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# Trials and tribulations in editing the IJ RMHM for 13 years (1991–2004)

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## 1. Introduction

During the 13 years for which I have so far been Managing Editor of RMHM I have accumulated certain experiences which I would like to present here as a basis for a discussion and, hopefully, to generate suggestions for improvement of our journal whose aim is to "bridge the gap between pure research and the more practical aspects of production and properties in order to provide a unifying medium for material scientists, technologists, engineers, designers and manufacturers" [1]. This presentation is also intended to make readers of the journal aware of the people who are contributing to the production of issues, such as Referees, the News Editor and the staff responsible for our journal at Elsevier UK. They should all be thanked for excellent and nearly friction-free collaboration, thereby ensuring the high scientific and reproduction standard of RMHM.

When Benno Lux and Peter Lanagan offered me the position of Managing Editor in 1991 I had just moved from Metallwerk Plansee in Reutte, Tyrol to Darmstadt, where I started to form the Department of Chemical Analytics within the Institute of Materials Science of the Darmstadt University of Technology. This was an excellent opportunity for me to remain in contact with a field that I originally became familiar with through my own field of expertise, materials characterization [2,3]. This area I developed as the head of the Central Analytical Services of Plansee for 20 years [4].

Of course, I initially had a strange feeling on taking up such a responsibility and I immediately realized the importance of having a high level Editorial Board to help me in critically but constructively refereeing the incoming manuscripts. The members of the Editorial Board are to be thanked for their essential work, along with the Referees as well as the News Editor, K.J.A. Brookes, and the Editor in Chief, Benno Lux. This is also a good opportunity to remind contributors on the scope of the journal and to invite colleagues in the field to contribute to the forthcoming Special Issue on the ICSHM 8 and to future issues of RMHM.

## 2. On the basic requirements of IJ RMHM

### *2.1. Faulty English is the international language of science and technology*

Communication among scientists is becoming easier because everyone speaks English—at least to some extent, and of course the written scientific literature is now available in English worldwide. There are very few scientific journals left in domestic languages and their distribution is limited to the country or countries where this language is spoken. For a journal to be described as "international" it must be published in English.

When I started at RMHM as Managing Editor in 1991, Elsevier corrected manuscripts linguistically—at least to a certain extent. Unfortunately in our times of overrationalization [5], this service has also been rationalized away. When manuscripts arrive from authors whose English is rather rudimentary, some of the Referees do an admirable job in correcting this English. This is, however, only possible to a certain extent—unless one rewrites the whole manuscript. Thus the scientific community will have to live with imperfect English in practically all scientific journals (except in a small number of top journals like "Science" which only accept manuscripts written in good English for which fewer

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corrections are required). Therefore, faulty English will remain the international language of science and technology for the foreseeable future.

To end this chapter, it might be useful to ask authors of manuscripts written in very poor English to find somebody who can help them to improve their papers because I cannot expect that a Referee will do this job. There is no escaping the fact that today knowing English well is a prerequisite to even a mediocre scientific career.

### 2.2. On the scope of IJ RMHM

Fortunately, most incoming manuscripts are totally in agreement with the scope of RMHM. However unfortunately, there are occasionally exceptions to this rule and I think it is therefore appropriate to remind readers of the scope of this journal as it is formulated on each inside cover page of every issue [1]:

"This international journal publishes papers concerned with all aspects of the science, technology and application of refractory metals and hard materials. New technological developments now enlarge the scope to cover not only those metals with melting points around 2000 °C, and higher but with similar powder metallurgical production and fields of application. The following metals and their alloys are covered: zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten, rhenium, ruthenium, osmium, rhodium and iridium.
Advances in hard materials continue and the journal deals with the production, uses and properties of the carbides, nitrides and borides of these metals and also those of titanium, as well as tools of ceramics, and the superhard boron nitrides, diamond and related compounds.
Papers are also published on the technologies of powder production (including their precursor materials), milling, granulation, cold and hot compaction, sintering, HIPing, hot-pressing, injection molding, as well as on the coating technologies for refractory metals, hard metals and hard materials. The characterization, testing, quality assurance and applications are also covered.
The *International Journal of Refractory Metals & Hard Materials*, by bridging the gap between pure research and the more practical aspects of production and properties, will continue to provide an unifying medium for material scientists, technologists, engineers, designers and manufacturers."

Some remarks about this scope might be helpful. People within the field might be surprised about the number of metals mentioned, which also include, e.g., vanadium and the platinum group metals ruthenium, osmium, rhodium and iridium. There are two reasons for these inclusions:

It is mentioned that the journal covers those metals with melting points around 2000 °C and higher and, hence, these metals are included. Fig. 1 gives an overview of metals with the highest melting points in relation to their position in the periodic system and compared to some of the most refractory compounds which are essentially carbides, oxides or borides [6]. Metals with melting points above 2000 °C are (with rising melting points in [°C]): Hf (2230), Ru (2400), Ir (2450), Nb (2470), Mo (2620), Os (3000), Ta (3030), Re (3170)

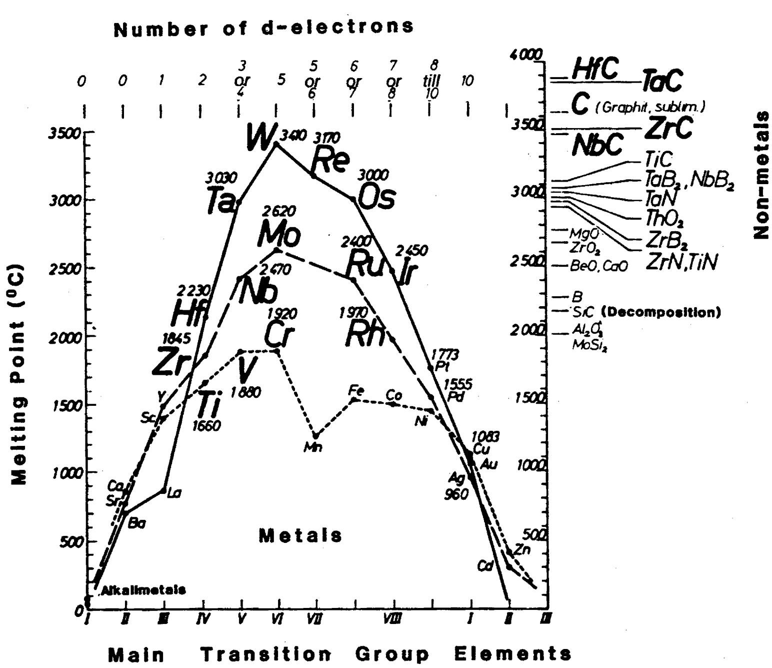



Fig. 1. Melting points of metals in relation to their position in the periodic system and compared to refractory compounds.

and W (3410). Only Rh exhibits a melting point below 2000 °C: 1970 °C.

Some of the other metals infrequently do play a role in hard metal technology such as, for example vanadium as carbide and the platinum group metals for certain exotic and complex hard metals [7].

It should therefore be clear that RMHM does not publish papers concerned with the technology or use of the pure metals (except for the refractory ones). The other pure metals are covered in other journals [8].

### 2.3. On the international balance of RMHM

An international journal in my opinion should try to provide a true and objective picture in its contributions of the present state of the art—in this case being the technology of refractory metals and hard materials from all those countries which are active in this field. It is clear that there are certain differences in the equipment and the subsequent know how of companies leading the field worldwide and those companies which are more limited to their national or continental field of activity. Of course, a certain and rather high level should be maintained in all articles, but some deficiencies in instrumental outfits and technological views should be tolerated in order to obtain a true picture of the state of the art on a worldwide basis. It is sometimes very difficult to turn down manuscripts of insufficient standards from a non-high-tech country. In addition, a new trend is emerging in which authors of mediocre manuscripts send their papers around several journals in the hope that:

(a) the respective managing editors or editorial board members acting as referees of these pertinent journals will not have contact with each other (but incidentally they do!),
(b) they will find a referee who is too tolerant.

In addition, it is, of course, desirable for contributions to really cover all countries active in the special field of the journal worldwide and fortunately this is, in my opinion, true of RMHM. As an example, I quote the countries of the contributions of the three issues of 2003 in Table 1. If one follows up all nations who contribute it very quickly becomes obvious that two continents are practically non-existent in this group: Africa with the exclusion of South Africa, and Australia. It is my request to the members of the Editorial Board that they try to stimulate authors of these countries to contribute in the not too distant future.

Table 1
Overview on countries of contributions of Vol. 21, 2003 of IJ RMHM

| Issue number 1–2 | Issue number 3–4 | Issue number 5–6 |
|---|---|---|
| P.R. China | India | P.R. China |
| Venezuela | P.R. China | U.S.A |
| Switzerland | Taiwan, ROC | Brazil |
| Sweden | Austria | Ukraine |
| Switzerland | Portugal | Brazil |
| Switzerland | Brazil | Brazil |
| Sweden | Sweden | Ukraine |
| Ukraine | Thailand | P.R. China |
| Russia | Japan | Japan |
| Germany | South Korea | |
| P.R. China | Taiwan, ROC | |
| | France | |

### 2.4. On the art of refereeing and the valuable work of the members of the Editorial Board

One of the most essential features of a good journal is the rather complex duty of refereeing of incoming manuscripts. This is not as clear a subject as the solution of a mathematical problem—with usually only one precise solution.

There is, of course, generally no problem with definite extremes, i.e. with outstanding or terrible manuscripts. For these, the decision is easy for the Referee as well as for the Editor. Problems are related to mediocre manuscripts which are near the borderline of acceptance or rejection. In such cases, the final decision may depend on the rigorousness of the Referee. The Managing Editor is in real trouble if in such a case, two adversary comments on such a manuscript arrive. It is a very uncomfortable but necessary job of the Managing Editor to come to a just and objective decision. Often, such a decision is further complicated by the fact that every scientific field today is so broad that nobody can be an expert in all the subjects treated in the manuscripts. This is, of course, the reason for the rather long list of members of the Editorial Board and still, in some unfortunate cases, it is difficult to find the colleague of the Board with the necessary expertise to judge the quality of work on a specific topic of a given manuscript. It is in this context that I would like to thank all members of the Editorial Board of our journal for their excellent work without which a proper level of manuscripts would not be possible. Their recommendations for improvement of manuscripts are an invaluable source for the "brushing up" of manuscripts to a final form which can be accepted for publication. No doubt that this will sometimes cause the authors a lot of headache and possibly much work but in the long run it definitely improves the manuscript.

A further request to the members of the Editorial Board—especially in times of great manuscript shortages—is to encourage possible authors to contribute a relevant manuscript on an interesting topic. In a time of harsh overrationalization this is not easy and the average time period for refereeing has been clearly prolonged due to work overloads. The latter is also the reason for manuscript shortages and if important conferences like the International Conference on the Science of Hard Materials or the International Plansee Seminars do not result in a significant increase in manuscript flow, I am afraid the situation could become very problematic.

Since, therefore, the importance of a qualified and reliable Editorial Board is of utmost importance to any scientific journal the present composition is shown in every issue of RMHM and I would just like to add a few remarks on its international composition. At first sight, it appears that the Board contains an unduly large number of Austrian members (eight or ten, if Benno Lux and myself are also included). This primarily has historical reasons since this journal was founded initially as the official journal of the Austrian Society of Powder Metallurgy of Metallwerk Plansee. This can be seen from the issues up to Vol. 9 in which it was written on the cover page of the journal: Official Journal of the International Plansee Society for Powder Metallurgy and the International Tungsten Industry Association [9].

The second highest number of Editorial Board members is from the USA (five members) which should emphasize the importance of the US powder metallurgy of refractory metals and hard materials. Three members of the Board are situated in the United Kingdom, China and Germany. Two members are from India and Japan and one each from the following countries: France, Hungary, Korea, Russia, Spain, South Africa and Sweden. Fig. 2 shows the regional distribution of Advisory Editorial Board Members.

I hope it can be agreed that this composition is not only justified from the expertise of its members but also from an international point of view. It also understandably demonstrates the prevalence of European Board Members. This has also practical reasons because it is usually easier, faster (and cheaper) to communicate with Europeans in the refereeing process than it is transcontinentally.

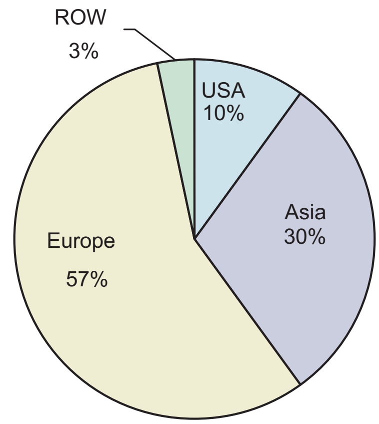



Fig. 2. Regional Distribution of Advisory Editorial Board Members ROW = rest of world.

### 2.5. Some geographically oriented business and statistical scientific information

It is evident that a scientific journal financially lives from the number of subscribers and on-line users. Table 2 exhibits the percentage breakdown of subscribers per region. As for practically all journals the overall number of print subscribers has been falling steadily over the past few years. However, given the wider availability

Table 2
Percentage breakdown of subscribers by region (Geographical breakdown of institutional subscribers over the last five years)

| | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|
| Western Europe | 48.8 | 45.3 | 44.5 | 40.3 |
| Asia | 21.5 | 22.7 | 25.5 | 34.7 |
| North America | 23.8 | 24.7 | 23.4 | 19.4 |
| Eastern Europe | 2.3 | 3.3 | 2.2 | 1.6 |
| Mid-America | 0.6 | 1.3 | 1.5 | 1.6 |
| South America | 0.6 | 2.0 | 2.2 | 1.6 |
| Africa | 1.7 | 0.7 | 0.7 | 0.8 |
| Australasia | 0.6 | 0.0 | 0.0 | 0.0 |

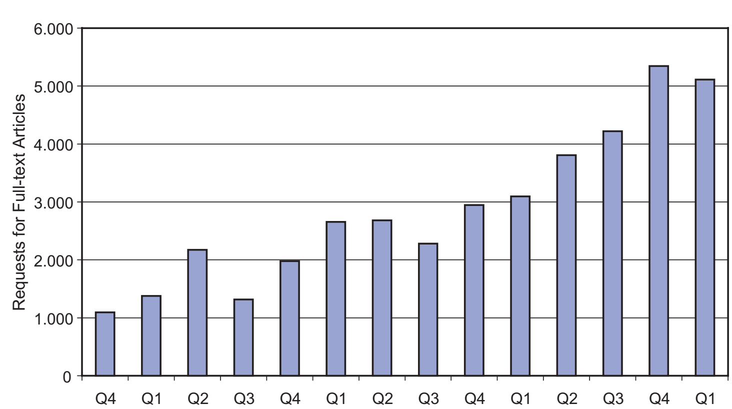



Fig. 3. Total full text article downloads (2003 to first quarter 2004).

of the journal via Science Direct, the subscription data should be considered in conjunction with electronic usage, Fig. 3. This figure shows the electronic usage of IJ RMHM. The data are a combination of Science Direct and Web Editions usage [10]. However, the majority of usage comes from Science Direct which exhibited a pronounced increase. If more information on Science Direct is required, it can be found in [10]. It might also be of interest in this connection to note which articles were most downloaded from 2003 to March 2004, and this information is shown in Table 3.

### 2.6. On the art of having the right people at the right places: the News Editor K.J.A. Brookes

Reliable information on forthcoming events in the field and a short and precise overview on new developments and happenings is also an important feature of a good journal. This duty is carried out excellently and with great clarity by our News Editor, Kenneth J.A. Brookes. He is also the Editor of the well known series "World Directory and Handbook of Hard Metals and Hard Materials" and it was in this connection that I first was intrigued by him. It was a phrase in the Introduction of the World Directory Edition of 1979 that immediately thrilled me because it was ironically expressing what many observers of the hard metal scene also experienced:

"Most manufacturers have for many years taken up a position of excessive secrecy. This, in many respects, has had disastrous results. In most cases, the only secret that the producers had was that they had nothing to hide!" [11]

I realized that this was a very true observation which however is seldomly expressed. His News Section and announcement of forthcoming events is a very vital part of our journal which I believe that everyone in the field appreciates. Hence, many thanks to Ken for this lasting feature in RMHM!

### 2.7. On the "proper" wires to Elsevier: future developments in electronics and the fashion and quality of printing

Every scientist who frequently writes manuscripts for publication in any scientific journal will have noticed dramatic changes in procedures in recent years. Not only have corrections and amendments become much easier with modern text management software and laser printers which yield pages that are no longer discernible from printed pages of books. It is with the advent of e-mail, however, that the really dramatic changes have taken place: If authors are situated in different parts of the world, manuscripts are sent around for corrections and amendments and thus can be completed and improved at a pace that was unthinkable previously. Of course, this must also eventually affect the way of handling manuscripts. And I am happy to announce a dramatic change for our journal: it is now possible to submit manuscripts in electronic form to my e-mail address, which will help improve the speed of the publishing procedure significantly; I can then forward such manuscripts much faster—and cheaper—by e-mail to the Referees who (of course) must also be reached by e-mail. They in turn will transmit their reports again electronically and subsequent correspondence with the authors will also take place by e-mail. I expect a significant increase in speed of getting papers ready for publication. Of course, it also happens from time to time that a server at one of the corresponding members is out of order and a message is thus not received—unfortunately up to now without notice of the sender. Hence, in case you don't hear from me in a usual time period of response of, say, a fortnight, please do contact me. I have experienced cases in which I e-mailed the Referees report to authors together with my comments and did not hear from the authors for about two months. Or the authors send me an e-mail after some time asking what is the state of their manuscript. This communication is *very important* since unfortunately nothing is perfect in our world and e-mails, too, are out of order from time to time.

Apart from this modern procedure of handling manuscripts electronically there is, however, another dramatic change in scientific literature to be expected in the future. As has already been observed it is possible to access our journal electronically since a so called Web Edition is provided by Elsevier. Of course, your institution would have to pay for access and this is, naturally, the way that the publishing companies are surviving this dramatic change to electronic information. Hence, printed versions of journals may sooner or later disappear in favour of the electronic versions. This will take time but the electronic use also of RMHM is increasing as has been shown in Fig. 3. However, it is Elsevier's official position that libraries and librarians will remain an important resource for handling and organising online information and holdings, and for teaching researchers how to use new electronic tools & databases to work more effectively. It is very important to emphasize that relationships with librarians will continue to be important. Summarizing all these changes we can state that our journal is at the front of all the changes modern electronics have caused in the world of scientific journals and we can look confidently to the future developments in the field of refractory metals and hard materials.

I would like to close this chapter with a remark on the "traditional" issues of RMHM. I hope you can agree

Table 3
Most downloaded articles from 2003 to March 2004

| Article title | Author(s) | Full-text requests |
|---|---|---|
| Machinability of hardened steel using alumina based ceramic cutting tools | Senthil Kumar, A.; Raja Durai, A.; Sornakumar, T. | 299 |
| Microstructure and properties of flame sprayed tungsten carbide coatings | Vamsi Krishna; Misrab, V. N.; Mukherjeeb, P. S.; Puneet Sharma | 213 |
| Performance of PVD TiN, TiCN, and TiAlN coated cemented carbide tools in turning | Jindal, P. C.; Santhanam, A. T.; Schleinkofer, U.; Shuster, A. F. | 206 |
| Friction and wear behavior of several hard materials | Quercia, G.; Gutierrez-Campos, D.; et al. | 200 |
| Production and characterization of ultrafine WC powders | Bock, A.; Zeiler, B.; Bock, A.; Zeiler, B.; Bock, A.; Zeiler, B. | 198 |
| Determination of the average grain size of cemented carbides | Engqvist, H.; Uhrenius, B. | 169 |
| Thermomechanical properties of TiC particle-reinforced tungsten composites for high temperature applications | Song, G.-M.; Wang, Y.-J.; Zhou, Y. | 157 |
| Mechanical properties of WC–10Co cemented carbides sintered from nanocrystalline spray conversion processed powders | Cha, S. I.; Hong, S. H.; Ha, G. H.; Kim, B. K. | 147 |
| On the formation of very large WC crystals during sintering of ultrafine WC–Co alloys | Sommer, M.; Schubert, W.-D.; Zobetz, E.; Warbichler, P. | 137 |
| Microstructure development of WCoB–TiC based hard materials | Saez, A.; Arenas, F.; Vidal, E. | 135 |
| WC grain growth and grain growth inhibition in nickel and iron binder hard metals | Wittmann, B.; Schubert, W.-D.; Lux, B. | 134 |
| On hardness and toughness of ultrafine and nanocrystalline hard materials | Richter, V.; Ruthendorf, M. v. | 131 |
| Trends and recent developments in the material manufacture and cutting tool application of polycrystalline diamond and polycrystalline cubic boron nitride | Cook, M. W.; Bossom, P. K. | 128 |
| Sintering features of cemented carbides WC–Co processed from fine powders | Allibert, C. H.; Allibert, C. H.; Allibert, C. H. | 128 |
| Formulation and testing of optimised coating properties with regard to tribological performance in cold forging and fine blanking applications | Klocke, F.; Raedt, H. | 127 |
| Effect of ball milling parameters on the microstructure of W–Y powders and sintered samples | Avettand-Fenoel, M.-N.; Taillard, R.; Dhers, J.; Foct, J. | 127 |
| Tungsten heavy alloy: deformation texture and recrystallization of tungsten particles | Lars Ekbom and Tomas Antonsson | 126 |
| Submicron and ultrafine grained hard metals for microdrills and metal cutting inserts | Gille, G.; Leitner, G.; et al. | 125 |
| Powder injection molding of WC–8%Co tungsten cemented carbide | Zhu Baojun, Qu Xuanhui and Tao Ying | 125 |
| Synthesis and properties of MoSi”2 alloyed with aluminum | Zhang, H.; Long, C.; Chen, P.; Tang, G.; Liu, X. | 124 |
| Corrosion resistance and properties of pump pistons coated with hard materials | Rosso, M.; Bertini, S.; et al. | 123 |
| On the contiguity of carbide phase in WC–Co hard metals | Golovchan, V. T.; Litoshenko, N. V. | 123 |
| Microstructure and properties of CVD @ c-Al“2O”3 coatings | Larsson, A.; Ruppi, S. | 119 |
| Production and characterization of dry lubricant coatings for tools on the base of carbon | Dittrich, K.-H.; Oelsner, D. | 117 |
| Corrosion properties of Co-based cemented carbides in acidic solutions | Sutthiruangwong, S.; Mori, G. | 117 |

that the quality of printing and especially of reproducing micrographs and diagrams is excellent as long as the material delivered by the authors is of top quality also. It is clear that a printed version cannot substantially improve the quality of poor artwork delivered by authors.

## 3. "I have a dream ...": Wishes to contributing authors

In the second part of this presentation I would like to express some wishes which developed in the course of managing this journal for more than a decade, and I would like to start with a very important subject: How should measured data be presented and what role should basic statistics play in this connection?

*Statistics*

"Two views are taken of statistics. One is a political condemnation as lies, damned lies and statistics, and the other one is a more positive definition in terms of the art of determining the probable from the possible. Whatever the point of view, there is no doubt that statistics have an essential, though sometimes abused, role to play in any sort of measurement."[12]

*Errors in data of measurements*: All measurements are subject to error and these can be classified into three groups:

(a) *Indeterminate or random errors*: Such errors are an inherent part of the operation of all sorts of measurements and cannot be eliminated, though it is sometimes possible to reduce their magnitude. The magnitude of these errors can be determined by repetitive measurement on the same sample. The principal use of statistical procedures is to predict the "true" value from a group of individual measurements each containing random errors.

(b) *Determinate errors or systematic bias*: One of the more pragmatic laws of the art of measuring is that all techniques of collecting data are subject to determinate error and that all respective scientists to systematic bias. Often such bias remains unsuspected and undetected and is the major cause of interlaboratory discrepancies. Systematic bias can arise from instrumental drift effects, uncertainties in respective correction procedures, or instrument misalignment. Questionable personal judgements, such as an inappropriate choice of reference standards to set up a calibration, or doubtful choice of operating conditions, also result in systematic bias. Personal bias also has the effect of influencing results so that they come closer to a preconceived notion of the true value for a measurement. The only guard against bias is a careful and systematic study of the performance of a technique in the measurement of as many reference standards as are available. Systematic bias does have a prominent feature—it normally affects results in one direction so that all data are either too high or too low.

(c) *Gross errors*: A third class of error affects any results of measurements. These are much less insidious than systematic bias, are usually readily detected, and lead to the abandonment of the determination. Such errors arise from serious malfunction of equipment, mislabelling of samples or failure of the operator to press the correct buttons in the right order (i.e. finger trouble). Usually such errors are temporary and have a readily identifiable source. Errors in this category can be avoided by self-discipline, a systematic scheme of work with cross-checking, and sometimes by automation so that repetitive operations are carried out under computer control. In these categories, statistics can only be used to predict the true value from sets of data subject to random error. Statistics can be used to test for the presence of, but not to correct for, the effects of systematic bias.

### *3.1. Statistics may be used as a drunk uses a lamp-post—more for support than enlightenment [13]*

"Everyone uses computers nowadays in one way or the other for obtaining and evaluating measurements. There is an unfortunate by-product of the computer/microprocessor age, however. Because the results are obtained automatically, the experimenter may come to believe they must automatically be correct, and take no thought about errors that may arise from the methodology involved. Worse, the experimenter may run only a single experiment to obtain a large number of data points for interpretation, and forget that any mistake in setting up the experiment will invalidate the results." [13]

I would therefore like to remind all contributors of some very basic and simple terms and procedures in presenting measurement data:

(a) Any measurement data should be given in the following form: $\bar{x}$, $\pm 1s$, $n$; $\bar{x}$ = arithmetic mean of measurements; $\pm 1s$ = one standard deviation of this mean; $n$ = number of measurements carried out and used in this calculation. If $n$ is only 2 or 3 it is often omitted—with good reason: A standard deviation based on just two or three results is not very convincing.

(b) The data should not contain more significant figures than can be justified by the experimentation. As was stated by C.F. Gauss many years ago:

"The deficiency of mathematical education is best demonstrated by an excessive number of significant figures." [14]

(c) Sometimes the standard deviation is greater than the mean, but no comment is made as to whether the results lack reproducibility or on a possible skewness of the distribution.

(d) There is an excellent series of figures which very well demonstrate these terms of paramount importance in any campaign of measurements: accuracy and precision, Figs. 4–9 [15].
The distinction between accuracy and precision often causes some confusion to technologists not well trained in statistics.
Accuracy is a measure of how close the measured data lie to the "true" value of the property determined. Precision is a measure of the repeatability of the measurement. A precise measurement is one where a set of reliable determinations forms a tight cluster about the average. The degree of precision is normally measured by the standard deviation of the determination. This is a measure of the width of the data distribution peak.

(e) Quite a span of standard deviations are justified according to the problem for which the data are

Fig. 5. . . . and this happens to Joe Puff, the old poacher! His precision is miserable! Obviously his gun is incorrectly adjusted and the accuracy of his shots also leaves much to be desired. Maybe, though, he's simply not in shape.

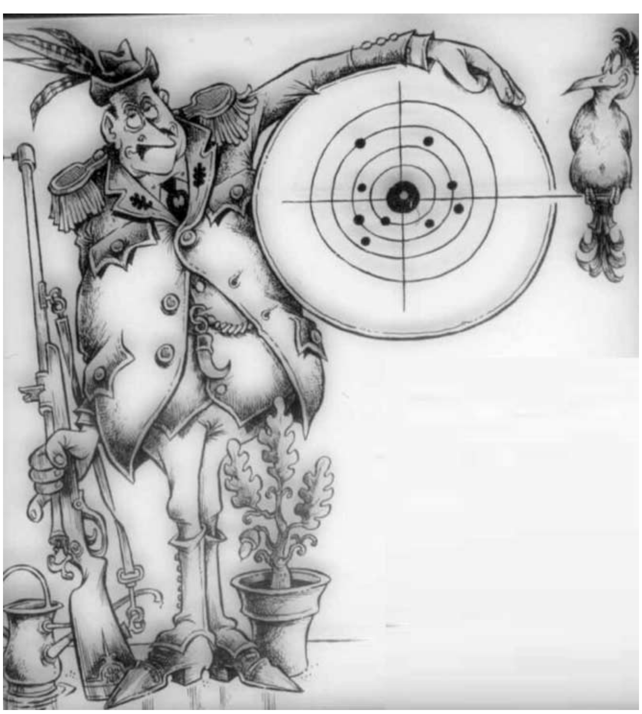


Fig. 4. This is Peter Piff and his practice target. Do you think he is a bad shot? Just wait and see. This can only be decided once all the others have had a shot, too—and maybe even then he's the best? The *accuracy* of his shots is not bad because they are all scattered evenly around the centre. His *precision* is nothing to write home about. This, however, could also be due to the ammunition used or to his gun.

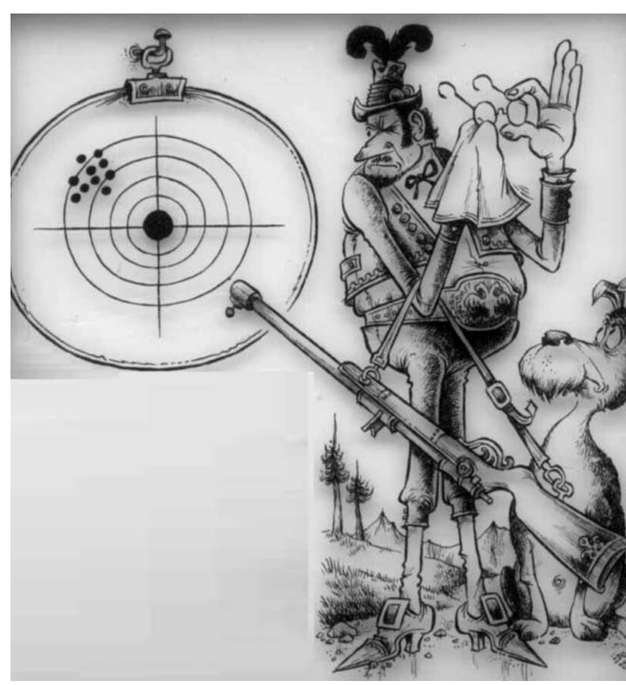


Fig. 6. With the target of Paff, it's the other way around. The precision of his shots is good. He probably would have won the contest if his shots were not so off range of the centre. He would be an excellent shot if there was not a *systematic error*. Is the reason a misadjusted rifle or faulty ammunition? Or did he practice a faulty technique when shooting?

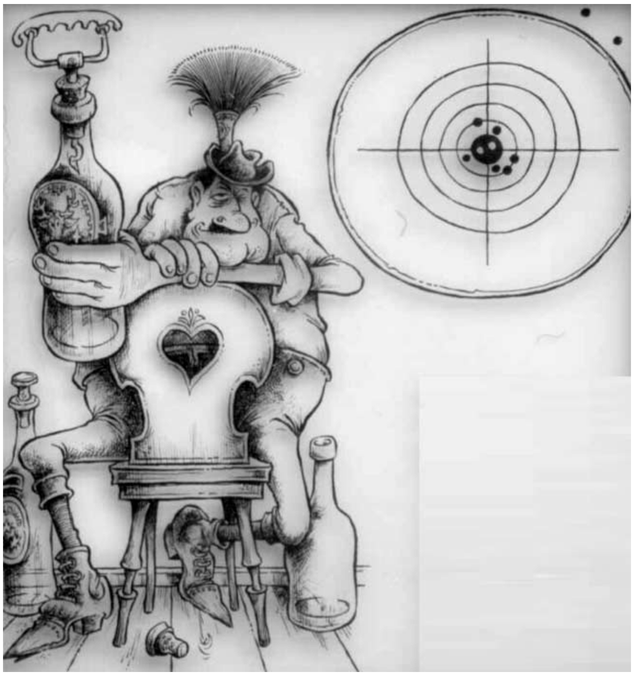


Fig. 7. Excellent precision, good accuracy: Eddie Poff. He would be the best if there weren't two shots out of range! Was he nervous? Was his gun out of order? Or did he drink before the contest started? For such grave mistakes there is often no rational explanation. This is the reason that they are so frightening—although statistically they are easy to eliminate.

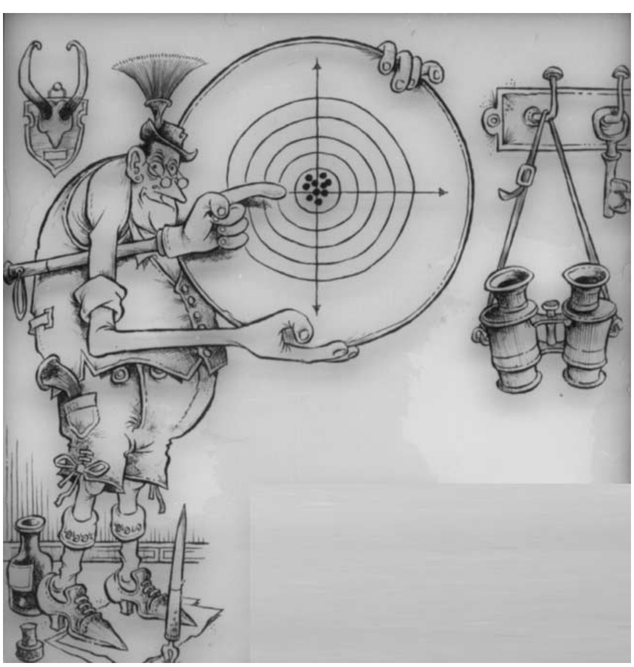


Fig. 8. "An impossible result!!" All, who saw this target said so. All 10 shots right in the centre! This never happened before. The puzzle was quickly solved—much to the harm of the participant: he was cheating with the aid of his brother who was in charge of the targets! The names of both were eliminated from the contest and the target was saved as a warning example for future contests.

derived. I would like to demonstrate this with an example from work in analytical chemistry:

- Relative standard deviations of 2% are today common-place in the range of 1–100% (w/w).
- Relative standard deviations of 10–30% are usually acceptable in trace analysis, i.e. in the μg/g- or ppm-range.
- In ultratrace analysis, e.g. for ultrapure materials (semiconductor silicon) one is happy with the correct order of magnitude. This is the regime of ultratrace analysis is the one at the ng/g- or ppb-level.

(f) The best and short introduction to the wide field of statistics for measurements to my knowledge is the one by P.J. Potts in [13], p. 7–18.

### 3.2. "Publish or perish" or: "Publish and perish"?

I would like to cite Bob Chalmers again from his very excellent article in Talanta [14]:

"As a result of the development of computers, microprocessors, robotics and so on, we now have the possibility of operating with very small quantities of material, with numerous data-points from a given experiment, and of exploring structure, structure–behaviour relationships, speciation, spatial distribution and so forth, to an extent never previously attainable."

All this is very exciting and full of promise, and it is all too easy to take the attitude "isn't science wonderful" without questioning its validity. As happens with almost all new techniques, however, we are carried along by the first flush of enthusiasm to believe that here at last we have the means to solve all problems, until further work begins to show up any shortcomings of the techniques and we find that the answers may be incomplete or even wrong.

- If we survey the current literature, we quickly see that we have substantial dedicated groups of leading thinkers and innovators, working to extend the frontiers in their particular fields.
- Then we have a larger group of workers we might call "implementers" who apply these new techniques along with others to solving specific problems in industry or in research projects.
- Finally we have a possibly even larger group of those who, whether from choice or because of economic restrictions, continue to tread well worn paths in research, operating a kind of cottage industry to turn out methods that, though "new", are devoid of much originality and are hardly ever likely to be used.

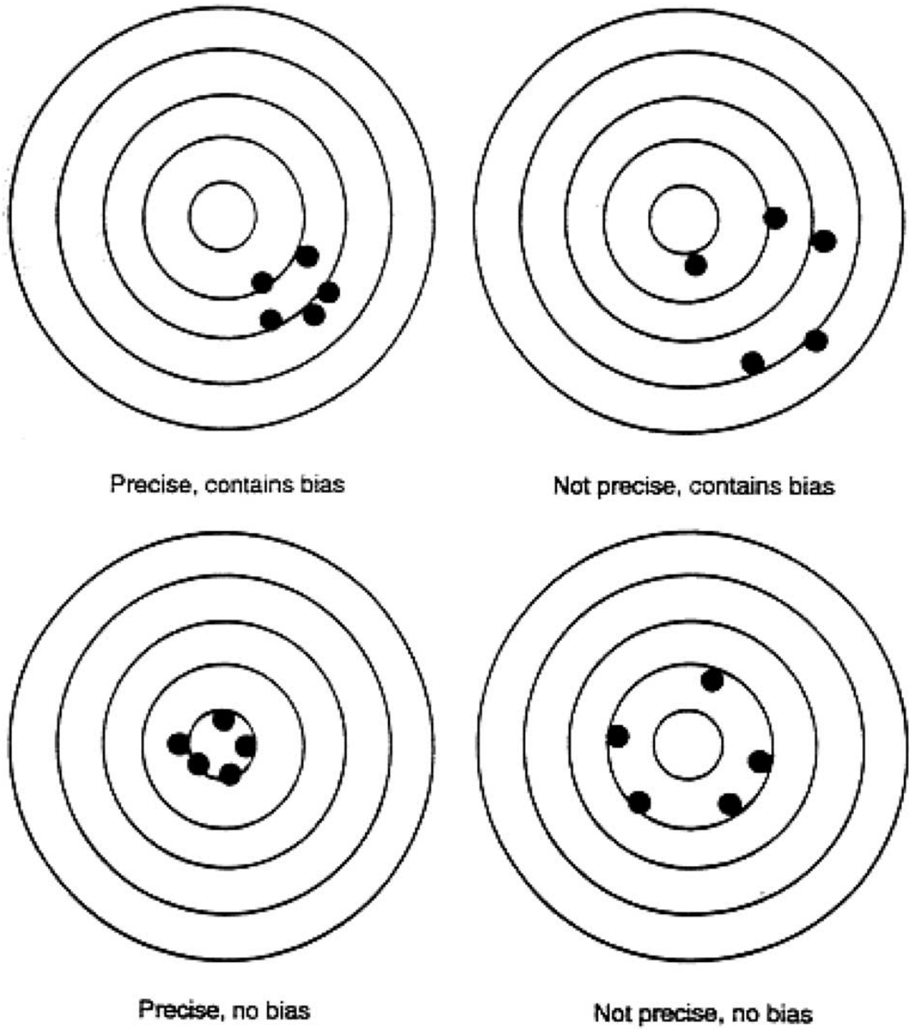



Fig. 9. Scientifically, these patterns can be assembled and commented as shown here and this should make the terms accuracy and precision understandable for everyone.

"Most of these authors were doubtless driven by the "publish or perish" syndrome, and perhaps did not realize that they could publish and perish. My plan for financing retirement would be to start a new journal called *Journal of Useless New Knowledge (JUNK)*, with a page-charge and circulation only to authors (with one copy of the issue in which their paper appeared)."

### *3.3. Impact factor: its relativity or use and abuse*

Many journals now carry an impact factor which offers a good basis for comparison of titles within a field, but is probably not equally applicable for the wide variety of journals on today's scientific scene. It must be mentioned, however, that ISI only assigns impact factors to pear reviewed journals which are considered to achieve above a certain threshold of original primary papers coming from a broad geographic base. Journals which contain predominantly conference proceedings (even if refereed) are not included as well as titles where there is not a significant spread in geographical origin of authors. There is an excellent paper on all aspects of this factor available from Elsevier [16] and I would like to cite the introductory passage of this communication:

"The ISI® Journal Citation Reports (JCR®) impact factor has moved in recent years from an obscure bibliometric indicator to become the chief quantitative measure of the quality of a journal, its research papers, the researchers who wrote those papers, and even the institution they work in. This pamphlet looks at the limitations of the impact factor, how it can and how it should not be used."

I consider it as absolutely essential to read this article before any interpretation of a current impact factor is performed. The simple reason is that the magnitude of the impact factor is not only a function of the quality of a journal but unfortunately depends on a series of further important parameters as, e.g.:

(a) The subject area and the number of scientists working in this area.
(b) The type and size of a journal: journals of industrially oriented areas will exhibit low impact factors.
(c) The so called "window of measurement".

### 3.4. What is an impact factor?

The *impact factor* is only one of three standardized measures created by the Institute of Scientific Information (ISI) which can be used to measure the way a journal receives citations to its articles over time. The build-up of citations tends to follow a curve like that of Fig. 10. Citations to articles published in a given year rise sharply to a peak between two and six years after publication. From this peak citations decline exponentially. The relative size of the curve (in terms of area under the line), the extent to which the peak of the curve is close to the origin, and the rate of decline of the curve. These characteristics form the basis of the ISI indicators *impact factor*, *immediacy index* and *cited half-life*.

The *impact factor* is a measure of the relative size of the citation curve in years 2 and 3. It is calculated by dividing the number of current citations a journal receives to articles published in the two previous years by the number of articles published in those same years. So, for example, the 1999 impact factor is the citations in 1999 to articles published in 1997 and 1998 divided by the number articles published in 1997 and 1998. The number that results can be thought of as the average number of citations the average article receives per annum in the two years after the publication year.

The *immediacy index* gives a measure of the skewness of the curve, that is, the extent to which the peak of the curve lies near to the origin of the graph. It is calculated by dividing the citations a journal receives in the current year by the number of articles it publishes in that year, i.e., the 1999 immediacy index is the average number of citations in 1999 to articles published in 1999. The number that results can be thought of as the initial gradient of the citation curve, a measure of how quickly items in that journal get cited upon publication.

The *cited half-life* is a measure of the rate of decline of the citation curve. It is the number of years that the number of current citations takes to decline to 50% of its initial value (the cited half-life is 6 years in the example given in Fig. 10. It is a measure of how long articles in a journal continue to be cited after publication.

It is clear that the number of citations of articles in a certain journal depends on the number of scientists working in the special field the journal covers and this is the first and most important factor for the modest size of the present impact factor of 0.429 for 2002 and for RMHM. The impact factor for 2003 is 0.509.

This most important observation of the dependence of the size of the impact factor on the scientific field is convincingly shown in Fig. 11. It is obvious that the

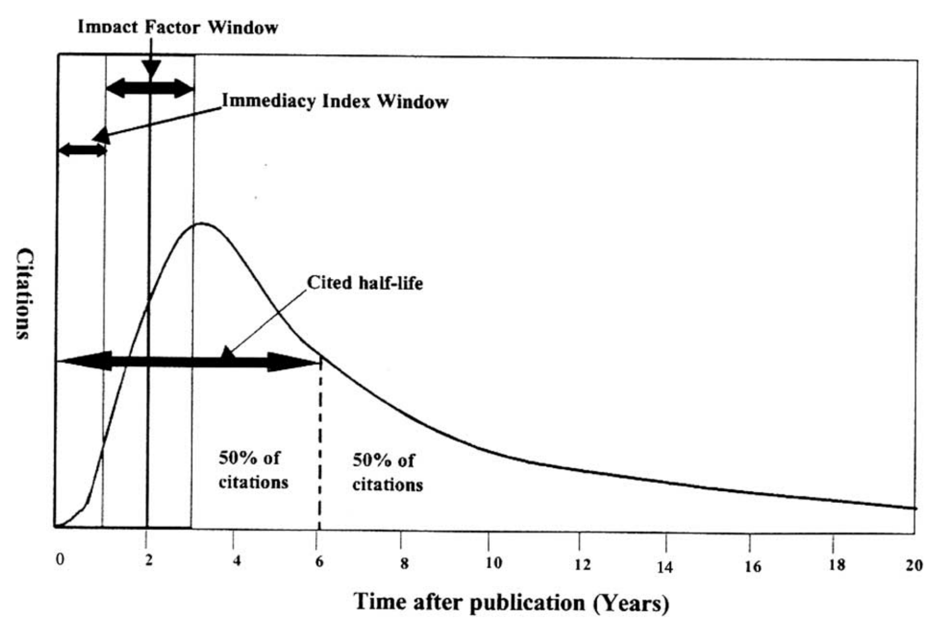



Fig. 10. Generalized citation curve.

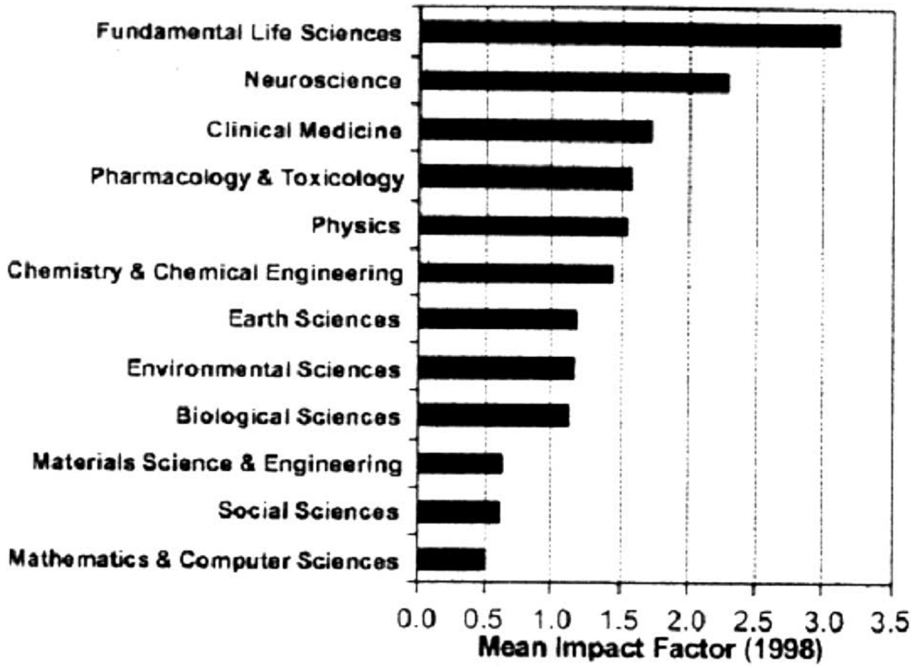



Fig. 11. Subject variation in impact factors.

absolute value of the mean impact factor exhibits significant variation according to subject field. This, however, proves the basic statement of the value of the impact factor to be wrong: ... to become the chief quantitative measure of the quality of a journal, its research papers, the researchers who wrote those papers, and even the institution they work in (see above). If this should be taken literally, it would indicate the Fundamental Life Sciences to be of dramatically better scientific quality than Materials Science or Mathematics. And this is just what happens if a basically statistical measure is taken for the definition of quality.

It is, of course, understandable that mankind is always longing for a clearly quantifiable figure of quality which is—as is impressively demonstrated by Fig. 11—simply not possible. Hence, what becomes obvious is the old fact that quality of scientific articles and of a journal in general can only be judged by insiders in the respective field after having used the journal for a certain time for their own work. Journal quality, therefore, of course is based on its refereeing system and how authors are treated by the Managing Editor and the staff of the publishing company of the journal. Hence, quality cannot be judged by a simple number but should also be judged by the experience of scientists using the respective journal for their scientific work. To relate this quality to journals in completely different fields is thus almost impossible and also unnecessary.

To further complicate matters, the impact factor is not constant over time as can be seen from Fig. 12. The figure shows the impact factor trends between RMHM and some of its main competitors. The latter were chosen by the number of times articles published in these journals were cited in RMHM up to 2002 [10].

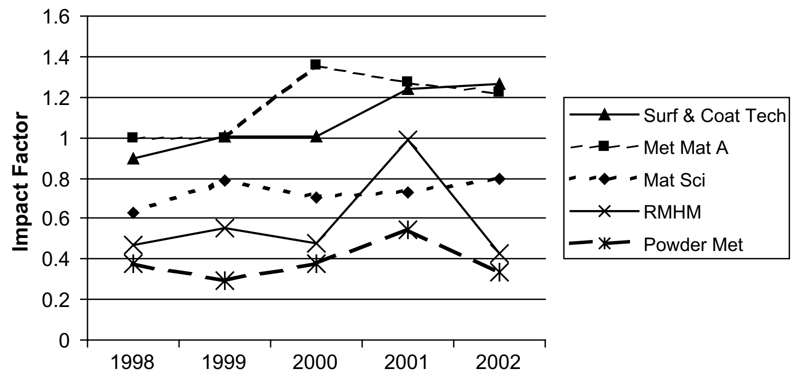
The significant peak in 2001 explains itself as follows: the number of papers published in 2001 was significantly higher due to two special issues in this year: Vol. 19, No. 1 was on the PM '99-conference "Advances in Hard Materials Production" in November 1999 in Turin, Italy.

Vol. 19, Nos. 4–6 was on the "7th Int. Conference on the Science of Hard Materials" in March 2001 in Ixtapa, Mexico.

This shows better than anything else the *statistical* nature of the impact factor: The number of papers in this year significantly exceeded the ordinary flow of papers of a year without a major conference in the field and, consequently, the impact factor jumped to 1.0. I hope you can agree that this does not necessarily mean that the quality of papers was so much better in 2001 .... And I hope you can also agree that it is not the fault of the Managing Editor that the paper flow is not constant over time.

Let us now go on with the discussion of Fig. 11.

Materials Science and Engineering ranges with the third lowest average impact factor of approximately 0.6 whereas the presently overestimated field of "Fundamental Life Sciences" leads the field with an impact factor of 3.3 [16]. This together with the journal type of RMHM publishing almost exclusively full papers and very seldom reviews or letters causes a further relatively low number of citations since understandably especially




| Acronym | *Journal Title* | *Publisher* |
|---|---|---|
| Surf & Coat Tech | Surface & C oatings Technology | Elsevier Ltd |
| Met Mat A | Metallurgical and Materials Transactions A-Physical Metallurgy and Materials Science | Minerals Metals Materials Society |
| Mat Sci | Journal of Materials Science | Kluwer Academic Publishers |
| RMHM | International Journal of Refractory Metals & Hard Materials | Elsevier Ltd. |
| Powder Met | Powder Metallurgy | Maney Publishing |

Fig. 12. Impact factor trends: comparison of the trend for RMHM and its main competitors.

reviews will be cited more frequently than full papers [16].

Hence, the impact factors are affected by a host of conditions which do not directly impinge on their principal use, a measure of the impact of publishing in a particular journal. The use of journal impact factors for evaluating individual scientists (by the impact factors of the journals he or she publishes in) is even more dubious, given the statistical and sociological variability in journal impact factors.

It is the same dilemma as all the different procedures to arrive at an objective means (!!!) of comparing the efficiency and quality of the departments and the faculties of a university. I myself consider it hopeless to arrive at a just and *objective* measure to do this. However, such dubious systems are in use today in steeply rising numbers in order to arrive at "justified" systems of channelling the constantly shrinking financial resources to the different working groups.

## 4. Conclusion

I would like to close with some maybe philosophical observations. The first one has to do with the frequent citations in this presentation. There is an excellent and prominent excuse for it and it stems from Ernest Hemingway:

"He who copies from another person is called a plagiarist.
He who copies from many people is called a scholar."

Hence, I very much hope that I can be considered as a scholar.

The second epigram stems from a recent article by Jean Fournet [17]:

"The magic of time will give a new patina to the past.
Tomorrow, the innovations of today will take on the charm of nostalgia."

This can be considered as a parallel observation to the very famous words of Heraklit some 2500 years ago:

"Panta rhei" (Everything flows on)

It is a warning for our proud accomplishments in science and technology. All too quick a sparkling new car model, e.g. from Mercedes, will ultimately land as an interesting object of past times in the museum—at best.

## Acknowledgement

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## Appendix A. Essential e-mail addresses

Since it is nowadays possible to submit manuscripts electronically as well as to obtain information on the status of a submitted manuscript I consider it useful to present the most important web addresses in the following:

Elsevier homepage: http://www.elsevier.com

Information on the International Journal of Refractory Metals and Hard Materials: http://www.elsevier.com/locate/ijrmhm

Instructions to Authors are available at: http://www.elsevier.com/journal/ijrmhm

Author gateway: The Author Gateway is Elsevier's online tool for authors. It provides an integrated website, allowing authors to track their article, to submit online for journals in the Elsevier Editorial System, as well as stay informed of new journal content and books from Elsevier: http://www.authors.elsevier.com/

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