Acta Applicandae Mathematicae **26**: 87 - 102, 1992

Idiosyncratic Remarks by a Bibliomaniac: 6. Classics, Masters, and Handbooks[1]

MICHIEL HAZEWINKEL
CWI, PO Box 4079, 1009AB Amsterdam, The Netherlands

The halflife of a mathematical text tends to be longer than that of a text in the sciences. This appears to be the case both for intrinsic reasons: mathematics is more cumulative in nature, and reasons of contemporary culture: theoretical physics, for example, seems to suffer much more from fashion and bandwagon effects, and in the more experimental sciences there are of course definite and valid reasons for wanting to be aware of the newest and latest. There is a concomitant over-emphasis on new discoveries. Apparently, as far as, for instance, the funding agencies are concerned, it is far better to make a quick, hasty, but new, epsilon discovery in some currently fashionable field, destined to be superseded in a few months, than to put together a major work of synthesis of known but scattered or inaccessible material. Research is funded; scholarship is not.

Not that mathematics is free from fashions and bandwagons; far from it. Indeed, it seems to be a (unique and unhealthy?) trait of our Western culture to have idols and heros and large changes in opinions, judgements, and behaviour patterns. Excessive communication and exaggerated veneration of the 'masters' can blow fledgling creative ideas right out of your head. Not that there aren't 'masters' and 'giants' in the sciences and mathematics; of course there are, but we seem to be overdoing the attention we pay them, and not nearly all branded 'master' by some of our more peculiar institutions, such as prizes, deserve the label and subsequent influence.

The prize-giving system is a major culprit; it should be abolished and the funds used for more interesting purposes in science. The difference between a Nobel or Fields laureate and someone who just failed to get the prize, if it can be measured at all, is like a random variable and can be as easily negative as positive; the difference in influence and authority deriving from the prize, on the other hand, is out of all proportion.

But I digress. There is much more to say, but I will leave that to a future column (if ever). The topic today is classics, and masters, and handbooks: books and authors in mathematics with an influence and time interval of relevance far above the average (and rightly so). Let me start by listing some classics.

---

[1] Previous instalments of this column can be found in the issues **1**:3, **7**:3, **10**:3 (by Ian Stewart), **11**:3 (by Bob Hermann), **13**:2. The opinions expressed in this column are those of the author and need not coincide with those of the publisher.

A Zygmund, Trigonometric series, second edition, volumes one and two combined, Cambridge University Press, £25.00, paperback, 383 + 364 pages, 1988.

G Hardy, J E Littlewood, G Pólya, Inequalities, second edition, Cambridge University Press, £12.50, paperback, 324 pages, 1988.

Sir Arthur Eddington, Space, time, and gravitation, Cambridge University Press, reprint, paperback, £8.95, 218 pages, 1987.

Norbert Wiener, The Fourier integral and certain of its applications, Cambridge University Press, reprint, £9.95, paperback, 210 pages.

All four are without a doubt 'classics' within the most rigorous meaning of the term, written by masters in their profession. Abel once recommended to read and study the masters themselves, instead of derived material. Certainly there is much to be said for that: force of ideas, originality, clarity of expositions. Assuming of course that those are present, which is not always the case. Sometimes, for instance, the master perceives something totally new dimly, and it will be the subsequent task of the journeymen, so to speak, to clarify, amplify, and elucidate. Much that was incredibly convoluted in its original form has become crystal clear much later through the cumulative efforts of many contributors. Mathematics does not only progress by flashes of genius; indeed, that part is percentagewise minor and without the steady plugging away by the legions there would be little material for genius to work on. Thus the original sources are by no means always the best; it all depends on what one needs. But the classics are nearly always worth their price.

It is an interesting decision to have to make: buy a true comprehensive classic like the book by Zygmund above at £25.00, or a slick modern treatise covering much less, but up to date in what it covers, at £80.00 or so. Most of the time the classic would seem to be better value for money, and publishers have recently started to realise that. Thus Cambridge University Press has started a systematic program of reissuing their classics. The four above are examples; there are many more. Other publishers have not been slow to realize the potential; for instance Addison-Wesley and Wiley; but, though laudable, their efforts suffer by the fact that they do not (yet) really have enough material, enough tradition to make it really work.

Thus the Addison-Wesley classics series contains a reprint of R F Streater, A S Wightman, PCT, spin, statistics, and all that (originally published by Benjamin, 1964), which certainly qualifies; but what about M F Atiyah, K-theory. Well, maybe. It was (and is) a very valuable set of lecture notes; but still a set of lecture notes and one has to enlarge the idea of a classic a bit to encompass these.

The Wiley classics library (largely based on what was once Interscience) contains a

paperback reprint of the magnificent three volume treatise by Dunford and Schwartz on Linear operators, most definitely a true classic; but can the same be said for the first volume of Peter Henrici's Applied and computational complex analysis, valuable though it is; and of Curtis and Reiner, Representation theory of finite groups and associative algebras, given the fact that a more complete and up to date two volume treatment is now available; of Richard Courant's two volume Differential and integral calculus? I confess to some misgivings; they don't all seem to fit together.

Be that as it may, all the books I just mentioned of Addison-Wesley, Cambridge University Press, and Wiley are valuable and at their 'classic reissue' prices very much worth purchasing. They are worth perusing, as generations before us have acknowledged, and, as J Ruskin remarked: "If a book is worth reading, it is worth purchasing". Moreover, present salaries being what they are, the time-wise investment in reading a book (let alone copying) is rather more substantial than its price (even at today's high prices of scientific literature).

The publishers who were wise enough to start this reissuing of classics will have their extra profit. And they will need it. For in spite of the prices that every one, rightly, complains about, scientific publishing is an increasingly marginal business; they are involved in a downwards spiral of increasing prices and diminishing sales that could easily lead to the same fate as overtook the planet Frogstar B, which disappeared down the shoe event horizon.

Let me return, briefly, to the four books listed above, which were sent to this journal for review. There are many different class of classics, and here are already four different kinds.

The first one, by Zygmund, is the near complete treatment at the time, 1935, of a subject that was already mature then, by a master in the subject, combining scholarship and research to the highest degree. Much has happened since in the field, but no comparable book has been written in it. Incidentally, for those, not a few certainly, for whom the work of Zygmund is a source and inspiration, his selected works have been published a few years ago. (Selected papers of A Zygmund, 3 volumes, KAP, 1456 pp in total, 1989, NGL 716.)

The second one by Hardy, Littlewood and Pólya on Inequalities is a classic no doubt. But different. Inequalities are important, and were at the time, but there was little systematic about it. The field illustrates quite well the dangers of research while neglecting scholarship and the kind of systematics that made Linnaeus, justly, famous. The book was a first attempt to give at least a fairly comprehensive collection, and it remains valuable today. A beginning of systematics in equalities seems to be emerging only recently, see for instance several treatises by Mitrinovic and others published in recent years (notably,

Inequalities involving integrals and derivatives of functions, KAP, 1991, the first of a three volume series).

The third one, by Arthur Eddington, has influenced generations. Is it the best introduction to relativity? I do not know. But I am one of those who read it at an influential age. A classic without a doubt, but not really mathematical enough for a real mathematician. But then, it was not aimed at that particular subpopulation.

The fourth, by Norbert Wiener, is yet again different. The work of a master who saw new things. Are there better treatises on some of these 'certain applications'? In my opinion, most certainly. Cf for instance Dym - McKean. But the original has value, a great deal, but it is not for Reader's Digest fans.

All in all, my opinion on the four books listed is as follows. If you still have a few pounds to spare, or a silver cigarette lighter or similar superfluous gadget to hock, invest in these books; if you will actually read them you will have had a bargain, if you don't, at least you will have rid yourself of some distinctly smelly things.

To conclude my remarks on these four classics, let me remark that two of them have seen earlier large print-run reissues. The book by Norbert Wiener appeared as a Dover reprint in 1968 at the mouth-watering price of $1.50, and the book by Eddington saw an American reprinting as a Harper Torch book in 1959 at $6.10. It testifies to the commercial strength of 'classics' that it is already now, more precisely 1987, 1988, sound business to issue them once again.

There are classics in many forms and shapes. Above I have discussed some classic monographs. Perhaps even more purely classic are the original papers by the masters in our subject. So next I intend to say some things about a number of collected and selected works. It is a characteristic of a master that his collected or selected works, the latter is preferable, tend to get published. The reverse is most emphatically not true. Sometimes this happens even during his lifetime, which has advantages when selection and/or comments are called for — always desirable if possible — but which does give both author and reader a slightly odd feeling. One would think that this is one more symptom and characteristic of this rushing, nonreflective age. But, in fact, this is not the case. The same thing happened to Arthur Cayley some hundred years ago. And indeed, a still living author can be invaluable. The comments by Julian Schwinger to his selected papers (KAP, 1979) are delightful and of great value; so are the remarks by Sir Michael Atiyah in his collected works; it is a pity that in the latter case, the author did not also do some careful and critical selecting (but this may easily have been caused by pressure from the publisher; publishers like 'complete things', and so do libraries; one of those perfect understandings which may yet ruin the scientific publishing enterprise; the mutual love of journals as opposed to

proceedings and monographs is contributing significantly to the same possible demise).

Here are the collected or selected works that have been submitted for review to this journal, that I intend to discuss briefly in this column, and that have also served as stimulus for the more general remarks below and above.

Sir Michael Atiyah, Collected works, five volumes, Oxford University Press, 1988. Vol. 1: Early papers; general papers, 364 pp, £30.00; Vol. 2: K-theory, 829 pp, £45.00; Vol. 3: Index theory 1, 593 pp, £40.00; Vol. 4: Index theory 2, 637 pp, £40.00; Vol. 5: Gauge theories, 685 pp, £45.00.

Kurt Gödel, Collected works, two volumes, Oxford University Press. Vol. 1: Publications 1929 - 1936, published in 1986, 474 pp; Vol. 2: Publications 1938 - 1974, published in 1990, 407 pp.

Shing-Shen Chern, Selected papers, four volumes, Springer. Vol. 1: 476 pp, 1978; Vol. 2: 444 pp, 1989; Vol. 3: 504 pp, 1989; Vol. 4, 1989, 462 pp.

A N Kolmogorov, Selected works, Kluwer Academic Publishers. Vol. 1: Mathematics and mechanics (ed. by V M Tikhomirov), 551 pp, 1991, NGL 360.00; Vol. 2, Probability theory and statistics (ed. by A N Shiryayev), 597 pp, 1992, NGL 360.00.

Hassler Whitney, Collected papers (edited by J Eells and D Toledo), Birkhäuser, 1992; Vol. I, 598 pp, DM 208.00; Vol. II, 554 pp, DM 208.00; price for the set of 2 volumes: DM 378.

Actually, the first volumes of the Gödel and Chern selected/collected works were not sent to this journal for review; those two I purchased myself; in one case quite a while ago.

In fact the first Chern volume was published in 1978 and at that time clearly no more was envisaged (correspondingly, there is no volume 1 designation). Thus volume 1 can be regarded as some sort of superselection (up to 1978). Since then either the status of Chern has gone up fourfold (unlikely it would seem; it was already quite high enough at that time), or the publisher decided that there is money in collected/selected works; as, indeed, there is. Besides the papers themselves, the Chern volumes contain a summary of Chern's life and work by Chern himself (in volume 1 and 2, the latter an updated version of the first, and in volume 1 appreciations by André Weil and Philip Griffiths). As is the case with virtually all of the 'blue series' of Springer, purchasing the Chern volumes is an excellent idea for library and individual alike. For the latter even more for he is unlikely to have all the original papers readily available. If your budget is really tight buy only the first volume, but be aware that you are missing rather a lot including some rather important post

1978 papers such as the ones on webs (with Philip Griffiths) which revived that then almost dormant subject. (At that time, as far as I know, the only activity left in webs was in the Soviet Union: M A Akivis, V V Goldberg and colleagues, who, ignored by the West, quietly and powerfully developed the subject further).

The Kolmogorov selected works project by Kluwer Academic Publishers is not yet finished. Volume 3 (Information theory and the theory of algorithms) is scheduled for 1992. Eventually there may also be a volume 4 and 5 on Kolmogorov's more philosophical and educational contributions (which were considerable); negotiations are going on.

These three first volumes are far more than just selected works of Kolmogorov; in addition they contain about 25% of additional material in the form of comments and supplements by eminent mathematicians, often students and colleagues of Kolmogorov. This material varies from comments around the origin of the papers and remarks on what were considered the important questions at the time, to discussions of what has happened since with Kolmogorov's ideas, and to what major developments his investigations have given birth. There is no doubt that Andrei Kolmogorov was one of the very greatest mathematicians of this century. According to many, myself included, the greatest. All this makes these two volumes (and the forthcoming third) very much worth purchasing. All the more so because even a first class library is unlikely to have all the original material available; it is widely scattered, and much of it has not been available in English before.

But the price is high, excessively so. Current expected library sales can explain but not excuse this. The present pretty universal policy is to aim at a modest, say 600, reasonably quick library sale, to get costs back in a year or so; after that the volume can be reprinted and a much more reasonably priced paperback can be issued for the individual market. This may anger an occasional buyer who purchased the original, but, as libraries do not like paperbound books, these are few, and on the whole, this is not such a bad strategy.

Still, in the present case, maybe this universal strategy should not have been applied. As a colleague remarked: in the case of Kolmogorov, given anything like a decent price something like half the active mathematical population in the more affluent countries would want to own these volumes. That makes some 21 000 potential individual sales, versus some 1200 (and shrinking) potential library sales. What should one aim at?

The two volumes of collected works of Gödel are rightly labelled 'Published works'. There is a great deal more of unpublished material, and we are promised selections from that in the future. If that is handled with the same care as the two present volumes the editors and publisher will have done a job for which we should all be thankful.

According to Hao Wang, Gödel has been the only one during the past century who has done truly fundamental work in science and has produced a set of philosophical reflections that is exceptionally precise and deep. What more is there to say? The two

volumes are very well produced; besides the papers by Gödel himself, there are introductory notes by eminent scientists; the price is reasonable (even if I can't find the exact amounts); the only advice I can give is: purchase! (If necessary give up drinking and smoking for a while; this material is as absorbing, but, be warned, could also prove addictive.) And while you are at it, maybe purchase a copy of the extremely interesting biography by Hao Wang as well:

Hao Wang, Kurt Gödel, Armand Colin, 1990, 352 pp, 175 FF.

This is the translation into French of the book originally published by MIT Press in 1987 under the title "Reflections on Kurt Gödel" and reprinted in 1988. These mere statistics already say a great deal; indeed, enough.

In the case of Sir Michael F Atiyah, the publisher has decided to group the collected works by subject (more or less). The idea was that then the individual volumes would also be attractive to the buying public. A most sensible decision in my view. And it works. I talked to one of the persons involved, and indeed there are quite a few single or two volume sales (and triple I would imagine, for I cannot really imagine someone buying the two volumes on index theory without the volume on K-theory as well).

These are collected works, and therein lies some criticism: selected would have been better, even in the case of such an eminent mathematician as Atiyah; selected is always better.

The only real point of criticism I have also has to do with that; except I do not know at whom the criticism should really be directed. Here are the facts: in 1964 Atiyah gave a course on vectorbundles and K-theory at Harvard University. Lecture notes appeared at a price of a few dollars. (Work on the lecture notes was supported by NSF, helping to keep the price down, I suppose.) A few years later, in 1967 to be precise, the same notes were commercially published by Benjamin, and recently they were reissued by Addison-Wesley, as a classic, at a price of US$ 31.25. These same notes are also facsimile included in the volume on K-theory (the second volume of these collected works). Together with the Russian translation that makes four copies of the same material on my shelves. (I missed the Benjamin issue). Including these notes seems to me overdoing it a bit on the completeness side (even if the Addison-Wesley reissue occurred later). Also these 166 very widely spaced typed pages seriously diminish the text density in this volume. Let me hasten to add that this is the only occurrence of this type except for 70 pages of unpublished lecture notes on 'Characters of Lie groups' in volume 4.

Having said this, let me recommend to one and all to purchase as many of these excellently produced volumes as your purse can stand. But be aware that you may need a substantial part of your remaining lifetime to read and digest it all.

Hassler Whitney was a pioneer, an explorer, who liked to work in uncharted terrain. He wrote seminal papers in several areas: differentiable manifolds, singularity theory, characteristic classes, geometric integration theory, stratifications, and one paper, with the innocuous sounding title 'On the abstract properties of linear dependence' in fact started a whole new field in mathematics: matroids. As the editors write: "... his papers are as fresh today as when they were written ...". From that the editors conclude that any comments from them could only detract, and so there are none. This is a pity, for, given their enormous expertise, they could have provided some excellent insights and guidance.

If you want to see a very original mind at work these may be the volumes to peruse.

As noted above, there could be a market in collected works. Though a Springer representative denied that, when I asked. Certainly, I myself am a pushover for such volumes (and other classics). Even though prices are, by and large, not unreasonable (if you take suitable advantage of the many discount possibilities open to individual buyers), this can run into money (besides the costs of the extra room you may have to tack onto your house). At the recent AMS winter meeting, I walked away vastly content, far more than a thousand dollars poorer (Gelfan'd, H Cartan (and if you are interested in a real bargain consider the collected works of Élie Cartan, published by the CNRS, France), A Borel (but Emil Borel is infinitely less expensive), Serre, Harish-Chandra, Jacobson (published by Birkhaüser), Gödel (Oxford Univ. Press)). Does anyone know of some decently priced copies of the collected papers of von Neumann and Poincaré?

So far, I have talked about two kinds of 'longer-lifetime' mathematical books: collected/selected works and classics in the sense of books that became famous and have been reissued. Publishers, libraries, and individuals in the mathematical world seem to have a special liking for comprehensive, larger, even a bit grandiose, products; notably 'Handbooks and Encyclopaedias'. Here is a brief selection of what is currently crowding the market of this type of material

— Encyclopaedic dictionary of mathematics, MIT Press/Iwanami Shoten; some 1750 pages in total; the edition I have is from 1977; there is also a newer updated version).

— Encyclopaedia of mathematics, Kluwer Academic Publishers; some 5200 pages in 10 volumes; 8 have appeared and the remaining two are planned for this year.

— Handbook of applicable mathematics, Wiley; 9 volumes on various subjects of some 450 pages each; one of these has been sent to this journal for review and will be discussed in some more detail below.

— A growing number of Handbooks on various parts of mathematics published by North-Holland – Elsevier: Handbook of logic, the first one, which defined the whole endeavour; Handbook of set-theoretic topology; Handbook of Boolean algebras

(more about that one below); Handbook of statistics; Handbook of theoretical computer science. More are scheduled.

— Survey of applicable mathematics (by Karel Rektorys), Iliffe, 1969; a new revised and updated edition in two volumes is scheduled for 1992 (KAP).

— The EMS project of VINITI-Springer. A comprehensive collection of very long surveys and monographs aiming to cover all of mathematics. Currently some 150 volumes are in one stage or another; more are likely from what I know.

— Encyclopédie des Sciences mathématiques pures et appliquées, A reprint of the French edition of the 'Encyclopädie der mathematische Wissenschaften' (Teubner, 1903 - 1916), Jacques Gabay, 1991 - 1992. At FF 4500 this seems — I have yet to see a volume — a bargain, and potentially bad news for those antiquarian booksellers who have (parts of) the original for sale; prices for these, recently, tended to be very much higher. Note, however, that the French, annotated edition stopped in 1916 (because of the war) while the German Teubner version continued to evolve till about 1935.

All of these seem to be doing rather well or even very well. Mathematicians seem to like this kind of product. And that is understandable for it would be nice indeed, wouldn't it, to have something like an overview of the whole field? Certainly that is what makes me buy a good many of these products (or be involved in them in other ways). On the other hand I doubt whether even a small percentage of the full interconnectedness of mathematics can be captured in a usable way through print, no matter the size of the project.

Let me turn to the two handbook type products that I have in front of me for review.

W Ledermann (chief editor), Handbook of applicable mathematics, Supplement, Wiley, 479 pp, £52.50.

J Donald Monk (ed., assisted by Robert Bonnet), Handbook of Boolean algebras, 3 volumes, North - Holland, 1989, 1367 (or so) pages total, no price given.

The Wiley Handbook of applicable mathematics, consists of six 'core' volumes on Algebra, Probability, Numerical Methods, Analysis, Geometry and Combinatorics, Statistics. Actually the last two are double volumes. In addition, there is the supplement volume mentioned above. Further there are a number of 'Guidebooks', of which the first one is: D J Bartholomew, Mathematical methods in social science, published in 1981. Further guidebooks concern engineering, medicine, management, economics, human geography, and planning. From these topics it can already be inferred that this handbook series is not aimed at the professional mathematician. And indeed in the 'Editorial note' in the Bartholomew volume we read:

" The *Handbook of mathematics* is chiefly addressed to persons who have had little or no academic training in mathematics but who, perhaps at a later stage of their careers,

find it necessary to master mathematical skills that are relevant to their professional work."

The core volumes present the basic mathematics that the authors/editors felt relevant for applications, and the guide volumes are designed to give the specialists in various 'not-so-mathematical' sciences an idea of which mathematics is used when and how in that science. All in all a novel idea and a very attractive one.

How has it been carried out? Well, on the whole I would say, quite reasonably well. My evidence for this remark, however, is less than complete. For review I only received the 'Supplement volume'; I cordially invited the publisher to send the remaining core volumes, so that a good solid comprehensive reviewing job could de done (quite possibly not by the writer of the present lines); they equally cordially refused to do any such thing, on the plea that the value of book reviews decreases exponentially with time elapsed since publication; a nice standard bureaucratic self-fulfilling prophecy type piece of thinking, especially when applied to a special, presumably long-life, project that has little or no actuality component. The library of my own institute, which has one of the best mathematical libraries in Europe (and hence the world), only had one of the core volumes, the one on geometry and combinatorics. It is only by assiduous telephoning all around the country that our librarian managed to locate one, and one only, of the guidebooks. Thus, as I said, my evidence, is scanty.

The project was nicely conceived and, by and large, well carried out it seems; but sales, at least in the Netherlands, may have been less than hoped for. There is a reason for that. For I also would not recommend purchasing this set to a mathematics or exact science library. But I would recommend it, strongly, to institutes which do not really have a mathematics section, but which cannot afford to neglect the subject entirely; the whole set would then serve as a 'micro-library' for mathematics. There are of course other solutions to building such a micro-library: the Encyclopaedia of Mathematics (Kluwer Acad. Publ.) would be one. For individuals, my advice would be similar. But reaching those many, but scattered, non-mathematical institutes and individuals is a non-trivial marketing problem. Wiley offers the whole set of core volumes (7 volumes, 9 books) for £300.00, which is very reasonable and 'preiswert'; it is a mystery to me why they do not make a similar offer for the set of core volumes together with the (7) guidebooks that are so far available, at, say, £400.00.

Now let me turn to the 'Supplement' volume , the only one, that I have actually received for review.

Whether this is true or not, it makes on me the impression of something hastily thrown together when the editors/authors discovered to some dismay that there is (far) more applicable mathematics (of a reasonably elementary kind), than is in the core volumes. What else can one say of a volume with 14 chapters on seemingly randomly selected topics whose length is equally random and bears no relation, except possibly a mild inverse one, to the importance of the corresponding topic. What can one say about 24 pages on systems and control theory (with 13 of those devoted to optimal control, the

speciality of the (well known) author) compared to also 24 pages on the Catalan numbers and 23 pages on the Fibonacci numbers. True, there is more to the Fibonacci numbers than one might think at first and there are regular conferences on the subject (which the author fails to reference), but still if the subject has more than 1% of the relevance of system and control theory in terms of applicability I would be vastly surprised.

One of the most important functions of a 'handbook' at any level is to give the consultor information as to where to look for more when needed. I confess to being totally out of sympathy with an author in such a project (S Vajda), who, besides mentioning the Fibonacci Quarterly, only refers to his own book of the topic. Nor should the chief editor have tolerated that.

Here is a suggestion. Take the publisher up on his £300.00 offer for the total set of core volumes and trade the supplement volume for one or two guidebooks. By the way, there are also valuable, well written chapters in the supplement volume.

When a project is really good, as a reviewer, there is really much less to say. Such is the case with the Handbook of Boolean algebras. There is one question I would like to pose though: if the Handbook of logic has 1165 pages, the Handbook of set-theoretic topology 1273 pages, the Handbook of theoretical computer science 2269 pages (in two volumes), then how many should the Handbook of Boolean algebras have. Well, 1367 pages, it seems, in three volumes. Actually this item from the North-Holland handbook series is more an exhaustive treatise than a handbook; the first chapter equals the first volume and is a complete monograph in itself (by Sabine Koppelberg, a fact that could have been more prominently displayed). Be that as it may, if Boolean algebras are important to you, get your library to purchase this handbook (and do so yourself as well when the paperbound reprint appears). If Boolean algebras are not central to your existence, just make sure that there is some introductory text in your department library; you definitely cannot afford to neglect the subject entirely.

Let me turn to yet another type of classic, the type that I personally find the most useful (and maybe also the most valuable) of all.

Joseph P S Kung (ed.), A source book in matroid theory, Birkhäuser, 1986, 413 pp, 108 SFR.

The volume consists of several excellent 'commentary' sections by the author/editor, about 90 pages in total, which serve to introduce concepts, to provide intuition, guidelines and historical settings, and a well selected collection of the original and seminal papers on the subject of matroids. Add to that that matroids, a far reaching and very fruitful abstraction of the idea of dependence, are important, and one obtains a volume that any moderately self-respecting library should have on its shelves, and many individuals as

well. Whether matroids are indeed one of the richest and most useful ideas of our day, as Gian Carlo Rota claims in his preface, I do not know, but certainly they are important enough to merit a few judicious purchases. Given that, the present volume could well be the best choice.

V I Arnol'd, Huygens & Barrow, Newton & Hooke, Birkhäuser, 1990, 120 pp, DM 28.

A modern master discusses the work, ideas, and, to some extent, the persons, of four great masters from the seventeenth century and relates their concerns to modern ideas.

V I Arnol'd, Geometrical methods in the theory of ordinary differential equations, Springer, 2nd edition, 1988, 351 pp, DM 128.00.

The Russian original of this volume appeared in 1978 and has as title something like 'Supplementary chapters in the theory of ordinary differential equations', and there is in fact a French translation with that title (Mir, 1980, which I purchased at the time at the price of FF 53.00, somewhere in Paris). Then I saw this one announced and bought it, on the title and the author's vast reputation alone, as one so often does. I remember being quite annoyed on discovering that I had it already both in French and in Russian under a completely different title.

On the other hand, consider the publisher's dilemma. A very nice manuscript by a very famous author, which you want, rightly, to publish in your most prestigious series (giving it, incidentally, the series number 250, which I do not for a moment believe to be a fortuitous accident). You can't really publish that under the title 'Supplementary chapters ...', especially if you did not publish the English translation of the volume that it is (more or less) supplementary to (V I Arnol'd, Ordinary differential equations, Nauka, 1971; French translation: Mir, 1974; English translation: MIT Press, 1973).

And let's be fair, the new title covers the content. This is a book on geometrical methods in the theory of ordinary differential equations, and a very good one. This second edition differs from the first one (1983) by the inclusion of quite a bit of recent exciting material. The subject is alive and well and living in Moscow; the author also. So this second edition is well worth purchasing even if you have the first edition already in one of its ≥ 3 incarnations. If you do not possess one of those, you were lucky to wait, but now don't hesitate.

Armand Borel, Linear algebraic groups, 2nd enlarged edition, Springer, 1991, 288 pp, DM 98.00.

If this book is not already a classic, it is destined to become one. The original version

of this volume was published by Benjamin in 1969 (in their then very flourishing lecture notes series). It had no index and it was and is difficult to find things in it; partly because of the indifferent typography (even for something produced on a typing machine). Even so, whenever I have needed to look up something, this is the volume I went to. It is now falling apart (even though I am not a specialist in this field; however, algebraic groups play a central role in many questions). Now we have this nicely typeset, revised, expanded (mostly with material pertaining to rationality), corrected version complete with indexes. Life and Springer are indeed good to us, and, for that matter, I have no doubt that publication of this volume will be good to Springer.

P M Cohn, Algebra, Wiley; Vol. 1, 2nd edition, 1982, 410 pp; Vol. 2, 2nd edition, 1989, 428 pp, £14.95 (paperbound), £35.00 (clothbound); Vol. 3, 2nd edition, 1991, 474 pp, £55.00 (clothbound).

The first volume of this three volume set has been discussed before in this column in this journal (issue **1**:3). As I wrote at the time, algebra is rapidly becoming more important in the general scheme of things mathematical. And that means that there is great need for very good authoritative well written textbooks. Here is one.

Let me elaborate a bit. One of the current trends in mathematics is nonlinearity. Defined by a negative, this means very little. Also to do anything beyond vague generalities we shall, as mathematicians, need to find strong structures to replace 'linear'. No doubt there will be many such, appropriate to different kinds of nonlinear phenomena. Examples are Hopf algebras and R-matrices in integrable systems (soliton theory), and self-similarity in fractals and chaos. One source, and a promising one, for strong structures, supplementary to the rather fluid one of, say, a dynamical system, is algebra. Indeed there already is a strong algebraic presence in both analysis and geometry. For instance, operator algebras, symmetry structures for (systems of) differential equations, and the role of irreducible representations of simple Lie algebras and groups in particle physics: an elementary particle is an irreducible representations I have still more reasons to be optimistic about the future growth of algebra; for instance its coming role as a structure, a notation system if you will, to keep track of increasingly elaborate (symbolic) computational processes. Also there are more kinds of 'regularity' than can be covered by the idea of symmetry.[2]

In order to have something of an idea of what is being discussed, let me give the list of chapters headings of the three volumes.

— Vol. 1: Sets and mappings, Integers and rational numbers, Groups, Vectorspaces and linear mappings, Linear equations, Rings and fields, Determinants, Quadratic forms,

[2] More remarks on these points can be found in M Hazewinkel, *Applied algebra*, preprint, CWI, Amsterdam, 1991.

Further group theory, Rings and modules, Normal forms of matrices.

— Vol. 2: Sets, Lattices, Field theory, Modules, Rings and algebras, Quadratic forms and ordered fields, Representation theory of finite groups, Valuation theory, Commutative rings, Coding theory, Languages and automata.

— Vol. 3: Universal algebra, Multilinear algebra, Homological algebra, Further group theory, Further field theory, Algebras, Central simple algebras, Quadratic forms and ordered fields, Noetherian rings and polynomial identities, Rings without finiteness assumptions, Skew fields.

Very complete and far ranging. Quite a bit different from the previous textbook classic in algebra: Nathan Jacobson, Lectures in abstract algebra, also three volumes, van Nostrand, 1951 - 1964. This illustrates how much more algebra the modern well trained mathematician should (ideally) know compared with just a score of years ago.

The subject has come of age. And that brings me to the only bit of criticism I really have. We are dealing with a sophisticated, well developed, mature topic. Should then the major multi-volume textbook on the topic include such elementary material as: Sets and mappings, Integers and rational numbers, Vectorspaces and linear mappings, Linear equations, Determinants. I think not. There simply is too much of a difference in level and flavour between these high-school/first-year-college topics and, say, central simple algebras. Not that the author does not deal well and economically with these topics. He does, and rereading these sections these days, I get the feeling that he enjoyed writing this material.

At this time, for me, these three volumes constitute the current classic basic textbook in algebra.

To conclude this already overlong column, let me devote a few lines to two books, by and about a unique mathematician of this century: S M Ulam, 1909 - 1984.

N C Cooper (ed.), From cardinals to chaos, Cambridge University Press, 1989, 320 pp, US$ 75.00 (hardbound), US$ 25.00 (paperbound).

S M Ulam, Science computers and people. From the tree of mathematics, Birkhaüser, 1986, 264 pp, SFR 74.00.

The first of these two books has the explanatory subtitle 'Reflections on the life and legacy of Stanislaw Ulam', and was first issued as a Los Alamos science special issue, in 1987. The subtitle of the second book, a collection of essays, strikes me as curious: I doubt very much that Stan Ulam saw mathematics as a tree, except maybe as the tree of life from which he derived a lifetime of stimulation and nourishment.

To decide whether you would like to read in these two books, I invite you to contemplate the following two quotes from Stan Ulam.

" Mathematics will change. Instead of precise theorems, of which there are now millions, we will have, fifty years from now, general theories and vague guidelines, and the individual proofs will be worked out by graduate students or by computers.

Mathematicians fool themselves when they think that the purpose of mathematics is to prove theorems, without regard to the broader impact of mathematical results. Isn't it strange?"

" Just as animals play when they are young, in preparation for situations arising later in their lives, it may be that mathematics is to a large extent a collection of games ... ."

The reader will have no difficulty in completing — in one of several possible ways — the second quote above: we are after all, hopefully, given the amount of folly daily presented in the news, in many ways a young civilization and species.

Whether you think Ulam is right or not — I personally do think he is right — if these two quotes appeal to you in some way, you will enjoy and profit from these two books; if not, you probably still will, for Ulam was a many-sided and far from consistent personality. The second book above abounds in praise for him; possibly too much so, and I can but little add to that from personal observation. I had lunch with him a few times in 1976 and the main impression that remains is that of a large, awe inspiring mind, which left unusually large tips.

If, as seems likely, after perusing the two volumes listed above, you want to know more about the man and his work, which ranged from logic to atom bombs, from cardinals to integrable systems, with biology and chaos somewhere in the middle, here are some sources:

S M Ulam, Adventures of a mathematician, Scribners, 1976, US$ 14.95, 317 pp, his very readable autobiography; S M Ulam, Problems in modern mathematics, Wiley, 1964, 150 pp, US$ 1.95 (paperbound), very much a classic, yet again a different kind; M Kac, S M Ulam, Mathematics and logic, F A Praeger, 1968, 170pp, US$ 5.95, originally written as a long article for an Encyclopaedia Britannica *perspectives* volume; and, an absolute bargain, also at the time, S M Ulam, Sets, numbers, and universes. The selected papers, MIT Press, 1974, 709pp, US$ 25.00. This last book appeared in the MIT Press series 'Mathematicians of our time', an admirable initiative which seems to be no longer actively around.

As in many longer book reviews, there are various complaints about prices above. And prices are high, certainly. Still they appear to me less inflated than the costs of advanced instruments in the physical, chemical, medical, ... sciences, and, quite frankly,

than the cost of hiring a big shot. A truly good mathematical library can be maintained for something like US$ 250 000 a year. So reflect what is more important for your department: an outstanding library or two big names. And while you are at it, are journals really so much more important than monographs that some 90% of the budget should go that way? I doubt it, and it seems time the matter is investigated; a most suitable task for the AMS or, perhaps even more so (if they quickly want to do something valuable), the new EMS (European Mathematical Society). Personally I spend much more time with advanced monographs and proceedings than with journals. But as long as your librarian believes that journals are overwhelmingly more important, the money will be spend on them; publishers will start more journals, and yet another down spiral starts which will land the whole scientific publishing business down a big red hole.