ELLIPTICAL ERYTHROCYTES

IN reply to the note of Terry[1] regarding the erythrocytes of the "sloth," the description by Gulliver[2] apparently need not be questioned. Examination of red blood cells in sections of various organs of several species of Edentata (*Cholopus didactylus,* the two-toed sloth, *Bradypus tridactylus,* the three-toed sloth, anteaters and armadillos) and of other types of mammals including four species of Camelidae, as well as many species of birds, shows that the morphology of these cells is sufficiently characteristic to prevent confusion. The erythrocytes of the sloths are, as in mammals generally, circular, bi-concave discs, while those of Camelidae are oval and convex. Incidentally, Gulliver[2] noted that the erythrocytes of llamas have a greater length-width ratio than those of camels, that, in certain Cervidae, these cells often are very irregular in shape, and that, in Edentata, they are among the largest found in mammals. This author also was aware that characteristic shape of red blood cells might be altered by disease. In captivity, the sloth usually is not a hardy animal. Perhaps Schartum-Hansen[3] encountered a description of blood cells from a diseased animal, although he does not give references.

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SCIENTIFIC BOOKS

TEXT-BOOKS IN PHYSICS

Physik. PAUL WESSEL. Pp. xii + 504. Reinhardt, München, 1938. RM 4.90.

College Physics. HENRY A. PERKINS. Pp. ix + 820. Prentice Hall, 1938. $3.75.

The Elements of Physics. ALPHEUS W. SMITH. Pp. xix + 790. McGraw-Hill, 1938. $3.75.

An Outline of Physics. ALBERT E. CASWELL. Pp. ix + 590. Macmillan, 1938. $3.75.

Glossary of Physics. LEROY D. WELD. Pp. vi + 255. McGraw-Hill, 1937. $2.50.

Physics for Technical Students. 2 Vols. W. B. ANDERSON. Pp. vii + 795. McGraw-Hill 1937.

Sound Waves and Acoustics. M. Y. COLBY. Pp. ix + 356. Henry Holt, 1938. $2.80.

Experimental Physics, A Laboratory Manual. S. W. WILLIAMS. Pp. 158. Ginn and Co., 1937. $1.00.

A First Course in Physics for Colleges. MILLIKAN, GALE and EDWARDS. vii + 712 + lxii, 1938. $4.00.

Introduction to College Physics. C. M. KILBY. Pp. x + 398. Van Nostrand. 1938. $3.25.

Elementary Practical Physics. BLACK and DAVIS. Pp. ix + 710. Macmillan, 1938. $2.00.

Physics of To-day. CLARK, GORTON and SEARS. Pp. vi + 633. Houghton, Mifflin, 1938. $1.80.

THE teaching of physics depends on three factors, the teacher, the laboratory equipment, the text-book. The teacher, master of his subject and of the techniques connected with it, given a reasonable appropriation, will see to it that the laboratory equipment is ample. He may find any one of several texts satisfactory; even a condensed syllabus may serve his purpose. Clear in voice, logical in arrangement, with experimental demonstration at his finger tips, masterful in presentation, he should be the inspiring factor. But a good text-book would help.

The text-books listed above are arranged more or less in order of the domain of general physics which they cover, not in order of the number of pages. The German text presents the entire subject, as we understand it in this review, in 354 pages (9×16 cm). Then to condense it still further it is gathered into 60 pages in a "kurtzes Repetitorium and Formelsammlung." This is followed by 60 pages of tests "Prufungsfragen und Antworten." It is similar to a catechism. A question is asked, the page on which the answer can be found is given. "Wie lauted das Daltonsche Gesetz? (S55)." "Was verstehl man unter Verdunstungkälte? (S87)." "Welches sind die Grundedanken der Quantheorie? (S348)." There are 1,447 such questions and answers. It is seen that these are non-computational questions. Numerical and algebraical illustrations are given in the body of the text. Finally, there are 40 pages of physical tables making the text a veritable handbook. Every artifice is employed by means of changes of type, capitals, bold-faced type, italics and by graphs of all kinds to emphasize and explain.

The next two texts are of the same order of completeness as the German text, but after the American manner of college texts in general physics. Professor Perkins's text is a first edition. A student will look at its 820 pages (10.5×17 cm) with apprehension. Can he master its contents in one college year? Probably not. Yet some teachers will value it for its completeness, others will reject it as a text to be used in their classes for the same reason.

The author maintains a high level throughout the book, and its compilation represents an intensive labor long continued. The last chapters dealing with modern physics are up-to-date and are among the best in the book. At times the reviewer has the feeling that the presentation is didactic rather than being based on experimental evidence. At times an extremely important point receives scant treatment. Take, for example, the treatment of the law of gravitation. It is stated that "the gravitational attraction between two

[1] M. C. Terry, SCIENCE, 88: 475, 1938.
[2] George Gulliver, *Proc. Zool. Soc., London,* p. 474, 1875.
[3] H. Schartum-Hansen, *Acta Medica Scandinavica,* 86: 348, 1935.

bodies is proportional to the product of their masses and is inversely proportional to the square of the distance between them." As this statement stands "the distance between them" has no meaning, and the statement is incorrect. The law should have been stated thus: "Every particle of matter attracts every other particle. . . ." Then it could have been pointed out, though this should have preceded the statement of the law, that one of the great contributions made by Newton was in proving that under the law of the inverse square the combined action of all the infinite number of particles of a uniform sphere upon a particle outside of it is equal to that of the whole mass of the sphere at its center. Only then are we justified in saying that the distance of the moon from the earth is 60 times the distance of an apple from the earth. Kepler's laws based upon experimental evidence then should replace the myth of the apple. The law of universal gravitation for every particle would follow.

The text is amazingly free from blunders and errors, but there is one fallacy. It is a fallacy which appeared about ten years ago in a text on modern physics and which has been adopted by various authors since then. It concerns the proof that light exerts pressure. The reviewer called attention to this fallacy and other fallacies in texts on modern physics a few years ago.

There is no padding in these eight hundred and more pages. There is no full-page photograph of the *Queen Mary* with joyous passengers on the decks waving to friends on shore, of monkeys describing parabolas as they leap from bough to bough, of Miss America in a one-piece bathing suit looping the loop on a bicycle. Practically no space is given to useless arithmetical computations, useless because they are of eighth-grade difficulty. The wording is direct, concise, clear. That this text is longer than any other in English with which the reviewer is acquainted is due to the fact that it deals with more topics than any other text. But what will the physics text of fifty years hence be like?

Professor Smith's text is the fourth edition; the first edition appeared in 1923. It has been greatly extended, new material has been added, there has been a change of emphasis in the older topics. A new chapter, an excellent one, on nuclear physics has been added. Then the author, feeling that 740 pages are not enough, adds another chapter on modern astronomy. But though relatively obsolete material has been discarded to make way for the new, we still find the antique ideas about levers of the first, second and third class. It appears that some writer of a textbook in physics back in the ages when the subject was young, desiring to fill up his book and to display a high sense for organization, set forth the above classification, and it has been repeatedly followed since.

Arithmetical solutions of problems, sometimes of an extremely elementary character, appear on almost every page. A formula has just been derived, the arithmetical values are substituted in the formula, the problem is solved. The student is excused from exercising his brain or of visualizing the phenomenon. Physics becomes something that is in a book. Thus

Example—What force is necessary to give a mass of 10 lb. an acceleration of 3 ft. per second per second? Force in poundals = mass in pounds × acceleration in feet per second per second.

$$F = ma$$
$$= 10 \times 3 = 30 \text{ poundals.}$$

And what does the student know about 30 poundals? For many years the reviewer has ruled out that kind of solution. He has told his students that frequently a formula is used in order to conceal one's ignorance. Here is the solution that the reviewer would accept. "Ten pounds (grams or tons) force gives to 10 lbs. (grams or tons) mass an acceleration of 32 ft. per sec. per sec. (Definition of a pound (gram or ton) force). Hence an acceleration of only 3 ft. per sec. per sec. would require only 3/32 of ten lbs. (grams or tons) force." The student knows what the answer means. No formula is required, none should be used.

There are not only some 780 pages in Professor Smith's text, there are 784 figures, some of them in two or three sections; there are also 9 full-page plates, some of them in color. This illustrates the great importance of visual aids in the teaching of physics. These visual aids supplement the classroom demonstrations of apparatus and of experiments; to these may be added moving pictures in slow motion. Text-book, teacher, student, all must emphasize the importance of an appeal to the eye. The great number of figures and plates in this text not only have a positive value as visual stories, they also have a value in making the text less terrifying to the student than it otherwise would be.

A physicist is probably an uncomfortable companion at any time. He may claim to know or want to find out cause and effect. But a physicist reviewing books may be looked upon as one in an excited state; and like an atom in that condition he is apt to emit a quantum of irritation upon seeing an error. In this case it is in "Fig. 267. Distribution of velocities." It should have been *speeds*. Hairsplitting? Not at all in this case. The curve for *velocities* is entirely different from that for *speeds*.

Professor Caswell's book is a second and greatly revised edition. The order of topics in the first edition (1928) was regarded as abnormal by many physicists. The new order is more nearly normal. The number of pages has been *reduced* from 773 to 590! This has been accomplished partly by omitting several topics in modern physics (only 40 pages as against 100) and by limiting the topics in mechanics. There are no positrons or neutrons, there is no heavy hydrogen, no artificial transmutation or radioactivity, practically nothing about cosmic rays, no cyclotrons, in this text. With these exceedingly important items omitted one wonders why space should have been given to the theory of relativity.

The first thirty or forty pages of this text are in the form of a glossary—physical terms are defined or very briefly discussed, mass, temperature, force, electron, atomic numbers. Now a glossary similar to the next book in this list is a very satisfactory volume in the office of a journalist or even in a physics library, but no teacher would use it as a text-book. The reviewer believes that a physical term should be introduced only when the phenomenon involving the term is being demonstrated and studied. And here we note that the old picture of the atom is retained, the picture that was discarded in 1932 after the discovery of the neutron. Our new picture now presents the nucleus as composed of protons and neutrons, not protons and electrons (hydrogen one proton). The definition of atomic number is now the number of protons in the atom, not the number of electrons in the shells, we may take away an electron or neutron, but we can not take away a proton without changing the atomic number. It is not the energy of any one electron but the *maximum* energy of the electrons having a metal under the influence of light which depends only on the frequency of the light and the kind of metal.

In the body of the book the statements are clear, the illustrations numerous and apt, there are review questions and problems at the end of every chapter.

The glossary by Professor Weld began with a collection of definitions in card catalogue form kept in his office in Coe College. The Division of Physical Sciences of the National Research Council appointed an advisory committee to work with him to revise and, if necessary, extend this list, but its chairman, Professor Weld, has been the responsible compiler. Some 3,500 or 4,000 terms occurring in physics texts and periodicals are listed. Obviously this book would be an important volume in the library of a physics department. Many instructors in physics, journalists, science editors, will want to own one. But this reviewer seems hard to suit. Opening the book at random he reads a definition "*Fresnel rhomb*—A rhombic glass prism so shaped that a ray of plane-polarized light entering by one face emerges from the opposite face after two internal reflections and is thereby elliptically polarized." The Standard Dictionary says *circularly* polarized. But it may emerge plain, circularly or elliptically polarized. The original function of the rhomb was to produce circular polarization. Again at random the reviewer finds the definition of *photoelectric* not to his liking. The definition excludes the action of the so-called photronic cell, which is the outstanding photoelectric device of to-day. That cell is included under the term photovoltaic. The reviewer would make this term a subdivision of the former and would define "photoelectric effect—an effect due to the absorption of a quantum of radiant energy by an electron in such a way as to release the electron from its restraints, thus giving rise to a voltage or a current or a decrease of resistance." This would include *photovoltaic, photoelectronic, photoresistant.*

Professor Anderson's text is a third edition. It is only slightly more technical than the first two texts on this list. It is a little more concerned with engines of various sorts and devotes a total of only one page to several items of modern physics, neutrons, positrons, cosmic rays, transmutation of the elements.

The subject of sound has had a rebirth during recent years. By electrical means we are able to produce and to record sounds of any frequency and of any intensity. The telephone, microphone, sound film, public address system, are of great importance in human affairs. Professor Colby's book is written in recognition of this fact. Gently instructing the student in the mysteries of the sine curve, Newton's laws, ordinary mechanics, wave motion and other elementary matters, he proceeds to the discussion of the Rayleigh disc, phonometers, pressure microphone, piezo-electric oscillators, decibels and modern devices. Architectural acoustics as developed by Sabine, Watson and Knudson, auditory sensations and reactions as developed by Fletcher, Wente and other workers in the Bell Laboratories feature the closing chapters.

The Millikan-Gale-Edwards volume is a successor to various other texts by these or some of these authors. It is decidedly up-to-date. The frontispiece shows cloud tracks of positive and negative electrons from cosmic ray nuclear encounters and the last plate is labeled neutron tracks. (But neutrons leave no tracks! The authors should have labeled it—"Tracks of ions produced by neutron bombardment.")

This text contains 712 pages of type, about 600 diagrams and 94 full-page photographs or plates, "portraits of physicists and illustrations of recent achievements in physics." It is this last feature that distinguishes it from all the texts and makes it an exciting book. Do you want to see at a glance the progress of artificial lighting from the early torch to the modern incandescent lamp? Here is a full-page plate giving lamps and dates, the torch, pre-historic, stone lamp 3000 B.C., metal lamp A.D. 400, oil lamp 1600; 1879, Edison's first lamp 1.4 lumens per watt . . .; 1913, gas-filled lamp 20 lumens per watt. . . . The Hammond organ, air-conditioning Pullman cars, the world's largest telescope and mirror, the Rocket 4½ tons and the Virginian Mallet 450 tons, side by side, lightning striking the Empire State Building. . . . There is perhaps a straining after "the world's greatest . . ." sometimes the student will learn no physics from the picture, but he will be interested and he may ask questions; certainly he will gain information.

Professor Kilby's book is a second edition (first, 1929). As the number of pages shows, it is a brief course in fundamentals. It is conservative and practical, orthodox and logical in its arrangement, direct and clear in statement, up-to-date in regard to neutrons, protons, electrons and atomic structure. It will answer the needs of many instructors giving a three-hour first course in physics.

Coming to high-school texts we have the book by the reminiscent combination, Black and Davis. Like the Millikan, Gale and Edwards text it has many figures (492), many photographs (116). As might be expected of these authors, the photographs are of up-to-the-minute affairs, the stratosphere balloon and gondola, radio meteorograph, electric refrigerator, rock-wool insulation, the cyclotron. Sometimes full use is not made of the photographs. Here is one of a tug of war between a 7,200-pound elephant and a tractor. But the weight of the latter was not given, nor the coefficient of friction in either case. Why not the draw-pull of each? (The tractor won.) The text is a study in pedagogy as well as in physics. It is inductive in method, emphasizes physical principles by illustrations from daily life, uses various styles of type to emphasize main points, qualitative questions and arithmetical problems follow each chapter, there are frequent summaries and reviews.

The Clark, Gorton, Sears text is very much like the Black and Davis, only more qualitative. Here again diagrams and photographs are much in evidence. There are 750 of these, together with several photographs of physicists. Some of the photographs of apparatus are out of the ordinary. Here are eight photographs which might be labeled "How to operate an airplane." Here are eight diagrams illustrating airplanes stunting—"A snap roll," "A chandelle," "An Immelman roll." There are several other photographs of airplanes. Obviously all these are for display or for arousing interest.

Again there is interest in the pedagogical aspect. There are previews of units, questions preceding every chapter to arouse the interest of the student, and at the end of each chapter exercises (qualitative questions and problems) and a summary.

The treatment everywhere is exceedingly elementary.

GORDON FERRIE HULL

SOCIETIES AND MEETINGS

THE AMERICAN CHEMICAL SOCIETY

ELECTION of 126 chemists to administrative and editorial posts in the American Chemical Society, which has a membership of more than 22,000, was announced recently. The society's eighteen professional divisions named officers for 1938–39, and editors of five scientific publications were chosen. The divisional officers are:

Division of Organic Chemistry: Chairman, Werner E. Bachmann, of the University of Michigan; *secretary,* Ralph L. Shriner, of the University of Illinois; *executive committee,* in addition to officers and ex-officers, Charles F. H. Allen, of the Eastman Kodak Company, Rochester, N. Y.; Louis F. Fieser, of Harvard University; Lyndon F. Small, of the University of Virginia.

Division of Physical and Inorganic Chemistry: Chairman, George Scatchard, of the Massachusetts Institute of Technology; *chairman-elect,* G. Frederick Smith, of the University of Illinois; *secretary-treasurer,* Harold C. Urey, of Columbia University; *on executive committee,* Harold S. Booth, of Western Reserve University; George S. Parks, of Stanford University.

Division of Industrial and Engineering Chemistry: Chairman, Walter L. Badger, of the Dow Chemical Company, Ann Arbor, Mich.; *vice-chairman,* Barnett F. Dodge, of Yale University; *secretary-treasurer,* Howard S. Gardner, of the University of Rochester; *executive committee,* Thomas H. Chilton, of E. I. du Pont de Nemours and Company, Wilmington, Del.; Donald B. Keyes, of the University of Illinois; Warren L. McCabe, of the Carnegie Institute of Technology; Walter A. Schmidt, president of the Western Precipitation Company, Los Angeles; Charles A. Thomas, president of the Thomas and Hochwalt Laboratories, Dayton, Ohio.

Division of Medicinal Chemistry: Chairman, Walter H. Hartung, of the University of Maryland; *vice-chairman,* Frederick Fenger, of Armour and Company, Chicago; *secretary,* Russell J. Fosbinder, of the Maltbie Chemical Company, Newark, N. J.; *on executive committee,* George D. Beal, Mellon Institute of Industrial Research, Pittsburgh.

Division of Biological Chemistry: Chairman, Joseph J. Pfiffner, of Parke, Davis and Company, Detroit; *secretary-treasurer,* G. O. Burr, of the University of Minnesota; *on executive committee,* Walter C. Russell, of the New Jersey Agricultural Experiment Station, New Brunswick, N. J.; Arthur H. Smith, of Wayne University; Carrell H. Whitnah, of Kansas State College; Thorne M. Carpenter, of the Nutrition Laboratory, West Roxbury, Mass.

Division of Agricultural and Food Chemistry: Chairman, Roy C. Newton, of Swift and Company, Chicago; *vice-chairman,* Charles N. Frey, of the Fleischmann Laboratories, New York City; *secretary,* Gerald A. Fitzgerald, of the Birdseye Laboratories, Boston; *on executive com-*