4. évfolyam · 11. szám · 1994. november

IMPAKT

TÉNYEK A TUDOMÁNYOS ALAPKUTATÁSRÓL

Szilárd: Csak a tényeket írom le – nem azért, hogy bárki is elolvassa,csakis a Jóisten számára.
Bethe: Nem gondolod, hogy a Jóisten ismeri a tényeket?
Szilárd: Lehet, hogy ismeri, de a tényeknek nem *ezt* a változatát.

[*Leo Szilard, His version of the Facts. S.R. Weart* & *Gertrud Weiss Szilard* (Eds), MIT Press, Cambridge, MA, 1978, p.149.]

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Chemistry in the 1990s: Active Areas Revealed

Most-Cited Papers in Chemistry, 1991-93, by Subject
(expressed in percentages)

Subject	1991 *	1992 **	1993 ***
Fullerenes and carbon tubules	46	42	63
Surface chemistry and semiconductors	9	12	0
Organic and asymmetric synthesis	9	11	6
Theory, theoretical and computational	9	9	0
Natural and biologically active products	8	6	13
Organometallic chemistry	5	4	0
Analysis techniques	5	3	13
Molecular recognition and self-assembly	4	3	0
Polymers	3	0	0
Proteins	2	5	0
Others	1	4	6

* papers attracting 50 or more citations; n = 131
** papers attracting 25 or more citations; n = 125
*** papers attracting 10 or more citations; n = 16
SOURCE: ISI's Science Indicators Database, 1991-93.

Government agencies need an objective assessment of the scientists and the research that they are expected to fund. So do independent or charity-based research institutes, whose trustees must also monitor closely what their staff is achieving. And so does industry — although people there are often better placed to understand what is going on, whom to sponsor, and what the return on the investment will be.

The *Science Citation Index* (*SCI*) provides one means of objective assessment. The *SCI* logs every new paper as it appears and subsequently records its citation by other researchers. In general the more a paper is cited, the more important that piece of work is.

It is part of my role as Science Writer in Residence at Imperial College to keep in touch with the active areas of my subject, chemistry. If I were asked to indicate the most interesting areas at the moment I would say: asymmetric synthesis, surface chemistry, new materials, molecular recognition, self replication, catalysis, analysis, and molecular modeling. I would also include fullerenes (sometimes called the buckminsterfullerenes, after the American architect), the best example of which is the C_{60} carbon soccer/football molecule — but I would not give them undue emphasis.

When I spoke to the editors of *Science Watch* and asked if there was any way of confirming my intuitive choices, they offered to carry out a three-year analysis of chemistry papers and their citations. There duly arrived a complete printout of all chemistry papers published for the years 1991, 1992, and 1993, which had collected 10 or more citations.

(Continued on next page)

What was I to make of this raw data? There were thousands of papers, but relatively few that were highly cited. The top-cited papers for 1991, 1992, and 1993 are shown in the table on this page. Of these, 29 had attracted more than 100 citations, and all these were published in 1991, as we might expect. Most are about fullerene chemistry — see below. Discovered in the mid-1980s, fullerenes immediately seized the imagination of chemists in all branches of the subject: organic, inorganic, physical, and theoretical.

A more detailed analysis of the papers of each year is needed to eliminate these distorting factors. I chose a progressively less demanding cut-off point for each year: 50 citations or more for 1991 papers; 25 or more for 1992 papers; and 10 for 1993 papers. I then grouped them under several headings, and this breakdown is given in the table on page 1. It still gives too much prominence to the fullerenes in all these years, but at least we get a broader overall picture of other areas.

The most-Cited Chemistry Papers of 1991, 1992, and 1993

Rank	1991	Total Cites
1	**P.J. Kraulis**, Molscript: a program to produce both detailed and schematic plots of protein structures, *J. Appl. Cryst.*, 24:946-50, 1991. [Uppsala Univ. Sweden]	280
2	**R.C. Haddon, A.F. Hepard, M.J. Rosseinsky, D.W. Murphy, S.J. Duclos, K.B. Lyons, B. Miller, J.M. Rosamillia, R.M. Fleming, A.R. Kortan, S.H. Glarum, A.V. Makhija, A.J. Muller, R.H. Eick, S.M. Zahurak, R. Tycko, G. Dabbagh, F.A. Theil**, Conducting films of C_{60} and C_{70} by alkali-metal doping, *Nature*, 350(6316):320-2, 1991. [AT&T Bell Labs, Murray Hill, N.J.]	280
3	**K. Holczer, O. Klein, S.M. Huang, R.B. Kaner, K.J. Fu, R.L. Whetten, F. Diederich**, Alkali-fulleride superconductors: Synthesis, composition, and diamegnetic shielding, *Science*, 252(5009):1154-7, 1991. [Univ. Calif., Los Angeles]	279
4	**J.M. Hawkins, A. Meyer, T.A. Lewis, S. Loren, F.J. Hollander**, Crystal Structure os osmylated C_{60}: Confirmation of the soccer ball framework, *Science*, 252(5003):312-3, 1991. [Univ. Calif., Berkeley]	229
5	**K.W. Kroto, A.W. Allaf, S.P. Balm**, C_{60}: Buckminsterfullerene, *Chem. Rev.*, 91(6):1213-35, 1991. [U. Sussex, Brighton, U.K.]	222
	1992	
1	**K.M. Creegan, J.L. Robbins, W.K. Robbins, J.M. Millar, R.D. Sherwood, P.J. Tindall, D.M. Cox, A.B. Smith, J.P. McCauley, D.R. Jones, R.T. Gallagher**, Synthesis and characterization of $C_{60}O$, the first fullerene epoxide, *J. Amer. Chem. Soc.*, 114(3):1103-5, 1992. [Exxon, Annandale, N.J.; Univ. Penna., Philadelphia]	95
2	**F. Wudl**, The chemical properties of buckminsterfullerene C_{60} and the birth and infancy of fulleroids, *Acc. Chem. Res.*, 25(3):157-61, 1992. [Inst. Polymers & Solids, Univ. Calif., Santa Barbara]	74
3	**K.B. Sharpless, W. Amberg, Y.L. Bennani, G.A. Crispino, J. Hartung, K.S. Jeong, H.L. Kwong, K. Morikawa, Z.W. Wang, D.Q. Xu, X.L. Zhang**, The osmium-catalyzed asymmetric dihydroxylation: a new ligand class and process improvement, *J. Org. Chem.*, 57(10):2768-71, 1992. [Scripps Res. Inst., La Jolla, Calif.]	72
4	**T.W. Ebbesen, P.M. Ajayan**, Large scale synthesis of carbon nanotubes, *Nature*, 358(6383):220-2, 1992. [NEC Corp., Tsukuba, Japan]	71
5	**K. Kikuchi, N. Nakahara, T. Wakabayashi, S. Suzuki, S. Shiromaru, Y. Miyake, K. Saito, I. Ikemoto, M. Kainosho, Y. Achiba**, NMR characterization of isomers of C_{78}, C_{82} and C_{84} fullerenes, *Nature*, 354 (6374):142-5, 1992. [Tokyo Metropolitan Univ., Japan]	70
	1993	
1	**Y. Rubin, S. Khan, D.I. Feedberg, C. Yeretzian**, Synthesis and X-ray structure of a Diels-Alder adduct of C_{60}, *J. Amer. Chem. Soc.*, 115(1):344-5, 1993. [Univ. Calif., Los Angeles]	30
2	**R.S. Ruoff, D.C. Lorents, B. Chan, R. Malhotra, S. Subramoney**, Single-crystal metals encapsulated in carbon nanoparticles, *Science*, 259(5093):346-8, 1993. [SRI Intl. Menlo Park, Calif.; DuPont, Willmington, Del.]	20
3	**P. Belik, A. Gugel, J. Spickermann, K. Mullen**, Reaction of buckminsterfullerene with *ortho*-quinodimethane: a new access to stable C_{60} derivatives, *Angew. Chem. Intl. Ed.*, 32(1):78-80, 1993. [Max Planck Inst., Mainz, Germany]	18
4	**M. Prato, T. Suzuki, H. Foroudian, Q. Li, K. Khermani, F. Wudl, J. Leonetti, R.D. Little, T. White, G. Rickborn, S. Yamago, E. Nakamura**, [3+2] and [4+2] cycloaddition of C_{60}, *J. Amer. Chem. Soc.*, 115(4):1594-5, 1993. [Univ. Calif., Santa Barbara]	18
5	**Y. Sato, Y. Yoshikawa, M. Inagaki, M. Tomita, T. Hayashi**, Growth and structure of graphitic and polyhedral particles in arc discharge, *Chem. Phys. Lett.*, 204(3-4):277-82, 1993. [Mie Univ., Japan; NTT Interdisciplinary Res. Labs, Musashino, Japan]	15
6	**C.C. Henderson, P.A. Cahill**, $C_{60}H_2$: Synthesis of the simplest C_{60} hydrocarbon derivative, *Science*, 259(5103):1885-7, 1993. [Sandia Natl. Labs, Albuquerque, N.M.]	15

Source: ISI's Science Indicators Database, 1991-93.; NB. Because two papers shared equal fifth placing with 15 citations, six papers are listed for 1993.

1991

Of the year's crop of papers, 29 were cited more than 100 times, but 21 were devoted to fullerenes. The eight nonfullerene papers came in the following categories: Computational chemistry was the subject of the of the papers, protein structure was the subject of two, and molecular recognition, substituent constants, mass spectra of biopolymers, and the immunosuppressant FK-506 each had one paper.

The most-cited paper of all is about protein structure and was published in the *Journal of Applied Crystallography*. It was by Per Kraulis, then based at Cambridge University, now working in Sweden. It reports a program to produce schematic plots of protein structures, and was cited no less than 280 times (attracting 227 of these in 1993). Although this paper appeared in what is essentially a structural chemistry journal, it has naturally been much cited by molecular biologists. Indeed, in previous issues, it appeared in the biology Hot Ten.

It might have been expected that many of these highly cited papers would be review articles, which tend to attract more citations than individual papers, but this appears not to be the case. Of the top ten, only two come into this category (one in *Chemical Reviews*, and one in *Angewandte Chemie*). Of the others, two are in *Nature*, two in *Science*, and one in *JACS*. *Nature* and *Science*, of course, publish across all branches of science and are eagerly read by all kinds of scientists. Clearly, if you want to be highly cited in chemistry, it pays to be published where there are the most readers.

Another surprising feature of the top 29 papers is the high proportion that originate from industrial laboratories: AT&T Bell Labs at Murray Hill has four on fullerenes; IBM Research at Almaden has three, again all an fullerenes; DuPont has one, also on fullerenes; and BioDesign has one, on computational chemistry. A cynic might see this as evidence that the fullerenes have yielded nothing exploitable, so it is safe to allow those who did the work to publish their results!

The papers published in 1991 with between 50 and 100 citations give a better picture of the year. There were 102 that came into this category, and although fullerenes still account for 39 of them, other areas were clearly evident: surface chemistry (12 papers); asymmetric synthesis (12 papers); theoretical/computational chemistry (9 papers); biologically active molecules and natural products (9 papers); organometallics/clusters (7 papers); and analysis techniques (6 papers).

The first of these, surface chemistry, has received a boost with the introduction of new techniques, such as scanning tunnelling microscopy (STM), which now allow surfaces to be examined atom by atom. Asymmetric synthesis and its importance in the preparation of biologically active molecules are shown; both have commanding positions on the list.

1992

Again in this year it is possible to impose the more demanding test of 50 or more citations, but only 16 papers that were published in 1992 come into this category. The most highly cited paper of 1992 has collected 95 citations and is about fullerenes — and so is #2. However, paper #3 is about an organic process, asymmetric dihydroxylation, which is catalyzed by osmium. The work was done by K.B. Sharpless's group at the Scripps Institute in La Jolla, California. Of the remaining papers, 11 are devoted to fullerenes, and three involve organometallic compounds.

Clearly, imposing a higher number of citations does not reveal the key areas, and so I fell back on a more reasonable 25-to-50 citations. This produced a further 109 papers, and these can be grouped in general classes that reflect those of 1991 — see the table on page 1. The most significant change between the two years was the emergence of protein chemistry.

1993

No paper in 1993 has collected 50 citations, which would be a truly remarkable feat, and indeed only one paper has collected over 25 citations (see the table on page 2). Sixteen have collected 10 or more. Ten of these are about fullerenes or the related carbon tubules. The remaining six papers deal with subjects already mentioned above: two are spectroscopic analytic techniques, two are concerned with biologically important systems (the enzyme nitrogenase, and porphyrins), one is devoted to the suppressant FK-506, and one to luminescent silicon colloids. This last one comes from the AT&T Bell Labs.

Closer inspection also reveals a noticeable change in the direction of fullerene research in 1993; several papers are about ways of making more stable derivatives, as the table on page 2 shows. This is a worthwhile goal to aim for because C_{60} itself decomposes in air. One paper from 1993 claims the first C_{60} hydrocarbon of formula $C_{60}H_2$ as is authored by C.C. Henderson and P.A. Cahill of the Sandia National Laboratory at Albuquerque, New Mexico.

Fullerenes Aside

So what do citations tell us about chemistry in the 1990s? They reveal that fullerenes are of great interest and that those in the field tend to cite a few papers disproportionately often. This feverish activity suggests a special factor that is perturbing the citation index. One explanation might by the popularly held belief that a Nobel Prize in Chemistry is imminent.

Pulling aside the veil of fullerenes reveals the other areas which are chemically active. This analysis shows them to be:

» Asymmetric synthesis and the objects of this — such as new drugs and natural products;

» Surface chemistry, which impinges on semiconductors, catalysts, and the techniques for monitoring matter at the atomic level, such as STM;

» Computational chemistry, which has been brought to desktop level and which has made molecular modeling such a powerful technique in designing and understanding molecules and their behavior;

» Macromolecular structures such as polymers and biopolymers, and in particular of proteins;

» New reagents, such as organometallic compounds, that can act as templates for molecular synthesis, and self assembly systems that can direct the construction of other molecules.

Dr. John Emsley,
Science Watch (July/August, 1994) 1

The Relationship Between Citing and Cited Publications: A Question of Relatedness

In exploring the unique advantages of citation indexing, we have looked at its usefulness in conducting searches, its relationship to other systems, and its flexibility in controlling the amount of information retrieved [1,2,3,4]. Building on this familiarity with citation indexing, we will now examine and explain the similarity as well as the perceived lack of similarity between citing and cited papers. (As you will recall from the first essay of this year, the cit*ed* work is a paper or book that has been mentioned in the references of other works, and the cit*ing* work is the one that contains the references.)

Are They or Aren't They

There is a basic assumption that citing and cited references have a strong link through semantics. Different studies have offered disparate findings on the validity of this assumption, and a like number of theories have been offered to explain those findings. Since an understanding of the interplay between citing and cited articles is key to an understanding of citation indexing, we will look carefully at these studies.

In a well-designed study, Peters *et al.* show that publications with a citing relationship as well as bibliographically coupled publications — those that have one or more cited documents in common — are content-related [5]. The study looked at the cognitive resemblance, or subject-relatedness, between citing and cited publications as well as the relatedness of bibliographically coupled publications in the interdisciplinary field of chemical engineering. The test examined cognitive resemblance with word-profile similarity and mapping. The study supports the results of an earlier study by Braam *et al.* that shows relatively strong cognitive resemblance within consensus groups for agricultural biochemistry and chemoreception [6].

On the other hand, a recent study by Harter *et al.* suggests that the subject similarity between citing and cited documents is usually small [7]. In the study, only one indexing term in ten for the citing documents was shared with the indexing terms assigned to cited documents. The study concludes that there is only a weak link between cited and citing papers in the library literature.

Explanations and Interpretations

Tiered Citations In reply to the findings of Harter *et al.*, Blaise Cronin suggests that a possible reason for the seemingly counterintuitive result is the use of tiered citations [8]. That is, the difference in importance between a very broad citation that cites the works of an author in general and a very targeted citation that cites just one word or phrase from a single article may not be apparent in the index.

Citation Motivation Although initial research on the topic of citation motivation has produced interesting results, systematic studies of citation behavior are needed. A clearer understanding of the motivational factors in citation behavior would surely shed light on the relationship between citing and cited papers. As it stands, same of the more commonly accepted motives are: recognition of work done previously, identification of methodology, justification, substantiation of claims, correction of one's work or the work of others, self-citation, and persuasion. And a key distinction must be made between studies in natural sciences versus those in social sciences and the humanities. In the latter, highly specific citation of papers is the norm.

Linguistic Interpretation When information scientists discuss the relationship between citing and cited documents they create probabilistic descriptions of the average situation. The reality of specific situations varies considerably from field to field. In my paper about the linguistic aspect of this and other situations, I indicate that a full text analysis of a scientific paper can never be complete unless it takes into account the cited documents and their full texts. This is especially true when considering certain selected groups of papers that are more directly related to the research in question. I call this "metatext," that is, the text of the cited paper.

A great deal of publication in science consists of a series of cumulative papers that are the result of many years of evolving research. The "ethics" of publication or the economics of limited journal space do not permit the full repetition of what has been previously reported. The surrogate or substitute for reiterating implicit knowledge is the reference citation.

KeyWords Plus Many journals compromise the usefulness of the already abbreviated but crucial linking of related documents through references by eliminating the title of the cited paper. In *KeyWords Plus*, this semantic link is restored. In effect, we restore a piece of the metatext. The experiments reported by myself and Irving Sher demonstrate the usefulness of this "derivative indexing" method [10].

Interestingly enough, some authors contend that we have sometimes supplied nonrelated terms for *KeyWords Plus*. These same authors are surprised when we are able to demonstrate that not only is the topic in question mentioned in the paper, but enough papers are cited in the discussion for it to pass the *KeyWords Plus* threshold.

Conclusions

Relatedness is quite variable. It can range from a total match to a situation in which there is no apparent semantic tie that would establish a reasonable connection. The study of the relationship between citing and cited articles — and, for that matter, citing and cited journals — is interesting and informative. Next month, we will look at a very interesting way to use citation indexing. We will explore a method for identifying noninteractive yet logically related pairs of medical literatures.

Eugene Garfield,
Current Contents (April 25, 1994) 3

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Critics Sharpen Assault on Peer Review

During the past several years, the practice of peer review of article submissions — accepted unquestioningly by some authors — has come under increasingly harsh scrutiny by others. Many of these authors — joined, in some cases, by the editors of the very publications they are criticizing — are demanding change: Some are suggesting that reviewers' identities be revealed to the author; some, indeed, want to see the traditional peer-review system abolished altogether.

Advocates of such changes fear that reviewers either are competitors of the authors whose research they are critiquing — and thus may have a vested interest in delaying the publication of their rivals' work — or are immersed in a subdiscipline at such distance from the papers they are ostensibly reviewing that they may know nothing about the subject. Some also worry that, because publishing in essentially a buyers' market, there is no accountability on the part of editors.

Editors themselves have their share of complaints about the system and reviewers, including their own. Among them: reviewers are not prompt, may be biased, or do not address the major arguments of the papers they are critiquing.

One of the most visible manifestations of concern is a call by some biomedical students for research into the peer-review process, which they say is central to all scientific communication, and yet poorly understood. Encouragement has come from the American Medical Association (AMA), which has provided staff support and funding for the First and Second International Congresses on Peer Review in Biomedical Publication, held in Chicago in 1989 and 1993. The first attracted 50 abstracts and the second more than 100, giving impetus to a third congress, planned for 1997.

The increasing interest in the subject is hardly surprising, since it seems that almost every scientist can recall a horror story stemming from an experience with a reviewer. The abundance of such tales notwithstanding, it is difficult to get a spurned author to name the journal in question: for fear of harming their future publication prospects, most prefer to keep their experiences off the record.

Take Loren Pankratz. His run-in with reviewers happened more than 15 years ago, but for Pankratz, a professor in the department of medical psychology and psychiatry at Oregon Health Sciences University in Portland, it seems like yesterday. Pankratz was a coauthor of a study that described the successful — and surreptitious — reduction of a narcotic administered to a chronic pain patient. He says that when his paper come out — in a journal he declines to name — to his surprise, it was accompanied by four critical commentaries, "some of which were horrified by what we had done [adjusting the dosage without the patient's consent]." The journal subsequently changed its editorial policy, and Pankratz was never allowed to pen a response. "So we thought we had used these wonderful strategies to help this guy cut down his narcotic abuse," says Pankratz, "but instead we got reamed out and we were left looking like manipulative guys."

How often do situations like this occur? No one knows, because few studies of the peer-review process have been conducted. To confuse things further, peer review means different things at different publications. Some journals give reviewers explicit instructions, for example, and some don't. Others have statistical consultants, while most don't. And some hide the authors' identifies from their reviewers, while others don't make the effort. So it's little wonder that anecdotal complaints abound from both editors and authors. But only in the past five years has biomedicine been encouraged to apply the scientific method to an examination of peer review.

Such self-examination is a good thing, according to Drummond Rennie, West Coast Editor of *JAMA* (*Journal of the American Medical Association*). Rennie, who has presided over the congresses, says he is pleased that AMA has recognized the importance of peer review to the quality of basic science and ultimately to patient care. "Scientific work doesn't exist," he says, "until it is peer reviewed and published."

Need for Study

Given his recent experiences and interest in the subject, Rennie probably knows more abut peer review than anyone else in biomedicine. But, emphasizing his concern, He says that in a scientific sense he doesn't know much at all, because there hasn't been enough research into the peer-review process. Rennie, who is professor of medicine at the University of California, San Francisco, Institute for Health Policy Studies, has heard all the anecdotes about peer-review abuse. Yet, absent systematic studies to confirm them, he says he would no more place stock in such tales than he would in unsupported claims made in any other area of science.

How reliable is peer review? Do the oft-mentioned problems with the system affect the quality of papers that are published? "We don't really know," says Erica Frank, a professor of family and preventive medicine at Emory University and associate editor of *Preventive Medicine*, "because we haven't done the research."

Stephen Lock, editor emeritus of the *British Medical Journal*, feels that part of the reason is that people were more frightened of editors in the past and didn't want to get on their bad side by criticizing their choice of reviewers. "Perhaps, too," he says "there wasn't this culture of challenging things." He explains that particularly in the United States, as the competition for funding has increased and the emphasis in tenure and promotion decisions has shifted to the sheer weight of published articles, scientists have recognized that they have a larger stake in questioning the process when it doesn't go their way.

In more relaxed times, argues Lock, since most papers eventually got published somewhere, "it was a bit of lottery. A delay didn't matter too much, so you shrugged your shoulders; it was part of the fun."

Frank has seen the problems as a researcher and editor. She thinks it's ironic and a bit embarrassing "that editors hold scientists to all sorts of stringent criteria, and yet we as editors have not held ourselves to any sort of criteria at all."

She still steam over an instance in which she feels uniformed reviewers and an arrogant editor — of a journal she prefers not to name — rejected an article that she eventually published elsewhere. Her work was torpedoed, she says, bey reviewers who didn't know the subject. Later, she says, when she spoke to the editor, he said, "I don't think we've ever made much of a mistake. I've never regretted having rejected a paper."

One of the problems, says Frank, is that editors are usually chosen for their research and not their editorial decision-making skills. Another is that, generally, journal publishers have the upper hand in the author-journal relationship, and if something does go wrong, researchers "don't want to risk offending the editors, because they have to submit to that journal in the future."

If It Ain't Broke...

Taking the opposite view is Marcia Angell, executive editor of the *New England Journal of Medicine*. She think peer review works well as is currently exists. She says that it's the responsibility of good editors to keep the process running smoothly: The editor must choose reviewers who know what they are doing and ride herd on them to ensure that they don't subvert the process — for example, by sitting on papers. Angell says editors also have to read reviewers' comments closely to ensure they are not too subjective. And in the final analysis, the editor has to make the decision on whether to publish and not be totally influenced by reviewers' comments.

Angell believes the journal marketplace already works well. The quality demands made by editors serve to direct papers to the publications where they belong. If a journal uses statistical consultants, for example, it will reject paper that contain statistical flaws and they will be published in less-selective journals, says Angell. She likes the fact that the process doesn't favor much innovation, too, because she thinks medicine should be conservative. But, she acknowledges, "there is nothing that an editor likes more than a breakthrough manuscript."

David Horrobin, editor of *Medical Hypotheses*, has provided just such a home for a lot of ideas that he says would otherwise not have found one. The journal, which is peer reviewed, "will publish ideas or criticisms of ideas from any person, irrespective of whether any experimental testing of the ideas is then performed by the writer," it notes on inside front cover.

Horrobin thinks most peer review is concerned too much with quality control and not enough with nurturing innovative ideas. Says Horrobin, who heads the Efamol Research Institute in Kentville, Nova Scotia, Canada: "I think we're killing a lot of interesting ideas at birth."

The scientific community is also making a mistake, says Horrobin, by fostering the illusion that scientists all review each other's work fairly. "Scientists are just the same as everybody else," he says, "particularly in today's competitive environment." For this reason, he doesn't think much of anonymous reviews. "In any situation other than science," he says, "anonymous communications are regarded as worthless."

A number of solutions has been proposed to the perceived difficulties with peer review, but as far as Rennie is concerned the only solution is research. He says, he'd be willing to shuck peer review completely if research showed that there was a better way of doing science. "Just because it has been done before," he says, "doesn't mean it should continue to be done."

That is not self-evident to Angell, who fears that research on peer review may lead to regimentation. She says each journal uses peer review differently and that is the way it should be. Angell thinks that in an attempt to study peer review — which is a subjective, qualitative process — researchers will use trivial, quantitative measures. "This will tell you almost nothing about the quality of the peer-review process," she says, "but it's the kind of busy work that makes you feel that you are looking at something."

Once this research is done, she suspects, the findings will be used to regiment journals — to get them all to do things the same way. She fears that research could lead to a levelling, in which poor journals become better as good ones become worse.

Rennie is particularly puzzled by Angell's concern about regimentation. He says all that peer review researchers want to do is find out what works best. If shielding reviewers' identities from authors, for example, is shown to produce better reviews, maybe more journals will adopt it, says Rennie, but there won't be any rules that require such blinding. "Journals can do what they damn well please," he says.

Lock is hopeful. He says that many editors are dissatisfied with the present system and are enthusiastic about improving it. "I think we will get somewhere," says Lock, "but it will take time."

At the moment there are a lot of strong feelings, with scientists taking positions for and against such things as anonymous reviewing and grievance mechanisms for authors. "Still, editors are an inherently opinionated lot," says Frank, "but opinion doesn't cut it on this. What we really need is more data."

P. McCarthy,
The Scientist, pp. 1, 21 (May 30, 1994)

White House Lauds Basic Research

For 18 months the academic research community has fretted that the Clinton Administration doesn't care about its issues. This week the Administration sought to soothe those bruised feelings, issuing a 31-page policy paper that glows with warmth toward basic research.

On 3 August, Vice President Al Gore unveiled "Science in the National Interest," a document that makes the case for the value of fundamental science and suggests that a $25-billion-a-year increase in the nation's investment in basic research (now hovering at $160 billion) may be needed to maintain the country's status as an international industrial power. Gore also urged scientists to "step up" to the challenge of increasing the country's l level of technical literacy. Scientific leaders welcomed the Administration's therapeutic rhetoric, but many said they're still waiting for evidence — next year's proposed budget, for example — that the words will be backed by deeds.

Calling science the "fuel" that powers the economy's technological engine, the policy paper says the nation should boost spending on research by both the public and private sector to 3% of the country's gross domestic product, from a current level of 2.6% — an increase reflecting science's "growing importance to society." It also calls on Congress to provide sufficient funds for new buildings, state-of-the-art instruments, and human resources to help researchers in the lab and to develop a scientifically literate public. It pledges to keep the country strong in all major scientific fields, saying this is the best way to respond quickly and decisively to new discoveries with commercial potential. And it sets out five goals for making sure science will pay off (see table).

Five Goals for Science

In its new white paper on research, the Clinton Administration has set the following goals for its "stewardship of science":

- Maintaining leadership across the frontiers of scientific knowledge;
- Enhancing connections between fundamental research and national goals;
- Stimulating partnerships that promote investments in fundamental science and engineering and effective use of physical, human, and financial resources;
- Producing the finest scientists and engineers for the 21st century; and
- Raising the level of scientific and technological literacy of all Americans.

Researchers who have read advance copies applaud the paper's tone and content. "It should reassure the scientific and medical communities that this Administration cares about research," says Robert White, president of the National Academy of Engineering. "And that will be very welcome," White adds, because "it could have been otherwise."

Indeed, the policy paper, crafted by the Office of Science and Technology Policy under the direction of associate director M.R.C. Greenwood, is widely seen as an opportunity for the White House to mend fences. One month after taking office, President Clinton issued a 36-page policy paper on the importance of technology in fostering economic growth. Although research — specifically, world leadership in basic science and engineering — was listed as one of three technology goals, it was a meager six-paragraph footnote to the overall policy statement, which served as rationale for a proposed $17-billion investment package (*Science*, 26 February 1993, p. 1244). Academic researchers were upset by what they perceived as an emphasis on technology at the expense of basic research. Their fears were heightened by congressional pressure on the National Science Foundation (NSF) to pursue more "strategic research."

To counter that perception, Greenwood organized a national forum last winter (*Science*, 4 February, p. 604), which was attended by 250 prominent researchers and science administrators. The views they expressed at the meeting are sprinkled throughout this week's document, which also incorporates parts of recent reports on the need for a new federal policy toward science from the National Academy of Sciences and the National Science Board, which oversees NSF. The report also offers nine one-page vignettes, covering subjects ranging from the life cycle of cells to galactic black holes, all of which make the point that fundamental research can have unexpected practical results. "I don't think that it's possible to oversell the value of fundamental research," says Greenwood about the underlying message of the short descriptions of science in action. "We want people to understand that the nation needs science more than ever."

The job of transforming this philosophy toward science into policy goes to the new National Science and Technology Council (NSTC), which is also charged with evaluating how the nation ranks internationally in every major scientific field. The document is silent on where to obtain additional funding, saying only that "this modest increment should be shared by the federal government and the private sector." But the lack of detail doesn't bother Roland Schmitt, president emeritus of Rensselaer Polytechnic Institute in Troy, New York, who has just completed 12 years on the science board. "You don't solve problems in this town by trying to hit a home run," says Schmitt. "This gives us a place to start, and the NSTC offers a mechanism for getting things one."

J. Mervis, Science 265 (5 August, 1994) 731

Best Brains in Neuroscience?
No Contest: It's Salk, in a Walk

Neuroscience Research, 1988-92:
Institutions Ranked by Citation Impact
(among those publishing at least 200 papers, 1988-992)

Rank	Institution	Papers	Citations	Impact
1	Salk Institute	304	5,019	16.51
2	Caltech	210	2,740	13.05
3	Max Planck Inst. Psychiatry	547	5,633	10.30
4	Brigham & Women's Hospital	236	2,367	10.03
5	Stanford University	1,001	9.810	9.80
6	Univ. Calif., San Francisco	1,268	11,626	9.17
7	Yale University	1,454	13,100	9.01
8	Washington University	1,034	9,251	8.95
9	Harvard University	2,194	19,373	8.83
10	Rockefeller University	604	5,308	8.79
11	Scripps Research Institute	288	2,523	8.76
12	Univ. Calif., Irvine	862	7,520	8.72
13	University of Heidelberg	587	5,086	8.66
14	MIT	419	3,583	8.55
15	NINCDS	1,062	8,768	8.26
16	NIMH	1,490	12,249	8.22
17	University of Chicago	620	4,919	7.93
18	Univ. London, Univ. Coll.	513	3,902	7.61
19	Columbia University	1,539	11,650	7.57
20	Massachusetts Gen. Hospital	807	6,048	7.49
21	Univ. Calif., San Diego	1,478	11,061	7.48
22	University of Miami	518	3,808	7.35
23	Georgetown University	371	2,697	7.27
24	McLean Hospital	267	1,882	7.05
25	Johns Hopkins University	1 ,698	11,909	7.01

SOURCE: ISI's Science Indicators Database, 1988-92.

Perhaps forever destroying the stereotype that Californians are wanting when it comes to gray matter, two research institutions in the Golden State — the Salk Institute for Biological Studies in La Jolla, and Caltech in Pasadena — have captured the top two spots in *Science Watch*'s latest ranking for neuroscience research. The new survey examined about 147,000 papers published and cited from 1988-92.

As the natives might say, "Like, totally excellent research, dude!"

It's no laughing matter, however. Half of the top 12 institutions in this field call California home. The other four from the sunny state ranking near the top are Stanford University, at fifth, UCSF, at sixth, and Scripps Research Institute and UC Irvine, at eleventh and twelfth, respectively.

In the table (Top), the top 25 institutions (among those that published at least 200 papers during the five-year span) are ranked according to their citations-per-paper scores, a weighted measure of research impact.

The current ranking actually updates a survey of neuroscience research that *Science Watch* featured three years ago, based of papers published between 1986 and 1990 (see *Science Watch*, 2[6]: 1-2, July 1991). In the previous study, neuroscience papers from the multidisciplinary journals *Science*, *Nature*, and *Proceedings of the National Academy of Sciences of the USA* were not included in the analysis, since such papers could not, at the time, be selected out from the countless other types of reports appearing in those journals.

This time around, however, neuroscience papers appearing in the Big Three multidisciplinary journals *were* taken into account. And, not surprisingly, the heavyweight trio provided nearly all the action in terms of highly cited papers.

The table on the next page lists the most-cited neuroscience papers of each year from 1988 through 1992. Of the 17 papers, *Science* and *Nature* published 15 between them, while *PNAS* and *Neuron* published one apiece. Among the top three institutions from page 1, two managed to get more than one paper onto the list of most cited reports: the Max Planck Institute for Psychiatry, Martinsried, Germany, fielded three of the papers (Leibrock *et al.* in 1989; Keinänen *et al.* in 1990, and Hohn *et al.* in 1990), while the Salk Institute fielded two papers (Hollmann *et al.* in 1989, and Boulter *et al.* in 1990).

Although *Science Watch* examined only those institutions that produced more than 200 papers between 1988 and 1992, a few smaller producers, whose output of papers was just below the cutoff for inclusion in the study, deserve mention. They include the pharmaceutical firm Merck, Sharp & Dohme (176 papers; impact of 14.41), the NICHHD (173 papers; impact of 8.18, the University of Geneva (186 papers; impact of 7.82), and Memorial Sloan Kettering Cancer Center (189 papers; impact of 7.58).

As the table of papers illustrates, same of the hot areas of investigation in neuroscience during 1988-92 include amyloid proteins in Alzheimer's disease, glutamate receptors, the role of calcium channels in neuronal function, and the identification of neurotrophic factors, such as nerve growth factor and brain-derived neurotrophic factor.

Science Watch, 5 (4)(February 1994) 1

The Most-Cited Papers in Neuroscience, 1988-1992		
Rank	1988	Total Citations
1	Kitaguchi, Y. Takahashi, Y. Takushima, S. Shiojiri, H. Ito, "Novel precursor of Alzheimer's disease amyloid protein shows protease inhibitory activity," *Nature*, 331:530-2, 1988.	432
2	E.S. Levitan, P.R. Schofield, D.R Burt, L.M. Rhee, W. Wisden, M. Köhler, N. Fujita, H.F. Rodriguez, A. Stephenson, M.G. Darlison. E.A. Barnard, P.H. Seeburg, "Structural and functional basis for $GABA_A$ receptor heterogeneity," *Nature* 335:76-9, 1988	348
3	L.D. Hirning, A.P. Fox, E.W. McClesky, B.M. Olivera, S.A Thayer, R.J. Miller, "Dominant role of N-type Ca^{2+} channels in evoked release norepinephrine from sympathetic neurons," *Science*, 239:51-61, 1988	315
4	N.W. Kleckner, R. Dingledine, "Requirement for glycine in activation of NMDA receptors expressed in *Xenopus oocytes*," *Science*, 241:835-7, 1988	298
	1989	
1	M. Hollmann, A. O'Shea-Greenfield, S.W. Rogers, S. Heinemann, "Cloning by functional expression of a member of the glutamate receptor family," *Nature*, 342:643-8, 1989.	241
2	J. Leibrock, F. Lottspeich, A. Hohn, M. Hofer, B. Hengerer, P. Masiakowski, H. Thoenen, Y-A. Barde, "Molecular cloning and expression of brain-derived neurotrophic factor," *Nature*, 341:149-52, 1989.	221
3	M.C. Raff, "Glial cell diversification in the rat optic nerve," *Science*, 243:1450-5, 1989.	206
4	M.R. Plummer, D.E. Logothetis, P. Hess, "Elementary properties and pharmacological sensitivities of calcium channels in mammalian peripheral neurons." *Neuron*, 2:1453-63, 1989.	202
	1990	
1	P.C. Maisonpierre, L. Belluscio, S. Squinto, N.Y. Ip, M.E Furth, R.M Lindsay G.D. Yancopoulos, "Neurotrophin-3: a neutrotrophic factor related to NGF and BDNF, " *Science*, 247:1446-51, 1990.	225
2	K. Keinänen, W. Wisden, B. Sommer, P. Werner, A. Herb, T.A. Verdoorn, B. Sakmann, P.H. Seeburg, "A family of AMPA-selective glutamate receptors," *Science*, 249:556-60, 1990.	222
3	A. Hohn, J. Leibrock, K. Bailey, Y.-A. Barde, "Identification and characterization of a novel member of the nerve growth factor/brain-derived neurotrophic factor family," *Nature*, 344:339-41, 1990.	212
4	J. Boulter, M. Hollmann, A. 0'Shea-Greenfield, M. Hartley, E. Deneris, C. Maron, S. Heinemann, "Molecular cloning and functional expression of glutamate receptor subunit genes," *Science*, 249:1033-7, 1990.	158
	1991	
1	R.K. Sunahara, H.-C. Guan, B.F. 0'Dowd, P. Seeman, L G. Laurier, G. Ng, S.R. George, J. Torchia, H.H M. Van Tol, H.B. Niznik, "Cloning of the gene for a humam dopamine D_5 receptor with higher affinity for dopamine than D_1," Nature, 350:614-9, 1991.	152
2	M. Masu, Y. Tanabe, K. Tsuchida, R. Shigemoto, S. Nakanishi, "Sequence and expression of a metabotropic glutamate receptor," *Nature*, 349:760-5, 1991.	144
3	V.M.-Y. Lee, B.J. Balin, L. Otvos, J.Q. Trojanowski, "A68: a major subunit of paired helical filaments and derivatized forms of normal tau," *Science*, 251:675-8, 1991.	110
4	B.T. Hope, G.J. Michael, K.M. Knigge, S.R. Vincent, "Neuronal NADPH diaphorase is a nitric oxide synthase," *Proc. Natl. Acad. Sci. USA*, 88:2811-4, 1991	97
	1992	
1	T.E. Golde, S. Estus, L.H. Younkin, D.J. Selkoe, S.G. Younkin, "Processing of the amyloid protein precursor to potentially amyloidogenic derivatives," *Science*, 255:728-30, 1992.	52

SOURCE: ISI's Science Indicators Database, 1988-92.

Dutch Science and Technology investment too low

The Netherlands may well be home to many of the world's leading scientific and technological publications, but when it comes to investing in research and development, its score is disappointingly low.

Since 1987, government and the business sector have together cut their share of R&D spending by one-sixth. And by 1991, only 1.9 per cent of the gross domestic product was being ploughed back into science. As a result, the Netherlands now risks losing its place among the world's leading R&D countries, which include Switzerland, Sweden, Germany, France, Japan and the United States.

This is the main conclusion of the first report by the Netherlands Observatory for Science and Technology (NOWT), recently submitted to State Secretary Job Cohen. The report discusses Dutch scientific and technological achievements in the light of international developments.

Pleased with NOWT's work so far, the State Secretary has decided to extend its funding by four years up to the end of 1998. Cohen will also ask the Ministry of Economic Affairs to contribute to NOWT's work by coordinating the monitoring of technology policy, with Education and Science retaining responsibility for science and research.

NOWT's report compares the state of Dutch science and technology R&D with the situation elsewhere in the European Union, in the EFTA member states, in the USA and in Japan. It sums up the strengths and weaknesses of the Dutch effort, basing its comparisons on three broad categories: human resources (education, the labour market and social involvement), investment in R&D and the results of R&D.

The Netherland compared

√ In the Education and Labour Market category, the Netherlands scores high on the number of university and college graduates. They rose as a percentage of the population from four per cent in 1960 to twenty-three per cent in 1992. The country also has a relatively large number of trainee researchers and research assistants in pure science and technology (forty-five per cent). However, since the start of the 1990s, job prospects for graduates have worsened and interest in pure science and medicine has declined.

√ In the category of Government Spending on Research and Development, the Netherlands fares well on industrial applications, but the overall trend has been downward since 1987.

√ As for International Scientific Influence, the Dutch make an especially good showing in pure science, with publication output per researcher higher than the international average. Dutch pure scientists are also more frequently quoted than most of their G7 counterparts — with an accompanying upward trend in technology. However, the Dutch score in social sciences is below the worldwide average.

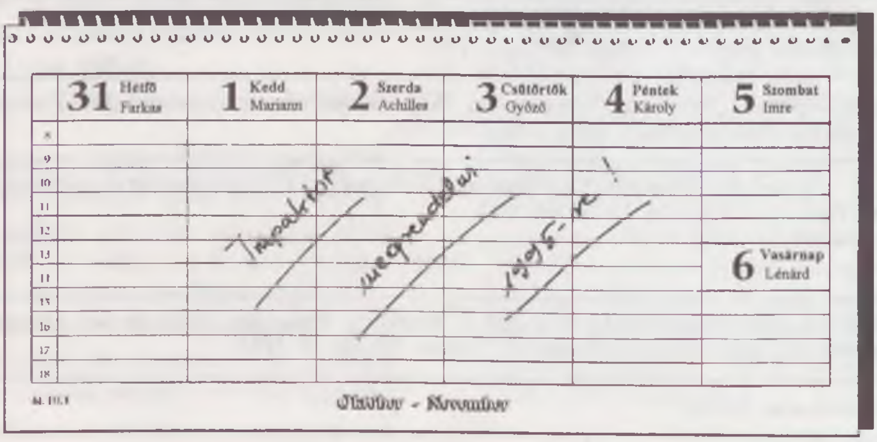
√ In the Patents category, the Netherlands scores high, mainly because of the large number of patents registered in the country and its relatively strong position in agricultural and food technology, electronics, computer science and chemistry. However, thirty to thirty-five per cent of all patents registered in the Netherlands are based on fundamental research conducted in other countries, usually by multinationals.

The report confirms the already prevalent view that the Netherlands risks falling behind internationally because of lower investment in science and technology. However, it also presents new informations in its extensive description of Dutch scientific output (publications, the influence of citations and national and international cooperation in the field of publication) and Dutch industrial output (patents).

Recommendations

The NOWT report makes two recommendations. First, the government should invest more in research on key social questions such as employment and the environment — which would have a knock-on effect in other spheres of society and encourage public interest in technological advances. Second, the government should support a stronger EU policy on science and technology geared to European cooperation. NOWT was set up in 1992 to track developments in science and technology and produce a report on them once every two years. It is a joint venture involving three organisations: Leiden University's Centre of Scientific and Technological Studies (CWTS), the Maastricht Economic Research Institute on Innovation and Technology (MERIT) at the University of Limburg and the Netherlands Organisation for Research Information (NBOI) at the Royal Dutch Academy of Arts and Sciences.

Science Policy, 16(2):3, (July 1994)



Der Forschungs Index

A kutatási index
A német kutatás vezető intézetei

Anyagtudomány — polimerek

Jó jegyeket kap a németországi anyagtudomány.

A német anyagtudomány nemzetközi viszonylatban is magas színvonalon van. Ezt mutatja az a tanulmány, melyet a Szövetségi Kutatásügyi Minisztérium a wiesbadeni Arthur D. Little tudományelemzési ügynökségtől rendelt meg. A teljesítményt többek között szabványelemzésekkel, intenzív technológiát igénylő termékek kereskedelmi mérlegével, valamint bibliometriai tudományos mutatószámokkal (pl. a *bdw* által is használt publikációszámmal és idézettséggel) mérték. Ezenkívül a tudományos és ipari kutatásban részt vevő, anyagismerettel rendelkező szakemberek véleményét is kikérték a német anyagtudomány teljesítményével kapcsolatban.

A befolyásosak

	Intézmény	Publ. száma 1990 — 93 dec.	Idézetek száma 1990 — 93 szept.
1	Max Planck Polimerkutató Intézet, Mainz	1339	339
2	Mainzi Egyetem	949	225
3	Freiburgi Egyetem	447	158
4	Jülichi Kutatóközpont, KfA	409	81
5	Hamburgi Egyetem	342	142
6	Bayreuthi Egyetem	277	98
7	Leuna-Merseburgi Műszaki Főiskola	242	175
8	Marburgi Egyetem	174	69
9	Német Műanyagkutató Intézet, Darmstadt	173	78
10	BASF, Ludwigshafen	141	57

Keleten nagy a kutatási potenciál. A német polimerkutatás fellegvára Mainzban van: Az egyetem és az 1983-ban alapított Max Planck intézet messze a legtöbb eredményt publikálja ezen a kutatási területen, mely többek között új műanyagok kidolgozásával és azok tulajdonságaival foglalkozik. Azonban az aktívak első tíz helyezettje között két új szövetségi államban lévő intézet is található, a Carl Schorlemmer Műszaki Főiskola, Leuna-Merseburgban, és a volt Erich Correns Polimerkémiai Intézet (újabban Max Planck Kolloid és Határfelületkutató Intézet), Teltow-Seehofban. A berlini Központi Szerves Kémiai Kutatóintézet és a Drezdai és Jénai Egyetemek a 11.-13. helyeken találhatók. A nyugati kutatási intézmények azonban befolyásosabbak, mivel gyakrabban idézik őket. A hatékonyak táblázata mutatja, hogy nagyobb kutatási tömeg nélkül is lehet nemzetközi szempontból említésre méltó eredményeket elérni: annak ellenére, hogy kevesebbet publikálnak, egy publikációra viszonyítva a Jülichi Kutatóközpont és a Münsteri és Müncheni Egyetem munkáit idézik a legtöbbször.

(Institut für Wissenschaft und Technikforschung, Bielefeld, a Science Citation Index alapján.)

A hatékonyak

	Intézmény	Egy publ.-ra eső id. száma	Publ. száma 1990 — 1993 szept.
1	Jülichi Kutatóközpont, KfA	5,0	81
2	Mönsteri Egyetem	4,5	28
	Müncheni Egyetem	4,5	18
4	Mainzi Egyetem	4,2	225
5	Max Planck Szénkutató Intézet, Mühlheim/Ruhr	4,0	22
6	Max Planck Polimerkutató Intézet, Mainz	3,9	339
	Konstanzi Egyetem	3,9	29
8	Göttingeni Egyetem	3,2	13
9	Heidelbergi Egyetem	3,0	31
10	Freiburgi Egyetem	2,8	158
	Bayreuthi Egyetem	2,8	98

Az aktívak

	Intézmény	Publ. száma 1990 — 1993 szept.
1	Max Planck Polimerkutató Intézet, Mainz	339
2	Mainzi Egyetem	225
3	Leuna-Merseburgi Műszaki Főiskola	175
4	Freiburgi Egyetem	158
5	Hamburgi Egyetem	142
6	Teltowi Polimerkémiai Intézet	106
7	Bayreuthi Egyetem	98
8	Berlini Műszaki Főiskola	86
9	Jülichi Kutatóközpont, KfA	81
10	Német Műanyagintézet, Darmstadt	78

Bild der Wissenschaft (8)(1994) 6

CD-ROM a tudományban — tudomány a CD-ROM-ban?

A Mayo Klinika (USA) neve nem ismeretlen az *Impakt* olvasói előtt. Klinikai orvostudományi publikációinak számát tekintve az Egyesült Államok és így gyakorlatilag az egész világ egyetemeinek rangsorában az első tíz között van. Hasonlóképpen kiemelkedő cikkeinek idézettsége is, amint az folyóiratunk 1992 májusi számából is kiderül (Clinical Medicine: The Top 50 U.S. Universities Ranked By Citation Impact, 1986 — 1990: *Impakt* 2 (5)(1992) 11).

Nem véletlen tehát, ha évtizedes kutatási eredményeinek közzétételére idővel populárisabb megjelenési formát is választott, és klinikájának többszáz közreműködője segítségével egy 1378 oldalas best sellert, majd annak *CD-ROM változatát* dobta piacra: Family Health Book címmel.

A betűszó: CD-ROM feloldása: kompakt lemez — csak olvasható memóriával, azaz tartalmának felülírása nem lehetséges. Speciális lemezegységet igényel, ez a fejlesztés azonban hatalmas tárolókapacitással bővíti ki a számítógépet. Egy-egy CD 600—700 Mbyte lemezterülettel rendelkezhet, ami több százezer nyomtatott oldalnak felel meg. (Egy-egy színes ábra vagy fénykép, ha az nagy felbontású és többezer színárnyalattal van megjelenítve, egymaga 20-30 Mbyte-nyi területet köthet le. Egy mozgófilm-jelenet akár ennek a többszörösét.)

— A Mayo Klinika *Családi Egészségkönyve* egyike a legjobb "íróasztali multimédiumoknak" — ismerteti a software-t *Bakos Attila*, a budapesti **AUTOMEX Multimédia CD Center** CD-ROM project-jének marketing megbizottja. — Korszerű, a multimédiára jellemző színes illusztrációk, animációk, kép- és hanghatások, valamint narráció segíti az orvosi információk eljuttatását a mindenkori felhasználóhoz, a családokhoz. A módszer interaktív, tehát a kiválasztott témakörön belül a keresett témával kapcsolatban közvetlenül lehet tájékoztatást kapni egy családot érintő valamennyi orvosi problémát illetően. Fő fejezetei:

— Part I.: Lifecycles
— Part II.: The World around Us
— Part III.: Keeping Fit
— Part IV.: Human Deisease and Disorders
— Part V.: Modern Medical Care

A CD saját feljegyzések elhelyezését is támogatja, a könnyebb megértést pedig értelmező szótár segíti. Az anyag angol nyelvű.

— Egy minimális konfigurációval kiépített gép milyen beruházást igényel?

— Cégünk üzleteiben a CD-ROM meghajtóval együtt a teljes gép 100-120 ezer forintból "kijön", ez az összeg azonban hónapról hónapra csökkenhet! Egy CD ezen felül csupán néhány ezer forintba kerül, klubtagjainknak pedig komoly kedvezményeket is biztosítunk.

— A tudományos kutatótársadalom számára milyen lehetőségeket rejt magában a CD?

— A jövő útja véleményem szerint mindenképpen az, hogy a frissen megírt szakkönyveket is, annak megjelenésével egyidejűleg CD-n is terjeszteni lehessen. A közvetlen adatelérhetőség, egy pontos, célratörő keresési rendszer és az eddig is hangsúlyozott kép (animáció) és hang (narráció) nem váltható ki egy akár a legpraktikusabban megszerkesztett könyvvel sem.

Hasonlóan egyedülálló lehetőségek rejlenek a nyelvtanulást célzó CD-kben is. "Learn to Speak English" elnevezésű lemezünk például egész komolyan megközelíti egy nyelvi kurzus adottságait. Mivel a tudomány nyelve az angol, nyelvi software-jeink közül elsősorban ezt tudnám még ajánlani a tudományos kutatóknak, illetve az *Impakt* olvasóinak.

Toma Olga

Készült az Argumentum Könyv- és Folyóiratkiadó Kft. nyomdájában

Felelős kiadó: az MTAK főigazgatója