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Current Comments

The 1976 Articles Most Cited in 1976 and 1977. Part I. Life Sciences

Number 13 March 26, 1979

About three years ago I completed a series of essays reporting the most cited papers for the years 1970-75.[1] I intended at the time to follow up with at least one similar report each year. As one is apt to say these days, my computer goofed! Two years overdue, I present the data you should have received in the spring of 1977. However, the delay allows me to present a study I could not have done had I been on schedule.

The reason for this lies in the chronological artifact of annual citation studies. Since papers may be published during any week of the year, the papers published in the last weeks are bound to be cited less frequently that year than those appearing in the first weeks. Thus, many papers, published too late in 1976 to receive any citations that year, received enough in 1977 to appear on our list. The delay permits me to report these latecomers, albeit at the sacrifice of some newsworthiness. Had I reported to you in 1977 on the papers by Roger Guillemin, I'm sure it would have been more meaningful, considering his *subsequent* receipt of the Nobel Prize. He and Andrew Schally received the prize for their independent work on peptide hormone production in the brain.

Of possible greater significance is the paper by C. B. Pert of the National Institutes of Health. The recent announcement of the 1978 Lasker Award for Basic Medical Research has produced a storm of controversy because Pert was not among those cited for the discovery of opiate receptors and the isolation of enkephalins.[2] S. H. Snyder, with whom she worked until 1975, J. Hughes, and H. Kosterlitz were named. Snyder has two papers on the list. I will discuss the controversy in more detail in a future essay.

In view of the difficulties mentioned above, I have resolved that in 1979, we shall create a program that will enable us to monitor, week by week, the citation patterns for papers published in 1979. This will allow me to report promptly and consistently those articles which accrue the number of citations one expects for "break-through" papers, or for review papers in hot fields. Indeed, the new program

will become the basis for a current science monitoring service for our readers.

It is apparent that all the papers listed in this essay are important contributions to science. Some of them have been cited frequently because they have had a significant impact. By this we mean that in one way or another these papers have contributed to the thought processes of the citing authors. Some review papers are highly cited because they conveniently summarize an entire area of activity that would otherwise require multiple citations for adequate documentation. However, it is a rare review paper in the highly cited group which does not also contribute new ideas while summing up a field's progress. Each paper must be judged on its own, with no special significance given to small differences in citation frequency.

The average article on the list received 65 citations during 1976-77. Of these, 14 were received in 1976 and 51 in 1977. As we went to press, I was able to determine that this group of papers averaged 56 additional citations in 1978. This indicates, as we have known all along, that the citation rate in early years is a good indicator of *future* citations.

Since these papers are on the average 1½ years old, the rate for 1976-77 was about one citation per week beginning about two months after publication. One expects a short delay in citation even for a work that has been seen by potential citers who referee the paper or have seen it in pre-print form. However, this assumption has not been verified by a precise week-by-week analysis. This will be possible when we do our week-by-week computer analyses. Incidentally, the "epidemiology" of citation has been studied by Bill Goffman[3-4] at Case-Western Reserve University. However, his work and most other citation studies examine citation patterns on a year-by-year basis.

The most-cited paper on the list received 290 citations—the least-cited received 40. Keep in mind that the average 1976 paper published in a journal covered by the *Science Citation Index®* was cited less than two times in the same period. Indeed, out of the thousands of 1976 life *and* physical sciences papers that were cited in 1976-77, only 4300 were cited 10 or more times. Of these, 127 were cited 40 or more times; 143, 30-39 times; 451, 20-29; and 3,588, 10-19 times. Thus, less than 1% of *all papers published* are cited ten or more times in the 18 months following publication. Less than .1% are cited 25 or more times. And yet, I must emphasize that one cannot conclude that those on this list are necessarily more important or more interesting than the next 100 we could have listed. We need to find a way to publicize not only more papers, but also papers from small fields like mathematics and botany.

The 33 journals in which the 100 articles were published are all journals with high impact, except one. A few journals have not appeared on these lists before. Four journals account for over half, that is, 56 papers. They are: *Proceedings of*

the National Academy of Sciences US (21), *Nature* (13), *New England Journal of Medicine* (12), and *Science* (10). A complete list of the journals represented appears in Table 1.

The authors were affiliated with 86 different institutions (shown in Table 2). The domination of American laboratories is an important indicator to watch. The United States is represented by 54 institutions; its closest rival, the United Kingdom, by nine. Five institutions are in Japan, three each in Australia and Canada, and two each in Sweden, France, and Switzerland.

The USSR, Argentina, Italy, Belgium, the Netherlands, and Israel each have one institution on the list. It is significant that all the papers on the list, except one, were published in English. The exception was Roger Guillemin's paper in *Comptes Rendus.*

Twenty articles are concerned with endorphin and enkephalin, endogenous opiates found in the brain and pituitary gland. These substances were discovered in 1975. The functions of these chemicals, and their possible applications to medicine and psychiatry, are only now being mapped out. Studies of brain opiates could lead to the development of non-addictive analgesics (pain relievers), to replace opium derivatives such as morphine and codeine. Further research could also lead to new understandings of the mechanisms of pain, pleasure, perception, memory, and mental disorders.

Sixteen papers are on cancer research; eight of them deal with a single powerful carcinogen, benzo (*a*)pyrene. This substance is not the most potent cancer-causing agent in laboratory animals, according to author W. Levin of Hoffman-La Roche in Nutley, New Jersey.[5] But since it is generated by any incomplete combustion process, in-

Table 1: The 33 journals represented on the list of the 100 1976 life sciences papers most cited in 1976-77. The numbers in parentheses are the impact factors for the journals. (Impact equals number of citations received by 1975/76 articles in 1977.) The figures at the right indicate the number of papers from each journal which appear on the list.

Proc. Nat. Acad. Sci. US (9.15)	21
Nature (4.96)	13
N. Eng. J. Med. (12.55)	12
Science (5.75)	10
Cell (11.08)	4
J. Exp. Med. (11.61)	4
Biochim. Biophys. Acta. (3.17)	3
Amer. J. Roentgenol. (2.02)	2
Annu. Rev. Biochem. (26.67)	2
Bacteriol. Rev. (15.74)	2
J. Cell Biol. (8.50)	2
Lancet (8.60)	2
Nucl. Acid. Res. (3.10)	2
Prostaglandins (3.42)	2
Biochem. Biophys. Res. Commun. (3.39)	1
Brit. J. Haematol. (3.58)	1
Cancer Res. (3.65)	1
Cell Immunol. (3.79)	1
C.R. Acad. Sci. Ser. D. (0.60)	1
Gastroenterology (5.79)	1
Immunochemistry (2.03)	1
In Vitro—J. Tissue Cult. Ass. (1.14)	1
Int. J. Cancer (5.06)	1
J. Biol. Chem. (5.84)	1
J. Clin. Invest. (7.51)	1
J. Immunol. (5.56)	1
J. Mol. Biol. (7.47)	1
J. Virol. (4.98)	1
Life Sci. (3.34)	1
Neuroscience (5.34)	1
Physiol. Rev. (10.55)	1
Psychopharmacologia (2.64)	1
Transplan. R. (14.79)	1

Table 2: The institutional affiliations of authors on the list. Shown with the number of authors from each institution.

National Institutes of Health		19
National Cancer Institute	6	
National Heart & Lung Institute	1	
National Institute of Allergy & Infectious Diseases	2	
National Institute of Arthritis & Metabolic Diseases	7	
National Institute of Dental Research	1	
National Institute of Mental Health	1	
National Institute of Neurological Diseases & Stroke	1	
University of California		14
Berkeley	3	
Irvine	3	
Los Angeles	2	
San Diego	2	
San Francisco	4	
Harvard University		10
Johns Hopkins University & Hospital		6
Salk Institute		6
Stanford University		6
Hoffman-LaRoche, Inc., Nutley, NJ		4
Karolinska Institue, Sweden		4
Wellcome Research Lab., Kent, UK		4
Yale University Medical School		4
Children's Hospital Medical Center, Boston, MA		3
Massachusetts Institute of Technology		3
National Institute of Medical Research, London, UK		3
Rockefeller University, NY		3
University of Texas		3
Addiction Research Foundation, Palo Alto, CA		2
Australian National University, J. Curtin School of Med. Res.		2
Cold Spring Harbor Lab., Cold Spring Harbor, NY		2
Columbia University, NY		2
Sandoz Ltd., Switzerland		2
Scripps Clinic & Research Foundation, La Jolla, CA		2
University of Chicago		2
University of Colorado		2
University of Southern California School of Medicine		2
University Washington, Seattle, WA		2
Uppsala University, Sweden		2
Washington Univ., St. Louis, MO		2
Academy of Sciences, USSR		1
Addiction Research Foundation, Toronto, Canada		1
Beckman Instruments, Palo Alto, CA		1
Brookhaven National Lab., Upton, NY		1
Center for Disease Control, Altanta, GA		1
Centre de Recherche Merrell Institute, Strasbourg, France		1
Chiba University School of Medicine, Chiba, Japan		1
Children's Hospital Nat. Med. Ctr, Washington, DC		1
Flinders University, South Australia School of Medicine		1
Hop. Saint-Louis, Paris, France		1

Institute for Cancer Research, Buckinghamshire, UK	1
Institute of Oncology, A. H. Roffo, Buenos Aires, Argentina	1
Istituto Nazionale Tumori, Milan, Italy	1
Jichi Medical School, Japan	1
Kuakini Hospital, Honolulu, HI	1
Kyoto University, Japan	1
London Hospital Medical College	1
Mayo Clinic & Foundation, Rochester, MN	1
Medical College of Virginia	1
Medical Research Council, Cambridge, UK	1
National Research Council, Canada	1
Okubo Municipal Hospital, Japan	1
Oregon State University	1
Princeton University, Princeton, NJ	1
Public Health Research Inst. City NY, Inc.	1
Reckitt & Coleman, Pharmaceutical Div., Hull, England	1
Rockland Psychiatric Inst., NY State Research Inst.	1
Royal Melbourne Hospital	1
Royal Postgraduate Med. School	1
St. Bartholomew's Hospital, London, UK	1
Memorial Sloan-Kettering Cancer Center, NY	1
State Univiversity New York, Albany	1
State University New York, Stony Brook	1
Toronto Western Hospital	1
University of Alabama	1
University Liege, Belgium	1
University of Maryland School of Medicine	1
University of Missouri School of Medicine	1
University Nijmegen, Netherlands	1
University of Tokyo, Japan	1
University of Virginia	1
University of Wisconsin	1
University of Zurich	1
Upjohn Co., Kalamazoo, MI	1
Veterans Administration Hospital, Sepulveda, CA	1
Veterans Administration Hospital, Denver, CO	1
Weizman Instute of Science, Rehovoth, Israel	1
Wistar Institute of Anatomy & Biology, Phila., PA	1
Wyeth Labs., Phila., PA	1

dustries and even forest fires spill tons of it into the environment each year. Levin says we don't know whether benzo(*a*)pyrene produces cancer in humans. But its potency makes it a good vehicle for studying the mechanism of carcinogenesis. Various other aspects of cancer research are the subject of the eight other papers.

Fourteen of the papers deal with T-lymphocytes or T-cells. These cells play an important role in the body's defense against diseases. B-lymphocytes, or B-cells, manufacture antibodies. T-cells regulate the B-cells' production of antibodies when antigens are present. Researchers want to know how T-cells "recognize" antigens, so that

the proper antibodies are produced to attack them. Some cancers may be caused by viruses, so T-cells may have a role to play in cancer prevention. T-cells can also kill tumor cells. Studies of T-cells have applications in fields other than cancer, since they also kill cells from transplanted tissues.

Genetic mapping is the topic of 11 papers. According to Lee Peachey of the University of Pennsylvania's biology department,[6] their high rate of citation reflects a burst of activity resulting from newer, easier methods of mapping. Understanding how genes work can help us understand how cells develop and differentiate. Of course, detailed genetic mapping could also provide preventive solutions to many genetic diseases.

Eight articles are devoted to research on cell surface membranes, which may play a role in regulating the growth of cells. Knowledge of the differences between the surface membranes of normal and tumor cells is very important. Author Garth Nicolson of the University of California at Irvine tells us this applies to "every aspect of cancer, from treatment and therapy down to understanding cancer at the molecular level."[7] But cancer is only part of the reason for the interest in cell surfaces. Nicolson asserts that cell surface membranes "are involved in almost every important physiologic process, from cell movement, differentiation, growth, development [and] formation of organs."

Except for the brain opiates, all of the areas of research mentioned above have some direct relevance to cancer. This accounts for 49 papers, or almost half of the list.

Six papers deal with prostaglandins, the fatty acids that lower blood pressure, stimulate contractility of the uterine and other smooth muscle, and affect the action of some hormones. The growth of research in this field has been phenomenal. But most activity may be in studies on heart disease. According to author Roy A. Johnson of Upjohn, prostaglandin X (prostacyclin) inhibits the aggregation of blood platelets, which are vital to blood clotting.[8] Prostaglandins are also of potential use in inhibiting ulcers and controlling fertility.

The other 25 papers fall into a variety of categories and report on assay techniques, physiological mechanisms, gastrointestinal disorders, etc. Included in this group is the key paper on plasmid nomenclature which appeared shortly after the essay in which I discussed the recombinant DNA question.[9]

The most-cited paper on the list is a review article, "Recalibrated linkage map of *Escherichia coli* K-12," by Barbara J. Bachmann, K. Brooks Low, and Austin L. Taylor. Bachmann tells us that most of the research on genetic mapping has revolved around *E. coli*.[10] This is because sexual recombination, involving the transfer of DNA, occurs naturally in this organism. It was also the first organism to be mutated in a laboratory. *E. coli* is very common, found in the intestines of humans and other animals. It is also the focus of most recombinant DNA experiments.

The second most-cited paper is "Surface modulation in cell recognition and cell growth," by Gerald M. Edelman of Rockefeller University. This paper is an extension of his work on antibodies, for which he received the Nobel Prize in 1972. In this theoretical article Edelman explores "the nature of those cellular structures that regulate division, movement, and cellular recognition in such a fashion as to give rise to tissue and organs." It has been thought that these functions were regulated by genes. However, Edelman proposes that cell growth, movement, and recognition are coordinated by a "transmembranous control system," made up of cell surface receptors (groups of chemicals that combine with other groups) and microtubules that exist within the cell. Apart from its theoretical importance, this paper also provides a review of the literature on the surface modulation of cell membranes. I might add that Edelman is a marvelous interpreter of his work for the lay person. This was demonstrated recently in a talk he presented to the Rockefeller University Council[11] on the same day Joshua Lederberg was inaugurated as president.

The third most-cited paper concerns "Combination chemotherapy as an adjuvant treatment in operable breast cancer," by Gianni Bonadonna and 10 co-authors from the Istituto Nazionale Tumori in Milan, Italy. Women with mastectomies and cancer-infected auxiliary lymph nodes were treated. They represented a group of patients who had a high relapse rate. The Milan team treated 207 women with chemotherapy consisting of a combination of *c*yclophosphamide, *m*ethotrexate, and *f*luorouracil, hence the abbreviation CMF. After 27 months of observation, they found that a control group of 197 women had a relapse rate of 24%, while those receiving the CMF chemotherapy had a relapse rate of only 5.3%. "These results should be considered with caution," the researchers warn, "since, at present, the effect of this therapy on survival and possible long-term side effects remain unknown." This paper reports on the first study to use only CMF for chemotherapy, rather than to use it along with other agents. It was also the first controlled study of CMF as a possible cancer treatment.

The fourth most-cited paper is a remarkable, collaborative immunological study performed by P. C. Doherty, V. Blanden, and R. M. Zinkernagel.

There are two basic types of antigens: those which come from outside the body such as viruses and bacteria—and those produced by the body, that is, the histocompatibility antigens. Histocompatibility antigens are "recognized" during rejection of transplanted tissues. The researchers found that histocompatibility antigens and foreign antigens may combine to form hybrid antigens containing elements of both. Apparently T-cells "recognize" antigens coming from outside the body only when they are presented on cell membrane in association with histocom-

patibility antigens. Wistar Institute director Hilary Koprowski calls this discovery "one of the most important in the field of immunology."[12]

Apart from its significant implications, this paper is also cited heavily, according to Doherty, because it provides the first clear review of the field.[13] That three of the four most-cited papers contain reviews, emphasizes once again the importance of review articles to researchers.[14] Almost one-fifth of the articles on our list are review articles.

Citation studies of this type are important because these rapid and early bursts of citations are good indicators of future activity in the fields involved. Derek Price has elaborated on this "pulse" of citations in a theoretical study.[15] Furthermore, these unusual citation frequencies tell us something about the future. Geller, deCani, and Davies show how one can use such information to accurately predict lifetime citation rates.[16] In identifying papers that have been cited frequently so soon after publication, we have isolated a group of works that will probably be heavily used by life sciences researchers for many years to come. Added evidence for this assertion is found in the increasing number of citations these papers received in 1978. The citation frequency for many of these papers is still rising.

In the future, I intend to identify more of the bicentennial year papers which prove to be most heavily cited in the third year after publication. Most of these would be among the 700 papers cited 20 or more times in 1976-1977. A similar group of "late comers" can be identified for every year we have studied so far.

I want to reiterate that this list does not necessarily report on the "best" or most important papers published in 1976. We limited this list to 100 papers only because of time, space, and energy. Undoubtedly the list includes many that are, by any reasonable analysis, "break-through" papers. Others indicate the interest and activity in hot fields. A careful analysis would be required to determine which, if any, of the "review" papers are cited merely because they provide a convenient means of condensing otherwise long lists of references.

In part II of this study, we will report on the 100 1976 physical sciences papers most cited in 1976 and 1977.

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2. **Marx J L.** Lasker award stirs controversy. *Science* 203(4378):341, 26 January 1979.
3. **Goffman W & Newill V A.** Generalization of epidemic theory: an application to the transmission of ideas. *Nature* 204:225-8, 1964.

4. **Goffman W & Warren K S.** Quality based information systems: an ecological approach. *Coping with the biomedical literature explosion—a qualitative approach,* 22-3 May 1978, Pocantico Hills, NY. New York: Rockefeller Foundation, 1978. p. 25-30.
5. **Levin W.** Personal communication. 15 January 1979.
6. **Peachey L.** Personal communication. 12 January 1979.
7. **Nicolson G.** Personal communication. 16 January 1979.
8. **Johnson R A.** Personal communication. 17 January 1979.
9. **Garfield E.** Genetic engineering—too dangerous to continue or too important to discontinue? *Current Contents* (35):5-11, 1 September 1975.*
10. **Bachmann B J.** Personal communication. 16 January 1979.
11. **Edelman G M.** The capitalism of curiosity. *The future of biomedical research and education: four talks on the occasion of the installation of Dr. Joshua Lederberg as President of Rockefeller University.* New York: Rockefeller Univ. Press. In press
12. **Koprowski H.** Personal communication. 29 December 1978.
13. **Doherty P C.** Personal communication. 23 January 1979.
14. **Garfield E.** So you wanted more review articles; ISI's new *Index to Scientific Reviews* (ISR) will help you find them. *Current Contents* (44):5-6, 30 October 1974.*
15. **Price D J D.** A general theory of bibliometric and other cumulative advantage processes. *J. Am. Soc. Info. Sci.* 27:292-306, 1976.
16. **Geller N L, de Cani J S & Davies R E.** Lifetime-citation rates to compare scientists' work. *Soc. Sci. Res.* 7(4):345-65, December 1978.

*Reprinted in: **Garfield E.** *Essays of an information scientist.* Philadelphia: ISI Press, 1977. 2 vol.

Figure 1: The 1976 life sciences articles most cited in 1976-1977. The authors' addresses follow each citation. Journals are often ambiguous about addresses. When we could not tell which author was at which organization, we have simply given the addresses without linking them to specific authors.

Total Citations 1976	1977	Bibliographic Data

ENDORPHINS & ENKEPHALINS

13 49 **Akil H[1], Mayer D J[2] & Liebeskind J C[3].** Antagonism of stimulation-produced analgesia by naloxone, a narcotic antagonist. *Science* 191:961-2, 1976.
(1) Stanford Univ., Dept. Psychiat., Stanford, CA 94305. (2) Medical College of Virginia, Dept. Physiol., Virginia Commonwealth Univ., Richmond, VA 23298. (3) Univ. of California, Dept. Psychol., Los Angeles, CA 90024.

31 65 **Belluzzi J D, Grant N, Garsky V, Sarantakis D, Wise C D & Stein L.** Analgesia induced *in vivo* by central administration of enkephalin in rat. *Nature* 260:625-6, 1976.
Wyeth Labs., Res. Div., P.O. Box 8299, Philadelphia, PA 19101.

Figure 1 (continued)

Total Citations 1976	1977	Bibliographic Data

ENDORPHINS & ENKEPHALINS (continued)

— 67 **Bloom F[1], Segal D[3], Ling N[2] & Guillemin R[2].** Endorphins: profound behavioral effects in rats suggest new etiological factors in mental illness. *Science* 194:630-2, 1976.

Salk Inst. La Jolla, CA 92037. (1) A.V. Davis Ctr. Behav. Neurobiol. (2) Lab. Neuroendocrinol., (3) Univ. California, San Diego, Dept. Psychiat., LaJolla, CA 92037.

17 27 **Bradbury A F, Smyth D G & Snell C R.** Biosynthetic origin and receptor conformation of methionine enkephalin. *Nature* 260:165-6, 1976.

Nat. Inst. Med. Res., Lab. Peptide Chem., Mill Hill, London NW 7 1AA, UK.

35 89 **Bradbury A F[1], Smyth D G[1], Snell C R[1], Birdsall N J M[2] & Hulme E C[2].** C fragment of lipotropin has a high affinity for brain opiate receptors. *Nature* 260:793-5, 1976.

Nat. Inst. Med. Res. Mill Hill, London NW7 1AA, UK. (1) Lab. Peptide Chem. (2) Div. Mol. Pharmacol.

16 44 **Buscher H H[1], Hill R C[1], Römer D[1], Cardinaux F[2], Closse A[2], Hauser D[2] & Pless J[2].** Evidence for analgesic activity of enkephalin in the mouse. *Nature* 261:423-5, 1976.

Sandoz Ltd. Ch-4002 Basle, Switzerland. (1) Biol. & Med. Res. Div. (2) Chem. Res. Pharmaceut. Div.

12 46 **Cools A R & Van Rossum J M.** Excitation-mediating and inhibition-mediating dopamine-receptors: a new concept towards a better understanding of electrophysiological, biochemical, pharmacological functional and clinical data. *Psychopharmacologia* 45:243-54, 1976.

Univ. Nijmegen, Dept. Pharmacol., Nijmegen, The Netherlands.

14 61 **Cox B M[1], Goldstein A[1] & Li C H[2].** Opioid activity of a peptide, β-lipotropin-(61-91), derived from β-lipotropin. *Proc. Nat. Acad. Sci. US* 73:1821-3, 1976.

(1) Addiction Res. Fndn., Palo Alto, CA 94305, and Stanford Univ., Stanford CA 94304. (2) Univ. California, Hormone Res. Lab., San Francisco, CA 94143.

10 52 **Creese I, Burt D R & Snyder S H.** Dopamine receptor binding predicts clinical and pharmacological potencies of antischizophrenic drugs. *Science* 192:481-3, 1976.

Johns Hopkins Univ. Sch. Med., Dept. Pharmacol., Baltimore, MD 21205.

1 42 **Elde R, Hokfelt T, Johansson O & Terenius L.** Immunohistochemical studies using antibodies to leucine-encephalin: initial observations on the nervous system of the rat. *Neuroscience* 1:349-51, 1976.

Karolinska Inst., Dept. Histol., S-10401, Stockholm 60, Sweden and Uppsala Univ., Dept. Pharmacol., 256 751 05 Uppsala, Sweden.

12 40 **Geffen L B[1], Jessell T M[2], Cuello A C[2] & Iversen L L[2].** Release of dopamine from dendrites in rat *substantia nigra*. *Nature* 260:258-60, 1976.

(1) Flinders Univ. South Australia Sch. Med., Human Physiol. Unit, Bedford Pk., Australia. (2) MRC, Neurochem. Pharmacol. Unit. Dept. Pharmacol., Med. Sch., Hills Rd., Cambridge CB2 2QD, UK.

4 68 **Goldstein A.** Opioid peptides (endorphins) in pituitary and brain. *Science* 193:1081-6, 1976.
Addiction Res. Fdn., Palo Alto, CA 94305 and Stanford Univ. Sch. Med., Dept. Pharmacol., Stanford, CA 94304.

32 75 **Guillemin R, Ling N & Burgus R.** Endorphines, peptides, d'origine hypothalamique et neurohypophysaire à activite morphinomimetique. Isolement et structure moléculaire de l'α-endorphine. (Endorphins, hypothalamic and neurohypophyseal peptides with morphinomimetic activity. Isolation and primary structure of α-endorphin.) *C.R. Acad. Sci. Ser. D.* 282:783-5, 1976.
Salk Inst., La Jolla, CA 92037.

5 44 **Hambrook J M, Morgan B A, Rance M J & Smith C F C.** Mode of deactivation of the enkephalins by rat and human plasma and rat brain homogenates. *Nature* 262:782-3, 1976.
Reckitt & Coleman, Pharmaceut. Div., Hull HU8 7DS, UK.

— 44 **Jacquet Y F & Marks N.** The C-fragment of β-lipotropin: an endogenous neuroleptic or antipsychotogen? *Science* 194:632-5, 1976.
Rockland Psychiatr. Inst., New York State Res. Inst. Neurochem., Ward's Island, NY 10035.

12 63 **Lazarus L H, Ling N & Guillemin R.** β-lipotropin as a prohormone for the morphinomimetic peptides, endorphins and enkephalins. *Proc. Nat. Acad. Sci. US* 73:2156-9, 1976.
Salk Inst., La Jolla, CA 92037.

19 81 **Li C H & Chung D.** Isolation and structure of an untriakontapeptide with opiate activity from camel pituitary glands. *Proc. Nat. Acad. Sci. US* 73:1145-8, 1976.
Univ. California, Hormone Res. Lab., San Francisco, CA 94143.

8 55 **Loh H H[1], Tseng L F[1], Wei E[2] & Li C H[3].** β-endorphin is a potent analgesic agent. *Proc. Nat. Acad. Sci. US* 73:2895-8, 1976.
(1) Univ. California, Langley Porter Neuropsychiatr. Inst., Dept. Pharmacol., San Francisco, CA 94143. (2) Univ. California, Sch. Publ. Health, Berkeley, CA 94720. (3) Univ. California, Hormone Res. Lab., San Francisco, CA 94143.

2 43 **Pert C B[1], Pert A[1], Chang J K[2] & Fong B T W[2].** [D-Ala[2]]-met-enkephalinamide: a potent, long-lasting synthetic pentapeptide analgesic. *Science* 194:330-2, 1976.
(1) NIMH, NIH, Sect. Biochem., Adult Psychiat. Branch, Bethesda, MD 20014. (2) Beckman Instruments, Inc., Bioproducts Dept., Palo Alto, CA 94304.

13 39 **Simantov R[1] & Snyder S H[2].** Isolation and structure identification of a morphine-like peptide "enkephalin" in bovine brain. *Life Sci.* 18:781-8, 1976.
Johns Hopkins Univ. Sch. Med., Baltimore, MD 21205. (1) Dept. Pharmacol. & Exp. Therapeut. (2) Dept. Psychiat. & Behav. Sci.

ONCOLOGY & BENZO(*a*)PYRENE

45 104 **Bonadonna G, Brusamolino E, Valagussa P, Rossi A, Brugnatelli L, Brambilla, DeLena M, Tancini G, Bajetta E, Musumeci R & Veronesi U.** Combination chemotherapy as an adjuvant treatment in operable breast cancer. *N. Engl. J. Med.* 294:405-10, 1976.
Ist. Nazionale Tumori, Via Venezian 1, 20133 Milan, Italy.

Figure 1 (continued)

ONCOLOGY & BENZO(*a*)PYRENE (continued)

— 45 **Brouet J C, Valensi F, Daniel M T, Flandrin G, Preud'homme J L & Seligmann M.** Immunological classification of acute lymphoblastic leukaemias: evaluation of its clinical significance in 100 patients. *Brit. J. Haematol.* 33:319-28, 1976.

Hop. Saint-Louis, Res. Inst. Blood Dis., Lab. Immunochem. & Immunopathol., 75475 Paris Cedex 10, France.

16 46 **Edmondson H A, Henderson B & Benton B.** Liver-cell adenomas associated with use of oral contraceptives. *N. Engl. J. Med.* 294:470-2, 1976.

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