3. évfolyam • 6. szám • 1993. június

I M P A K T

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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The n Cultures

The two cultures

My springboard is a famous 1956 essay by the British scientist and literary figure, the late C.P. Snow [1]. Snow's essay was titled "The Two Cultures," and its central point was despair at the existing gulf between the scientific and the humanistic cultures that Snow saw about him. Snow himself personified a link between those cultures: he had been trained as a scientist and had done research, but he later shifted to become an important novelist. Snow felt that there were all too few such links; he pointed to physicists whose idea of advanced literature is Dickens' novels and equally to poets without the least glimmer of scientific method.

The n cultures

Of course it is an oversimplification to consider only *two* cultures. As Snow himself says, "The number 2 is a very dangerous number: that is why the dialectic is a dangerous process... I was searching for something a little more than a dashing metaphor, a good deal less than a cultural map: and for those purposes the two cultures is about right..." [1].

But the main diversity of culture for us is the standard one of disciplinary cultures: statisticians, psychologists, physicists, and so on, swim in different seas. My major theme is that combining the waters of these seas can be indeed productive.

So I am interested in cultures of intellectual disciplines, where n lies perhaps between 15 and 50. Of course one could also extend n greatly, first to all individuals, since each of us has a little separate cultural sea. As Samuel Butler said, "There are not more stars in haven than there are worlds of thought within this our own planet..." [2]. So we immediately have an n in the millions or billions. But we need not stop there: each moment of time is distinct. George Steiner writes of a heraclean flux, "...we never step twice into the stream of our own consciousness; it alters always... The first person pronoun is a momentary fiction, a momentary arrest in a stream of constant transformative energies." [3].

Federal agencies

NSF's director, Eric Bloch, is an enthusiast of crossing disciplines. His recent statement, "Changing for the Next Century," stresses "emphasis on multi-disciplinary research, because knowledge is exploding beyond the boundaries of the traditional disciplines."

Without pausing to ask how new that boundary-crossing explosion may be, I note that NSF's much publicized current plans for Science and Technology Research Centers is suffused with cross-disciplinary terminology and enthusiasm. This new program, when and if it is funded, will complement a number of existing programs, including one on Engineering Centers. Of course I should mention a long tradition of NSF cross-disciplinary research support now under the rubric of Measurement Methods and Data Improvement.

There must be many other Federal cross-disciplinary statistical activities, for example, those in the National Institutes of Health, those in the National Bureau of Standards, and those in the now statistically vigorous General Accounting Office. I expect that there are further examples in the Department of Defense, where we see a

complex tradition going back to that wonderful post World War II book *The American Soldier*.

Outside government

There are all sorts of cross-disciplinary activities going on, many of them on university campuses. The survey/cognition crossing is especially promising. Social psychologists Norman Bradburn, Howard Schuman, and their colleagues have been hard at work for years on such boundary topics as survey question wording, question order, training of interviewers, effects of interviewer characteristics, etc.

Negative aspects of cross-disciplinary research

All is not peaches and cream in any diet, and there certainly are potential drawbacks in cross-disciplinary research. Perhaps the first that comes to mind is that simply putting a psychologist and a statistician in adjacent offices and saying "Go to it" may not work well. An analogy might be to proud parents of a beaming marriageable son and the equally proud parents of a beautiful nubile daughter. Pushing the kids toward each other may have just the opposite effect from what the parents want. On the other hand, I am told that in some cultures arranged marriages are the usual thing, that they work out well, and that they have ardent defenders. Another facet of n cultures.

A second that cynics might raise is that third rate scientific talents are attracted to cross-disciplinary research, perhaps because standards are fuzzier. Joint research from a psychologist and statistician, for example, might be approved by the psychologist without understanding the statistical part, and vice versa.

No doubt there are such problems, together with risks of faddishness, but I do not make too much of them provided that we are alert.

Meta-cross-disciplinary research

There has grown up an appreciable literature *about* cross-disciplinary research. A few minutes with our library's search program, for example, turned up several relevant books, including

Problems in Interdisciplinary Studies (A Netherlands Symposium [4]);

Managing Interdisciplinary Research (An English Conference [5]).

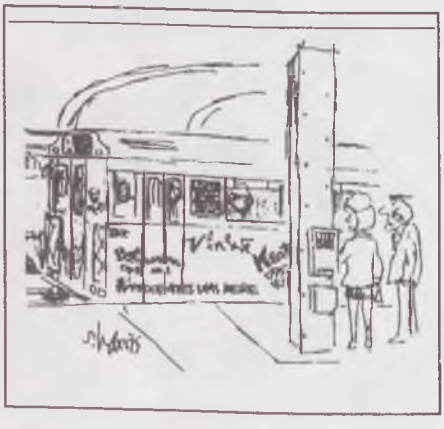
The papers in these volumes are full of example and analyses. One point of special interest is whether it is intrinsically harder to evaluate proposals for interdisciplinary research support than for traditional research support within a single discipline. I do not have a crisp opinion.

Another example of celebration and analysis of cross-disciplinary research is a marvellous 1949 article on the education of a scientific generalist by Frederick Mosteller, John Tukey, Charles Winsor, and Hendrick Mode [6]. The articles comes at cross-disciplinary research from the educational and preparation viewpoint, but it is surely relevant to our theme, and just as much so today as almost 40 years ago. Indeed, Mosteller, in his recent Pfizer Colloquium Lecture in 1988, argued for the broadening of statistical education and research, with special reference to questions of public policy [7].

Kruskal W.H.
Current Contents (1989) 5-9 alapján

1. Snow C.P.: The two cultures and the scientific revolution. New York: Cambridge University Press, 1959. 58 p. (*The two cultures* was first published in *New Statesman*, 6 October 1956.)
2. Turner F.M.: Between science and religion. New Haven CT: Yale University Press, 1974. p. 180.
3. Steiner G.: Some black holes. *Bull. Amer. Acad. Arts Sci.* 41:12-28, 1987
4. Jurkovich R. & Paelinck J.H.P., eds.: Problems in interdisciplinary studies. Brookfield, VT: Gower, 1984. 200 p.
5. Epton S.R., Payne R.L. & Pearson A.W., eds.: Managing interdisciplinary research. New York: Wiley, 1983. 200 p.
6. Bode H., Mosteller F., Tukey J. & Winsor C.: The education of a scientific generalist. *Science* 109:553-8, 1949.
7. Mosteller F.: Broadening the scope of statistics and statistical education. *Amer. Statist.* 42:93-9, 1988.

"I think you've crossed that thin line between transmuting and cooking."



"This one stops at Fordham, Columbia, N.Y.U. ..."

The Best of Biology Among US Universities

Most of the dozen U.S. universities appearing in the accompanying table would be on anyone's list of powerhouse institutions for research in the basic biological sciences.

But would you have forgotten to list Brandeis University or the University of Oregon? Probably so.

These two institutions, although small in their output of papers when compared to the other ten, pack a sizeable punch. Their impressive research record is typically obscured by the sheer number of papers put out at universities such as Yale, Stanford, or Harvard. But when ranked on a citations-per-paper basis, the high impact of these two institutions shines through. Both Oregon and Brandeis turned up on a previous ranking of top U.S. universities in the biological sciences. That analysis covered the period September 1987 – August 1990 (see *Science Watch*, 1[10]:1, November 1990). Oregon was ranked tenth and Brandeis was sixteenth. In other words, both have been high-impact producers for many years, not just the three-year period previously examined.

It is noteworthy that Caltech and MIT – sort of bicoastal bookends of engineering and technological excellence – now carry the greatest clout in basic biological research as well. In the previous survey, Caltech ranked second and MIT third, both behind first-ranked Rockefeller University.

The list divides evenly between East Coast and West Coast universities. Midwest institutions are absent altogether. The University of California is very well represented, no doubt thanks to a tradition of generous support in California for higher education. As the U.C. system now faces formidable financial pressures, these numbers would seem to demonstrate that there was a significant return on that investment.

The Dynamic Dozen: Top Ranked U.S. Universities in the Biological Sciences

Rank	University	Papers 1981-91	Citations 1981-91	Citation Impact
1	Caltech	2,327	56,994	24.49
2	MIT	6,078	141,543	23.29
3	Rockefeller University	5,633	123,877	21.99
4	Harvard University	34,374	582,826	16.96
5	Stanford University	13,187	213,066	16.16
6	Univ. of California, Berkeley	8,461	130,193	15.39
7	Brandeis University	1,692	26,048	15.39
8	Yale University	15,223	228,273	15.00
9	Washington University	12,731	183,273	14.40
10	Univ. of Oregon	1,834	26,255	14.32
11	Univ. of California, San Diego	13,070	185,111	14.16
12	Univ. of California, San Francisco	20,049	281,213	14.03

Source: ISI's Science Indicators Database, 1981-91

In this analysis, *Science Watch* counted only those articles that were reports of original research. Not counted were reviews, letters, editorials, etc. *Science* and *Nature* papers were not counted either, since some of these articles represented research outside the basic biological sciences.

Science Watch (January 1993) 7

New Monoclonal Antibody HA-1A Offers Hope in Treating Sepsis

"...provides significant and sustained reduction in mortality in septic patients with Gram-negative bacteraemia." So claims an advertisement for the monoclonal IgM antibody to endotoxin known as HA-1A. Leiden-based Centocor is thought to have put some $50 million into the development of this agent. Licensed widely in Europe but not yet in the United States, Centoxin™ is very expensive; the single 100 mg dose required would cost about $3,500, on the basis of the current U.K. price. The only published evidence cited for the above claim that HA-1A saves lives is a multicenter clinical trial that appeared in the *New England Journal of Medicine* in 1991 – and that paper heads the first of *Science Watch*'s new style "What's Hot in Medicine."

The *Science Watch* listings for medicine will have looked odd to clinicians, for they have tended to draw on journals (*Science*, *Nature*, *Cell*) whose pages busy doctors leave well alone, and they have focused on topics such as oncogenes that remain tantalizingly far from the clinic. Journals rather closer to the bedside, such as *NEJM* and *The Lancet*, look likely to provide much of the menu from now on.

Papers with clinical outcomes are seldom clear-cut. An infection with a gram-negative organism that proceeds to bacteremia carries a poor but not uniformly disastrous prognosis. In the Ziegler trial, 30% of these patients given HA-1A died, while half of those who got the albumin control survived. Furthermore, fewer than 40% of all patients in this trial turned out to have gram-negative bacteremia. Nonetheless, HA-1A, which is produced from a heteromyeloma cell line, has obvious advantages over the experimental polyclonal J5 antiserum that piloted this novel approach to life-threatening sepsis, and which can be raised only in human volunteers. "The availability of Centoxin has provided clinicians with a frustrating dilemma," says Professor Jonathan Cohen, an infectious diseases specialist at London's Royal Postgraduate Medical School. "Faced with a very ill patient and a gloomy prognosis, many feel that any prospect of an improved outcome is welcome, yet the uncertainties surrounding the efficacy of Centoxin, the difficulties in identifying the subset who might benefit, and the high cost have led many to wait for the results of further trials now in progress."

Elsewhere the clinical top papers come in pairs. Leukemia treatments that come most quickly to mind are chemotherapy and bone marrow transplantation, but leukemia is not just one disease. Hairy cell leukemia, for example, has lately proved amenable to other treatments, and so has the variety known as acute promyelocytic. The active metabolite of vitamin A has two naturally occurring isomers. One of them, the all-*trans*-retinoic acid – or tretinoin to give it its proper drug name – induces differentiation in acute promyelocytic leukemia cells *in vitro*. Sylvie Castaigne and her colleagues in a 1990 *Blood* paper (#3) and Raymons P. Warrell and coworkers six months later in *NEJM* (#4) offered clinical confirmation. Both groups are cautious, and the French authors note that complete remissions were short-lasting and that this drug, though it did seem to work via differentiation, "does not eradicate the leukemic clone."

Rash would any commentator be to predict the most controversial issue in medical practice in 1993, but the management of asthma is a likely candidate. It has certainly provoked fierce debate already, stemming from a concern among clinicians and epidemiologists that asthma is somehow becoming more serious; the worry is that the drugs patients take might make matters worse. The New Zealand paper by Malcolm Sears' group (#8) focuses on one beta-agonist that happens to have been at the center of the recent furor but their conclusions – that regular use of this agent means less asthma control than that achieved by ondemand use – may well extend to other drugs in this class, they say. We must dip into the "also-rans" to find, at #11, the twin for the Sears paper. From Canada, this time with an epidemiological slant Walter O. Spitzer and colleagues (*NEJM*, 326:501-6, 1992) provide supportive evidence for the concern about beta-agonists and fenoterol in particular.

What's Hot in Medicine...

Rank	Paper	Citations This Period (Sep-Oct 92)
1	**E.J. Ziegler, C.J. Fisher, C.L. Sprung, R.C. Straube, J.C. Sadoff, G.E. Foulke, C.H. Wortel, M.P. Fink, R.P. Dellinger, N.N.H. Teng, I.E. Allen, H.J. Berger, L.oBuglio, G.L. Knatterud, A.P. C.R. Smith,** "Treatment of gram-negative bacteremia and septic shock 1A with HA-human monoclonal antibody against endotoxin," *New Engl. J. Med.*, 324(7):429-36, 14 February 1991. [13 institutions worldwide]	34
2	**G Brown, J.J Albers, L.D. Fisher S.M. Schaefer, J.-T. Lin, C. Kaplan, X.-Q. Zhao, B.D. Bisson, V.F. Fitzpatrick, H.T. Dodge,** "Regression of coronary artery disease as a result of intensive lipid-lowering therapy in men with high levels of apolipoprotein B," *New Engl. J. Med.*, 323(19):1289-98, 8 November 1990. [Univ Wasington, Seattle]	25
3	**S. Castaigne, C Chomienne, M.T. Daniel, P. Ballerini, R. Berger, P. Fenaux, L. Degos,** "Alltrans retinoic acid as a differentiation therapy for acute promyelocytic leukemia. I. Clinical results," *Blood*, 76(9):1704-9, 1 November 1990. [Hop. Claude Huriez, Lille, France; Hop. St. Louis, Paris, France]	24
4	**R.P. Warrell, S.R. Frankel, W.H Miller, D.A. Scheinberg, L.M Itri, W.N. Hittelman, R. Vyas, M. Andreeff, A. Tafuri, A. Jakubowski, J. Gabrilove, M.S. Gordon, E Dmitrovsky,** "Differentiation therapy of acute promyelocytic leukemia with tretinoin (all-trans-retinoic acid)," *New Engl. J. Med.*, 324(20):1385-93, 16 May 1991. [Memorial Sloan-Kettering Cancer Ctr., New York, N.Y.; Univ. Texas, M.D. Anderson Cancer Ctr., Houston, Tex.]	22
5	**C.L. van der Poel, H.T.M. Cuypers, H.W. Reesink, A.J. Weiner, S. Quan, R. Di Nello, J.J.P. van Boven, I. Winkel, D. Mulder-Folkerts, P.J. Exel-Oehlers, W. Schaasberg, A. Leentvaar-Kuypers, A. Polito, M. Houghton, P.N. Lelie,** "Confirmation of hepatitis C virus infection by new four-antigen recombinant immunoblot assay," *The Lancet*, 337(8737):317-9, 9 February 1991. [Red Cross Blood Bank, Amsterdam, The Netherlands; Chiron Corp., Emeryville, Calif.; Municipal Healts Service, Amsterdam; Netherlands Red Cross, Amsterdam]	21
6	**J N. Cohn, G. Johnson, S. Ziesche, F. Cobb, G. Francis, F. Tristani, R. Smith, W.B. Dunkman, H. Loeb, M. Wong, G Bhat, S. Goldman, R.D. Fletcher, J. Doherty, C.V. Hughes, P. Carson, G. Cintron, R. Shabetai, C. Haakenson,** "A comparison of enalapril with hydra-lazine-isosorbide dinitrate in the treatment of chronic congestive heart failure," *New Engl. J. Med.*, 325(5):303-10, 1 August 1991. [Univ. Minnesota, Minneapolis, Minn.]	19
7	**J.I. Esteban, A. González, J.M. Hernández, L. Viladomiu, C. Sánchez, J.C. López-Talavera, D. Lucea, C. Martín-Vega, X. Vidal, R. Esteban, J. Guardia,** "Evaluation of antibodies to hepatitis C virus in a study of transfusion-associated hepatitis," *New Engl. J Med.*, 323(16):1107-12, 18 October 1990. [Hosp. Gen. Univ. Vall d'Hebron, Barcelona, Spain; Univ. Autonoma Barcelona, Barcelona]	16
8	**M.R. Sears, D.R. Taylor, C.G Print, D.C. Lake, Q-Q Li, E.M. Flannery, D.M. Yates, M.K. Lucas, G.P. Herbison,** "Regular inhaled beta-agonist treatment in bronchial asthma," *The Lancet*, 336(8728):1391-6, 8 December 1990. [Univ. Otago, Dunedin, New Zealand]	16
9	**R.O. Dillman, S.L. Seagren, K.J. Propert, J. Guerra, W.L. Eaton, M.C. Perry, R.W. Carey, E.F. Frei, M.R. Green,** "A randomized trial of induction chemotherapy plus high-dose radiation versus radiation alone in stage III non-small-cell lung cancer," *New Engl. J. Med.*, 323(14):940-5, 4 October 1990. [Univ. Calif. San Diego: McGill Univ., Montreal, Canada; Dartmouth Call., Hanover, N.H.; Univ. Missouri, Columbia, Mo.; Harvard Univ., Cambridge, Mass.; Mass. Gen. Hosp., Boston; Dana Farber Cancer Ctr., Boston]	16
10	**M.J. Stampfer, F.M. Sacks, S. Salvini, W.C. Willett, C.H. Hennekens,** "A prospective study of cholesterol, apolipoproteins, and the risk of myocardial infarction," *New Engl. J. Med.*, 325(6):373-81, 8 August 1991. (Brigham & Women's Hosp., Boston; Harvard Univ. Med. Sch., Boston, Mass.]	16

Source: ISI's Hot Papers Database
NB. Only of papers published since September 1990 are tracked. In the event that two or more papers collected the same number of citations in the most recent bimonthly period, total citations to date determine the rankings.

For many years, some patients with what seemed to be a viral hepatitis post-transfusion had to carry the frustrating label "non-A, non-B hepatitis." We know now that most of the transfusion NANB cases will have been hepatitis C. Over the years a range of diagnostic tests for antibody to hepatitis C virus has been developed. In their 1991 *Lancet* paper (#5) Dutch transfusion workers described a radioimmunoblot assay with four antigens instead of two. That test picks out potentially dangerous blood and is independently confirmatory of other screens. How does Cees van der Poel, of the Red Cross Blood Bank in Amsterdam, see the RIBA-2 now, almost two years on? "The second generation four-antigen RIBA (RIBA-2) is now used worldwide as the standard

confirmatory assay for HCV antibody. Little doubt remains over a positive or a negative result," he says. "However, HCV infected as well as uninfected individuals may have antibody to only one antigen, usually C22 or C33. These 'indeterminate' results are most commonly resolved by polymerase chain amplification. In future, the addition of NS5 antigens or non-cross-reacting epitopes from other serotypes may improve the RIBA format so that sera from infected individuals will nearly always show reactivity to multiple antigens." The companion here is the *NEJM* paper from Barcelona (#7) which provided some of the first solid evidence on what screening blood might achieve in terms of preventing transfusional non-A, non-B hepatitis. Both papers and much else from that time (1990/91) and since show how quickly things can develop from molecule to medicine. Isolation of the cDNA clone for the HCV genome was recorded in *Science* in 1989, yet by 1990 people were already studying potentially important public health issues such as the safety of blood donations in respect of HCV, the sexual transmission of this virus and its role in liver cancer, and the progression of HCV infection to a state of chronic liver damage.

David W. Sharp, Science Watch, (January 1993) 6-7

Fullerene "Flavors," DREIDING Force Field Fill Chemistry Chart

Which will the fullerenes achieve first: a Nobel Prize or a commercial application?

The former seems a safer bet, but Japanese researcher Satoru Isadora of Mitsubishi Electric has raised the chances of the latter by making a semiconductor film of the fullerene C_{60} doped with boron and phosphorous. This, he says, may be even more versatile than silicon microchips (see *New Scientist* , 31 October 1992, p. 20). Meanwhile, academic interest in the "third form" of carbon continues unabated. Fullerene papers monopolized the *Science Watch* Top Ten lists throughout 1992, and such papers occupy places 1 through 9 in the current list.

The list is not static, however. At #3 is a *Science* paper of April 1991 in which four fullerenes larger than C_{70} were announced. This paper entered the chart for the first time at #10 in August last, and is now joined by a related publication in *Nature* which appears at position #9. The *Science* paper, coauthored by eleven chemists headed by François Diederich and Robert Whetten, reports C_{76}, C_{84}, C_{90}, C_{94} and the first fullerene oxide, $C_{70}O$.

When graphite is heated resistively, under an inert atmosphere, it produces a fluffy type of carbon that can be extracted with toluene and from which fullerenes C_{60} and C_{70} can be obtained in high yields in the ratio of about 80:20, respectively. The toluene extract also contains about 4 percent of the larger fullerenes. By careful chromatographic separation of such

What's Hot in Chemistry...

Rank	Paper	Citations This Period (Sep-Oct 92)
1	**R. Taylor, J.P. Hare, A.K. Abdul-Sada, H.W. Kroto,** "Isolation, separation and characterisation of the fullerenes C_{60} and C_{70}: the third form of carbon," *J. Chem Soc. – Chem. Comm.*, **20**:1423-5, 15 October 1990. [Univ. Sussex, Brighton, U.K.]	30
2	**J.M. Hawkins, A. Meyer, T.A. Lewis, S. Loren, F.J. Hollander,** "Crystal structure of osmylated C_{60}: Confirmation of the soccer ball framework," *Science*, **252**(5003):312-3, 12 April 1991. [Univ. Calif. Berkeley, Berkeley]	23
3	**F. Diederich, R. Ettl, Y. Rubin, R.L. Whetten, R. Beck, M. Alvarez, S. Anz, D. Sensharma, F. Wudl, K.C. Khemani, A. Koch,** "The higher fullerenes: Isolation and characterization of C_{76}, C_{84}, C_{94}, and C_{700}, an oxide of D_{5h}-C_{70}, "*Science*, **252**(5005):548-51, 26 April 1991. [Univ. Calif. Los Angeles; Inst. Polymers & Organic Solids, Univ. Calif. Santa Barbara]	22
4	**D.S. Bethune, G. Meijer, W.C. Tang, H.J. Rosen,** "The vibrational Raman spectra of purified solid films of C_{60} and C_{70}," *Chem. Phys. Lett.*, **173**(3-4):219-22, 9 November 1990. [IBM Corp. Almaden Res. Ctr., San Jose, Calif.]	20
5	**W.I.F. David, R.M. Ibberson, J.C. Matthewman, K. Prassides, T.J.S. Dennis, J.P. Hare, H.W. Kroto, R. Taylor, D.R.M. Walton,** "Crystal structure and bonding of ordered C_{60}," *Nature*, **353**(6340):147-9, 12 September 1991. [Rutherford Appleton Lab., Chilton, Didcot, U.K.; Univ. Sussex, Brighton, U.K.]	19
6	**P.J. Fagan, J.C. Calabrese, S. Malone,** "The chemical nature of buckminsterfullerene (C_{60}) and the characterization of a platinum derivative, "*Science*, **252**(5009):1160-1, 24 May 1991. [DuPont Corp., Wilmington, Del.]	18
7	**D.S. Bethune, G. Meijer, W.C. Tang, H.J. Rosen, W.G. Golden, H. Seki, C.A. Brown, M.S. de Vries,** "Vibrational Raman and infrared spectra of chromatographically separated C_{60} and C_{70} fullerene cluster," *Chem. Phys. Lett.*, **179**(1-2):181-6, 12 April 1991. [IBM Corp. Almaden Res. Ctr., San Jose, Calif.]	17
8	**J.P. Hare, H.W. Kroto, R. Taylor,** "Preparation and UV/visible spectra of fullerenes C_{60} and C_{70}," *Chem. Phys. Lett.*, **177**(4-5):394-8, 1 March 1991. [Univ. Sussex, Brighton, U.K.]	16
9	**R. Ettl, I. Chao, F. Diederich, R.L. Whetten,** "Isolation of C_{76}, a chiral (D_2) allotrope of carbon," *Nature*, **353**(6340):149-53, 12 September 1991. [Univ. Calif. Los Angeles, Los Angeles]	16
10	**S.L. Mayo, B.D. Olafson, W.A. Goddard,** "DREINING: a generic force field for molecular simulations," *J. Phys. Chem.*, **94**(26):8897-909, 27 December 1990. [BioDesign Inc., Pasadena, Calif.]	15

SOURCE: ISI's Hot Papers Database
NB. Only papers published since September 1990 are tracked. In the event that two or more papers collected the same number of citations in the most recent bimonthly period, total citations to date determine the rankings.

a solution on neutral alumina, the four new fullerenes were isolated as stable solids and characterized by mass spectrometry, ^{13}C NMR, IR and UV/VIS spectroscopy.

In a more recent paper, Diederich and R.F. Bunshah have reported that if graphite is vaporized by sputtering or electron beam evaporation, then C_{70} and the larger fullerenes are the favored products (see *Journal of Physical Chemistry*, 96:6866, 1992). This work follows on from paper #3 and is also likely to attract a lot of attention because it accesses a new arena of fullerene chemistry – and one with a degree of complexity not anticipated.

The structures of C_{60} and C_{70} were reported in paper #1, and C_{60}'s spherical cage was confirmed in papers #3, #5, and #6. Diederich and Whetten's molecule C_{76}, however, proved more sophisticated: its cage was chiral!

These researchers isolated 36 mg of C_{76}, which was contaminated with a small amount of C_{78} which they removed using HPLC. The ^{13}C NMR spectrum of C_{76} consisted of 19 lines of equal intensity, a perplexingly large number for such a spheroid.

There are several thousand possible structures of this molecule but, according to the theoretical calculations of D.E. Manolopoulos (*Journal of the Chemical Society–Faraday Transactions*, 87:2861, 1991), the most likely is a twisted arrangement of edge-sharing pentagons and hexagons. The twist means that there can be a left or a right hand helix; so that C_{76} must have chiral forms. The 19-line NMR pattern is consistent with C_{76} having the required D_2 symmetry for this.

The only non-fullerene work in the chart is paper #10 by William Goddard, Stephen Mayo, and Barry Olafson, and comes from BioDesign, Inc., of Pasadena, California, although Goddard is based at the California Institute of Technology in Pasadena. The paper is devoted to a new force field for predicting molecular configurations, which they call DREIDING. This is based on simple concepts and can predict the structures and dynamics of organic, non-metal inorganic, and even biological molecules. The DREIDING force field is based on bond lengths derived from atomic radii, simple hybridization bonding arrangements, and torsional barriers, of which only six different values are required.

Goddard *et al.* tested DREIDING on 76 molecules whose structures are accurately known, and they computed rotational barriers and conformational energies for these compounds. Agreement between theory and observation is excellent. This paper should appear again on future Top Ten listings. However, if DREIDING is to make the #1 spot it may need to display some predictive power.

Could DREIDING have forecast the structure of C_{76}? If it could, it may be on the way to the top of the list!

J. Emsley,
Science Watch, (January 1993) 5

Moscow Tops in Paper Productions; Osaka Rises Rapidly

"Mindless." "Pedestrian." "Mere accountancy." These and other terms have been used to describe the quantitative analysis of the research literature.

True, the tasks involved in counting journal articles and citations can be mindnumbing, but bibliometrics is becoming less and less burdensome thanks to well organized databases and high-speed computing. Moreover, by bringing order and shape to unordered and shapeless facts, such methods can reveal otherwise unrecognized phenomena and trends.

"Mere accountancy?" Accountancy, yes. Mere, no.

Take the table at right, for example. *Science Watch* surveyed all papers indexed in ISI's *Science Citation Index* in 1991 and determined the 25 cities that produced the most papers. For these 25, *Science Watch* calculated the percentage increase in their output of research reports from 1981 to 1991.

Production of most things in Moscow has been falling lately, but scientific papers seem the exception. Moscow turned out the greatest number of papers worldwide in 1991 – nearly 15,000 of them. Close behind was London, England, with just over 14,000. Boston/Cambridge, Massachusetts came in third, Tokyo was fourth, and New York City took fifth place.

In this analysis Boston/Cambridge, as well as San Diego/La Jolla and Stanford/Palo Alto, were treated as single

Research Rich Cities

Rank	City	No Papers in 1991	Percent Change 1981 vs. 1991
1	Moscow	14,541	+ 7.3
2	London (U.K.)	14,051	+ 11.4
3	Boston/Cambridge	12,480	+ 18.4
4	Tokyo	11,582	+ 41.1
5	New York	8,551	+ 6.8
6	Paris	7,964	+ 11.4
7	Los Angeles	6,601	+ 13.6
8	Bethesda	6,233	+ 13.3
9	Philadelphia	6,183	+ 19.0
10	Osaka	5,408	+ 57.3
11	Washington, D.C.	5,388	+ 1.4
12	Chicago	5,174	- 0.9
13	Baltimore	4,933	+ 44.7
14	Houston	4,911	+ 27.9
15	San Diego/La Jolla	4,740	+ 32.3
16	Stanford/Palo Alto	4,201	+ 16.3
17	Seattle	4,055	+ 22.8
18	Berlin	4,040	+ 15.0
19	Ann Arbor	3,907	+ 43.9
20	Montreal	3,895	+ 41.3
21	Toronto	3,887	+ 32.2
22	Cambridge (U.K.)	3,850	+ 30.4
23	San Francisco	3,773	+ 20.2
24	Kyoto	3,679	+ 43.0
25	Oxford (U.K.)	3,597	+ 47.1

SOURCE: ISI's Science Citation Index, 1991.

municipalities, although, speaking legally, they are of course separate entities. *Science Watch* decided that if two cities had contiguous borders, the two should be counted together. City boundaries are, after all, artificial units of division when it comes to scientific research. Regions are no less artificial but are perhaps even harder to define.

Of the 25 identified as the top producers, 14 are U.S. cities, three are British, three are Japanese, two are Canadian, and one each is located in Russia, France, and Germany.

In terms of growth, the rising star among the nations represented is Japan. Papers from Osaka increased 57.3% from 1981 to 1991, while those from Kyoto rose 43.0% and those from Tokyo shot up 41.1% during the decade.

Other big movers among the group include Oxford, England (+47.1%), Baltimore, Maryland (+44.7%), Ann Arbor, Michigan (+43.9%); and Montreal, Canada (+41.3%).

Finally, the skewed distribution of this dataset should be noted. These 25 cities account for approximately one out of every four research papers indexed by ISI in 1991. This illustrates the impressive concentration of scientific activity on the planet in a very small number of locations.

Science Watch, (December 1992) 7

ISI's Journal Selection Guidelines and Use of the Journal Citation Reports (JCR)

Discussed here will be journal selection considerations and some aspects of the *Journal Citation Reports* (*JCR*) that are published for both the *Science Citation Index* (*SCI*) and *Social Sciences Citation Index* (*SSCI*).

Primary publishers and journal editors often express a strong desire to have their journals covered in ISI products since inclusion in these services gives a journal exposure to a large audience [1]. We too are interested in seeing their journals be successful and publish significant research that our customers will find useful. Yet we must remain very selective, not only out of the cost considerations that all businesses face, but also in the interest of the users of our services whose time for scanning journals is limited. As most of you are probably aware, ISI's method of selecting journals for its services differs from that of most other abstracting and indexing (A&I) services. Many A&I services aim for comprehensive coverage of particular subject areas. ISI's journal selection procedures have been based upon Bradford's Law of Scattering and the premise that 90% of the significant literature will be contained in a relatively small core of journals [2].

For journals not already in our products, we obtain the most recent sample issues from the publisher and consider seven basic factors during our evaluation:

– The content of the journal is examined and reviewed against present coverage in the subject area. We (1) determine whether subject area enhancement is needed; (2) look for and favor, for coverage, journals with full, original research and/or review articles; (3) consider whether the intended audience matches our customer base; (4) examine author and editorial board affiliations; and (5) in some cases note whether the research being reported was supported by grants.

– Citation analysis is also a tool used in journal evaluation. We examine the citation frequency of the journal's authors, editorial board members, and, if the journal has been publishing for several years, of the journal itself.

– In an effort to maintain geopolitical balance, we take into account the extent of our present coverage from a particular country or in a specific language, and generally favor journals with international scope and contributions.

– Recommendations from our subscribers and Editorial Advisory Board members play an important role.

– Two other aspects of journal evaluation that Isabel Czech discussed in her paper are whether the journal is able to publish on-time, and the format of the journal [3].

– Finally, space limitations must be considered. Besides the nearly 350 new journals that were evaluated in 1986, we also reviewed hundreds of other established journals. Moreover, 1986 and previous years saw substantial internal growth within covered journals that increased their number of articles per issue and their number of issues per year. This mandates even greater selectivity in the choices that are made.

Review and refinement of present coverage is also ongoing. Recommendations and inquiries from subscribers, editors and publishers as well as our regularly scheduled studies prompt us to reevaluate covered journals and conduct subject/product placement studies. Journals that have been covered for a number of years may have been superseded by new journals publishing research articles of higher impact, or may have changed in scope and should be placed in different categories or products. Coverage needs may have changed and new fields of research emerged. When reevaluating currently covered journals, we review content and scope of the journal, extent of our coverage in the discipline, geopolitical representation, length of time the journal has been covered, new journals in the field being considered, whether the journal has problems with publishing on time, and citation data on the journal or subject area.

In our citation analysis, we use the *JCR* and other internal citation reports generated from our database. When used properly, the *JCR* serves as a valuable tool. As we and others have repeatedly cautioned, however, citation data and the *JCR* are not intended to use alone or indiscriminately, but should be viewed as objective quantitative information to be used in concert with other objective and subjective considerations [4]. The *JCR* has proven useful not only to us, but also to librarians as an aid in selection

and deselection and in making decisions about serials maintenance and deacquisitioning [5]. The *JCR* may help authors determine where to publish their papers and to locate journals publishing related research. In addition, it assists publishers in knowing how frequently the research appearing in their journals is being referenced and by which journals [6].

The *JCR* is a major source of quantitative data concerning the relationships among journals. It includes five data listings: the Journal Ranking package, Source Data Listing, Journal Half-Life Listing, Citing Journal Listing, and Cited Journal Listing. In this paper attention is focused on the Journal Rankings package, the Citing Journal Listing and the Cited Journal Listing. Examples from the 1985 *SCI JCR* will illustrate the points made.

SCI JOURNAL CITATION REPORTS
Citing Journal Listing

	CITING JOURNAL / CITED JOURNAL	TOTAL	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	Rest
		<----------Number of Times This Year Was Cited in 1985---------->											
2.69	NEUROPHARMACOLOGY	4636	84	328	547	516	485	417	317	309	248	227	1158
2.91	BRAIN RES	323	7	25	29	36	27	38	30	25	23	24	59
3.18	EUR J PHARMACOL	297	11	34	44	30	41	22	26	17	14	18	40
2.69	NEUROPHARMACOLOGY	262	10	23	55	43	29	22	12	16	10	11	31
2.78	LIFE SCI	232	5	10	32	36	25	28	20	21	10	11	34
3.63	J PHARMACOL EXP THER	229	1	8	29	24	17	17	10	17	11	9	86
4.09	BRIT J PHARMACOL	203	9	17	29	11	14	12	8	16	8	5	74
3.51	J NEUROCHEM	168	2	12	19	12	21	21	12	9	9	10	41
12.86	NATURE	165	1	12	8	10	21	26	11	11	26	11	28
10.90	SCIENCE	131	0	5	10	18	19	22	11	8	11	4	23

Figure 1

The Citing Journal Listing includes entries for each *SCI* source journal. The entry for *Neuropharmacology* shows the total number of references in articles it published in 1985, the journals it cited and the distribution by year to the articles it cited (Figure 1). The impact factor, which is a measure of the number of times the average article in a journal is cited in a particular period, is also given for the citing and the cited journals. The significance of impact factors will be discussed later.

SCI JOURNAL CITATION REPORTS
Cited Journal Listing

	CITED JOURNAL / CITING JOURNAL	TOTAL	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	Rest
		<----------Number of Times This Year Was Cited in 1985---------->											
2.69	NEUROPHARMACOLOGY	4950	74	487	837	652	549	459	340	340	297	175	740
2.91	BRAIN RES	361	3	30	69	46	43	20	33	41	19	14	43
1.73	PHARMACOL BIOCHEM BE	291	2	24	60	33	32	20	19	19	19	14	49
2.69	NEUROPHARMACOLOGY	262	10	23	55	43	29	22	12	16	10	11	31
3.18	EUR J PHARMACOL	233	6	25	41	35	30	26	17	11	14	7	21
2.78	LIFE SCI	213	9	18	35	46	20	22	11	12	10	10	20
1.85	PSYCHOPHARMACOLOGY	181	2	17	45	22	13	22	22	8	8	2	20
2.83	NEUROSCI BIOBEHAV R	147	0	18	25	34	14	18	2	5	6	1	24
3.63	J PHARMACOL EXP THER	128	2	15	21	19	11	15	6	11	5	4	19
3.51	J NEUROCHEM	113	1	12	19	17	14	5	9	16	6	3	11

Figure 2

The Cited Journal Listing in the *SCI JCR* includes entries for science journals referenced by the journals in our database. Included are journals covered in the *SCI*, those in *Current Contents* but not the *SCI*, and a few titles that may be heavily cited, but because of format are not appropriate for coverage in ISI's services. The entry for *Neuropharmacology* in the Cited Journal Listing section (Figure 2) shows that in 1985, it was cited 4950 times by the journals in our database. We know which titles cited it, the number of times, and the chronological distribution of articles cited.

The type of data available in both the Citing and the Cited Journal Listings can be analyzed to identify whether it is primarily newer articles, older ones, or articles from a consistent range of years that are being used in current research. Ties between journals and the strength of both ties are revealed. This information aids in identifying journals publishing related research and emerging research fronts, and in determining subject category and product placement.

The Journal Rankings package contains listings of science journals cited by the journals in our database, and like the Cited Journal Listing includes entries for journals not covered in the *SCI*. This package contains an alphabetical list of journals cited, five other listings ranked by different indicators such as impact factor or number of times cited, an alphabetical listing of social sciences journals, and finally, journals in the *SCI* that are ranked by impact factor within their subject category.

SCI JOURNAL CITATION REPORTS
Journals in Alphabetical Order

SECTION 1

SEQ #	JOURNAL TITLE	<--------CITATIONS IN 1985 TO--------> ALL YEARS	1984	1983	84+83	<--SOURCE ITEMS IN--> 1984	1983	84+83	IMPACT FACTOR	CITATIONS IN 1985 TO 1985 ITEMS	SOURCE ITEMS IN 1985	IMMEDIACY INDEX
3126	NEUROPHARMACOLOGY	4950	487	837	1324	263	228	491	2.697	74	198	0.374
3127	NEUROPHYSIOLOGY	258	32	22	54	91	73	164	0.329	7	33	0.212
3128	NEUROPSYCHIAT ENFAN	31	4	6	10	60	77	137	0.073	4	77	0.052
3129	NEUROPSYCHOBIOLOGY	445	62	80	142	97	84	181	0.785	10	44	0.227
3130	NEUROPSYCHOLOGIA	2133	88	134	222	84	76	160	1.388	15	82	0.183
3131	NEURORADIOLOGY	1511	91	125	216	94	76	170	1.271	14	104	0.135
3132	NEUROSCI BIOBEHAV R	841	66	161	227	42	38	80	2.838	59	42	1.405
3133	NEUROSCI LETT	7812	1209	1651	2860	527	493	1020	2.804	213	600	0.355
3134	NEUROSCIENCE	8015	849	1400	2249	261	250	511	4.401	206	257	0.802
3135	NEUROSURGERY	2471	247	390	637	281	255	536	1.188	74	302	0.245

Figure 3

The alphabetical listing shows the 1985 impact factor of *Neuropharmacology* was 2.7, which was calculated by dividing the number of 1985 citations to material *Neuropharmacology* published in 1983 and 1984 by the total number of citable articles [7] it published in those same two years (Figure 3). Calculating the average number of citations per article eliminates the advantage that older journals or ones that publish a large number of articles per issue or with higher frequency have over newer, smaller, or less frequently published ones, and therefore is more meaningful than the absolute citation counts. The impact factor is one of many indicators of the impact a journal has in its field.

The immediacy index calculation indicates the number of times the average article is cited in the year that it was published, and thus indicates how quickly a journal's articles are being cited. The frequency of a journal as well as its discipline will affect this number.

SCI JOURNAL CITATION REPORTS
Journals by Category – Ranked by Impact Factor

RANK	TITLE	IMPACT FACTOR	CITED HALF-LIFE
	NEUROSCIENCES		
1	J NEUROSCI RES	18.928	2.6
2	ANNU REV NEUROSCI	14.794	4.5
3	BRAIN RES REV	6.182	3.7
4	INT REV NEUROBIOL	5.474	8.7
5	J CEREBR BLOOD F MET	5.426	2.9
6	J NEUROPATH EXP NEUR	4.632	> 10.0
7	NEUROSCIENCE	4.401	4.1
8	TRENDS NEUROSCI	4.397	2.8
9	ANN NEUROL	4.367	4.3
10	J COMP NEUROL	4.256	7.0
.	.		
.	.		
.	.		
23	NEUROPHARMACOLOGY	2.697	4.7

RANK	TITLE	IMPACT FACTOR	CITED HALF-LIFE
	PHARMACOLOGY & PHARMACY		
1	PHARMACOL REV	20.556	> 10.0
2	REV PHYSIOL BIOCH P	9.750	5.6
3	ANNU REV PHARMACOL	9.630	5.9
4	MOL PHARMACOL	4.794	5.8
5	BRIT J PHARMACOL	4.093	6.7
6	ANTIMICROB AGENTS CH	3.860	4.5
7	N-S ARCH PHARMACOL	3.821	6.0
8	CLIN PHARMACOL THER	3.672	6.0
9	J PHARMACOL EXP THER	3.630	7.2
10	EUR J PHARMACOL	3.182	4.7
.	.		
.	.		
.	.		
16	NEUROPHARMACOLOGY	2.697	4.7

Figure 4

Within the Journal Rankings package is a breakdown of *SCI* source journals by category, with journals ranked by impact factor within the categories (Figure 4). Since journal citation particles and patterns vary from one discipline to another, journals in different fields should not be compared in terms of citation frequencies. The category ranking is useful for providing a means for intradisciplinary comparisons. A journal with an impact factor ranking at the top of the category is publishing significant research or review articles that are being recognized and cited. Journals ranking at the bottom of the categories generally become candidates for ISI's further evaluation. A decision to change coverage in our products will not occur until all of the factors mentioned above are considered. Moreover, several years worth of citation information will be reviewed to determine if this instance of low impact factor is an anomaly, or if it is part of a continuing trend. Journals under review for citation index coverage will be compared with currently covered ones, but again, the decision as to whether or not to add a journal to a citation index can be based partially on citation analysis but will not be entirely dependent on it.

We also use special internal reports generated from our database to conduct studies of particular subject areas. These studies may indicate that product placement or category changes need to be made, or may identify journals in the study. This often leads to our contacting publishers for sample journal issues or other information.

As a secondary publisher, we appreciate and rely on the cooperation of primary publishers who supply us with materials, and inform us of new or changing serials. Without that cooperation, our ability to produce services of value to the research community would be difficult indeed.

Ruth W. Allee, The Serials Information Chain (1988) 47-54

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[1] **E. A. Garfield**, "Journal selection for *Current Contents*: Editorial merit vs. political pressure," *Current Contents*, 11 (March 18, 1985):3-11.

[2] **E. A. Garfield**, "The mystery of the transposed journal lists – wherein Bradford's Law of Scattering is generalized according to Garfield's Law of Concentration", *Essays of an Information Scientist* (Philadelphia: ISI Press, 1977), pp. 222-223.

[3] **Isabel W. Czech**, "The relationship between primary and secondary publishers: A general overview," *Serials Librarian*, in press.

[4] **E. A. Garfield** (ed), *SCI Journal Citation Reports*. (Philadelphia, Institute for Scientific Information, 1986), p. 7A-9A; idem, "Citation analysis as a tool in journal evaluation", *Science* 178 (November 3, 1972):474-476; **Linda C. Smith**, "Citation analysis", *Library Trends* 30 (Summer 1981):86-106. Also see Garfield, *SSCI Journal Citation Reports*, pp. 52A-60A for a lengthy bibliography on journal citation analysis and its applications.

[5] **S. J. Bensman**, "Journal collection management as a cumulative advantage process", *College & Research Libraries* 46 (January 1985):23-25; **R. N. Broadus**, "A proposed method for eliminating titles from periodical subscription lists," *College & Research Libraries* 46 (January 1985):30-35; **M. B. Line**, "Use of citation data in libraries: A response to Broadus," *College & Research Libraries* 46 (January 1985):36-37; **R. N. Broadus**, "On citations, uses, and informed guesswork: A response to Line," *College & Research Libraries* 46 (January 1985):38-39; **T. E. Smith**, "The *Journal Citation Reports* as a deselection tool," *Bulletin of the Medical Library Association* 73 (October 1985):387-389.

[6] The length of subentry lists under the main entries for the Citing Journal Listing and the Cited Journal Listing is controlled by an algorithm. To include every citing or cited journal in subentry lists would result in many more *JCR* volumes with negligible additional value. For a more complete description of the algorithm, see **Garfield**, *SCI Journal Citation Reports*, 29A.

[7] These are also referred to as source items. In the *JCR*, only original articles, technical notes and review articles are counted as source items. An exception occurs with five journals in the 1985 *SCI JCR*, which had meeting abstracts included in the source item counts for calculating the impact factor and immediacy index. See **Garfield**, *SCI Journal Citation Reports*, p. 13A.

The importance of being useless

Arturo Sangalli advocates the case for irrelevant research

"In time of government restraint, how much do we need to know about eunuchs in imperial China?" The title of the newspaper article was an invitation to read on. I did so, without really expecting an answer to what was clearly a rhetorical question. The author had cast a critical eye over the $82 million in grants handed out by the Social Sciences and Humanities Research Council of Canada in 1990-91, and was not happy with what he saw. "At a time when the (Canadian) government is paring services, it is spending $15435 to finance a study on eunuchs in imperial China, with special focus on the 10th to 14th centuries".

And it went on: "Among other projects Canadians are helping finance through taxes are a study of the modern American diet ($27700), an analysis of criminality and religious charity in the 16th-century Bologna ($6901) and a look at the late prehistoric archeology of the Ha'apai Islands in the Kingdom of Tonga ($80318)."

Many will agree that such use of public funds is, at best, questionable. But on what grounds? Are we assuming the only "useful" research merits support? And what are the criteria for usefulness?

In this particular case, the judgement appears to be based, not on the projects themselves, but on their titles. But a title may be irrelevant, uninformative or incomprehensible to everyone except the experts in the field. How would a journalist – or many a scientist, for that matter – have reacted early in the century to "The special theory of relativity"?

Besides, if you apply for a grant, your project must have a title, presumably describing what you're up to. However, in many cases, an appropriate title will follow from, not precede, your discovery.

A popular choice is to measure utility in purely materialistic terms: something is useful (only?) if it is good for the economy. Most scientific research financed with public funds is guided by the principle that there should be a correlation between research spending and the state of the country's economy – in crude terms, taxpayers want value for their money. But with such a narrow definition entire branches of knowledge would not qualify as useful. Are we to deny support to those studying the past or searching for a meaning to life or trying to understand the Universe simply because such knowledge is not necessarily linked to economic prosperity?

The British mathematician G. H. Hardy wrote in 1940: "If useful knowledge is knowledge that is likely, now or in the comparatively new future, to contribute to the material comfort of mankind, so that mere intellectual satisfaction is irrelevant, then the great bulk of higher mathematics is useless." Hardy was obsessed with preventing the use of science and mathematics for inflicting human suffering and was known for glorying in the uselessness of his work, because useless knowledge is harmless knowledge.

A more generous definition of "useful" is "beneficial to mankind", although this begs the question of what precisely we understand by "beneficial". The Nobel committees must know the answer, because they award the prestigious prizes to those who have most benefited humankind in physics, chemistry, medicine, literature and peace.

Occasionally, humankind is best served by not trying to do something useful. In 1965, the American physicist Richard Feynman won the Nobel Prize for Physics. In a volume of anecdotes, his friend Ralph Leghton reports how Feynman, after observing a wobbling plate that had been thrown into the air, started to play with the equations describing its motion. This was a luxury Feynman could afford, for his boss at Cornell University had advised him not to worry about what he should or shouldn't be doing. "There was no importance to what I was doing," wrote Feynman, "but ultimately, there was. The diagrams and the whole business that I got the Nobel prize for came from that piddling around with the wobbling plate."

Whatever the definition of useful, who can predict all the consequences of a given piece of research? Take the eunuchs in the imperial China of the 10th century, for example. We may end up discovering that the reason they were castrated was to prevent the spread of a terrible disease, thus raising the possibility of the existence 10 000 years ago, of HIV-like virus.

There is an analogy between the totality of all research and the pile of seeds of an ancient Greek paradox. If we remove one seed from a pile of seeds, we still have a pile. But if we keep removing seeds, eventually we will not have a pile any more, even though removing each individual seed made no difference. If we are supporting enough research for society's needs (including the economy) and the advancement of knowledge, surely eliminating a single project will have no noticeable effect. But then by this rationale we could eliminate them all – and still have enough. How many can we drop without destroying the pile?

I would have liked to make out a stronger case by providing some scientific and statistical evidence. Unfortunately, my application for a grant to study the importance of useless research was rejected: the referees did not see the use of such a project.

A. Sangalli,
New Scientist, 11 (January 1992), p. 52

A tudományos kutatás és a gyógyszeripar információs kapcsolatainak vizsgálata a szabadalmakban

A neves amerikai közgazdász E. Mansfield [1] megállapítása szerint: "The patent system is at the heart of our nation's policies toward technological innovation."

Az említett szerző 100 amerikai céget választott ki 12 iparágból és megvizsgálta, hogy 1981-83 között hány olyan innovációjuk volt az összeshez viszonyítva, amely nem jött volna létre akkor, ha nem működött volna a szabadalmi rendszer. Az illető cégek vezetőivel készített interjúk révén arra is választ kért az amerikai kutató, hogy hány olyan, már a piacra bevezetett terméke volt az illető vállalatoknak, amelyeket nem fejlesztettek volna ki, ha nem állt volna fenn a szabadalmi védettség lehetősége. Az eredmények azt mutatták, hogy a szabadalmi védettség két iparágban (gyógyszeripar, vegyipar) igen fontos szerepet játszik. Az említett iparágakban az összes termék 65, illetve 30%-ának fejlesztésénél, illetve bevezetésénél a szabadalmi védettségnek alapvető jelentősége volt. Az olajiparban, a gépgyártásban és a fémtermékeket előállító iparágakban a szabadalmi védettség az összes innovációnak csupán 10-20%-ában játszott lényeges szerepet.

Narin [2] volt az első, aki a szabadalmakban lévő hivatkozások forrásait vizsgálta abból a célból, hogy arra következtethessen, mennyire tudományigényes, illetve technikaigényes egy új termék létrehozása. Elemzése azt mutatta, hogy egy speciális, gyógyszeripari területen (prosztaglandinok) 8,2 volt szabadalmanként a tudományos folyóiratok cikkeire, míg 3,3 a szabadalmakra történt hivatkozások száma. A gyógyszeripar köztudottan kutatásigényes, a prosztaglandinkutatások pedig különösen erősen támaszkodtak a vizsgálat időpontját megelőző időben a tudományos kutatásokra. Ezért is találhattak a szabadalmak tudományos információigényére ilyen nagy számot.

A tudományos kutatás és az ipar közötti információs kapcsolatok feltárásának érdekében az 1990. évben Magyarországon megadott gyógyszeripari szabadalmakban lévő hivatkozásokat vizsgáltuk források szerint. Az 1. táblázat adatai szerint összesen 104 gyógyszeripari szabadalmat adtak meg magyar szabadalmasoknak. A leginventívebb cég 1990-ben a CHINOIN volt. Az említett szabadalmak közül a gyógyszeripari vállalatok 79 szabadalmát dolgoztuk fel.

1. táblázat
Az 1990. évben megadott hazai gyógyszeripari szabadalmak tulajdonosai

Intézmény	Megadott szabadalmak száma
CHINOIN Gyógyszer és Vegyészeti Termékek Gyára	25
BIOGAL Gyógyszergyár	18
EGIS Gyógyszergyár	16
RICHTER GEDEON Vegyészeti Gyár Rt	15
Gyógyszerkutató Intézet	18
ALKALOIDA Vegyészeti Gyár	4
EGAL Közös Vállalat	3
Egyéb (összesen 13) vállalatok, intézmények, intézetek, egyetemek	15
Összesen	104

Megjegyzés:
csak a kettőnél több szabadalmat kapott intézményeket tüntettük fel

A szabadalmakban található hivatkozásokat forrásuk jellege szerint a következőképpen csoportosíthatjuk:

– tudományos folyóiratban megjelent cikkek, könyvek, konferenciakiadványok, disszertációk (ezeket összefoglalóan tudományos publikációnak nevezhetjük);

– szabadalmak;

– egyéb kiadványok (belső jelentések, katalógusok).

Feltételezhetjük, hogy a hivatkozott tudományos publikációkból származó információ a szabadalom létrehozásához szükséges tudományos alapokat adja meg, míg a szabadalmakra történő hivatkozások a piachoz közelebbi, elsősorban alkalmazott kutatási, fejlesztési eredmények átvételére utalnak.

A vizsgált három fejlett ipari ország esetében a szabadalmak *tudományigényessége* hasonló, hozzávetőleg 5-6 publikációra hivatkoznak szabadalmanként, szemben a magyar adattal, amely 3,39 (2. táblázat). A cikkekre vonatkozó adatokban hasonló az eltérés. A magyar adatok feltehetően azért ilyen szerények, mert a külföldi szabadalmak *új termékre*, míg a hazaiak zömmel *új*

eljárásra vonatkoznak. Ha kizárólag az új termékekre vonatkozó magyar szabadalmakat számítjuk, akkor egy szabadalomban átlag 3,81 cikkre történő hivatkozást találunk. (Ez az adat még mindig kisebb, mint pl. az USA adata, azonban csak 21 szabadalomra vonatkozik, ezért kevésbé megbízható.) A szabadalmakra történő hivatkozások száma viszont hazánk esetében a legnagyobb (4,47). Érdemes felfigyelni arra, hogy relatíve milyen nagy a külföldi szabadalmi információk felhasználása (3,33).

A 2. táblázat adatainak alapján kiszámíthatjuk az ún. *Relatív Tudományos Információigény* mutatószámot (RTI), amely a tudományos publikációkra, illetve a szabadalmakra történő szabadalmankénti információforrások hányadosa. Így pl. RTI = 3,39/4,47 = 0,76 Magyarországra számítva, míg USA, Németország és Nagy Britannia esetében az RTI adatok rendre a következők: 1,36; 1,47; 2,01. Ha hazánk esetében csak a 21 termékszabadalommal számolunk, akkor RTI = 3,81/3,45 = 1,10, amely már megközelíti a vizsgált másik három ország megfelelő adatát.

2. táblázat. Az 1990-ben Magyarországon megadott gyógyszeripari szabadalmak fajlagos információforrás-igénye (forrás/szabadalom)

	Tudományos információforrás		Szabadalmi információforrás		
Ország	cikk	tudományos publikációk összesen	hazai	külföldi	összesen
USA	4,34	5,00	2,80	0,88	3,68
Nagy Britannia	4,67	5,59	0,72	2,07	2,79
Németország	4,88	5,94	1,18	2,86	4,04
Magyarország	2,54	3,39	1,14	3,33	4,47

3. táblázat. Szabadalmi "önhivatkozások" (hazai szabadalmakra való hivatkozások) száma és aránya országonként az 1990-ben Magyarországon megadott gyógyszeripari szabadalmakban

Hivatkozó ország	Vizsgált szabadalmak száma	Összes hivatkozott szabadalom száma	Hazai szabadalmakra történt hivatkozások száma	Önhivatkozások %-ban
USA	50	188	140	75
Nagy Britannia	46	128	33	26
Németország	49	198	58	29
Magyarország	79	353	90	25

4. táblázat. Hivatkozott országok, illetve csoportok százalékos aránya az 1990. évben Magyarországon megadott gyógyszeripari szabadalmakban (az összes hivatkozott szabadalomra vonatkoztatva)

	Hivatkozott ország, illetve csoport (szabadalmi hivatkozások %-os aránya)			
Hivatkozó ország	USA	Európai országok	Japán	Egyéb
USA	75	23	2	0
Nagy Britannia	16	78	5	1
Németország	24	72	3	1
Magyarország	19	70	9	2

Megjegyzés: Az európai országokra történt hivatkozásokba beleértendőek a saját országra történt (ön)hivatkozások is.

A 3. táblázat bemutatja, hogy a szabadalmasok milyen arányban használnak fel hazai, illetve külföldi információkat. Feltűnő, hogy az USA mennyire meghatározó mértékben (75%) támaszkodik saját korábbi szabadalmi információira. A többi három ország csupán 25 - 29%-ban épít saját szabadalmaira.

Ha azonban az európai országokat *egységnek* tekintjük, akkor a kép az USA-hoz teljesen hasonló lesz, hiszen pl. Nagy Britannia "hazai" (értsd: európai) hivatkozásai 78%-ot, Németországé 72%-ot és Magyarországé 70%-ot tesznek ki (4. táblázat).

Érdemes megfigyelni, mennyire csekély arányú a japán szabadalmak igénybevétele. A Japánból származó szabadalmi információkra hazánk, úgy tűnik, jobban épít, mint a többi vizsgált ország (4. táblázat).

Végezetül álljon itt Soete és Wyatt [3] megállapítása, amely szerint: "... the analysis of patent information remains one of the most established, directly available and historically reliable methods of quantifying the output of a science and technology system."

Vinkler Péter, MTA KKKI

[1] E. Mansfield, *Management Science*, 32 (1986) 173
[2] F. Narin, E. Noma, *Scientometrics*, 7 (1985) 369
[3] L.G. Soete, S.M.E. Wyatt, *Scientometrics*, 5 (1983) 31

Készült az MTAK bázi sokszorosító részlegében

Felelős kiadó: az MTAK főigazgatója