"muscular sense" to the usual five. He can hardly have read Tracy, for he claimed that no "writer on the human mind" had advanced the concept of spontaneous movements; these were the movements which Tracy considered "peut-être très nombreuses aussi, qui ne sont la source d'aucune perception."

Young gives the center of the stage to Herbert Spencer, that strange character who could have come to eminence only in the Victorian age. Starting with an extreme belief in phrenology which he later almost completely shucked, Spencer worked his way to his "Universal Postulate," his ultimate criterion of belief: that "in the last resort we must accept as true a proposition of which the negation is inconceivable." This reminds us of Locke, who gave as example the belief that the dead shall rise again—a belief impossible to test. But it is Spencer's later change from phrenologically derived psychology to association psychology, which he eventually united with the theory of evolution, that led to the concept of adaptation of man to his environment.

It was Spencer's belief that localization of functions ("the concentration of special kinds of activity in special places") must exist in the brain that was attractive to Hughlings Jackson, who became the outstanding proponent of sensorimotor physiology in the West. In Eastern Europe, Sechenov's *Reflexes of the Brain* (unmentioned by Young) was making its stormy way toward acceptance. Written by an experimentalist, it went much farther than Thomas Laycock's speculations on the same theme.

Speculation gave way finally to experiment when, in 1870, Fritsch and Hitzig found that, contrary to all previous opinion, the cortex was excitable and moreover possessed areas specifically excitable for well-defined muscle groups. Localization of the motor cortex therefore ousted the corpus striatum from the false position it had been assigned (even by Hughlings Jackson).

Objective localization of sensory cortex (far more difficult to achieve) followed within a decade, but went unnoticed by the psychologists of the 19th century (as it goes unnoticed by Young). It had been assumed a priori impossible to detect, let alone locate, sensory impressions except by the crude technique of ablation, as used by Munk (what Gall called mutilation), but within five years of Fritsch and Hitzig's delineation of the motor areas a new technique, not for stimulating but for recording from the unmutilated brain, provided the objective demonstration of the cortical localization of sensory modalities that is used to this day. Responses to visual stimulation proved easier to localize than those for other modalities, as indeed they are now, but the differentiation of the area involved from the area of response to sound was mapped and the intermingling of sensory and motor in the neighborhood of the motor strip discovered.

But Caton's reports (1875, 1877, 1887, 1891) and Beck's extended study of the same phenomena (1890, 1891, 1892, 1895, and later) went unnoticed by Spencer, Ferrier, and Hughlings Jackson (though not by Victor Horsley). Beck's maps of rabbit and dog brains show the specific locations for responses to sight and sound and to stimulation of the various limbs. These discoveries were published in the *British Medical Journal* and the *Centralblatt für Physiologie*, the outstanding journals in an era less flooded with periodicals than our own, and were even reported at the ninth International Medical Congress and at the second International Congress of Physiology. So lack of recognition of their importance by at least two generations of psychologists in the West (though not in Eastern Europe) remains a mystery. Even Young makes no mention of these achievements.

Ablation as a method for localization has fallen from favor among neurophysiologists, who are now aware of the imbalance it produces in the remaining circuitry of the brain, and the years that have followed Ferrier have only served to pile up the evidence against the idea of specific highly localized cortical areas. The sensorimotor strip is not as closely segregated into motor and sensory mechanisms as was once thought, nor are the primary sensory projections the sole receivers of sense modalities. And cortical exploration has not revealed the sites that Gall sought for the various faculties. One has to delve below to seek evidence for systems that subserve memory, emotion, and the drives of sex, hunger, and thirst that come to us down the evolutionary trail. Brain "centers" have given way to "systems." The 19th-century localizers believed they had laid to rest the notion of the ancients that the heart was the site of emotional qualities, and they did not foresee that the following century was to recognize the interplay, by feedback, of cerebral and visceral mechanisms. Gall's use of the words "mental faculties" covered many complex qualities that well may, like the lists of Bain and of Spencer, reflect this interplay. Where do these reactions lie? "Tell me where is fancy bred, or in the heart or in the head?"

There is a clue in the introduction to this book that Young may be planning a further study. His readers will be waiting for it, for this volume is of unusual excellence. Read it.

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Artificial Vision

Visual Prosthesis. The Interdisciplinary Dialogue. Proceedings of a conference, Chicago, June 1969. T. D. STERLING, E. A. BERING, JR., S. V. POLLACK, and H. G. VAUGHAN, JR., Eds. Academic Press, New York, 1971. xviii, 382 pp., illus. $18.50. Association for Computing Machinery Monograph Series.

Although it appears at the very end of this unusual book as appendix B, the section "Blindness in the United States" could well be the part to be read first, particularly by those not acquainted with the extent of blindness and the problems it causes. The economic, moral, and social grounds for pursuing the daring thoughts and experiments recorded in the remainder of the book are established by the demographic analyses in this appendix.

The book is the first of its kind, the first volume to be devoted almost exclusively to the somewhat controversial topic of visual prosthesis achieved by surgical intervention and device implantation somewhere in the human visual system. It contains as appendix A the otherwise almost unavailable summary of the first conference on visual prosthesis held in Cambridge, Massachusetts, in 1966. The bulk of the book, though, comprises a supplemented record of the exciting proceedings of the second conference.

Central to the materials covered in the book is the concept of artificial vision created through controlled patterned stimulation of phosphenes in blind persons by means of arrays of stimulating electrodes. The signal work of G. S. Brindley and W. S. Lewin, who have implanted a device in a human and studied the parameters of phosphene screen production, is re-

ported in due detail. Even though the retina is known to map in reasonably homologous fashion onto parts of the visual cortex, one must be cautioned that at its most optimistically expected best phosphene-induced "vision" will not be anything like the exquisite view provided by a functioning intact human visual system, and at its worst it could be an annoying display of uninformative lights. Uncertainty as to what degree of "vision" actually could be achieved with a prosthesis is a frequently echoed theme in the pages of the book, the doubts usually being ascribed to an insufficiency of experimental data. It is interesting to note that several of the professionally employed blind people whose comments appear in the book seemed the least interested in having a prosthesis of the general class discussed here.

The interdisciplinary nature of the topic and the book stems from involvement with aspects of visual physiology, neurosurgery, engineering, and computer science. Some controversy as to the relative importance of these several disciplines is evident in the book, and is to be expected considering that the contributors tend to be spirited proponents of their own disciplines. This has led to the exceptionally broad coverage one finds in the book.

The book is valuable because almost all current workers in the field are either represented or referred to. The large sections devoted to dialogues between participants are most valuable. Some sensory aids for the blind that do not depend on surgical intervention are mentioned. These are perhaps out of place in this volume, but the authors have attempted to develop points of relevance to the principal topic so that their inclusion provides a good supplement.

The unexpectedly large number of typographic errors does not detract from the worth of the book, which has been published at what seems a most propitious time. Advances in each of the disciplines cited above seem to be pointing with promise toward the possibility of some form of human visual prosthesis. Analogous advances are probably still required in the general medical and biological areas to clear the way for routine long-time implantation of electrically active devices.

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A Biomedical Science

Progress in Parasitology. P. C. C. GARNHAM. Athlone, London, 1971 (U.S. distributor, Oxford University Press, New York). xii, 244 pp. + plates. $9.75. University of London Heath Clark Lectures, 1968.

Although its title leads one to expect that this book is narrowly technical, Garnham's book, a personal account of a scientist looking upon a lifetime of experience, knowledge he has contributed, and progress he has witnessed, shared, and initiated in a branch of science to which he devoted a generous segment of his life, is written in a style that will make it comprehensible to the individual of limited exposure to science as well as useful to the teacher and the professional scientist. It is a refreshing review and account of advances in a specialized field with experiences familiar and principles applicable to any branch of science.

Concise, well-defined introductory material enhanced by examples the author has selected from his vast experience in the clinic, field, and laboratory sets the scene into which he introduces two chapters on "the parasitic life," subtitled "Problems of the parasite" and "Problems of the parasitologist." Parasites are likened to "commuters on suburban railways" maintaining "a regular time table" and being "compelled to do so in order to catch the bus to their next destination." What must be considered in the selection and completion of a scientific problem, including ethical, personal problems and publication of data, is discussed. The young parasitologist, whom the author addresses in particular, is made aware of some of the areas of parasitology that have offered challenges in the past and that still do. The author discusses facilities and opportunities for research in institutions throughout the world. He recounts his own experiences as a researcher at these institutions, thus informing the young parasitologist where the greatest challenges exist and where best to take them up.

The concluding chapter discusses "some great parasitologists of the past." Twelve personalities are selected on the basis of national origin rather than scientific discipline. Garnham believes that "each race has its own particular contribution to make, an attitude to the subject or a peculiar insight, which is distinctive as the different schools of nationalistic music." All the parasitologists discussed were born in the 19th and died in the 20th century. All pursued the study of life cycles, seeking through their experiments measures for the control of disease. The majority founded centers of learning attracting zealous students who followed in their footsteps. Garnham introduces each with an imaginative, vivid, often poetic description of his birthplace, enabling the reader to visualize the environment and familial ties that nurtured him and contributed to his success. This is followed by a summary of the individual's discoveries and contributions and the importance of his work in the light of present-day advances. Garnham successfully conveys those invaluable personal qualities that each possessed and gives the reader intimate details of each unique personality, based in most cases on his knowledge of the person directly or indirectly through family, intimates, or colleagues or from careful selection of details given in biographies.

To the reviewer, who holds Garnham in great esteem, this small volume reads well and pleasantly unfolds the life, hopes, and achievements of its author, himself an outstanding and unique personality in the community of parasitologists.

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