FILTERED, FIDDLED, FORGOTTEN
Scientific data between screening imperatives, oblivion and fraud

by

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For Prof. Dr. Reinhart Leitinger on his 60th birthday

Abstract
The causes and consequences of the three processes data filtering, data oblivion and data manipulation are very different indeed. As, however, from a scientific point of view the negative consequences of fraudulent manipulation are both the most detrimental (materially and in terms of credibility) and the most unpredictable, it is worth while taking a closer look at the causes.

1. We are dealing here with a highly dangerous, **self-reinforcing** factor which has been operative in exacerbating the public distrust of "**objective**" science, a distrust reinforced by the increasing bureaucracy encountered at all turns. We must also bear in mind that for their indispensable verification and validation "**objective**" data require the **intersubjective** approval ("evaluation") of the scientific community; this, in its turn, means that they cannot be entirely objective in the true sense of the term.
2. The negative effects of the growing number of technologically complex large-scale systems. For example the extent to which *administrations* require scientists and engineers to "**operate**" (as opposed to "**co-operate**") is proportional to the degree to which necessary and sensible administration turns into counter-productive **over-administration**.
3. The (today) unavoidable mixture of public/private in the use and marketing of the results of basic research for economic/industrial purposes; the inadequately established awareness of the complementarity principle, in conjunction with an insufficiently scrupulous and judicious use of language.
4. The fact that in many nation states and societies there appears to be (more or less tacit) agreement that added-value (e.g. money value) is the real **value** (*Is this added-value really the greater value?*). The fact that the principle of "more and quicker" is an eminently marketable rationale has led to a situation in which a) the "**velociferic**" trend can be expected to gain ever greater momentum (this development is bound up with an ill-advised rationalization drive curtailing the indispensable areas of "tolerance" in the interplay between humans and machines) and b) there is also insufficient perception of the ethical obligations inherent in science as a profession. Accordingly, the (legal and financial) risks go on mushrooming in the (highly) developed nation states, notably because there is less and less time a) for the necessary optimizing of the man-machine adaptation process, and b) for achieving better understanding of, and skills in dealing with, (non-linear) complex hybrid systems at the software and hardware levels. Hence the incessantly ballooning costs for the prior prevention (prophylaxis) and subsequent elimination of the damage attendant on these risks.

Contents

1. Introduction

The causes and consequences of the three processes data filtering, data oblivion and data manipulation are very different indeed. As, however, from a scientific point of view the negative consequences of fraudulent manipulation are both the most detrimental (materially and in terms of credibility) and the most unpredictable, it is worth while taking a closer look at the causes.

1st cause: the growing competitive pressure generated by the reduction of (government) funding, plus the fact (largely attributable to the data explosion) that an insufficiently clear distinction is made between a) the necessary, user-friendly, qualifying[1] filtering of data (including validation[2] and verification[3]) and b) fraudulent data manipulation.

We are dealing here with a highly dangerous, **self-reinforcing** factor which has been operative in exacerbating the public distrust of "**objective**" science, a distrust reinforced by the increasing bureaucracy encountered at all turns. We must also bear in mind that for their indispensable verification and validation "**objective**" data require the **intersubjective** approval ("evaluation") of the scientific community; this, in its turn, means that they cannot be entirely objective in the true sense of the term [2, 23, 24, 30].

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[1] **Qualifying filtering** is necessary because of the colossal data growth rates and the fact that as the quality of data decreases the legal and financial risks incurred in using them increase.

[2] **Data validation**: systematic errors can only be measured if the same physical object is measured at least once more with a measuring configuration based on a different principle from the first. The comparison of these two (or more) sets of data is called validation. The degree of agreement between the two sets of data (a standard established **intersubjectively** by the scientific community) determines the "value" of the data, i.e. the degree of reliability the data can claim, i.e. their quality. Data validation is unthinkable without this **participation by the community**. (The value thus determined is called "**accuracy**" (indeterminacy)).

[3] **Data verification** means repeating the measurement independently with the same equipment, using the same hypotheses and references, and then comparing the results. The cross-correlation between two sets of data obtained independently of one another is a gage for the verification, whose standard (quantitative value) has to be agreed on **intersubjectively** by the scientific community. (The value thus determined is called "**precision**" (indeterminacy)).

2nd cause: the negative effects of the growing number of technologically complex large-scale systems.

At present these effects are responsible for an increasing hostility vis-à-vis science in general; at the same time, they are thrusting the scientists and engineers working in research and development (R&D) into a hitherto unaccustomed **culprit or scapegoat role**. So far, legal protection (source responsibility etc.) in this connection has been inadequate (I refrain from touching on the moral aspect). The extent to which *administrations* require scientists and engineers to "**operate**" (as opposed to "**co-operate**") is proportional to the degree to which necessary and sensible administration turns into counter-productive **over-administration**. By this we mean the kind of senseless "*red tape*" which (in the long term) has an (economically) counter-productive, foot-dragging effect (which is truly "destructive" through the negative synergies it generates) as opposed to the supportive effect (positive synergies) that any form of administration worthy of the name may be rightly expected to have.

3rd cause: the (today) unavoidable mixture of public/private in the use and marketing of the results of basic research for economic/industrial purposes; the inadequately established awareness of the complementarity principle, in conjunction with an insufficiently scrupulous and judicious use of language [1-4, 23, 31, 34, 35].

4th cause: the fact that in many nation states and societies there appears to be (more or less tacit) agreement that added-value (e.g. money value) is the real **value** (*Is this added-value really the greater value?*)

The fact that the principle of "more and quicker" is an eminently marketable rationale has led to a situation in which a) the "**velociferic**"[4] trend can be expected to gain ever greater momentum (this development is bound up with an ill-advised rationalization drive curtailing the indispensable areas of "tolerance" in the interplay between humans and machines) and b) there is also insufficient perception of the ethical obligations inherent in science as a profession. Accordingly, the (legal and financial) risks go on mushrooming in the (highly) developed nation states, notably because there is less and less time a) for the necessary optimizing of the man-machine adaptation process, and b) for achieving better understanding of, and skills in dealing with, (non-linear) complex hybrid systems at the software and hardware levels. Hence the incessantly ballooning costs for the prior prevention (prophylaxis) and subsequent elimination of the damage attendant on these risks.

In this context it is salutary to remind ourselves that the costs caused by the "Year 2000 Problem" (also called Y2K or the Millennium Bug) have so far amounted to over $9 billion and can be expected to increase further. In point of fact, these costs have been caused by a very simple (albeit colossal) problem and it is a development which will certainly continue in the future.

2. Data inflation problems

Humans are non-specialized beings driven in what they do by curiosity. As such they need information. For some years the industrialized nations have been observing a phenomenon operative not only in the earth sciences (e.g. research on the earth's atmosphere) but in many other areas as well:

[4] The term "**velociferic**" was coined by J.W. von Goethe in 1825 from "velocitas" and "Lucifer". It describes first and foremost the negative consequences of acceleration. Our present age - sometimes referred to as the Age of Acceleration - is outstandingly "velociferic".

the constant increase in the **plethora** of **primary information**, over and against a signal **dearth** of **secondary information**. By primary information we mean such things as the raw data generated by measuring processes and also all the knowledge needed in order to be able to "make something" (what Aristotle calls *techné*). Secondary information refers to data that have been subjected to qualifying filtering (selection, screening), verification, validation and interpretation, together with the knowledge needed in order to be able to "do something with something" (what Aristotle calls *phronesis*, literally: reasoned action or practical wisdom). In many areas the tensions between these two poles have become so extreme that we are fully justified in talking of an information crisis and an incipient "information explosion" in the domain of primary information.

Atmospheric research is a case in point, illustrating both the glut of primary information and the rate at which it is growing. In this area today we have over $2 * 10^{14}$ bits of information growing at a rate of about 10% annually. This volume corresponds to about 2,000,000,000 closely printed pages of A4 paper. If we assume a page thickness of 0.1 mm, the result is a row of books 290 km long. Current estimates suggest that at present humanity generates about 10^{18} bits of information each year. The physical ceiling for the generation of bits in the sun-earth-space system is 25 orders of magnitude higher (10^{43} bits per year), so in that respect there is plenty of leeway yet. But the same is quite definitely not true of the biological limits imposed on the human capacity for retaining and processing information. Those limits are in fact very close at hand [10, 13].

The headlong development of computer systems has encouraged this drastic increase in sheer information volume because the restraints imposed on electronic processing and storage are relatively minor. But it has become abundantly clear that coping with this deluge of information poses entirely new problems for the purveyors and users of such data, and hence notably for those institutions whose job it is to ensure their bibliographic and/or numeric archivization or to document them in a more general sense, i.e. "capture" them, store them and make them available (in a user-friendly, interactive way). It would appear that progress in using bibliographic data has outstripped advances in the management of numeric data, especially where large volumes are involved. Today about 90% of data processing (DP) expenditure goes on the development of suitable software and only about 10% on hardware. About 20 years back the situation was precisely the opposite. Over the last 15 years the software-hardware gap has turned into a full-blown **software crisis** highlighting the increasingly crucial problem of ensuring quality control and the regular, painstaking overhaul of information systems such as large databases and thesauruses.

The celerity of technical progress has made it increasingly difficult to process older data. In some cases it is impossible today to process data going back further than 10 years. This has given rise to the term "**technical amnesia**". This new form of "knowledge death" not only generates a staggering cost spiral, it also confronts us with some other very unpleasant problems. So far, and for reasons difficult to fathom, very little has been done to obviate the causes, so that little improvement can be expected in the near future. This is a crucial hazard for science because the costs thus arising will probably devolve to a very high degree on science itself, i.e. they will have to be met from available funding, quite simply because scientists, technologists and engineers are regarded as the main culprits.

The new media flood us with global, regional and local information. On the one hand, this leads to the rejection and deformation of information; on the other, of course, it offers at least in theory an opportunity for a broader and more in-depth "view of the world", for more democracy, responsibility and greater participation in decision-making processes, albeit usually via indirect (technically filtered) channels rather than immediate experience via the senses.

In general, then, the new media contribute to a deepening of the cleft between mind and body, a kind of latter-day **Platonism**. The computer "recycles" classical Platonism; this, at least, is the view taken by American philosophy professor Michael Heim. If it is true, then it flies in the face of one of the central declared tenets of present-day thinking - heightened synergetic interplay between mind, body and spirit, in other words, an acceptance and espousal of complementarity[5]

Only the future will tell us whether Bill Gates is right in his conviction that the data highways will play a major role in solving the great global problems or whether his adversary, the American media critic Neil Postman, will be borne out in his warnings about the negative consequences of over-information, which he calls "information overkill".

If we look at the most urgent global problems assailing us at present - over-population, hunger, destruction of the natural environment - the trend appears to moving more in Postman's direction. It seems as if we will be in much greater need of data to mitigate the negative after-effects of disasters and to recover more quickly and completely from them than to genuinely solve the great global problems, directly or indirectly. But even this far less ambitious project of minimizing catastrophic aftermaths can only be realized if we do indeed contrive to offset Postman's overkill effect. What is most urgently required for this to happen is a considerably faster and more genuinely **"qualifying" method for filtering** primary information. A spin-off requirement from that is faster interactive access to the secondary information thus generated, with corresponding representation possibilities and opportunities for fast linking ("cross-correlation") with data from other sources. (See also the concept for the **DUST-2 CD-ROM: Linking Text Data and Measuring Data**). Here multi-media technology is a crucial tool. But even with such modern hi-tech implements human users will still invariably select the information which is relevant to them, i.e. corresponds most closely to their expectations. It is fair to say, in general terms, that primary information (possible, potential information) is hardly understood by the (broad mass of the) public; this is not true of (qualifyingly filtered) secondary information.

We are confronted at present with a strangely vague and woolly concept of what information actually means. The term dates back well before Shannon's information theory, not to mention the extended versions of it central to communications theory or the relatively young information science, the science of computers and the basics of their application. Originally the word *informatio* meant precisely what it says: that which gives form or shape to something. Hence the idea that God's creative will "in-formed" all being. In the Middle Ages the accepted meaning of "information" was the essential form of something, which, in accordance with its nature, then in-formed its extensions and ramifications. Since science has given up inquiring into anything remotely resembling the "substance" of things, we now obviously feel free to apply the term "information" to any kind of formalized or formulated communication, transmission, signal or impulse as something which delimits, makes perceptible, determines, influences, etc. The more the term is used to relate to mere content and the greater the sophistication applied to studying the "objective" givens of the constantly "self-differentiating" sciences, the more variegated the definitions of "information" become. At present we can readily marshal over 160 such definitions. Confusingly, however, they appear on closer inspection to have little or nothing in common. In the face of the constantly growing information problems bearing in on us, this cannot but be a source of disquiet and should make reflection on what is actually meant by the term an absolute must. And this both specifically - at the level of the premises and methodologies of the scientific subjects themselves - and above all, as a matter of fundamental principle, in the all-encompassing context. The author of this article admits

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[5] The author understands Niels Bohr's (1928) term **complementarity** to mean:

- that being things manifest themselves in two different forms which are logically incompatible
- that the nearer one approaches one of these forms, the further one moves away from the other (more simply: the "sharper" the one is, the "fuzzier" the other becomes)
- that the two forms cannot be completely "unmixed" (a consequence of temporality or of the finitude of observation time). **Complementarity is a given which needs to be firmly established in our philosophy of things and in many cases replaces *Either/Or* by *Both/And*.**

to having a definition of his own: "*Information is the product of a filtering process*". If we accept this, then the logical rider is: "**Information contains provisional certainties marking themselves off against determinable uncertainty**." Whether and to what extent this actually takes place depends on at least two different time intervals: observation time and filter time constants. Thus the **determinable uncertainty** (e.g. *noise*) has become just as significant a factor as that which can be adduced as (provisional) certainty (e.g. the *signal*). In the force field generated by the question and answer process the two are inextricably interlinked [5-8, 23].

3. Empirical science and intersubjectivity

Looking at empirical science as a "form of knowing" we soon find that here too metaphysics and ethics play a constitutive role over and above the fundamental links obtaining between them. We find historical instances of this in such cases as Johannes Kepler pivoting a new view of the world squarely on a form of solar mysticism and postulating, in keeping with the spirit of the Renaissance, that the principles underlying the design of the Universe must be recognizable to Man. But Kepler was content with approximate mathematical equations. One of the aims of modern empirical science is to give a more realistic shape to our imperfect notion of our "environment", in other words to get nearer the truth. The instrument it uses for this purpose is measurement and the data derived from measuring processes. Now the empirical sciences are by no means as empirical as they are often made out to be. Both the verification method (logical empiricism) and the falsification method (critical rationalism) appeal to pure facts as the final authority determining the validity of theories. But in reality there is no such thing as **pure** facts, not even in theoretical physics. Anyone setting out to measure something is espousing (tacitly or explicitly) a number of theories: a theory of measuring, a theory of the things to be measured, a theory of the measuring instruments used. But given the inevitably finite temporal and spatial measuring intervals and the characteristics of the measuring instruments, measurement accuracy is invariably relative, i.e. there will always remain a finite indeterminacy or uncertainty. This is frequently referred to unthinkingly as "error", although in many such cases there is in fact no way of knowing what it is that is "wrong". The selection of representative measurements takes place with the aid of a theory of error whose application normally masks the very problems that can arise precisely from the unthinking use of the term. For instance, how far can the value measured stray from the value expected before the theory is termed to have been falsified by the data? The **value** (or standard) is determined intersubjectively by the scientific community. This joint consensus, and this alone, is what is are really referring to when we speak of "objective" empirical facts [3, 23, 24, 30].

So-called measurement errors are easier to determine in connection with measurings or observations taking place at the location of the parameter in question (in situ) than with measurings that have to be done via remote sensing because the location in question is inaccessible. A complicating factor here is the fact that **remote sensing data** are normally *time-series* data, which means they cannot be repeated under the same conditions. Most of the data scandals publicized in the recent past stem from the domain of "in situ" data. But in principle data manipulation of whatever kind is much easier to undertake and conceal in the field of remote sensing and by all the laws this should increase the probability of such cases occurring. The fact that there appear to be relatively few instances of this, for example in the field of remote sensing data culled from the earth's atmosphere, can probably be ascribed to the large number of different experiments and the huge volumes of data they generate, thus both facilitating and necessitating data comparison and data combination and accordingly verification and validation. This is of course essential if we want to (or have to) enhance the reliability and accuracy of the "data products". And it is a *conditio sine qua non* when putting in for new (government and non-government) funding. As data comparisons increase and improve, fraudulent manipulation, though not absolutely impossible, is much easier to detect, not least because of the effects of the self-regulation called for on all sides.

Note
The more radical the cutbacks in (government) funding for research and development, the greater the competitive pressure becomes, thus increasing the likelihood of fraudulent data manipulation. In many areas of research there is also a decline in the number of competent staff, thus reducing in its turn the possibilities of effective (self-)regulation and facilitating fraudulent data manipulation.

In the sphere of **"in situ" data** independent repetition of the measuring (a second measuring) has a "validating" effect. What militates against this is not only the costs involved but also the inherent unattractiveness of such an activity. In today's western thinking you have to be the "first" in order to count; coming **second** and being the **runner-up** means being relegated to the status of an also-ran, a **nobody** hardly eligible for funding and simply nowhere in the career stakes, not least because such findings, if they get published at all, only get aired after a substantial time-lag. As the "**publish or perish**" principle has lost none of its validity, very few people are prepared to let themselves be bundled into the category of the runner-up or mere "replicator", although this role is in fact absolutely essential for the verification and validation of data. Nature proceeds on exactly the opposite principle, providing for all, not only the winners, (although the one(s) bringing up the rear admittedly get the least encouragement). In this way nature has kept evolution going successfully for millions of years [16].

4. Increasing risks from inadequate "tolerance" between humans and machines

As science (which is somewhere between a profession and a vocation) turns more and more into a job like any other (i.e. has less and less to do with vocation and *Bildung*, although becoming a scientist is much more than a mere matter of "vocational" (!) training), and as social solidarity declines within societies, we can confidently predict a growth in the number of cases of fraud in the scientific field. This means that society will be increasingly unable to "reap" the fruits of its investment in science, research and development (R&D).

The greater the potentially hazardous consequences of large-scale complex technological systems, the higher the necessity of learning to quantify and minimize the probability of accidents, e.g. via so-called *early warning systems* and corresponding *risk model calculations* required for preventive measures. The "*in-valuation*" (say, of the results of these risk model calculations) into the given cultural background (the complement to the *e-valuation* of data) and the readiness of insurance companies to provide insurance cover for these risks under certain conditions are the basis for the assessment of culturally conditioned qualitative *risk-acceptance thresholds*. The indispensable prerequisite for insurance companies is the availability of corresponding qualifyingly filtered data allowing for a quantitative assessment of the *risk probability*.

The more unacceptable the disastrous potential effects of large-scale complex technical systems become, the greater is the necessity not only to minimize possible sources of error via *human and machine "activities"*, i.e. via increasing automation, but also to create possibilities for human intervention in cases of emergency. Automation brings with it a substantial reduction in the potential sources of human error, notably those arising from the collision between "linear (clock-)time and "non-linear, rhythmic time", at the points of contact or interfaces between the two. Linear time determines the functioning of machines, non-linear rhythmic (cyclical) time the functioning of natural (human) life [9, 23].

Providing for "overruling" human intervention will lessen the probability of disasters caused by machines because humans are better at recognizing complex, unexpected patterns than computers are, the latter having major problems with the fundamental and unavoidable uncertainty (inaccuracy) of measurement data. The discussion on how to improve the synergistic interplay between humans and machines is greatly hampered by reluctance to discuss a problem epitomized by the ambiguous phrase "computer responsibility" [9, 23, 25-29, 37].

One of the great challenges facing empirical science (or, more properly, the scientists) is what can be achieved via the complementary rivalry/symbiosis/situation between humans and machines. But it is equally essential to determine what is not possible. Accordingly, and despite the inevitable time delay before new knowledge can be implemented on a political plane, it is one of the tasks of genuine *Bildung* to define what is desirable or undesirable and what can responsibly be done in this connection.

Note
Originally, the Humboldtian idea of Bildung *encompassed not only the ideals of inquisitive, inquiring, keen-minded thinking but also extended to poetic, visionary, prophetic, even mystic approaches. Humboldt's concept of* **Bildung durch Wissenschaft** *(approximately: formation of the whole personality through*
science)makes this very clear. (W. von Humboldt on the idea of Bildung*: "But when we say* Bildung *in our language we mean something infinitely higher and more inward; it is the cast of mind harmoniously permeating the sensibilities and the character and born of the insight and sensitivity of an all-pervading intellectual and moral striving." The implications in the term* Bildung *have resolutely defied translation into other languages.) Now, some 200 years later, we no longer speak of the* ***progress of science*** *but rather of* ***progress through science****. The term* Bildung *appears to have been stripped of all its original connotations besides the canon of factual knowledge (disposable knowledge) and the technical skills inculcated by modern European-style education systems. Ideas such as the concepts of "ordering knowledge" and "life-knowledge" so central to the thinking of philosophers like Eric Voegelin and Hans-Georg Gadamer have obviously been relegated to a very minor position. A sea-change indeed!* [3, 4, 38].

It follows from this that in the face of the rediscovery of complementarity, the responsibility of modern science and computer responsibility is probably the biggest single challenge facing education (in the sense of Bildung), not least - in fact precisely because - complementarity calls in question an essential premise underlying what German philosopher Hans Jonas (1984) called the "Principle of Responsibility" in his book of the same name.
That premise is nothing other than the absolute priority of Being over Nothingness. It is a premise that no Buddhist brought up to think in complementary dimensions could ever subscribe to. A genuinely intercultural dialog is hence more imperative now than it has ever been [7, 9, 23, 25].

Writing 82 years after Max Weber's famous lecture on "Science as a Profession" the present author sees (empirically grounded) **science as a contribution to a better understanding of ourselves in relation to the cosmos, as a complement to transcendence; it makes techn(olog)ical activity possible and for the scientist represents a challenging and rewarding opportunity for self-presentation.** Science thus conceived must not only live with provisional certainties standing out from the determinable (complementary) uncertainty around them but also with (and between) Newton's and Goethe's sorcerer's apprentices.

Necessary (but unfortunately not sufficient) for a successful discussion (or better: dialogue) and above all for the practical implementation of findings is the growth of a "*sound middle class*" in most nation states and direct support from the *élites* operative in all cultures. (Sound stands here for a synergistic blend of specialist knowledge, personal and personal identity, motivation, commitment and willingness to accept responsibility). [9, 18, 23].

5. Scientists, engineers and technicians in the role of culprits

5.1 The Eschede train disaster (1998)

Investigations into the Intercity train disaster in Eschede on 3 June 1998 will probably show that the Deutsche Bahn AG failed to give the safety of its passengers high enough priority in its overall concept. But there is a definite risk that in the legal handling of the case this defect in the company's overall planning will be relegated to the background and attain very little prominence in comparison with the immediate cause of the accident (the technical defect in the wheel rim). The reasons for this are probably not only attributable to economic policy considerations; the fact of the matter is that a faulty "concept" is much more difficult to arraign legally than the immediate consequences of its implementation in practice. This is especially the case when the whole issue is compounded with the provisions of the civil service laws, as we shall see in the following.

5.2 The problem of the law on civil servants

The provisions of the German laws on civil servants are largely responsible for the fact that over a year after the indisputable case of "data fraud" involving Friedhelm Herrmann and Marion Brach this offence has so far proved resistant to punishment, and indeed may prove to be so indefinitely. The law on civil servants is not applicable to employees (*Angestellte*), i.e. scientists, engineers, technicians, mechanics working for state and non-state institutions, and where it is applicable then to a much smaller degree. The upshot of this is that this group of people is being driven more and more into the *role of scapegoats or culprits*. In other words, the attempt is made to make them bear the major brunt of responsibility and liability for mishaps. This is true not only in the Eschede case but in a variety of other instances as well. The consequences of the recently discovered year-long fraudulent manipulations by a (mentally deranged?) employee at the Max Planck Institute of Breeding Research in Cologne show up this difference very distinctly. The same is true of many judgments on product liability in the United States, which are frequently dictated by the so-called "deep pocket syndrome" (sue the person/institution/company with the most money). Admittedly, the tougher verdicts on product liability will probably lead to greater quality awareness on the production side. But this is an inadvertent spin-off effect and not the main aim behind them.

5.3 Professional fouls

In the case of the latest "data scandal" involving bio-researcher Prof. Dr. Peter H. Seeburg, director of the molecular neurobiology department of the Max Planck Medical Research Institute in Heidelberg, all these three factors are inextricably intertwined. On the basis of the latest MPI guidelines what Seeburg did can only be termed unethical behavior. In a legal compromise, as here at the culmination of a dispute over patents, where everybody wins or at least nobody loses (i.e. no one suffers ruinous financial damage), the unimportance of professional ethics appears to stand in direct proportion to the gains the people involved stand to win, especially when the case at issue took place so long ago as to be subject to the German equivalent of the Statute of Limitations and the authors' statements are contradictory. Seeburg's admission that he faked data or at least intentionally "covered his tracks" in an article in the journal *Nature (281,544-548, 1979)* is disputed by the co-authors of the article (see Wolfgang Blum's article in DIE ZEIT, December 1999). But after the legal compromise it is highly unlikely that this matter will lead to any further legal dispute. Hence as things stand it is now probably inaccurate to speak of a punishable offence but rather of immoral acts or unethical conduct. In another article in DIE ZEIT (5 January 2000), Nobel Prize laureate

Chistiane Nüsslein-Vollhardt set out to defend or justify Seeburg's actions but in the opinion of the author of the present article in fact only made matters worse for him.

5.4 Possible counter-measures

Although one would expect the opposite to be the case, most of the cases of fraudulent manipulation of data detected in the Federal Republic (and elsewhere) in the last two years stem from the sphere of "in situ" data rather than from the complementary area of "remote sensing" data. These "data scandals" are a welcome excuse for politicians to decree further funding slashbacks for research and development, especially in those sectors which promise little or nothing in the way of short-term *disposable knowledge* (i.e. power) but a great deal of long-term *in-depth knowledge*. These sectors serve basic research in the first instance and as such represent the essential **foundations** for **future innovations** or new research and development activities. Competition within the scientific community is hotting up all the time. But largely due to bureaucratic overkill this rivalry leads to remarkably little innovation activity or constructive criticism. Instead it generates ever greater efforts to comply with the demands and expectations of short-range policy-making (for fear of losing the status quo - the so-called "page syndrome") or even more (intentional and detected) instances of fraud. But this is precisely the opposite of what politicians can truly be aiming for if they want to improve the economic complexion of their country and above all the situation on the labor market. The proposed (and now implemented) external and internal controls and self-monitoring (the latter promises to be much more effective than the former) are essential steps towards an improvement of the situation. But they can only be successful if the following necessities are given sufficient heed:

1. A clearer definition of what we mean by science and technology and how the responsibility for them is to be apportioned.
2. More reliable knowledge about the accuracy, the (unavoidable) inaccuracy and the underlying error theory of empirically established data. (Uncertainty is greater, for example, the smaller the period of measurement/observation is.) This implies learning to be more accurate about, and heedful of, the concurrences and differences between the terms error and uncertainty, indeterminacy and inaccuracy, in short being more scrupulous in our use of language.
3. Learning to be more accurate about, and heedful of, the adaptation/interface problem between humans and machines.

It is however difficult to avoid the impression that the number of people prepared to address these questions are dwindling (or the number of them willing to suppress or want only ignore them is increasing). The upshot of this is that we spend more and more of our time conserving the "*ashes*" rather than the "*fire*". There appears to be a preference for risking sudden disaster or total (revolutionary) collapse of the "system" in the future rather than undertaking in the present a relatively "gentle" (evolutionary) process of adaptation, e.g. via bio-cybernetic system control.

6. Information between the public and private sectors

In the case of science, Germany's data protection laws together with the competence (competence = specialist skill plus professional identity) of suppliers and users of data networks provide an adequate degree of security. Here we are dependent on insight rather than sanctions. Data protection is only a practicable proposition if it is accepted as an absolute necessity by suppliers and users, rather than being enforced by political regulations. There are five factors bedeviling the protection of general scientific data in the long term:

1. increasing computer software delinquency
2. multiple storage of data (for data security reasons) and hence the increase of large-scale central EDP systems and their increasing concatenation. *Note: the more we seek to ensure the integrity of data via multiple storage the less well-protected those data ultimately are. We cannot enhance data security and data protection both at once; in other words, we must weigh the matter and find compromise solutions because we live in an imperfect world.*
3. "technical amnesia": an increasing volume of older data can no longer be read by modern machines/technologies
4. uncertainty about what should/must be public or private in science (and if so, from what point in time), combined with the time-delay problem
5. headlong data growth rates, a problem of accumulation compounded by the fact that information can be accumulated indefinitely, whereas human life-time cannot.

The very notion that science is not public but is entitled to retain and reserve acquired knowledge as private property contradicts the nature of science as it has been understood since antiquity. In addition, it is also entirely unrealistic. Private knowledge that evades exposure to general intersubjective testing is not "scientific". In the context of cultural history it represents a reversion to the disciplines of archaic religiosity, the "ominous lore of the gnostic initiates". We shall only make scientists' alive to their political responsibility and assure the political monitoring of scientific endeavor if and to the extent that we can guarantee publicity and intersubjectivity at least for basic research. The (inevitable?) intermingling of the public and the private domains is unpredictable and unassessable at the outset of basic research. It sets in with the much later application for, approval and use of patents, the right to privately market results of what has in the interim turned into applied research [5].

Note

Wilhem Conrad Röntgen, awarded the physics Nobel Prize in 1901 for discovering X-rays, refused to patent his discovery, saying to Max Levy, the delegate sent by AEG to sound him out on the question, that he felt "that his inventions and discoveries belonged to the public and should not be reserved for individual companies via patents, licencing contracts and suchlike". On 6 September 1929, long after Röntgen's death, Max Levy added: "He was clear in his mind that with this attitude he was relinquishing any financial gains he might have had from his invention". Scholars like Röntgen were no exception in the 19th century.

7. Between parallel and serial information processing

The debate on information processing (notably in connection with pattern recognition) is dominated by two main topics:

1. the comparison between human intelligence and artificial intelligence (AI), and (an offshoot of this)
2. the question of what we mean by intelligence.

In *philosophical* terms this comparison is surprising, to say the least. The subsequent question of what we mean by intelligence has been the subject of debate in East and West for some 3,000 years and the answers this debate has come up with are astoundingly unanimous. We need only set about revising them if we have carefully read them first and then decide we are not satisfied with them. Instead of futile quibbling about word meanings, we can safely turn to the original significance of the term for the most reliable definition. In Latin *intellegere* means "*choosing between*" whatever things there are to choose from. For Cicero *intelligentia* means the capacity for recognition, later the highest faculty of the human soul for *contemplatio*. Thomas Aquinas equates *intellectus purus* with *intelligentia divina*, for him the angels are "*intelligences*". While the social sciences have signally failed to agree on a clear-cut concept, psychology has split up the phenomenon of intelligence into more than 100 categories (see J.P. Guilford, The Nature of Human Intelligence, New York 1967) of which only a few can be imitated by machines. Phenomenology (notably M. Scheler, "The Position of Man in the Cosmos", 1962; and E. Husserl "Ideas on Pure Phenomenology and Phenomenological Philosophy", 1913-53) homes in on the transcendental functions of intelligence, a fact which in itself should suffice to prohibit the use of the term for technical processes. But even on the technical plane, i.e. in terms of hardware, structure and software, there are clear differences between human intelligence and so-called Artificial Intelligence. Most notable among them is the fact that a human brain can associatively process complementary sense-connections - between intell-igible and non-intelligible - and can register information arriving on various channels in a non-linear, *parallel, i.e. "simultaneous"* way. By contrast, computers can so far only process information that can be "strung together" from decideable alternatives (binarily), and mainly only serially, i.e. one after the other. (So-called "parallel processing" by computers is only an imperfect simulation of the parallel processing in the human brain, of which we still have no more than very imperfect knowledge). In this way it is not yet possible to emulate the holistic and directly situation-related perception capacity of the human mind [5].

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10. Scientific Curriculum Gerd Hartmann

Gerd Karlheinz Hartmann, born in 1937 in Eschwege, Germany, studied physics from 1957 to 1964 at the Georg-August-University in Göttingen, where he received his PhD. in 1967. Since 1965 he has worked as a scientist at the Max-Planck-Institut für Aeronomie, D-37191 Katlenburg-Lindau. For over ten years he concentrated his activities on studying the upper atmosphere using satellite (radio) beacon signals.
Since 1967 he has been dealing also with general and specialized information and documentation problems, from the viewpoint of large volumes of time dependent and space dependent data, especially of the type collected in his research projects. At present he works as a consultant on several national and international committees and holds lectures and seminars throughout Europe, and especially in the USA., in Argentina, and Chile, countries he has often visited in the course of his scientific projects.
From 1975 to 1978 he was the provisional director of a division of the institute, the Institute for Long-term Control of Geophysical Environmental Conditions (ILKGU).
Since 1979 his main area of specialization has been studying the lower atmosphere by means of microwave radiometry. He is the Principal Investigator of the **M**illimeter Wave **A**tmospheric **S**ounder (MAS) experiment which as a joint enterprise of Germany, Switzerland, and the USA has been flown as core payload of the NASA ATLAS (Atmospheric Laboratory for Applications and Science) Space Shuttle Missions (ATLAS-1 (1992), ATLAS-2 (1993), ATLAS-3 (1994); (http://www.linmpi.mpg.de/english/projekte/masnew)
Since 1980 he is "consultant" for information problems of the Institute of Intercultural Cooperation/Intercultural Research" (ICC/IIR: Heidelberg/Zürich/Pernegg). In the 80ties he travelled on behalf of that institute to India and Asia, especially for discussing his concept of the (intercultural) information system OCIR/VIGRODOS. He participated in and contributed to international conferences on problems of intercultural understanding and cooperation.
1986 he became guest professor and guest lecturer for filter and information theory at the University of Mendoza, Argentina. This task was extended in 1988, now also including problems of conserving utilization of the environment (sustainable development). In this context he is the international coordinator of the environmental program PRIDEMA started by the University of Mendoza (UM) in 1988.
1991 he became full professor at the engineering faculty of UM for "remote sensing for a conserving utilization of the environment" (sustainable development) and also "external scientific director of the institute for environmental studies (IEMA) of UM. In December 1991 he received the Dr.

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