to accomplish the purposes described by Osborne. These drugs were studied in a thorough way in order to determine which of the group would be most satisfactory for clinical trial. One of these vasopressor local anesthetics of Alles and Knoefel, β-benzoyloxy-β-phenyl-ethyl-demethylamine hydrochloride, came to clinical use and was reported upon by E. W. Ferber.[5] The purpose of this present note is not to detract from the merit of the report of Dr. Osborne and his associates. It does seem, however, that his statement in SCIENCE would have given a more correct impression had it referred to previous work of the same character.

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THE ACTION OF ESERINE AND ITS ANALOGUES ON SKELETON MUSCLE

IN SCIENCE for December 18, 1936, p. 551, Morison and Rosenblueth deal with the cause of their earlier failure (Rosenblueth, Lindsley and Morison)[1] to detect the potentiating effect of eserine and its analogues on the response of a mammalian muscle to a motor nerve volley. Brown, Dale and Feldberg[2] had suggested that the anesthetic might have been responsible for the absence of this action in Rosenblueth, Lindsley and Morison's experiments; but Morison and Rosenblueth have now found that the length of the interval between successive motor nerve volleys is a much more important factor. This observation we had made ourselves even before the paper by Brown, Dale and Feldberg was published, and we have dealt fully with the point in a paper which has for some months been awaiting publication in the *Journal of Physiology*. A preliminary account of the observation had, indeed, already been given by one of us (Z. M. B.) in a review published as long ago as October 11, 1936, in *Liége Médical*.[3] The journal in question has probably not a wide currency, and we welcome the note by Morison and Rosenblueth, as showing that they had independently confirmed our observation.

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SCIENTIFIC BOOKS

RECENT PHYSICS

The Renaissance of Physics. By KARL K. DARROW, pp. 306, $3.00. The Macmillan Company, 1936.

THE author of this volume is no stranger to the world of physics. Eight or ten years ago a stream of luminous essays poured forth from the Bell Telephone Laboratories under the title of "Some Contemporary Advances in Physics." These immensely helpful papers, directed mainly to his professional colleagues, disclosed not only a remarkable grasp of the various fields of recent physics but also a rare mastery of the art of exposition.

The present volume, however, is the outgrowth of a series of Lowell Lectures, greatly amplified but still addressed to the intelligent reader whether with or without laboratory experience. It is indeed one of those rare messages which contain much for the beginner and much for the expert, reminding one, in this respect, of Maxwell's "Matter and Motion" and Tait's "Recent Advances in Physical Science."

If the merits of a volume are to be appraised upon the matter which is chosen for discussion, upon the worthiness of the treatment and upon the tenacity with which it holds the interest of the reader, Dr. Darrow's "Renaissance of Physics" must take high rank. For the task undertaken is the explanation, in words of one syllable, of the rapid evolution of physics during the last fifty years; but this is to be done by building upon foundations already firmly established; and there is to be no discontinuity with the classical physics. "The continuity of thought," he says, "the partial adequacy of old ideas to new discoveries—these have outrun anything which the physicists of the past could reasonably have foreseen." The entire discussion is based upon the solid ground of mechanics, heat and waves. The spirit of the author is well exemplified at the very outset by the manner in which he wisely detours the definition of physics, with all its metaphysical quagmires, and, in its stead, defines a physicist as "some one who uses his senses for observing; mechanical and thermal instruments for measuring; and mathematics, especially the mathematics developed in the service of physics, for reasoning. I say nothing about a limitation of the subjects of his inquiry; there is none—he is authorized to use his methods and his mathematics on anything whatsoever."

The second and third chapters lead up through Gilbert Faraday, Hittorf, Crookes and Edison to J. J. Thomson and "the release of electrons from matter . . . an event . . . of transcendent importance." Here again I quote a thoroughly pragmatic definition to illustrate the beautiful accuracy with which the author fits his language to his purpose. "May we say," he

[5] Ferber, *Jour. Amer. Dental Assoc.*, 23: 788, 1936.
[1] A. Rosenblueth, D. B. Lindsley and R. S. Morison, *Amer. Jour. Physiol.*, 115: 53, 1936.
[2] G. L. Brown, H. H. Dale and W. Feldberg, *Jour. Physiol.*, 87: 394, 1936.
[3] Z. M. Bacq, *Liége méd.*, No. 41, p. 1173, Oct. 11, 1936.

asks, "that 'vacuum' shall stand for any density of gas, however high or low, provided only that what is left of the gas in the tube is not interfering at all with the phenomena which we happen to be observing?" The discovery of the Edison effect is alluded to as "one of the observations which change the course of history."

A fine illustration of the manner in which a discussion can be made quantitative without the use of mathematical symbols is found in chapter IV, where various matters beside electrolytic conduction and the size of the electronic charge are taken up. One factor which contributes largely to the outstanding clarity of the book is the use of excellent metaphors and similes. Here, for example, is the ferryboat upon which electrons travel; and again a metal described as "a forest in which the motionless trees stand for atoms with positive charges, while the footloose electrons correspond to roving wild beasts." No man, if he reads this while he is awake, can lay the book down without having a clearer conception of what happens in the photoelectric effect and in thermionic emission from incandescent metals.

"The Mystery of Waves and Corpuscles" is the heading of Chapter VIII; and the mystery largely remains —I think the author himself will agree with me—when the end of the chapter is reached. Here, if anywhere, it would appear that some discontinuity between classical and recent physics must be admitted. When the two fundamental equations of Einstein

$$E = h\nu \quad \text{and} \quad p = h/\lambda$$

come up, the author frankly confesses that the problem of "making sense" of these two rules is "a very tough one." "So tough is it," he says, "that physicists have been driven to all manner of singular devices. It is the origin of most, if not all, of the amazing and baffling assertions which have crept into popular literature—sources of grief to those who expect a classic sobriety of statement from the scientist, and of malicious joy to those who like to see unsettlement and incoherence invading an authoritative science."

The paragraph just quoted, coming at the end of a brilliant chapter, easily turns one's mind to the following remark of Professor Max Born in his "Atomic Physics" (p. 120) that "There is naturally no way of deducing the wave-equation by strict logic; the formal steps which lead to it are merely matters of clever guessing."

The structure of the atom is taken up in Chapter IX, which opens with the following thumbnail sketch of this complex microcosm:

> An atom is a constellation of negative electrons organized and held together by the attraction of a positive charge ensconced upon a nucleus which is the center of the constellation and is many times more massive than all the electrons put together.

Here before the end of the chapter is reached Dr. Darrow lays down the solid foundations of spectroscopy and clearly enunciates the basic principles which underlie the work of Aston and Dempster. He also embraces this opportunity to pay his respects to Pythagoras by imagining the delight with which this ancient Greek would have listened to the story of Moseley's discovery that the various elements differ one from another, mainly in a number which is attached to each by definite experimental fact.

The next two chapters are devoted to "the masterpiece of the contemporary group of physicists," *the transmutation of the elements*. Here, in following the work which Lord Rutherford initiated in 1919, the author is at his best and even outdoes his own previous achievements in clear and picturesque exposition. Witness the following account of the production of radio-sodium in the cyclotron of Lawrence and of the evidence for thinking that a neutron lurks in every deuteron:

$$_{1}H^{2} + {}_{11}Na^{23} \longrightarrow {}_{11}Na^{24} + {}_{1}H^{1}$$

upon which he comments, "One may imagine that the neutron is charioted by its attendant proton to the portals of the nucleus through which it slips while its companion is barred out." This penultimate chapter carries the happy title, "Victory over the Elements"; and the volume is fitly brought to a close by one on "The Unity of Nature," in which the remarkable theorem of Einstein, that "Any energy E has a mass E/c^2; any mass m has an energy mc^2," is established in beautifully logical sequence and in carefully chosen words. The reader is here introduced to the crowning achievement of twentieth century physics—the establishment of each of the great laws of conservation of matter and of energy by uniting them into one single valid general principle.

So much for the contents and style of this admirable book, characterized by accurate scholarship, perfect clarity, fine perspective and fascinating diction. If I were an instructor in English composition, I would probably disapprove of the efflorescence of parentheses which meets the eye in every chapter; this on the principle that the introduction of round brackets is, in general, a confession of obscurity in the structure of the sentence. But those of us who have read or listened to Dr. Darrow know how deftly these asides are woven in, how much they add to clarity and how cleverly they protect the reader from wrong impressions.

When one is just arising from a bountifully spread table, nothing could be more ungracious than to complain because some additional course had not been served. So I am not going to ask for an additional chapter, but merely remark that these eleven chapters whet one's curiosity as to what comment the author would make upon the view of Sir J. J. Thomson ("Recollections and Reflections," pp. 368–9) that "the mass, momentum and energy of a charged sphere are distributed throughout the medium around it and not in the sphere itself."

When the present administration has completed its investigation of the methods of the American Telephone and Telegraph Company it is to be hoped that they will find both reason and space for commending the policy of any corporation which has the wisdom, foresight and ability to maintain a research staff of the caliber of the men now at the Bell Telephone Laboratories and of their late director, to whom the book is so appropriately dedicated.

HENRY CREW

NUCLEAR PHYSICS

An Introduction to Nuclear Physics. By N. FEATHER. x + 213 pp. 21 figs. 3 plates. New York: The Macmillan Company; Cambridge: The University Press. 1936. $3.00.

RADIOACTIVITY was discovered in 1896 by Becquerel in connection with studies concerning the nature of fluorescence. Later developments, coming as a result of this discovery, have been of benefit both to the medical profession and to physicists and chemists wishing to gain an insight into the fundamental properties of matter. Alpha-particles, obtained from radioactive elements, were the tools with which Lord Rutherford was able to perform his scattering experiments, the results of which led to the famous nuclear atom (1911). This hypothesis was the foundation stone upon which Bohr was able to build his theory of the hydrogen atom. The tremendous developments brought about in physics, chemistry and astronomy as a consequence of Bohr's theory are now known to every one.

While rapid strides were being made in understanding the outer structure of the atom, steady progress was also being made in our knowledge of the nucleus, albeit this work was somewhat eclipsed by the great volume of papers in the other field. Since the discovery of the positron, the neutron, artificial radioactivity and transmutations by high velocity particles, the amount of work being published on nuclear physics is beginning to rival that produced during the atomic structure "boom" of the 1920's. The author of the present volume has made very notable contributions to the study of nuclear physics.

With experimentation in nuclear physics going forward at such a terrific rate, one would have a certain feeling of futility in attempting to write a book on the subject, since it would be supposed that the book would be out of date before it could possibly be published. It takes rare skill on the part of the author to choose material which will be fundamental and at the same time up to date, and a considerable amount of speed on the part of the publisher to get the book off the press and distributed in a very short length of time. This rare feat has been accomplished in a singularly successful manner by Dr. Feather and the Cambridge University Press.

The book is divided into four parts, the first of which is introductory in character, giving the necessary background for an understanding of the subject. The next three parts treat in turn stable nuclei, unstable nuclei and transformations produced by fast-moving particles and by radiation.

The superbly written introductory chapters give an excellent description of the development of atomic and nuclear physics during the last forty years. At the outset the author describes in detail the types of measurements made in experiments on nuclear physics, showing clearly the relation of the quantities measured to our well-known standards of length and mass. In these introductory chapters all branches of physics having to do with the study of the nucleus are concisely discussed, the essential points being introduced in such a way that the fundamentals are clearly before the reader at all times. After a discussion of the important experiments on radioactivity and scattering of alpha-particles, the results are considered in the light of the classical theory—including also the Bohr theory. The shortcomings of the classical theory in accounting for certain experiments in nuclear physics are pointed out and the wave mechanics is then introduced from an experimental point of view, without recourse to mathematics. The general results of the theory are given and the uranium paradox, resonance capture, and the scattering of identical particles are treated. The closing chapter of Part I, entitled "Elementary Particles: Nuclear Structure," contains an account of the various suppositions made as to the constitution of nuclei, the laws of force between elementary particles, and a particularly enlightening discussion of the nature of the Heisenberg-Majorana exchange force.

Part II deals with the measurement of nuclear masses by means of the mass spectrograph and by optical methods, together with a discussion of the determination of masses by means of the energy balance in disintegration experiments. The chapter on nuclear spins and moments is somewhat inadequate, but gives the main results obtained in this field, together with a table of nuclear spins and moments.

Part III deals with the emission of alpha-particles, of electrons, positive and negative, and of gamma rays. Since other treatises exist in which the subject of the emission of alpha-particles and gamma rays is