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WILL PHYSICS PUBLISHING SURVIVE THE ELECTRONIC CHALLENGE?

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The influence of the new electronic possibilities on scientific publishing is an important feature for everybody dealing with scientific information. In order to get a deeper understanding of the different aspects, an overview of the craft of publishing will be given, followed by a discussion on the needs for scientific information. By analysing the functions of the publisher and by reviewing the different technical possibilities, it will be shown that the electronic challenge can only enhance the role of the publisher.

1. What is scientific journal publishing

Before assessing the impact of computers and electronic techniques in general on scientific publishing, I will begin by overviewing the craft of publishing itself. For convenience I will limit myself to the publishing of primary scientific journals, in particular in physics.

In order to grasp a clear understanding of what electronic tools can do for scientific publishing, I will first dwell on a description of the actual state of scientific publishing. The situation in the scientific journal publishing world is completely different compared to any other branch of publishing.

First of all, we have the unique situation that authors and readers form by and large one and the same group. Writing articles is a way of communicating activities to people who are active in the same field and who communicate back through the same medium. Therefore, in contrast to journals like Times or Playboy where many millions look at the creative results of a few, in scientific publications a few individuals look at the creative work of all the other individuals in a particular field. Let me mention a few figures to illustrate this. For large society publishers like the American Institute of Physics who publishes journals with a low membership subscription rate, the printruns of their top journals are only between 5000 and 10000 copies, despite the fact that in the US, members of societies do subscribe to the main journals of that society, which as a rule is not the case in Europe. An average scientific journal has a printrun of between several hundreds and a few thousand. On the other hand, the number of authors is about the same. Our very successful weekly Chemical Physics Letters for instance publishes about 1200 articles a year, while about 1500 articles are initially submitted. One has to realise that this large number of papers represents even more authors. These 1200 published short articles, called letters, make up for more than 6000 large-size printed pages a year. Of course 6000 pages is a lot, but it is not even of the size of real large journals, like Nuclear Physics, which has about 20000 pages a year. These 20000 pages contain very

This paper is in final form and no version of it will be submitted for publication elsewhere.

elaborate mathematical expressions and one can easily understand why this type of journal only ends up in libraries, where all the different authors, now in their role as reader, will sit down to browse and read. So the complete overlap of author and readership generates a special situation.

Secondly, in scientific publishing the quality control is a very unique one. A submitted article will be sent by the editor of the journal to one or more so-called referees. These are respected colleagues of the author who will read the manuscript and write a small anonymous report, which will be returned as such (or in paraphrased form) by the editor to the original author. It is the editor who, after consultation with the referees and if necessary after corrections or revisions by the author, decides whether or not the article will be published. This highly developed system of so-called peer-reviewing is the cornerstone of scientific publishing. It is for the sake of all people involved that the quality control of published material is sound. And as there are no other experts outside the closed authors–readers group the only people who are able to check manuscripts are the members of the group themselves. This system is however not an automatic process, the prestige and the quality of scientific journals are highly determined by the editorial policy, consistency and rigour.

Thirdly, scientific publishing is a very open and democratic communication channel. Only novelty and scholarship are criteria for publication. Sound manuscripts in fields which are not fashionable or even obscure have an equal opportunity of being published. The same holds for unknown authors. In principle it is not the name but the actual result of the research that counts. The scientific journal therefore is a source of various kinds of information, always new, permanently changing in authorship and always full of interesting surprises.

Fourthly, in journal publishing only, the competition between publishers is of a special kind. As scientific articles are only published once, the competition is oriented to the authors. Having the best authors in your journals is the most important feature. The competition on the sales side depends on the product which can be sold, the better the quality of your authors, the better the sales.

This kind of scientific journal publishing is called primary publishing because the fresh results of research endeavours are presented. The second step in the dissemination process of scientific information, the production of bibliographic indexes, like Physics Abstracts or Chemical Abstracts is therefore called secondary publishing. To make the series complete, the publishing of comprehensive books, which collect and digest all the research information after some time is sometimes called tertiary publishing.

Besides the researchers, other people also use the published information, e.g. funding organisations, government agencies who follow education and research, industries, etc. As many of the needs of these users overlap, I will identify the main requirements for scientific information as the next step in the analysis of possible new developments.

2. The need for scientific information

Publishing scientific journals is a reflection of the demands of the scientific community and all those groups in society who rely on or use scientific publications. Not all the demands of the different groups overlap. For the sake of clarity I will list some major needs of the different parties involved.

(1) Reliability: The most important feature of information for all users is the reliability of it. This element has different components. Firstly, the data-integrity of numbers (and spelling); secondly, the correctness and completeness of the bibliography; and thirdly, the most important aspect: the scientific standard of the material. The quality control is the predominant aspect of scientific publishing and concerns all users.

(2) Retrievability: The possibility of finding a particular document, or the articles of a particular author, or articles on a defined subject is also a key demand for all users of scientific information.

(3) Availability: As a consequence of the need to search for information one also wants to see it. The actual availability is however not equally important for all users of scientific information. The question a National Science Foundation might ask, for example, if a particular person does indeed publish in a certain prestigious journal, does not imply necessarily the need for the very article itself.

(4) Awareness of new developments: For researchers as well as for all kinds of agencies and industries it is always important to know the current state of affairs in a field. Looking up published material is the easiest and most comprehensive method of learning about ongoing work.

(5) Who is doing what: In order to follow the developments in certain fields, the internationalisation or the shrinking into a local hobby of some research area is of major importance for all institutions who grant money to research groups. In order to assess their own funding program one has to rely heavily on published material.

(6) Collection formation: In order to keep track of the ongoing research and to conserve the actual information for future generations, scientific libraries badly need established scientific journals as the backbone of their collection.

(7) Applications: Thoroughly controlled scientific information is of the utmost importance for industries. Following the basic research endeavours enables them to start up development programs on new products and new applications of scientific facts.

(8) Look at me: One of the most important needs of a researcher is to let the world know what he or she has performed. Journals are a quick vehicle to serve this purpose and publishing in a prestigious journal is of major importance to the career of a scientist.

3. The role of the publisher

Taking the previously mentioned specification of demands for scientific information into account, I would like to move on to a general description of the role of the publisher within the whirlpool of information flows.

3.1. Collection of manuscripts

The acquisition or collection of manuscripts is not a simple matter of random picking. Nobody needs an unstructured collection of articles in one general mammoth journal. A scientific journal serves a defined group of users and harbours a defined and finite set of scientific topics. In the case when new fields grow out of old ones, new journals are needed or old ones have to change or adjust their scope. So the acquisition of manuscripts presupposes the existence of appropriate journals for them. It implies the creation of journals or their reshaping in the course of the developments.

Collecting manuscripts is the first step

to a comprehensive packaging of information. The fact that authors do send their articles to established journals does not contradict this feature. The very existence of the different journals, enables the authors to carefully select the appropriate journal to submitting their manuscripts. The role of the publisher is to provide these "natural outlets" and to organise them.

3.2. Quality control

The scientific quality control is normally done by editors appointed by the publisher, in most cases active leaders of a field. These editors, very often make use of advisory editorial boards and always of outside referees. The tradition of peer-reviewing is one of the most developed systems of mutual quality control science has brought forth. As was mentioned before, a precondition for a good system of scientific refereeing is the existence of a clear editorial policy and clear editorial procedures. Here also the role of the publisher is crucial. The organisation, control, upgrading and development of an editorial system is a key activity in the process of information dissemination. Within North-Holland Physics one of the major activities is the permanent discussion with editorial boards on the policy, the rejection rate, the adjustment of the scope, and the rotation of individual editors.

3.3. The processing of the material

A pile of well-refereed manuscripts on for example semiconductor physics, is still not of any value for anyone interested in this field.

The publishers office takes care of the mark up of the manuscripts, often corrects the language, checks the quality of the figures and makes everything ready for typesetting. After receiving the proofs of a paper back from the typesetter proofreading and correction take place. Although the skill of most of the technical editors in a publishing house is very high, proofreading by the author is almost always indispensible. Not only because authors can be very unclear in technical details, but also because very often authors have last-minute corrections after sending in the paper or even after the refereeing procedures. Research is on-going and therefore extra information might need to be squeezed in (fig. 1). The final typeset articles should now have a uniform reader-friendly appearance. This formalisation of the appearance of a scientific article is twofold. Within a field, some traditions of lay-out emerge as a standard (fig. 2). Within a publishing house a house style is also developed over the years. For readers this uniform style is extremely convenient and allows an easy retrieval.

After the transformation of our original pile of manuscripts into neatly typeset articles, the next step is of course the packaging of the different articles into a journal issue. This issue will then be printed and bound according to the specifications of the publisher, so that a clear system of consecutive page, issue and volume numbering makes retrieval possible.

3.4. Dissemination

A printed journal issue in the warehouse is still an unknown entity if no elaborate subscription system exists. Subscribers to these highly specialised journals are few and widely spread over the globe. Therefore the publishing industry has to have a very advanced system of subscription administration and promotion. The possibility of subscribing to a journal and the knowledge of

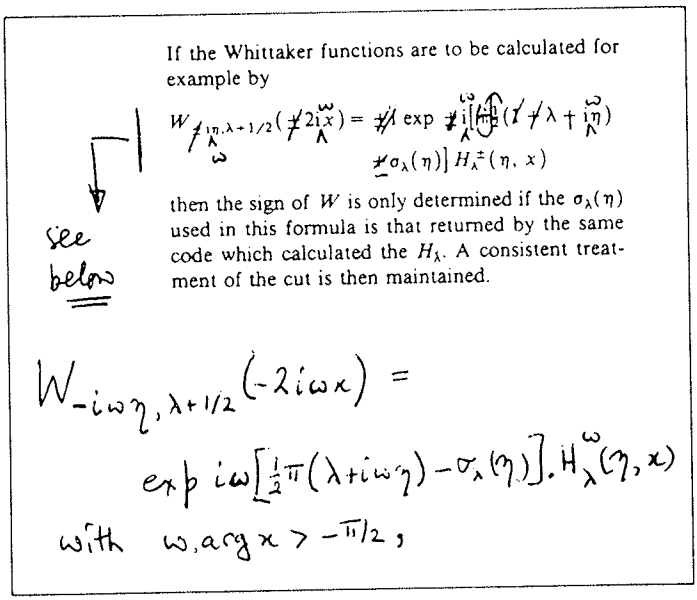
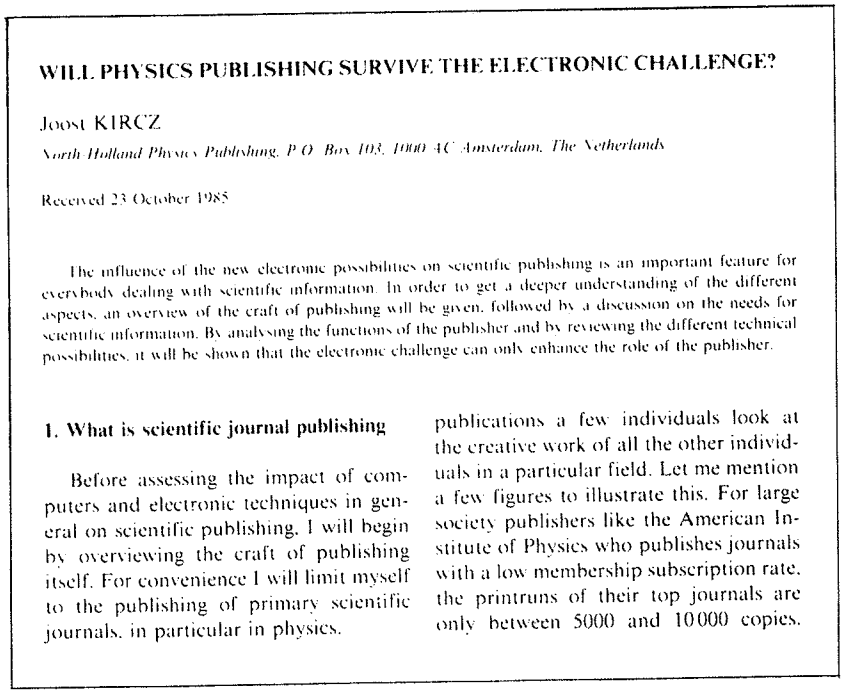


Fig. 1. Example of a major author's correction in a proof.



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publications a few individuals look at the creative work of all the other individuals in a particular field. Let me mention a few figures to illustrate this. For large society publishers like the American Institute of Physics who publishes journals with a low membership subscription rate, the printruns of their top journals are only between 5000 and 10000 copies.

Fig. 2. Typical lay-out of a North-Holland physics journal.

what is offered by subscription are two sides of the same coin. The dissemination of the final article printed in a journal issue, needs promotion as well as a worldwide distribution network. Only well-organised publishers of a critical size can develop such services.

A related point here is that the packaging of articles in a journal issue itself is of course already an important form of information dissemination. It is very obvious that the articles of the Einsteins of a generation will be read. But only the articles of the known, mature Einsteins will have that feature. The articles of the unknown, the promising or the rank and file scientist who did a nice piece of work, will simply be drowned in the avalanche of articles if they are not neatly published in a journal issue, where readers expect articles in a broad but well-defined subject area. This way people, who are not aware of the author's name, and/or the research subject can come across this piece of work. Imagine the really good article of some Jim Smith, from a small town university in Montana, which has an unclear title. In a database no one will come across it, whilst in a journal issue it has a good chance to be discovered. Browsing is still a major source of information gathering, and browsing demands a browsable medium, e.g. a journal.

3.5. Storage

The final stage in the process is the storage of the published journal issues. Publishing also means having material in stock so that even after many years, people or libraries can purchase back-issues, and back-volumes they need.

In summary, one can distinguish three major functions of a publisher: (1) The organisation and steering of the quality control of the submitted manuscripts by organising editorial structures. (2) The packaging of random information available into defined and recognisable entities, in our case journal issues. (3) The worldwide marketing, distribution and storage of all published articles.

4. What can electronic media add to publishing

I will now try to identify how the main functions of the modern publisher will be influenced by the electronic revolution, and in what way. Also novel possibilities in the art of publishing will be discussed.

4.1. Production upgrading

The first and major application of electronic tools is of course the possibility of computerised typesetting. Nowadays almost all scientific publishers have access to computerised typesetting systems. One must realise, however, that even within physics publishing hot type is still a frequently used medium. Especially in the countries of the Comecon and in Asia, hot type is still a normal mode of production. Qualitywise hot type is very good and for straight journal publishing the difference for the reader is very small (fig. 3). Apart from aspects such as the productivity of labour (the speed of typing) and the very unhealthy atmosphere of hot lead, a main reason for switching to computerised typesetting is the easiness of correction and storage. The memory feature not only enables typesetters to reduce production time. A marked up manuscript has only to be keyed in once, so the stored manuscript can be reproduced in different lay-out styles, indexes can be generated, etc.

$$S_k = \frac{c^2}{16\pi\omega}\left(E_i^{(s)*}\hat{p}_k E_i^{(s)} - E_i^{(s)*}\hat{p}_i E_k^{(s)} + \text{h.c.}\right), \tag{10}$$

where $\hat{p}_k = -i\nabla_k$.

Substituting eq. (9) into (10) we obtain after simple but cumbersome transformations,

$$\langle S_k\rangle = \frac{c^2}{8\pi\omega}\int\frac{d^2k_\parallel}{(2\pi)^2}\int dz'\int dz'' R_{ijss'}(\mathbf{k}_\parallel - \mathbf{k}_{0\parallel}, z', z'') \times E_s^{(0)}(z')E_{s'}^{(0)*}(z'')k_k d_{ij}(\mathbf{k}_\parallel, z, z')d_{ij}^*(\mathbf{k}_\parallel, z, z''), \tag{11}$$

$$R_{ijss'} = \left(\frac{\omega}{c}\right)^4 K\delta_{js}\delta_{is'} + \left(\frac{\omega}{c}\right)^2\{L_s\nabla_j\delta_{is'} + L_{s'}^*\nabla_i\delta_{js} - (L_i^*\nabla_i + L_i\nabla_i)\delta_{js}\delta_{is'}\} + M_{ii}\nabla_i\nabla_i\delta_{js}\delta_{is'} + M_{ss'}\nabla_j\nabla_j - M_{is'}\nabla_i\nabla_j\delta_{js} - M_{si}\nabla_i\nabla_j\delta_{is'},$$

$$S_k = \frac{c^2}{16\pi\omega}\left(E_i^{(s)*}\hat{p}_k E_i^{(-)} - E_i^{(-)*}\hat{p}_i E_k^{(-)} + \text{к. с.}\right), \tag{10}$$

где $\hat{p}_k = -i\nabla_k$. Подставляя (9) в (10), после несложных, но громоздких преобразований получим

$$\langle S_k\rangle = \frac{c^2}{8\pi\omega}\int\frac{d^2\mathbf{k}_\parallel}{(2\pi)^2}\int dz'\int dz'' R_{jj'ss'}(\mathbf{k}_\parallel - \mathbf{k}_{0\parallel}, z', z'') \times k_k d_{ij}(\mathbf{k}_\parallel, z, z')\, d_{ij'}^*(\mathbf{k}_\parallel, z, z'')\, E_s^{(0)}(z')\, E_{s'}^{(0)*}(z''), \tag{11}$$

где

$$R_{jj'ss'} = \left(\frac{\omega}{c}\right)^4 K\delta_{js}\delta_{j's'} + \left(\frac{\omega}{c}\right)^2\{L_s\nabla_j\delta_{j's'} + L_{s'}^*\nabla_{j'}\delta_{js} - (L_i^*\nabla_i + L_i\nabla_i)\delta_{js}\delta_{j's'}\} + M_{ii}\nabla_i\nabla_i\delta_{js}\delta_{j's'} + M_{ss'}\nabla_j\nabla_{j'} - M_{is'}\nabla_i\nabla_{j'}\delta_{js} - M_{si}\nabla_i\nabla_j\delta_{j's'};$$

Fig. 3. Example of Western computer typesetting and hot type from the Soviet Union of the same book.

Although most typesetters in the western world use computers, they only use the typesetting application, while the full potential of the computer-assisted production is hardly utilised. It is only very recently that discussions on the creation of electronic databases has begun. The fact that the same file of structured data can be used for a variety of applications is not always understood. To mention a few of these possibilities: (i) plain typesetting, (2) generation of indexes, contents lists, etc., (3) the creation of address lists of authors, (4) the creation of bibliographic and citation databases, etc.

The last point is especially interesting because the abstracting services still rekey most of the bibliographic information. They take the printed journal issue, add key-words according to their specific system, sometimes change the abstract of the article, e.g. in cases built-up mathematical formulae are present, and then retype everything. The result is that an article on some interdisciplinary subject, say advanced physical methods for tracing radio-active metals in human tissue, shows up in about 10 different abstracting systems. This means that the printed information has been retyped, proofread again, and recorrected equally as many times.

Therefore the next logical step would be integration of the typesetting in some data management, or even better, database environment. The computer enables the publisher to integrate the production of the traditional product with those techniques, which allows the application of the most advanced methods of information retrieval. Eventually in processing primary and secondary information the borders may fade away, as the secondary

information will be almost completely, automatically generated as a byproduct of the primary publishing activities.

A precondition for such a development is the standardisation of the structure and storage of information. The development of a Standard General Markup Language (SGML), which is also an important issue at this conference, is a precondition for any further steps to be taken.

4.2. Distribution and delivery upgrading

Given the subject of this conference, I will not dwell long on the possibilities of automation of administrative processes in the publishers office and in relation to third parties. I think that it is sufficient to say that a full use of automated procedures will enable the publisher to have on-line ordering, using an on-line catalogue including every gadget one can imagine. The large overlap between authors and end-users for instance creates the beautiful option of using the authors' address lists for dedicated direct mail activities.

4.3. Upgrading the logistics between all parties

An extremely valuable asset of the new technologies is the electronic mail option. Integration of the administration and files of a journal editor with the publishing house and among editors themselves will facilitate enormously the discussions on acceptance or rejection of articles, editorial changes in manuscripts, control on the manuscript traffic to and fro the authors, the editors and the publisher, etc.

As in every international enterprise, rapid telecommunications, integrated with the decentralised automated administrations of all parties involved will introduce a qualitative step forward in the mastering of the gigantic copyflow.

On the other hand, one has to realise that only about 20% of the loss of time in the publication process is due to postal delays. The major problem is the human factor, i.e. refereeing of manuscripts is a time-consuming process.

4.4. The acceptance of compuscripts

Although many people feel that the pivot for future developments in the dissemination of scientific information is electronic text processing, I do have some critical comments on this and therefore will spend some more time discussing it.

First of all, we have to realise that despite the enormous growth in the use of computers, many scientists around the world still do not use word processors and will not use them within the coming decade. Not only because they do not have access to these fancy tools, but also because even legible handwritten manuscripts are in principle just as easy for a publisher to handle as is every other system which is not compatible with the publisher's computer system. The complete lack of any standard in word-processing systems is known. As long as this problem is not solved the acceptance of compuscripts remains very problematic.

This observation brings us one of the most crucial problems in modern text-processing systems. There is a distinct difference between text-processing systems for production plants and those for individual users. For a typist a little wiggle with some strange letters on top and on bottom is easy to type as long as the icon $\int$ has a distinct code. For the researcher who types his/her own manuscript only the notion $\int_{\alpha}^{\infty}$ (integral from alpha to infinity) makes sense. The production typists will know from experi-

ence that there must be some symmetry around the wiggle and will check for that. The researcher will directly see that it is not α but 0 from where the integration starts. For a production environment where hundreds of thousands of pages are being typeset per year, every key stroke counts, while nobody will ever understand the contents of the typed material. A production key-in program must be extremely straightforward with a minimum of key strokes and is completely oriented to the coding of icons. Not the notion summation sign but the icon $\sum_{n=1}^{n=m-j}$ has to be recognised. For an author the situation is completely different. An author reads the manuscript and reads summation from n equal one to n equal m minus j. He or she does not read icons but the meaning behind it.

Therefore in production programs such as STI (North-Holland uses) the level of abstraction is very high, whereas in authors programs like TROFF, SCRIPT or TEX, one can easily read what one is typing (fig. 4). For an author reading "integral" is convenient; however, for a typist typing ten thousand times a year "*bi" instead of "integral" is much easier, less boring and less time consuming. Especially because many mathematical symbols start with "*b".

Until now no real integration of typesetting programs for production environments (with all their very specific needs) and user-friendly text processors has taken place. A real breakthrough in the

$$s(x) = (1 + \sigma)u_0 - \frac{q}{l}\left[1 + \delta b + 2\sum_{k=1}^{\infty} \frac{a_k + b \tanh \alpha_k \delta}{\alpha_k(\alpha_k^2 + b\alpha_k \tanh \alpha_k \delta + 1)} \cos \alpha_k x\right]$$

STI

```
$(s(x)=(1+*gs)u*d0_$fg$s1$t [1+*gdb+2$z*bs$sk=1$s*be$s$fa*dk+b@3t*rh*ga*dk
*gd$s*ga*dk (*ga*u2*dk+b*ga*dk@3t*rh*ga*dk*gd+1)$t @3c*ga*dkx]$)
```

EQN (IBM version)

```
:df.
    s(x) = (1 + sigma) u sub 0 - q over l %% left lb 1 + delta b + 2
          sum from <k=1> to infinity of <a sub k + b tanh alpha sub k  delta>
               over
          <alpha sub k ( alpha sub k sup 2 + b alpha sub k tanh alpha sub k
          delta + 1 ) > %% cos alpha sub k x right rb
:edf.
```

TEX

```
$$ s(x)=(1+\sigma)u_0-{q\over l}\>\left[1+\deltab+2\sum_k=1^\infty{a_k+b\tanh
    \alpha_k\delta\over\alpha_k(\alpha_k^2+b\alpha_k\tanh\alpha_k\delta+1)}
    \>\cos\alpha_kx\right]$$
```

Fig. 4. A mathematical formula with its translation into STI, EQN and TEX. Clearly visible are the different approaches of coding.

way manuscripts are submitted will happen only if it becomes possible to translate the various text-processing programs into one another.

It may be worth noting that although programs like TROFF or TEX might look very appealing, people still have to go through a very cumbersome learning process. For people who do not use these programs regularly, it is impossible to start immediately by writing the first draft of an article directly on the computer. The visibility of the formulae is a necessity in writing drafts. As long as the user programs do not directly display the final results, the author still first has to make a draft using paper and pencil in order to reprocess that on the word processor.

A second major obstacle at present is the lack of a generally accepted SGML. As long as authors have the freedom to invent their own macros, e.g. for all kinds of fancy lay-out tricks, the translation into standardised and general processable input is impossible. Automation of text processing does not mean that every author can just do what he/she wishes, that was already perfectly possible in the age of the clay tablet. Automated text processing means a stratification and organisation of the submitted text in such a way that the author has a readable copy, that it can be uploaded into a database without major conversions and that the file can be converted to appropriate typesetting and other publishing systems.

Only when the text of a compuscript can be easily uploaded into a central database, can it be sent around to editors and referees using a central electronic mail system, linked to the database. Of course the problems with figures still remain. In the case of pictures a fast facsimile transmission (of the original typed or handwritten manuscripts) is superior and faster than conversions of part of the article in standardised ASCII codes.

4.5. Enhancement of information retrieval

At present the most intriguing possibility of computer-assisted publishing is the enhancement of the retrieval of scientific information. Two related policy lines may be followed.

(a) The break up of the text file, according to a SGML, into defined fields to be loaded into a database.

(b) Scanning the complete article and storage thereof in facsimile form onto an optical disc or a compact disc.

It is clear that the first option can easily be integrated with typesetting. This will eventually lead to a technical integration of primary and secondary information generation. Making available part of the publishers database to the outside world will then create the most powerful public indexing system of published and still to be published material. In principle a researcher will then be able to trace articles from the earliest stage. An article accepted for publication which arrives at the publishers office will be administered by typing title, authors names, etc., in the publishers database, thereby making it retrievable at the same time.

The second method has of course the great advantage of having figures, linedrawings and photographs, integrated in the text. The representation of results in graphical form is crucial not only for experimental articles, but for almost every article. The decision to read a full article is earlier made by a quick glance at the pictures then by reading the abstract.

Given the actual state of technology one can imagine that an integrated system of a publishers database coupled to

an optical memory containing the full articles will lead to a really new approach for retrieval of scientific information. This kind of system is currently under investigation in the publishing industry. It will take, however, still quite some time before I can present the first successful examples to you.

Another important feature future will provide, is the possibility of changing from paper to optical discs for the dissemination of journals. A compact disc, containing some full journal issues including tables and figures, can be browsed comparably to a journal issue printed on paper. This change in carrier of the information is also a hot issue in full development.

5. What electronic media cannot do for publishing

In the previous section a series of important actual and possible improvements for the whole publishing industry were mentioned. But are all these improvements really so far reaching that the whole craft of publishing will be surpassed by a series of networks on which private people route all kinds of information to everybody?

In section 2 of this paper some essential demands with regard to scientific information are listed. Referring back to this list it becomes clear that many needs will be perfectly served by the implementation of electronic tools. Computer-assisted publishing is an enormous improvement compared to the traditional activities, with regard to retrieval, data integrity, speed of publication, editorial office operations, etc. However, crucial aspects of publishing will remain un-automatable. These are just those aspects where (like in science itself) intellectual input is the driving force.

The first problem area concerns the editorial procedures of selection and quality control. Although the sending of manuscripts to and fro editors, referees and publisher might be speeded up using facsimile machines, high-speed fibre cables or even satellite transmission, the editor and the referees have to read and examine the manuscript before a publishing decision (in any form) can be made. In the ever-increasing maelstrom of publications, scrupulous and conscientious editorial endeavours remain more than ever the cornerstone for genuine scientific communications. The use of modern techniques can facilitate the editorial tasks (the essence of the craft) but they will never replace them.

A second key feature mentioned is that the readers and authors largely form the same group. Every author has the same opportunities to be read by his colleagues in the field. The very character of a journal issue guarantees the maximum exposure for every author, for the young and unknown as well as for the established scientist. This becomes clear if we compare database searching to browsing through a journal issue. In database searching, one looks for known author names, or clusters of known keywords. This provides an intrinsic curtailing for flashes of surprise or association. Flipping the pages of a journal on the other hand offers all the flexibility one needs.

On the distribution side the packaging role of the publisher remains crucial. Although browsing is essential for scientific work, browsing at random is as useless as reading a database from a to z. So comprehensive packaging, defined by the day-to-day dynamics of the scientific developments is another feature which cannot ever be automated. As mentioned before in relation to the compact disc, not the carrier but the intellectual labour is what makes publishing it a craft.

6. Conclusions

Beginning with the demands and requirements for scientific information, I have attempted to describe the role of the publisher as an intermediary, a broker, between the supplier and end user of the information. Quality control, packaging, worldwide distribution and marketing, as well as storage are the key functions of the scientific journal publisher. These functions remain undoubtedly valid in this era of a new technological revolution. The integration of the new technologies in those parts of publishing which are ready for automation will greatly enhance the strength and dynamics of the publishing industry.

As in many industries, the electronic challenge is not a phantom nor an invading enemy, but just a fantastic option which, when properly applied, will boost the role of the scientific journal publisher as a provider of scientific information in society.

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