scription of this particular column as detailed by Mr Rettig:

> "A number of stories related to cancer appeared in March and April, but the most significant publicity occurred in mid-April, when Ann Landers devoted an entire column to urging support for S34. 'Dear Readers,' she began, 'if you are looking for a laugh today, you had better skip Ann Landers'. But, 'if you want to be part of an effort that might save millions of lives—maybe your own —please stay with me'. She asked, 'Who among us has not lost a loved one to cancer?' If enough citizens let their senators know that they want the bill—S34—passed, it will pass'.".

That single column resulted in more than 1,000,000 letters and telegrams to Senators and Congressmen.

A highlight of the entire drama—especially for democratic societies—was the impact of the Senate vote on House of Representatives action. Had the Senate vote been 80–0 rather than 79–1, it is probable the story would have been significantly different. I remember clearly the night Senator Gaylord Nelson decided that standing alone would be good science and good political statesmanship.

Senator Nelson's decision made Representative Rogers and his committee's action possible. Mr Rettig describes with great accuracy the role of the various scientific and academic associations, led by the Association of American Medical Colleges, in providing the congressman with information and testimony to justify significant modification of the Senate Bill.

Although the National Cancer Act of 1971 was a compromise of many actions by many parties over many months, Representative Rogers of Florida emerged as the advocate for the scientific community. He reported the Act as "basically the bill which the House approved". "Mr Speaker", he said, "this report represents a substantial victory for the House of Representatives, the biomedical community and the American people".

In the Act finally passed, the NCI remained a part of the NIH, with the Director of the NCI still reporting to the Director of the NIH for most purposes. However, among other less important changes, the budget of the NCI now went unchanged from the Director of the NCI to the President. A special Presidential panel of three persons was established to oversee the NCI, and the Act provided that both the Director of the NIH and the Director of the NCI be appointed by the President.

Perhaps the weakest part of this book is the attempt by the author to analyse the current and future issues raised by the Act. Yet this must be the case, because we really don't know even today whether the Cancer Crusade was a good idea or bad—and Mr Rettig can't tell us. My main criticism of the book is a criticism of the debate itself. It was too far removed from the substance of science for my liking. Viral oncology was fading as a key factor in the fight against human disease, even as inbred animal models with virus-induced cancers were trumpeted as possible answers to our hopes. Environmental pollutants were emerging as troublesome factors with high price tags in costs and personal liberty, even as suggestions were made that the price was dollars, not self denial or tradeoffs with other major social desirables.

Those who saw the Cancer Crusade as outstripping the science base and thus constituting overpromise of an unachievable goal at unreasonable costs and at the expense of other desirables may well be right. However, science is always unpredictable.

On the crucial debate about the separate nature of the NCI the issue seems resolved, at least in the mind of the current Director of the NCI, Dr Arthur Upton, who said recently:

> "I report to NIH Director Don Fredrickson, Assistant Secretary Richmond, and Secretary Califano just as any other Institute Director. Regarding the so-called budget bypass, it is a great advantage for NCI to be able to submit its budget directly to the White House and the Office of Management and Budget but within this administration cancer program matters have been delegated directly to Secretary Califano. So now the Department of Health, Education and Welfare is much more in the picture."

On the other hand, the budget of the NCI has increased greatly, reversing a more stable trend of seven years ago. It will be surprising indeed if this increased effort does not increase our understanding of cancer and other life processes.

The Cancer Crusade was, and is, an event of major interest. A fair question would be how does it compare with other issues at the NIH in these years? Symbolically, it was not in the class as the several Nobel Prizes and other high awards in the intramural programs and in the nation as American biomedical science came of age. From a substantive standpoint the whole DNA/RNA story has raised more new issues and made far more demands on the time of the Director. From the practical standpoint, the depressed mortality statistics possibly related to changes in life style—smoking, diet, exercise—are surprisingly early in coming (if true). Training grants and full funding of non-competing grants were great, although less dramatic issues. In short, the great cancer debate was one of several important issues of the late 1960s and early 1970s at the NIH.

The book ends with the subchapter title, "Transition to a New Era?" However, I fear a new era in which the question is science or no science, not the almost joyous debate of how best to find the truth. I fear adversaries who are not noble and competent, but who are mean-minded and self-seeking. I fear a world in which the outcome of experiments are manipulated, not where the outcome is debated. I fear a world in which a crusade is never launched even if, as often is the case, it may be imperfectly conceived. □

Robert Q. Marston was Director of the NIH from 1968–73, and is now President of the University of Florida.

Cosmical magnetic fields

Magnetic Field Generation in Electrically-Conducting Fluids. By H. K. Moffatt. Pp. 343. (Cambridge University Press: Cambridge and London, 1978.) £15.50.

"How could a rotating body such as the Sun become a magnet?" was the title of Sir Joseph Larmor's celebrated talk at the 1919 meeting of the British Association for the Advancement of Science. He proposed in that lecture that the magnetic field of the Sun was due to ordinary electric currents in the solar interior and that the electromotive forces required to maintain these electric currents against ohmic dissipation were due to inductive interaction between fluid motions in the solar interior and the magnetic field itself. Geophysicists now accept that the main geomagnetic field is produced in a similar way, by a 'self-exciting dynamo' mechanism operating in the molten core of the Earth, and the dynamo process has also been invoked to explain the more recently discovered magnetic fields of Jupiter and other planets. Unlike the dynamo process, other proposed mechanisms for generating the magnetic fields of these astronomical bodies are much too feeble; only the dynamo theory holds out any promise of final success.

The main difficulty with dynamo theory was exposed by Cowling when, in 1933, he demonstrated that the particular configuration of fluid motion and magnetic field invoked by Larmor was one of a more general class that are incapable of producing dynamo action. The subsequent pioneering work on the dynamo theory of the Earth's magnetism, by Bullard, Elsasser,

Parker and others, had therefore to be carried out without the support and comfort of an 'existence theorem' demonstrating that flow and field configurations of a 'non-Larmor' type in a simply connected electrically conducting body of fluid could produce dynamo action. Fortunately for the development of the subject, Backus and Herzenberg were able in 1958 to provide two independent proofs of such a theorem, and research towards the elucidation of the details of the dynamo mechanism has grown rapidly since that time.

The method of attack is almost entirely mathematical, because of the practical difficulty of attaining sufficiently high values of the so-called 'magnetic Reynolds number' R with available laboratory fluids. (R is defined as the product of four quantities: the electrical conductivity, magnetic permeability, typical speed of fluid flow and typical length scale of the system; it is thus quite high even for poor conductors on the length scale of astronomical systems, and this is why the study of 'magnetohydrodynamics' first emerged from astrophysical investigations.) Several excellent reviews of dynamo theory have appeared in the specialist literature during the past few years, but Professor Moffatt has provided the first monograph setting out "the general mathematical theory of magnetic field generation by inductive fluid motion, with particular reference to the two most accessible examples of cosmic bodies (Sun and Earth) exhibiting magnetic fields", with the objective of placing a wide range of work within a common framework and clarifying areas of overlap as well as areas of conflict in this technically highly complex subject.

A dominant idea which recurs throughout this book, which is based on a graduate lecture course given over a number of years at Cambridge, is the lack of reflexional symmetry of fluid flows capable of producing dynamo action; in short, typical fluid eddies in 'non-Larmor'-type configurations have a helical structure. A measure of this lack of reflexional symmetry is the pseudo-scalar quantity 'helicity', defined as the scalar product of the flow velocity vector and the local 'spin' vector (vorticity) of the fluid. In the author's words, "In a sense, this is a book about helicity; the invariance and topological interpretation of (helicity) are discusssed at an early stage (chapter 2) and the central importance of helicity in the dynamo context is emphasised in chapters 7 and 8. Helicity is also the main theme of chapter 10 (on helical wave motions) and of chapter 11, in which its influence on turbulent flows with and without magnetic fields is discusssed".

As far as the rest of the book is concerned, chapter 3 deals with the convection, distribution and diffusion of magnetic fields, and chapters 4 and 5 are accounts of the magnetic fields of the Earth and Sun, with a few remarks about the fields of other planets. Chapters 6 and 9 deal respectively with laminar and turbulent "kinematic dynamos", in which the field of fluid flow is specified *a priori* in the calculation of magnetic effects from the equations of electrodynamics. It is with this part of the subject that the most striking progress has been made during the past decade by workers in several countries, including the Soviet Union and the German Democratic Republic. The final chapter indicates what little work has been done on the much more difficult problems arising from the investigation of 'magnetohydrodynamic dynamos' which seeks simultaneous solutions of the equations of hydrodynamics and electrodynamics.

This book is certainly not aimed at the mathematically faint-hearted but, in the tradition of the Cambridge University Press monographs on Mathematics and Applied Mathematics edited by Professors G. K. Batchelor and J. W. Miles, the subject is introduced in an interesting way, and the mathematical equations and derivations are well supported by physical ideas and explanations. The book contains a few misprints and errors (for example Herzenberg's famous paper is inadvertently omitted from the list of references) and can be recommended to anyone interested in the nature of cosmical magnetic fields, which Einstein evidently regarded as presenting one of the most important unsolved problems in physics.

R. Hide

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Progress report on perception

The Perceptual World. By Kai von Fieandt and I. K. Moustgaard. Pp. 680. (Academic: New York, London and San Francisco, 1978.) $62.50; £32.

DRAW a rough sketch of what could be called a map of knowledge. Physics and astronomy would share common frontiers with chemistry and geology which in turn have borders with molecular biology and physiology. There are many disciplines each of which has its own set of concepts and language. For some subjects, however, it is not always clear where the borders are; for example, modern linguistics merges imperceptibly into terrains where philosophy, mathematics and logic have traditionally held sway. Nowhere is this problem more acute than for psychology. Suffice to say its subject matter is vast; its methods and procedures are parasitic upon many other disciplines, but at the same time it is not always clear what it is that constitutes a problem for the psychologist. But psychology does have one concern where a clear picture of its problems are emerging and where there are now concepts and a language appropriate to it. This area of psychology is what is generally referred to as perception. Perceptual psychology has two concerns: first, how events in the external world become stored as information in the brain, and second, how this stored information becomes knowledge of the world. Psychologists have made great strides with the first problem but the second still awaits clarification from philosophers and workers in artificial intelligence.

The Perceptual World, written by psychologists, is a progress report of work in perception. This work is backed up by the insights and methods from colleagues in many other disciplines. John Mollon's two chapters indicate the scope of the enterprise. He discusses neural coding and analysis, and in doing so, annexes to the service of perceptual psychology large areas of what was previously thought to belong exclusively to the province of neurophysiology. But he does this to good effect; he shows, for example, that at the neural level an account can be given of how external events are detected, coded and stored in the brain. This ecumenical spirit pervades the book, and so we find that the chapter on psychophysics draws on signal detection theory, which was originally developed by communication engineers to describe information flow in noisy systems.

Many books on perception deal all too exclusively with the input side—with the collection coding and storage of information—to the neglect of the output which issues as behaviour and experience. *The Perceptual World* avoids this fault: there are chapters dealing with object perception and the perception of self and these chapters therefore have something to say about knowledge of the world. This final section of the book discusses the experience of perception, and how this interacts with the perceiver's personality, life history and culture. The chapter on pictorial art is a *tour de force*, and manages to be original and interesting and to avoid the woolly inanities which so often pass for discussion on this topic.

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