Josef Popper-Lynkeus, .B.

Friedrich Stadler, Vom Positivismus zur "Wissenschaftlichen Weltanschauung": Am Beispiel der Wirkungsgeschichte v. Ernst Mach in sterr. von 1895 bis 1934, Wien, München 1982:"Zu den Gründungsmitgliedern (des "Vereins Allgemeine Nährpflicht" K.S.) zählten vorallem Mitglieder des Vereins "Bereitschaft" (u.a. Edgar Herbst) und von den späteren Mitarbeitern und Anhängern seien zur Illustration der starken Präsenz intellektuell-bürgerlicher Kreise neben Wilhelm Börner nocoh Felix Frankl, Bruno Frei, Fritz Wittels, Albert Einstein, Margit Ornstein, Richard Coudenhove-Kalergi genannt. Der Verein scheint in der Ersten Republik allerdings eher ein Schattendasein geführt zu haben, wenn man die rund 1000 Mitglieder für 1929 in Betracht zieht."

Frankfurter Allgemeine Zeitung 4.2.87: Allgemeine Nährpflicht statt Wehrpflicht. Errichtung der Josef Popper Stiftung an der Goethe Universität (durch August Schorsch aus Hanau, Ingenieur und Architekt der in Wien studierte und bis 1928 dort lebte).

16) The literature with respect to the "second principle" of thermodynamics is nearly infinite. Some experts in the beginning denied its validity or (practical) relevance, thus Gustav Zeuner at Zürich and Gustaf Adolf Hirn at Mulhouse, both "eminent" thermodynamicians. Others exaggerated its range of validity. It certainly became and for some continues to be a philosophical issue of no small significance. Finally there is an abundant literature on this subject within the "discipline" of the History of Science:

Rankine, Outlines of the Science of Energetics, Proc.Phil. Soc.Glasgow, III, 1848-1855

Gustav Adolf Hirn, Theorie mecanique de la chaleur (contenant la traduction du livre de G.Zeuner: Grundzüge der mechanischen Wärmetheorie, Paris, Colmar 1862:"Il est peu de branches des sciences exactes qui aient eu un development aussi rapide et aussi grand que celle dont je vais essayer de faire l'expose. A peine nee depuis guinze annees, la theorie mecanique de la chaleur forme aujourd'hui une doctrine complete, assise sur des bases inebranlables, au point de vue de la confirmation experimentale aussi bien qu'a celui des principes simples et elementaires sur lesquels s'est exercee avec tant de fruit l'analyse mathematique, elle constiute un corps de science nouveau, independant et degage des hypotheses qui lui ont servi des points de depart, une science dont les affirmations et les inductions, on peut le dire sans aucune exageration, presentent toute la grandeur et toute l'importance de celles qui ont decoule de la decouverte de la gravitation universelle: ce que celle-ci a appris a notre pensee a voir, et a peser sans le voir, a des distances immenses dans l'espace infini, celle-la nous permet de le poursuivre et de le peser dans l'infiniment petit, dans les secrets memes de la structure des corps."... Dans son rapprt a la societe de physique de Berlin (10 Juillet 1857) sur le memoire que j'avais presente au concours. Clausius terminait en emettant le voeu que j'examinasse moimeme de nouveau tous les resultats de mes experiences et que je reprisse une parite de celles-ci, s'il etait necessaire, mais en partant des donnees essentielles de la theorie mecanique de la chaleur. Ceci signifiait, sous la forme la plus polie, mais aussi la plus claire, que je m'etais tenu en dehors de ces donnees. Au lieu de voir dans ces paroles

une epigramme, j'y reconnus, ce qui s'y trouvait en effet, un conseil donne par un critique des plus bienveillants; au lieu de m'en facher, je pris le parti beaucoup plus sage d'en profiter, et d'apprendre, s'ily avait lieu."

Gustav Zeuner, Grundzüge der mechanischen Wärmetheorie mit Anwendungen auf die der Wärmelehre angehörigen Theile der Maschinenlehre, insbesondere auf die Theorie der calorischen Maschinen und Dampfmaschinen, Leipzig 1866 (2nd ed.)

Gustave-Adolphe Hirn, Consequences philosophiques et metaphysiques de la thermodynamique, Paris 1868

Julius Robert Mayer, über nothwendige Consequenzen und Inconsequenzen der Wärmemechanik, Das Ausland, 42, 1061, 1869

E. Liebermeister, Die Lehre von der Unzerstörbarkeit der Materie und der Kraft, Das Ausland 42,625,1869

Dr.B. Die Naturkräfte in ihrer Wechselbeziehung, Das Ausland 42,981,1869 (review of Adolf Fick's book (which he dedicated to Rudolf Clausius)

Prof.Dr.Reuschle, Die Nichtigkeit der Thomsonschen Lehre von dem endlichen allgemeinen Stillstand der Welt. Das Ausland 45,337,1872

Adolf Fick, Über das Prinzip der Zerstreuung der Energie 1874 in: ges. Schriften 1,362, Würzburg 1903

A.Mühry, Die neuere Naturwissenschaft und die Teleologie, ein Beitrag zur exacten Naturphilosophie, Das Ausland 48,326,1875

Hans Vaihinger, Hartmann, Dühring und Lange, die Philosophen der Gegenwart, von O. Caspari, Das Ausland 49,866,1876

Josef Popper, Über J.R.Mayer's "Mechanik der Wärme." Das Ausland 49,681,1876

Ein frommer Astronom über die Verschwendung in der Natur, Das Ausland 50,937,1877

Hans Vaihinger, Moderne Modificationsversuche der kantischen Weltanschauung, Das Ausland, 50, 328, 1877

H.Wernekke, Die wissenschaftliche Philosophie, Das Ausland, 50,625,1877 (with respect to Avenarius' new periodical:Zeitschrift für wissenschaftliche Philosophie)

Kurt Lasswitz, Atomistik und Kriticismus, Ein Beitrag zur erkenntnistheoretischen Grundlegung der Physik, Braunschweig 1878

R.Dellinghausen, Die metaphysische Grundlage der mechanischen Wärmetheorie, Kosmos 6,93,1879

Anton von Leclair, Der Realismus der Modernen Naturwissenschaft im Lichte der von Berkeley und Kant angebahnten Erkenntniskritik, Prag 1879:"Befreiung der Kulturwelt von der sterilen und ethisch nicht unbedenklichen Einseitigkeit des Materialismus einerseits, von der verblendenden und vielfach lähmenden Zaubermacht des religiösen Fanatismus und superstitiöser Vorstellungen andererseits".

B.Carneri, Ideologismus und Idealimus,Kosmos9,249,1881:"Eine "kleine Zahl Auserwählter" wie Leclair die modernen Idealisten nennt, kommt uns nun mit dem Ansinnen, die materielle Welt aufzugeben. Da ist es doch nichts als billig, wenn wir fragen, was uns dafür geboten wird? Aber man braucht nur diese Frage zu stellen, um die Gefahr zu sehen, die uns da droht.Man kann dafür nur entweder garnichts uns beiten, was denn doch gar zu wenig sein würde, oder eine Geisterwelt a la Berkeley, der man allerdings für die Noth den theologischen Charakter abstreifen könnte, die aber darum doch nicht minder eine Geisterwelt a la Berkeley wäre...Wir begreifen vollkommen den Standpunkt Leclair's, solang es ausschließlich um allgemeine Grundsätze sich handelt und um Berichtigung des naiven Realismus, dem die wahre Gewissheit die sinnliche ist. Dieser Standpunkt ist gerade so verfehlt, als die Aufstellung einer, der äusseren Erfahrung ganz entgegengesetzten innern Erfahrung, die in ihrem Gebiete zu absolutem Wissen gelangen will. Bei beiden haben wir es mit einem Complex von Empfindungen zu thun, der jedoch in dem ersten Falle direct, in dem

letzern indirect uns zum Bewußtsein kommt. Hier hat der Kriticismus seines Amtes zu walten. Aber so wenig wir die Materie als etwas transcendentes betrachten können, ebensowenig vermögen wir eine positive Wissenschaft zu denken, welcher bei ihren Forschungen die Materie als ein bloßer Schein gelten sollte..."

Anton von Leclair, Kritischer Idealismus und Positivismus, Vjschr.wiss.Phil.5,229,1881

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Gouy, Sur l'energie utilisable, J.phys.2e ser.8,1889

Ferdinand Rosenberger, Geschichte der Physik III, 1890

Georg Wald, Die Energie und ihre Entwertung, Leipzig 1889

Couturat, De l'evolutionisme physique et du principe de la conservation de l'energie, Rev. Metaphys.Mor.1893

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Gustav Mie, Entwurf einer allgemeinen Theorie der Energieübertragung, Sitz.Ber. Wiener Akad. Abt.IIa, 107,1113,1898

Wilhelm Ostwald, Vorlesungen über Naturphilosophie, Leipzig, 1901

Eduard von Hartmann, Die Weltanschauung der modernen Physik, Leipzig 1902

Felix Auerbach, Die Weltherrin und ihr Schatten, ein Vortrag über Energie und Entropie, Jena 1902

Johann Zmavc, Vorbemerkungen zu einer Neugrundlegung der Wirtschaftswissenschaft, Ann.Nat.Phil.4,386,1905

Hermann Wolff, Atomistik und Energetik vom Standpunkte ökonomischer Naturbetrachtung, Vjschr.wiss.Phil.29,1,1905

Friedrich Wolfgang Adler, Bemerkungen über die Metaphysik in der Ostwaldschen Energetik, Vjschr.wiss.Phil.Soz.29,287,1905

Georg Helm, Die kollektiven Formen der Energie, Ann.Nat. Phil.6,366,1907

Arthur Erich Haas, Die allgemeinsten Gesetze des physikalischen Geschehens und ihr Verhältnis zum zweiten Hauptsatze der Wärmelehre.Ann.Nat.Phil. 1907(?)

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Felix Auerbach, Ektropismus oder die physikalische Theorie des Lebens, Leipzig 1910, cf.review by Wilhelm Ostwald,Ann. Nat.Phil.1910

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Swetomir Ristitsch: Cassirer, Ernst, Substanzbegriff und Funktionsbegriff, Berlin 1910, a review in Vjschr.wiss.Phil.36, 106,1912:"Es fällt auf, daß der Verfasser einen anderen nicht minder wichtigen Begriff der theoretischen Physik, und zwar Funktionsbegriff, nicht einmal erwähnt. Es ist das der Begriff der Entropie. Auch diesem Begriff entspricht keine sinnlich-physikalische Eigenschaft. Die Meßbarkeit des Verlaufs (der Richtung nach) der Naturprozesse ist durch ihn möglich."

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(/fileadmin/user_upload/imgs/clausius/ClausiusDampfm.jpg) Zeichnung R. Clausius (Gynasiast) 1840

Zürich.

(KS 2018:) Grete Ronge hat 1955, wie sie schreibt "als bescheidener Beitrag zur Hunderjahrfeier der ETH von der Schweizerischen Gesellschaft für Geschichte der Medizin und Naturwissenschaften dargebracht", Rudolf Clausius, seiner Arbeit und seinem Leben in Zürich, seiner Heirat mit Adelheid Rimpau, seiner Freundschaft mit John Tyndall etc. einen ausführlichen schönen Artikel gewidmet, ua. gestützt auf Mitteilungen und Dokumente seiner Enkel Rudolf und Otto Budde und seines Großneffen Konrad Sochatzy. (Gesnerus 12, 1955, 73-108)

(KS 1985:) In der Schweiz hatte der Streit um Zulassung und Verbot der Jesuiten den Anlass zur Bildung des 'ultramontan' bestimmten 'Sonderbundes' einiger Kantone gegeben und zum Feldzug der liberalen Kantone gegen sie 1847. Von 48 datiert dann die 'Wiedergeburt der Schweiz' mit einer neuen Bundesverfassung. Ab 49 beschäftigt neben dem Thema Eisenbahn das 'Flüchtlingsproblem' also das traditionelle Asylrecht der Schweiz die Bundesväter und die Öffentlichkeit. Man entzieht 'Flüchtlingen' die Staatsunterstützung , es heißt, dass viele die Schweiz wieder verließen. Die Wiedergeburt brachte den Entwurf einer eidgenössischen Univerität, der wurde 1854 abgelehnt, aber für ein Polytechnikum wurde beschlossen, jährlich 176 000 Franken auszugeben.

Am 15. Oktober 1855 wird das eidgenössische Polytechnicum in Zürich eröffnet. Präsident und für die Lehrkörperrekrutierungspolitik des schweizerischen Schulrats maßgeblich war 1854-57 Konrad Kern (1808-1888), in Basel, Berlin und Heidelberg studierter Jurist. Ihm folgte im Amt für lange Zeit der auch in Berlin und Heidelberg ausgebildete Jurist Karl Kappeller (1816-1888). Clausius wird mit Gutachten von Wilhelm Weber in Göttingen und Johann Christian Poggendorf in Berlin berufen und mit 3700 Franken Jahresbezügen bestallt. Carl Linde (1842-1934), der von 61 bis 64 in Zürich studiert, beschreibt 1916 die Lehrer Zeuner (1828-1907) Reuleaux (1829-1905) Clausisus: Zeuner lebendig und klar, Reuleaux schwungvoll und geistreich, Clausius ruhig und etwas trocken... "umso tiefer aber griff der Inhalt".

Clausius geht in der nachrevolutionären Periode nach Zürich, die bis zur Krise 1857 zwar ersten großen Wirtschaftsaufschwung bringt, aber in Preußen von Repression geprägt ist und von der Fortdauer, ja Stärkung der orthodox-preussisch-konfessionell gesteuerten Politik. 'Innere Mission' (Wichern, Fliedner) in Sachen 'Soziale Frage', Herrschaft der 'Kreuzzeitungspartei' (nach einem 49 in Berlin gegründeten Blatt), ideolotischer Einfluss von Leuten wie dem Schelling-Schülder und Oberkirchenrat Fr. J. Stahl, die 'Stiehlschen Regulative'...

Vor seinem Amtsantritt in Zürich reist Clausius nach Paris. Seit März 54 läuft die Expedition Krimkrieg: " Den meisten Vorteil trug augenblicklich Napoleon III davon, dessen Heer mit Ruhm und Erfolg für eine zivilisatorische Idee gekämpft hatte und welcher nun der mächtigste Mann geworden war, dessen Bündnis viel umworben ward und auf dessen Worte ganz Europa mit Spannung lauschte" (Meyers, 5te, 1897). 40 000 Franzosen , 20 000 Briten, später 15000 sardische Truppen standen den Türken gegen die Russen bei, im September 1855 feierte man die Eroberung der Festung Malakoff und die Einnahme von Sewastopol. Preussen konnte neutral bleiben. Napoleon III seit 51 per Staatsstreich an der Macht und seit 52 'Empereur' stabilisiert per Krieg Herrschaft und industriellen Aufschwung: Bessermerverfahren, Panzerplattenherstellung, Ankurbellung der Stahlindustrie.

Preussen ohne Krieg? die Kreuzzeitung hatte für den Zaren votiert. Nächste Gelegenheit zum Kreuzzug bot die Schweiz. Neuenburg war seit 48 'Republik', das hatte man stillschweigend geschluckt. Die Camarilla jedoch, die Hofpartei unterstützt selbstverständlich die Königsstreuen in Neuchâtel und die glauben im September 56 die Gelegenheit zum Putsch sei günstig. Die Republikaner werden jedoch schnell mit ihnen

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1986:RClausius

fertig und die Eidgenossenschaft möchte die gefangenen Royalisten aburteilen. Ein Kriegsgrund für Preussen? Napoleon III darf vermitteln und im Mai 57 einigt man sich in Paris: Preussen verzichtet auf Neuenburg, die Royalisten haben freien Abzug.

In seinen Briefen berichtet Clausius auch von der Affäre Moleschott. In den darauffolgenden Jahren lernen die beiden Herren sich näher kennen, die Famlien bewohnen eine zeitlang dasselbe Haus. In seinen Memoiren spricht Jacob Moleschott von Rudolf Clausius als von seinem treuen Freund...

(Nachsatz 2018: der 'naturwissenschaftliche Materialist' Jacob Moleschott (1822-1893), niederländischer Arzt und Privatdozent für Physiologie an der Universität Heidelberg wurde 1854 wegen seines zwei Jahre zuvor erschienenen, als 'atheiistisch' verschrieenen Buches "Der Kreislauf des Lebens" mit Berufsverbot bedroht, quittierte den badischen Dienst und wurde, nicht unumstritten 1856 nach Zürich berufen, die weiteren Stationen des Physiologen waren 1861 Turin und 1879 Rom. Seit 1876 war er Senator in der konstitutionellen Monarchie Italien.)