Book Reviews

Sir Richard Gregory, His Life and Work. W. H. G. Armytage. Macmillan, London; St. Martin's Press, New York, 1957. 241 pp. $5.

The reputation of *Nature* was largely built by Richard Gregory. From 1893 to 1939, first as assistant editor and then as editor, he selected and solicited the material that has made *Nature* the world's most highly respected scientific journal. But more important, he wrote. It was Gregory who started the "leaders," or leading editorials, that have long been one of *Nature's* most important and influential features, and it was Gregory who for years wrote most of those leaders.

Great editors are, almost by definition, great crusaders. Gregory was such an editor. His creed was science, scientific humanism, the progress of society, and the application of the forces of science in the cause of human advancement. A long, enthusiastic, and vigorous life (1864 to 1952) was devoted to the furtherance of that program of science in the service of society. His weapons were the public platform, the committee, from time to time the organization of a special conference, sometimes the creation of a new organization (the British Science Guild, the Parliamentary and Science Committee, the Scientific Advisory Committee of the Trades Union Congress, a new section and a new division of the British Association for the Advancement of Science), and always *Nature*.

Emphasis on the editorship of *Nature* and the crusade to make science a more effective participant in the advancement of human welfare is proper, but may hide other facets of a life that would have been counted a success without these primary activities. In many respects, Gregory's life was a Horatio Alger story, but with the unusual aspect that his father—a poorly paid cobbler all his life—was also one of the influential early leaders of the labor movement, the author of several books of poetry, and the recipient of an honorary degree from the University of Bristol.

After a few years of school and odd jobs, Gregory became an apprentice shoemaker, a voracious reader, and a night-school student. These after-hours activities led to appointment as a laboratory assistant to A. M. Worthington at Clifton College and put him on the road to his career. A scholarship to the newly established Royal College of Science, at South Kensington, provided preparation for appointment as a science teacher and established the basis for a lifelong friendship and collaboration with his fellow-student, H. G. Wells. After a few years of successful teaching he was appointed, in 1889, assistant to Sir Norman Lockyer, an astronomer and the first editor of *Nature*. Four years later Lockyer appointed Gregory to the staff of *Nature*. But *Nature* never absorbed all of Gregory's writing and editorial energies. From his busy pen came original editions and careful revisions of nearly a score of texts and other books. As science editor for Macmillan, he edited more than 200 science books. From its founding in 1898 until 1938, he edited the *School World* (which became the *Journal of Education* in 1919).

Armytage's biography is a sympathetic and admiring account of the life of a remarkable and admirable man.

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Scientific Uses of Earth Satellites. James A. Van Allen, Ed. University of Michigan Press, Ann Arbor, 1956. x + 316 pp. Illus. $10.

Scientific Uses of Earth Satellites is an unusual type of scientific book. It is probably the first really comprehensive treatment of the subject of scientific experimentation with artificial earth satellites. But this is not what makes it so unusual. It is unusual because it is written before the fact. Usually, a researcher carries out his experiment, then checks his results carefully for internal consistency, accuracy, and validity before he ventures to present them to the scientific public. In the present book, however, one finds a wide variety of satellite experiments described and analyzed before any satellite has been launched.

There is, however, a good reason for this preview of possible satellite experiments. The cost of each experiment will be so very great that to do the very best that can be done is absolutely imperative. Perhaps the most effective way of insuring maximum return for the investment is to enlist the thinking of as many scientists as possible. To this end, the Upper Atmosphere Rocket Research Panel devoted its tenth anniversary meeting, which was held at the University of Michigan in January 1956, to a review of specific, detailed proposals for experiments to be performed in scientific satellites of the earth. The present book is a compilation of some of the papers that were presented at this highly stimulating meeting.

The subject of orbits and their determination receives considerable attention in the book. In the first two chapters, F. L. Whipple, R. J. Davis, and J. B. Zirker, of Harvard College Observatory, discuss the principal features of the orbit of a satellite that is close to the earth and the time that will be available for observing such a satellite optically. The authors give quantitative estimates of the changes in orbital parameters (such as the semimajor axis, perigee and apogee heights, eccentricity, inclination to the equator, and period of revolution) that will be produced by specified changes in initial height, geographic position, speed, and direction of motion. The relationship of these considerations to the problems of guidance and propulsion in the satellite-launching vehicle is obvious. In addition, the authors discuss the perturbations that will be caused by the oblateness of the earth and by atmospheric drag. Careful observation of these effects will permit a determination of the oblateness, on the one hand, and of the atmospheric density, on the other. This subject also receives attention from J. L. Sedwick, Jr., of the Ballistics Research Laboratories, Aberdeen Proving Ground, Maryland.

In the matter of observing the satellite optically, Whipple and his colleagues decide that a specularly reflecting satellite has a slight advantage over one that reflects sunlight diffusely and that, in either case, the total time available for observing the object during a specific passage is never more than a matter of minutes and is sometimes only a fraction of a minute.

H. J. Merrill, of the Signal Corps Engineering Laboratories, considers the tracking of a satellite by electronic optical means. It is desirable to track the satellite optically because of the high precision that can be obtained. By means of electronic techniques, improvement over the customary visual and photographic methods can be obtained. These improvements include superior time constants and the elimination of background. In addition, one can choose the optimum spectral region in which to work.

One of the disadvantages of relying on illumination of the satellite by the sun is the fact that the object can be observed only when it is present in the vicinity of the observer and during a short interval after sunset or before sunrise. To eliminate this restriction, D. E. Hudson suggests the use of a flashing light in the satellite. If a xenon discharge tube were used, an installation could be made, to permit visual tracking, that would have an over-all weight of 8 pounds, whereas, if telescopic tracking is considered, the installation might be reduced in weight to about 1 pound.

In further discussion of the determination of atmospheric density and drag on the satellite, L. M. Jones and F. L. Bartman, of the University of Michigan, L. Spitzer of Princeton University, and H. S. Sicinski and R. L. Boggess, of the University of Michigan, present methods other than the use of tracking data. Jones and Bartman point out that the orbital approach to the measurement of upper air densities will give only averages over a long period of time. If it is desired to obtain instantaneous values, some other approach is required. They suggest the use of an improved version of the transit-time accelerometer that is now being used in sounding rockets for this same purpose. In this, a 5-pound sphere of 5-foot diameter would be used. It would contain, in its interior, a small chamber in which a little ball can be alternately caged and released. When caged, the ball is centered in the chamber. When released, it drifts to one side of the cage at a rate that depends on the acceleration or deceleration of the sphere. The time interval from release to contact with the side of the chamber will, therefore, provide a measure of the drag on the sphere. To use this method at satellite altitudes would, however, require an increase in sensitivity of several orders of magnitude over that of similar devices now being used in rocket soundings.

Spitzer agrees that the orbital method of obtaining air density gives enormous accuracy, but he points out that this accuracy applies only to the vicinity of perigee. He suggests that a satellite be designed so that its center of pressure is far from its center of mass and that it be launched into its orbit with a spin. Such a spinning satellite would precess because of the air drag on it, and observation of this precession rate would make it possible to determine air densities as low as 10^{-16} grams per cubic centimeter.

Sicinski and his associates suggest the use of a "synchrometer," which operates on the principle of the cyclotron, for determining the partial pressures of the different molecular species in the vicinity of the satellite. When these partial pressures have been ascertained, the total pressure can then be calculated. This approach has the additional attractive feature of providing local information all along the orbit rather than average values for the orbit as a whole or for a large number of orbits.

One of the most interesting subjects related to satellite research is that of the environment within and immediately surrounding the object as it revolves in its orbit. Ways of determining this environment are discussed by H. E. La Gow, of the U.S. Naval Research Laboratory, by Maurice Dubin of the Air Force Cambridge Research Center, and by S. F. Singer, of the University of Maryland. La Gow proposes that thermistors be used for determining temperature within the satellite. He suggests that the pressure within sealed compartments be monitored in order to detect penetration by meteors and that thin resistance strips be installed on the surface of the vehicle for measuring erosion of the surface. Dubin proposes that calibrated microphones in the satellite be used to determine the mass and density of interplanetary matter.

One of the most exciting aspects of satellites is the opportunity they will provide to observe the sun from above the atmosphere. P. R. Gast, of the Air Force Cambridge Research Center, and T. A. Chubb, H. Friedman, and J. Kupperian, of the U.S. Naval Research Laboratory, discuss this possibility. Gast takes up the experimental problems to be encountered in instrumenting an artificial satellite of the earth. Friedman and his coworkers make the specific suggestion that a satellite be instrumented with an ionization chamber that is sensitive to a narrow region about the Lyman alpha line of hydrogen. It is proposed that the peak intensity during each orbit and the instantaneous reading at the time of passage over the telemetering station be measured. It is also suggested that short wavelength x-rays would be an interesting part of the solar spectrum to study by means of satellites.

Friedman and his colleagues also propose one of the most fascinating of satellite experiments. By comparing the Lyman alpha radiation that comes to the satellite from space with that which comes directly from the sun, they propose to determine the densities of hydrogen atoms and hydrogen ions in interplanetary space.

The satellite also offers the opportunity to observe the radiations that come to us from the stars and the galaxy. This exciting possibility is discussed by R. J. Davis, of the Harvard College Observatory. According to his estimates, the sky should be quite "spectacular" in the ultraviolet wavelengths, a region of the spectrum that cannot be observed at the surface of the earth because of the absorption by the earth's atmosphere.

The possibility of using an artificial satellite for meteorological studies is taken up by W. G. Stroud and W. Nordberg, of the Signal Corps Engineering Laboratories, and by J. I. F. King, of the Air Force Cambridge Research Center. Stroud proposes to use photocells in a spinning satellite vehicle to scan the surface of the earth for purposes of determining the variations in albedo. This experiment is particularly interesting because it would be the beginning of weather reconnaissance and surveillance. From such photocell observations, the extent and location of cloud cover, with considerable detail in the cloud structure, could be determined as a function of time. In the future, such cloud cover surveillance will probably prove to be extremely valuable as a basis for weather prediction.

The subject of cosmic ray observations is covered by J. A. Van Allen, of the State University of Iowa. Satellite instrumentation that consists of a single Geiger counter or scintillator could monitor the total cosmic-ray intensity above the atmosphere on a comprehensive geographic and time basis. Van Allen also proposes to use a Cerenkov detector to study the relative abundances of the heavy nuclei in the primary radiation—particularly the Li, Be, and B nuclei.

A number of authors discuss the possibility of studying the aurora and the earth's magnetic field from orbiting satellites. For example, J. P. Heppner, of the U.S. Naval Research Laboratory, proposes the use of a proton precessional magnetometer in the satellite vehicle. One of the most interesting problems that such satellite magnetometer measurements could help resolve is that of the Chapman-Størmer ring current, which is assumed to encircle the earth at a distance of a number of earth radii. The satellite data, when combined with similar data taken at the surface of the earth, could prove or disprove the existence of such a current.

Finally, five chapters are devoted to a discussion of the possibility of using satellite experiments for a study of the ionosphere. Both propagation and Langmuir probe type experiments are possible, although, in my opinion, many of the ionosphere experiments might better be performed with vertically launched rockets.

Two articles, one by L. G. De Bey, of the Ballistics Research Laboratories, and one by H. K. Ziegler, of the Signal Corps Engineering Laboratories, discuss the problems of systems design and basic instrumentation. This is an extremely important consideration in connection with the use of artificial satellites for scientific research. In fact, the various proposals for experiments must be considered to be only indications of how one would start to construct a specific satellite. Until one comes to grips with the actual building of the hardware, the temperature control problem, the vibrations that the satellite will have to stand during the launching, the question of how to separate the satellite itself from the empty last stage, and such problems, treatment of the basic design of a particular experiment is, in a very real sense, incomplete. This is particularly true during this initial period in the development of research satellites, when small size and severely limited weight greatly enhance the various instrumentation and construction problems. Ziegler lists many components that are now available or will soon be available that should be useful in the design of satellite instrumentations. Of particular interest are solar power supplies and transistors. These should make it possible to boil down the required instrumentation weights by a considerable amount.

The typography of *Scientific Uses of Earth Satellites* is very good, and the illustrations are clear. The book should be taken as a compilation of thoughts, in various stages of advancement and completeness, on what research one might do with earth satellite vehicles and how one might go about doing it. Taken thus, it makes worth-while reading and should serve as a valuable source of ideas in the field for some time to come. It stands as a challenge to its various readers to devise other experiments or to improve on those that are described.

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Chromosomes, Sex-Cells and Evolution in a Mammal. Based mainly on studies of the reproductive glands of the gerbil and a new list of chromosome numbers of mammals. Phillip V. Tobias. Lund, Humphries, London, 1956. 420 pp. Illus. 60s.

The author of *Chromosomes, Sex-Cells and Evolution in a Mammal,* who is senior lecturer in anatomy at the University of Witwatersrand in Johannesburg, Union of South Africa, describes and interprets his investigations on the chromosomes in the germ cells of the seminiferous tubules of the gerbil, a desert rat—more specifically, of the subspecies *Tatera brantsii draco*—as a first step toward a comparison of the chromosomal complements of various species of *Tatera*. His presentation of the material is greatly influenced by his acute awareness of "the need to break down the artificial apartheid between chromosomes and their cellular and physiological milieu" (page xvii). Against this background of the new "unitarian biology," the author "treats a restricted set of cytogenetical facts from a morphological and cytochemical, a genetical and evolutionary viewpoint" (page 5). The facts themselves could be more accurately described as strictly cytological, since the gerbil is, genetically speaking, a complete unknown.

Phillip Tobias is fully aware of the limitations of his project. The researches were undertaken between 1946 and 1952, and the literature is covered, in the text of the book, through 1952; the more recent work on mammalian chromosomes, done with improved cytological techniques by Hsu, Makino, and others, could thus not be included. This lack is particularly noticeable in the chapter on the chromosomes of the rat, in which the author introduces the criteria used in characterizing the chromosomes of a mammal and discusses their validity. More recent papers, through 1955, are included in the appendix, which gives the most complete list of mammalian chromosome numbers available at present, covering 264 species and subspecies.

The main body of the book is divided into six parts entitled (i) "Introductory section," (ii) "The chromosomes," (iii) "Descriptive account of spermatogenesis," (iv) "Nuclear behavior during spermatogenesis," (v) "Cytoplasmic behavior during spermatogenesis," and (vi) "The spermatogenetic wave."

The chromosomes of the gerbil offer certain advantages for intensive study. The diploid number is 34 (relatively low for a eutherian mammal) and the average length of the chromosomes is somewhat greater than in the rat (6.0 to 7.9 microns for the largest chromosome as compared with 3.9 to 4.4 microns in the rat). Twenty-two chromosomes have subterminal, and 12 have submedian, constrictions, marking their point of attachment to the spindle fibers. The second part of the book also contains a chapter on chromosomal evolution in rodents and in mammals in general, a highly interesting but speculative subject. For the uninformed reader, the most obvious fact seems to be that morphological evolution of mammals has taken place, together with diversification of chromosome numbers in some groups, without such diversification in others ("multiformity" versus "uniformity"). In "multiform" groups, the mechanisms responsible for the changes in chromosome number are still a matter of debate; however, it seems quite clear that polyploidy has not played an important, if any, role.

In the fourth part, sections of particular interest include (i) a description of the last two premeiotic divisions of the spermatogonia, in which the chromosomes are excessively contracted because of a prolonged prophase, (ii) an account of the behavior of the plasmosomes (nucleoli), and (iii) a detailed description of the behavior of the sex chromosomes, which are the largest pair in the diploid complement, with the Y chromosome slightly shorter than the X; both X and Y possess a submedian centric constriction and two subterminal secondary constrictions that mark off two terminal pairing segments.

If a general criticism of the book can be made, it would be that the treatment of the older literature is too detailed and follows a historical approach more appropriate for a textbook. There are some minor errors and omissions. At the very beginning of the book, and in keeping with the tenets of "unitary biology," the reader would like to have a brief description of the gerbil, which is an unfamiliar animal to most of us, and an account of its natural history. To me it seems illogical to speak of "polysomic loss of chromosomes" and to define polysomy as "the duplication or loss of one or more chromosomes from the complement" (page 79). Any biologist who works with amphibians will object to having this class of vertebrates, following Matthey (1949), referred to as "ancient and almost extinct" (page 88). Under the heading "Experimental induction of polyploidy," a single reference to plants is given, while the work of Beatty and Fischberg on mice, which was first published in 1949, is not mentioned. Labeling of the structural details of the seminiferous tubules in plates ix–xii would be helpful, as would a statement of the magnification. This is omitted from all plates with the exception of one figure.

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Elements of Engineering Materials. Charles P. Bacha, Joseph L. Schwalje, and Anthony J. Del Mastro. Harper, New York, 1957. 494 pp. Illus. $6.50.

Elements of Engineering Materials is an introduction to the study of engineering materials and is on an elementary level. It is not directed specifically toward any one of the usual engineering curriculums but is intended as a general survey textbook for all engineering students.

The book consists of four sections. Part I, entitled, "Fundamentals of engineering materials," includes a chapter with qualitative descriptions of thermal, mechanical, and electric properties of interest to the engineer. This is followed by a chapter on the principles of strength of materials. There is also a chapter on the structure of metallic materials, with