and standing as to effectively stimulate research. Production of research is the important thing, not the acquisition of a chapter of the Sigma XI. Some of the most advanced institutions in regard to research, such as Harvard, Johns Hopkins and Princeton, do not have chapters of the Sigma Xi. We are justified in assuming that they have developed effective substitutes.

The existence of a research organization may be the deciding factor when application is made for a chapter of the Sigma Xi. If a number of Sigma Xi members are present these can form a Sigma Xi Club. "Such clubs have all the powers of chapters except that of electing to membership and furnish a simple and effective means of testing the environment to determine whether it is adapted to the establishment of a chapter of the society." In the opinion of the writer Sigma Xi Clubs do not satisfactorily meet the needs of the situation in educational institutions. If it is advisable in the interests of research for the Sigma Xi to offer the reward of a chapter to the institutions which measure up to certain standards it is equally desirable that the research organizations in colleges offer the reward of election to membership to those individuals who have made achievements in research.

VICTOR BURKE

PULLMAN, WASHINGTON

SIGMA XI has no policy in regard to state colleges. It has no policy in regard to state universities, privately endowed universities, technical schools, or any other *group* of institutions. Its one object is the promotion of research, and in its work covering nearly four decades it has tried to maintain the same unbiased attitude as does any *real* scientist toward the investigation in which he is engaged.

Election to membership is based on scientific achievement, actual or potential, and on that only. Were *every* student pursuing scientific studies elected to membership the society would soon become inert and purposeless. In making elections, the line is drawn at such a point as will, in the judgment of the society, result in the greatest possible contribution to the objects of the society.

The granting of a charter likewise is based on the scientific achievement, actual or *potential*, of the petitioning institution, *and on that only*. Were each institution of higher education in the country granted a charter at present, the society would be unable to maintain its high standards either as regards ideals or accomplishments. The line must be drawn somewhere, but in drawing the line there has *never been the suggestion* that any class of institutions should be excluded. The chapter roll of the society is as cosmopolitan as is its membership.

I repeat: Sigma Xi has no policy in regard to state colleges.

F. K. RICHTMYER,
President

QUOTATIONS

THE AMERICAN CHEMICAL SOCIETY AND THE AMERICAN ASSOCIATION

THE American Association for the Advancement of Science held its seventy-eighth meeting, celebrating the seventy-fifth anniversary of the association, at Cincinnati. The local sections of the American Chemical Society of that region cooperated with Section C, having been encouraged to do so by a vote of the council at the Milwaukee meeting. There are among our members many who regret that circumstances have made it advisable for the American Chemical Society to hold its meetings independently of the American Association for the Advancement of Science, and who have felt that more should be done to assist in the work of Section C than has been possible in late years.

At Cincinnati it was fully demonstrated that the intersectional meeting plan could be put into operation with Section C to mutual advantage. The result was not only a program of unusual merit, but an attendance which must have been gratifying to those responsible for the arrangement. The papers presented covered a wide range of subjects. The attendance was good at all the sessions, the discussion interesting, and on the whole the experiment was a success. We commend the plan to those local sections where future meetings of the American Association for the Advancement of Science will be held and assure them that it is possible to attract to these meetings many of our leading chemists.—*Industrial and Engineering Chemistry.*

SCIENTIFIC BOOKS

Bibliographical History of Electricity and Magnetism. By PAUL F. MOTTELAY. London. Charles Griffin & Company, Limited, 1922, pp. xix, 673.

THE history of electrical science falls somewhat naturally into three chapters. The first deals with electrostatics and magnetism, beginning in 1600 with the appearance of Dr. Gilbert's "De Magnete" and ending in 1800 when Volta's cell was reported to the Royal Society of London; the second period covers the rapid development of the Voltaic cell and the science of electrolysis, which took place during the first quarter of the nineteenth century; the third begins with the discovery of electromagnetism—1820 and 1831—and extends to the present. The volume under review deals mainly with the first two of these chap-

ters, although its first 80 pages are devoted to all the electrical and magnetic references from 2637 B. C. to 1600 A. D.—a period of four millenniums in which the only discovery of importance is that of the mariner's compass.

The general plan of Dr. Mottelay's work is to consider all the publications which have anything to do with electrical science, to arrange them in chronological order, and to indicate briefly the import of each paper. The date associated with each author is that of his first important publication. Each name is followed, as a rule, by one or two brief biographical notes, then by a statement of the author's new contribution to knowledge, often accompanied by a quoted opinion as to the value of this contribution, and finally comes a list of references to books, treatises and periodicals which mention this man's work. So much for the general scheme.

The reader comes to the text, well introduced by a foreword from Sir Richard Glazebrook, a dedication to Lord Kelvin, a preface by the author and an introduction by the late Silvanus P. Thompson. One striking and characteristic remark in this introduction by Thompson—a really devoted and profound scholar in the same line with Dr. Mottelay—deserves quotation. "The art of scientific discovery—for it is an art—can be obtained but in one way, the way of attainment in all arts, namely, by practicing it." At the other end of the volume the reader is fortified by an index of no mean proportions, covering 109 octavo pages, something unusual in an English book. Here one finds much new information and many cross-references, adding distinct value to a work which is already indexed in a chronological sense.

Concerning the main body of the work, it is interesting to find only seven references which antedate Thales, the point at which most electrical histories begin; and in none of these seven citations is the reader convinced that any electrical or magnetic phenomenon is referred to save only in the case of Job (xxxviii, 35) where one is sure that "lightnings" never connoted to this patient poet anything electrical. To Job, lightning was merely a phenomenon of the atmosphere.

In the case of magnetic phenomena, some of these early descriptions are surprisingly accurate. Witness the following account of magnetic induction from St. Augustine's "City of God" (426 A. D.):

> When I first saw it (the attraction of the magnet), I was thunderstruck (*vehementer inhorrui*), for I saw an iron ring attracted and suspended by the stone; and then, as if it had communicated its own property to the iron it attracted and had made it a substance like itself, this ring was put near another and lifted it up, and, as the first ring clung to the magnet, so did the second ring to the first. A third and fourth were similarly added, so that there hung from the stone a kind of chain of rings with their hoops connected, not interlinking but attached together by their outer surface. Who would not be amazed by this virtue of the stone, subsisting as it does, not only in itself, but transmitted through so many suspended rings and binding them together by invisible links?

There can be no two opinions about the great service which Dr. Mottelay has rendered in placing at our disposal this enormous collection of electrical notes arranged in an orderly way, enabling one to obtain with the least possible trouble some desired bit of information. At the same time, one does not read very far into this chronology without discovering that many of the opinions quoted are of little value, and that the critical judgment of the compiler is practically never given.

It is all very well to quote opinions which represent the various sides of a question and allow the reader to form his own judgment; but when it comes to introducing Paracelsus, Mesmer and Mme. Blavatsky as electrical witnesses (which is done in more than a dozen different paragraphs) the author is perhaps beyond the line which separates the useful from the useless.

On the other hand, these "mere opinions" are sometimes instructive as illustrating the difficulty of appraising one's contemporaries. Thus, Lord Bacon, in 1604, says of Gilbert's great treatise on magnetism which was published some four years earlier:

> Gilbert has attempted to raise a general system upon the magnet, endeavoring to build a ship out of materials not sufficient to make the rowing-pins of a boat.

This concerning the man whom Poggendorff, two centuries away from the canvas, calls "the Galileo of Magnetism" and who was named by Priestley as "the Father of Modern Electricity." Dr. Mottelay devotes ten pages to Gilbert; but nowhere does he set forth the essential contributions which this great pioneer made to electro-statics and magnetism. No indication is given, for example, of the essential distinction between Gilbert's "electrics" and "non-electrics"—a classification which is still valid and useful.

For one who is seeking odd facts and curious bits of information, this chronology is an inexhaustible mine. Such, for example, as the following: that Otto von Guericke (1660) was the first to hear and see the light in artificially produced electricity; that Halley's magnetic voyage in a British vessel (1698) was the first scientific expedition by any government; that the use of the magnet for removing a foreign particle of iron from the human eye dates from the year 1700; that the word *magnetism* is first used by William Barlow in 1613; that spider webs were first used for suspensions by Fontana at the University of Padua

in 1775; cobalt was shown to be magnetic as early as 1733, and nickel in 1750.

Concerning these and the many other strange facts scattered through the pages of this book, the surprising thing is to find how early in the game most of the known phenomena of electrostatics were discovered. One finds here dozens of illustrations of the well-known fact that nearly every great discovery in physics has been not only adumbrated but more or less clearly anticipated. Thus the law of inverse squares was distinctly enunciated by Lambert twenty years before the experiments of Coulomb. Nor is it less amazing to see what an enormous amount of fiction has been seriously reported as fact. A paper read before the Royal Society in 1749 explains earthquakes as caused by electricity; an eminent Frenchman, Boulanger, writes a treatise on electricity in 1750, in which he explains that black ribbons are more readily attracted than those of other colors, etc.

This collection of Dr. Mottelay is a veritable treatise on the embryology of electrical science, which will be wanted in every public library, and will be indispensable to students of the history of physics. So long as there is no *index expurgatorius* for electrical books there will ever remain the need for competent critics who can hand on the really essential features of each period, who can appraise the relative merits of various investigations, and who possess the perspective necessary to set forth, in their proper succession and relation to each other, the great discoveries of science. Such a developmental history means much economy of thought. A critical history of this type which would do for the entire subject of electricity and magnetism what Whittaker has done for a portion of the subject in Chapters II and III of his "History of the Theories of Aether and Electricity" would form a worthy companion-volume to that of Dr. Mottelay.

HENRY CREW

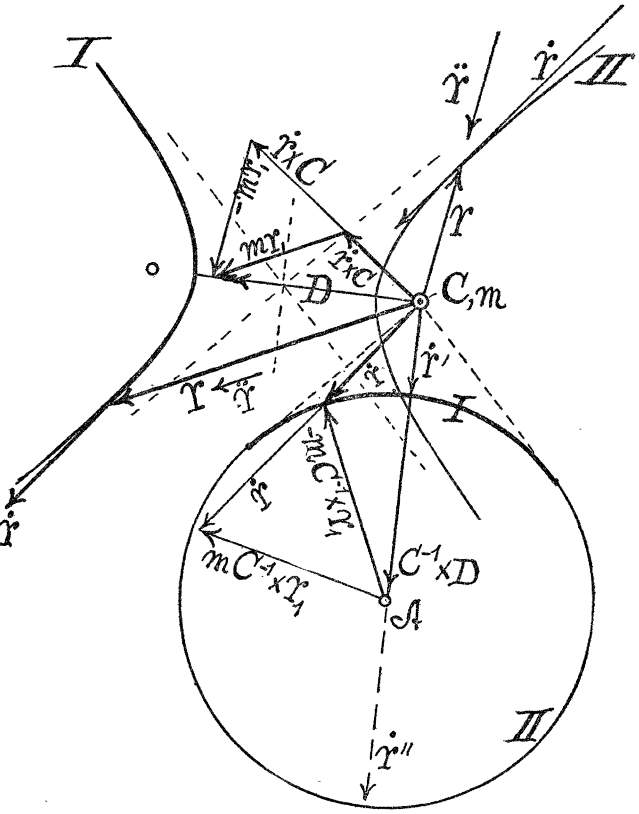
SPECIAL ARTICLES

THE HODOGRAPH OF NEWTONIAN HYPERBOLIC REFLECTION

APROPOS of Sir Oliver Lodge's recent treatment (*Nature*, January 5, 1924) of the reflection of atomic nuclei, a graphic exhibit of the hodograph of such cases which we have been considering in my classes may be given, as it contains many interesting features. The vector equations[1] taken in succession (if r is the radius vector, C the angular momentum per gram of planet, m the mass of the repulsive sun and D a vector along the major axis) are: $d^2\mathrm{r}/dt^2 = \mathrm{r}_1 m/\mathrm{r}^2$, $\mathrm{C} = \mathrm{r} \times dr/dt$, $\mathrm{D} = (dr/dt) \times \mathrm{C} + m\mathrm{r}_1$, $dr/dt = \mathrm{C}^{-1} \times (\mathrm{D} - m\mathrm{r}_1)$, the subscript denoting a unit vector. For the case of hyperbolic motion subject to an attracting sun it is then merely necessary to change m into $-m$.

[1] Vectors in roman.

The figure gives the twin hyperbolas with their common axis and asymptotes. If a repelling mass is at m, and C is a normal vector erected there outward (the usual electrical symbol) the hyperbola I on the left is in question. The diagram gives all the vectors (heavy lines) for the construction of the hodograph with its center at A. It is interesting to see that only the part I of the hodograph is needed. This is limited by tangents parallel to the asymptotes and comprehending the smaller velocities (minimum primed in figure, being normal to D).



The hyperbola II (light lines) and the remainder of the hodograph belong together and these correspond to an attracting mass at m. Consequently the velocities are all relatively large with a maximum $(dr/dt)''$, again normal to D. All vectors through m originate there. The aim is along the asymptotes.

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STIMULATION OF THE VAGUS NERVE

FOLLOWING a suggestion made to me by Professor W. B. Cannon, I have found that a definite relationship exists between frequency and strength of stimulation of the vagus nerve in the cat and the effects