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FRIDAY, MAY 6, 1904.

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THE GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY.

A GENERAL meeting of the American Philosophical Society which undertakes to bring together the members from widely different parts of the country has now become an annual event of the week following Easter. All the general meetings which have been held so far have been highly successful and profitable and have served to arouse much interest in the history and purposes of this organization, which is the oldest scientific society on this continent. The interest in the meeting this year was in no respect inferior to that of former years, as was evidenced by the large attendance of non-resident members and by the extensive program of scientific papers.

That these meetings fill a real need in the scientific life of this country is the opinion of most of those who have attended them. This society, more than any other in this country, with the possible exception of one, stands for the solidarity of human learning. A lively appreciation of this fact is awakened by an inspection of the contents of the long series of volumes issued by the society during a period of more than one hundred and fifty years, as well as by a glance at the varied character of the papers offered at the general meeting. There are few if any organizations in this country which attempt to cover the same field. The American Association for the Advancement of Science and the National Academy of Sciences are devoted to scientific subjects in the stricter sense. The American Philosophical So-

ciety, on the other hand, is devoted not merely to the sciences, but to the humanities and literature as well. It has been objected that such an ambitious program belongs rather to the eighteenth century than to the twentieth, and certainly the numerous technical societies which have arisen in relatively recent years bear witness to the increasing tendency to specialization in all fields of learning. It does not, however, follow that the growth of these technical societies has supplanted the need of more general ones. It is of course desirable that the papers presented at the meetings of the American Philosophical Society should be of broad and general interest, and such they generally are.

These general meetings afford the opportunity of hearing and discussing recent advances in various subjects and also of meeting and becoming acquainted with eminent authorities in those fields; to many persons these have seemed to be attractions of no small order.

The meeting of the society was held this year on April 7, 8 and 9, in the historic home of the society on Independence Square, Philadelphia, where regular meetings have been held for about one hundred and twenty years. The meeting was called to order on Thursday morning with a brief address of welcome by the president, Professor Edgar F. Smith, after which the following papers were presented in the order named:

The Rôle of Carbon: Professor Albert B. Prescott, Ann Arbor, Mich.

The central position of the element carbon among the others as shown in the periodic system, together with its innate character, preeminent rather than exceptional in comparison, together give its capacity for combination. Through studies of carbon compounds chemistry at large has been enriched by facts of molecular constitution, correlated with all physical constants. When the nature of the living proteids shall become known molecular constitution will be included in that knowledge, and the atom of carbon or its theoretical equivalent will have its part in the discoveries then made.

Dimethyl Racemic Acid, its Synthesis and Derivatives: Professor H. F. Keller, Philadelphia.

The subject of this paper is an experimental study of a crystallized acid which had first been obtained, in very small quantities, by Professor Fitting and the author in an investigation upon diacetyl, an important compound of carbon discovered by them. The present paper describes the synthetic preparation of the acid on a larger scale, and by an improved method, and supplies more complete data concerning its physical and chemical characters. It records the preparation of a number of new salts and many analytical results, confirming the deductions which had been drawn from scanty observations in the original research.

Sources of Error in the Determination of the Atomic Weight of Nitrogen: Theodore W. Richards, Cambridge, Mass.

On comparing Stas's and Scott's analyses of ammonic bromide, it is shown that while Stas probably failed to purify ammonia with sufficient care, Scott, although working with purer ammonia, used bromine which was less pure. Thus Stas's results would yield too high an atomic weight of nitrogen, and Scott's one too low. The study of the other available data, including the results of Ramsay and Aston and some preliminary Harvard work, seems to show that the assumption of inconstancy in the atomic weights is not demanded by the facts, and that the atomic weight of nitrogen is between 14.02 and 14.04.

The Constituents of the Venom of the Rattlesnake: Professor JOHN MARSHALL, University of Pennsylvania.

Researches on the constituents of the venom of the rattlesnake are not as numerous as those on the physiologic action of the venom and those bearing upon attempts to discover an antidote. The most comprehensive research on the constituents of the venom of this snake was made by Drs. Weir Mitchell and Reichert in 1886. Since then a better knowledge of albuminous substances has been obtained, newer classifications of these substances have been made and more accurate methods for their separation and identification have been devised.

All of the substances hitherto separated from the venom of this snake by the methods employed were toxic. The toxicity of the substances separated is believed by the author to have been due to an admixture of a toxic substance which was precipitated with the non-toxic part as an adherent material.

By the method of separation by fractional precipitation by means of ammonium sulphate the author has been able to separate the venom (using that of the *Crotalus adamanteus*) into three fractions. Of these three fractions one is toxic and two are non-toxic. The first fraction of the series of three was separated from the venom, while in one per cent. sodium chloride solution by the very slow addition of saturated ammonium sulphate solution with constant, rapid stirring by means of a mechanical stirrer until the venom solution was saturated with ammonium sulphate solution to the extent of 4.5/10. The first fraction consists of euglobulin and pseudoglobulin, is white and non-toxic. The second fraction was obtained from the filtrate from the first by saturation to 6/10 with ammonium sulphate, is yellow and is toxic. Whether it is a chemical individual or a mixture is still under investigation. The yellow coloring matter was separated and is soluble in absolute alcohol, producing a greenish fluorescent solution. It is not a lipochrome, nor bile coloring matter, nor an ordinary coloring matter. It is non-toxic.

The third fraction was obtained from the filtrate from the second fraction by saturating with crystals of ammonium sulphate. It is white, non-toxic and consists of albumin.

The author was unable to detect any albumoses or peptone in the venom.

The Atomic Weight of Tungsten: Professor EDGAR F. SMITH and Dr. F. F. EXNER, Philadelphia.

Our study, extended over a long period, has revealed:

1. That it is quite doubtful whether any chemists who in the past occupied themselves with a redetermination of the atomic weight of tungsten have worked with pure substance. Tungstic acid is prone to form 'complexes.' It was found that if the acid contain no iron, for instance, but be digested with acids, *i. e.*, hydrochloric or nitric acid, in which iron is present, the latter will enter the tungstic acid. Iron and manganese are eliminated from the acid with the greatest difficulty. In the earlier work there is no evidence of their removal; neither do we discover that vanadium and phosphorus had been considered as present, yet in purifying ammonium paratungstate by recrystallization alone it was found that the tenth recrystallization showed vanadium.

2. The slimy, greenish or bluish-white masses believed to be 'para-tung-states' because of their great insolubility are probably 'complexes.'

3. The use of pure sodium carbonate (two per cent.) to dissolve tungsten trioxide gives an excellent means of ascertain-

ing when the iron, manganese and silica are fully removed, but that its development into a method for the determination of the atomic weight of tungsten is not at all probable.

4. The plan of digesting pure ammonium paratungstate with nitric acid, then evaporating to complete dryness and gently igniting affords pure oxide.

5. That porcelain vessels are preferable to those of gold, silver or platinum for the ignition of ammonium paratungstate and tungstic acid.

6. That the oxidation of metal (method 2) leads to reliable atomic numbers when the material is pure.

7. That tungsten hexachloride can be completely transposed into pure oxide with water and a little nitric acid.

Trisulphoxyarsenic Acid: Professor LeRoy W. McCay, Princeton.

This paper explains how magnesium salt of trisulphoxyarsenic acid is formed. This salt has the composition represented by the formula $Na_3AsOS_3 + 11H_2O$. The tertiary potassium salt is prepared in an analogous manner. Two double salts $NaSrAsOS_3 + 10H_2O$ and $KBaAsOS_3 + 7H_2O$ have also been prepared. Methods for separating trisulphoxyarsenic acid from monosulphoxyarsenic and disulphoxyarsenic acid have been worked out and the behavior of the compound toward strong mineral acids is now under investigation. This work was done conjointly with Dr. William Foster, Jr., of Princeton University.

The Expansion of Algebraic Functions at Singular Points: Professor Preston A. Lambert, Bethlehem, Pa.

In this paper the author bases the expansion in series of algebraic functions at singular points on that application of McClanim's series which, at the last general meeting of the American Philosophical Society, was developed for the determination of all the roots of a numerical equation. The method is more direct than the methods employed for this purpose by either Puiseux or Nöther.

The Continuum and the Theory of Masses: Professor I. J. Schwatt.

The theories of continuity as given by Peano, Borel, Couturat, Poincaré and others are viewed in the light of Cantor's ideas. The classification of the different kinds of numbers and their relation to the continuum is given. The relation between the m-fold and n-fold space and the continuity of these spaces is studied.

Biblical Pessimism: Professor Paul Haupt, Baltimore. Read by title.

The Ripening of Thoughts in Common: Professor Otis T. Mason, Washington, D. C.

Thoughts in common and the activities linked with them are spoken of under the heads of biology, speech, industries, fine art, social life, learning and lore and religion. Activities which are purely biological thoughts-in-common are shared with the animals. Speech is considered as the first occasion of thoughts. Industries of life give rise to much simultaneity and identity of mental operations. The esthetic faculty affords most wonderful examples of the force of emotions felt in common. The first society developed a vast number of thoughts in common that have persisted in all ages and areas. In learning and lore and in religion the same similarity of thought is pointed out.

THURSDAY, APRIL 7.

Afternoon Session—2 o'clock.

Vice-President Scott in the chair.

An Attempt to Correlate the Marine with the Fresh and Brackish Water Mesozoic Formations of the Middle West: Professor JOHN B. HATCHER, Pittsburgh, Pa.

1. Marine and fresh-water or other non-marine deposits when present even in the same region, the one superimposed upon the other, do not necessarily represent distinct time intervals. When considered as formations they may have been deposited contemporaneously and may represent approximately the same time interval.

2. The Atlantosaurus beds and Dakota sandstones are considered as the possible equivalents of the Jurassic and Lower Cretaceous.

3. The relations of the Eagle sandstones, the Judith River beds and the Laramie to the Colorado and the Montana formations are pointed out.

The Miocene Rodentia of Patagonia: Professor WILLIAM B. SCOTT, Princeton, N. J.

Recent Advances in our Knowledge of the Evolution of the Horse: Professor HENRY F. OSBORN, New York.

The special explorations and studies on the evolution of the horse in the American Museum of Natural History, under the fund donated by Mr. William C. Whitney for this purpose, have considerably extended our knowledge of the evolution of the horse in America in recent years.

The Oligocene horses have been revised and are shown to embrace a large number of types, among which are the ancestors of at least two of the distinct lines of Miocene horses. In the Miocene it is found that the genera *Merychippus, Protohippus* and *Hypohippus* described by Leidy in the middle of the last century all represent distinct lines or stages of evolution.

The museum exploring parties under Mr. J. W. Gidley secured complete skeletons of *Mesohippus bairdii* from the Upper Miocene, the new genus *Neohipparion whitneyi* and the Lower Pleistocene horse, *Equus scotti.* The existence of three and possibly four distinct but contemporaneous lines of Miocene horses has been demonstrated.

The cause of the extinction of the Pleistocene horses in America remains a mystery. No horse remains are found recorded with human remains, as is the case in South America. It is also not positively demonstrated that the modern horse, *Equus caballus,* originated in North America. This remains an open question until we know more of the geology of Asia.

The Silurian Fauna of Arkansas: Mr. GILBERT VAN INGEN. (Introduced by Professor W. B. Scott.)

The Yukaghir Language: WALDEMAR JOCHELSON, New York. (Introduced by Dr. Franz Boas.)

The morphological peculiarities of this language may be summed up in the following main propositions.

Word-formation is accomplished mainly by means of suffixes; but prefixes are also used (almost exclusively in connection with verbal forms). In this respect the language differs from those of the Ural-Altaic group, which uses suffixes only, and approaches the American languages.

The possessive suffix of nouns is but little developed (except in the third person); the language thus differing from the Ural-Altaic, as well as from the Eskimo dialects.

Sound-harmony of vowels (*a* and *o* should not occur in the same word) is little developed, and in this respect the language resembles some of the Indian dialects, but differs absolutely from the Ural-Altaic languages with their intricate system of

vowel-harmony. For instance, an important feature of the vowel-harmony of the latter group of languages consists of the adaptation of the suffix vowels to the vowel of the root, which never changes. The vowel of the first syllable thus governs all the rest of the vowels, no matter what their number may be. In the harmony of the Yukaghir language, the root-vowel frequently adapts itself to the vowel of the suffix. Besides, in the plural forms of the personal pronouns (met, mit; tet, tit; tudel, titel) an attempt may be noticed in the language to derive new forms by means of changes of vowels within the root (the method of Semitic languages) without any additions from outside, a feature of which traces may be found in two other so-called 'isolated' Siberian languages—that of the Kott and the Ostyak from Yenisei.

The difference in the conjugation of transitive and intransitive verbs which we have in the Yukaghir language is a feature common to almost all American languages. The same may be said of the capacity of bases of transitive verbs to change into intransitive by means of suffixes, and *vice versa*.

Suffixes of purely verbal forms are different from case-suffixes, and they can not be brought in connection with personal pronouns.

A necessary element of plurality is the sound *p*; while that of futurity, *t*. In the Chukchee and Eskimo languages *t* constitutes the element of plurality, and in the Koryak language it forms the element of the dual number.

Adjectives, being verbal forms, do not undergo any inflections.

There is no difference between animate and inanimate objects, as is the case in some Indian dialects.

The feature known as 'polysynthesis' in American dialects, and which consists of a combination of two or more uninflected bases into one word, in which one of the bases expresses the principal idea, and is put at the end of the word, while the other bases figure as secondary definitive ideas, is also to be met with in the Yukaghir language.

It is true that there is no actual incorporation to be found in the language; neither pronouns nor nouns, when direct or indirect objects, are incorporated in the predicate; but the nature of the syntactical construction of the Yukaghir language is akin to incorporation. The verb plays the main part in the sentence. It is always placed at the end of the sentence, being preceded, first by the subject with all its modifiers, then by the direct and indirect objects with their modifers, then by the adverbs. If the subject is not accompanied by any modifiers, and it is known from the sense of the story who the acting person is, then it is usually dropped. The subject very often does not assume the element of plurality, though there are many acting persons, as long as the sense of plurality is expressed by the verb.

The Horizontal Plane of the Skull: Dr. Franz Boas, New York.

Evening Session—8 o'clock.

At the Free Museum of Science and Art, University of Pennsylvania, President Smith in the chair.

Pompeii and Saint Pierre: an Examination of the Plinian Narration, and other Studies (with lantern slide illustrations): Professor Angelo Heilprin, Philadelphia.

A reception was given in honor of the members of the society and the ladies accompanying them, at 9 o'clock, at the Free Museum of Science and Art.

FRIDAY, APRIL 8.

Morning Session—10 o'clock.

Vice-President Barker in the chair.

The Reflex Zenith Tube: Professor CHAS. L. DOOLITTLE, Philadelphia.

More than fifty years ago an instrument known by this name was constructed from designs by Mr. J. B. Airy for use at Greenwich. The instrument consists of a telescope fixed in a vertical position. A basin of mercury below the objective at a distance equal to one half its focal length reflects the rays from a zenith star upwards, bringing them to a focus immediately in front of the objective. A micrometer thread moving in the focal plane furnishes the means of measuring the positions of stars which culminate sufficiently near the zenith to be within the field of view. The instrument was designed especially for use with γ Draconis, which culminated very near the zenith of Greenwich. The object was a more accurate determination of the constant of aberration, and incidentally the star's parallax. So far as known this is the only instrument of this description ever constructed.

In the course of the long series of latitude observations carried on at South Bethlehem, and afterwards at this place, anomalous results have appeared from time to time which seem to merit further study. The practical method for attacking the problem appears to be to carry on two series of observations simultaneously, employing two instruments of different construction. With this in view Mr. Joseph Wharton has generously provided the means for installing a reflex zenith tube of eight inches aperture at this place. Warner and Swasey have this instrument well advanced and it is hoped that it may be in practical operation at an early day.

It will be used in connection with the zenith telescope, which has been thoroughly renovated and the optical power increased so that stars as faint as the eighth magnitude may be employed. It is hoped that simultaneous observations with the two instruments may be carried on for two or three years at least.

Faint Double Stars: Mr. ERIC DOOLITTLE, Philadelphia.

The table of limiting distances given by Mr. R. T. A. Innes, within which a pair of stars is to be considered as a double star and entered into the catalogues, was examined, and the opinion was expressed that the limits of this table were too narrow. In support of this opinion it was pointed out that of the 175 Burnham stars known to be binary, 16 would have been excluded by the above criterion, and attention was called to the triple systems μ *Herculis* and *o Eridani,* which exceed the limits of the table. The 1,290 Burnham stars were examined as to proper motion, and it was shown that an average of 8 out of 51 minute stars measured in the vicinity of a bright star have an independent proper motion of their own, while an average of 27 out of 51 are carried along with the bright star; the stars examined in each case exceeded the limits of the above table. It was pointed out that many cases of proper and orbital motion might, therefore, reasonably be expected among the faint stars, and the importance was urged of securing an initial series of measures to serve as a basis for the investigation of their future motion.

New elements of μ *Herculis* were given, and the recent measures of this system and of Krueger 60 and *o Eridani* secured at the Flower Observatory were referred to.

On the Spectra and General Nature of Temporary Stars (with lantern slide illustrations): Professor WILLIAM W. CAMPBELL, Mt. Hamilton, Cal.

Our knowledge of the visual spectrum of the Orion nebula began with the invaluable pioneer observations of 1864–65 by Sir William Huggins. The first photographs

of the spectrum were obtained independently and simultaneously in March, 1882, by Sir William Huggins at Tuke Hill, London, and by Dr. Henry Draper in New York.

The Tuke Hill spectrograms of the nebula differed widely from each other, even in the most prominent features; from which the conclusion was drawn by many persons that the spectrum of the Orion nebula varies rapidly with time.

On account of the great value of accurate knowledge at this point in stellar evolution, it was desirable that the striking discrepancies shown should be explained and removed as promptly as possible. With this end in view an excellent series of spectrograms of the four Trapezium stars and four neighboring stars was secured in December, 1903, and January, 1904. These compared with spectrograms previously obtained by Campbell at the Lick Observatory, and by Keeler at Allegheny, fail to confirm the changes formerly suspected.

The discrepant Tuke Hill results for the nebula seem to be due to variations in the time of exposure, to fortuitous arrangements of the silver grains such as one must be on his guard against in under-exposed and over-developed negatives, and to the fact that the commercial plates in the eighties were considerably less sensitive than those of the last decade.

In case of the Trapezium stars, every exposure on the star is at the same time an exposure on the nebula. The particular instrumental arrangement and time of exposure may in one case emphasize the spectrum peculiar to the nebula, and in another that of the star, with the result that spectra obtained with different instruments and under different conditions will possess comparatively few points of resemblance. We can safely say that these stars are closely related to the nebula in chemical constitution and relatively closely in physical condition.

The results of this investigation were communicated to Sir William Huggins for criticism and comment. He is inclined to accept in the main the conclusions reached, with, perhaps, some reservation regarding some of the many points involved.

Systems of n Periplegmatic Orbits: Professor Edgar Odell Lovett, Princeton. (Introduced by Professor C. L. Doolittle.)

The paper on systems of periplegmatic orbits was inspired by Dr. G. W. Hill's memoir on pairs of such orbits which appeared in the current volume of the *Astronomical Journal.* The notion of a periplegmatic orbit is due to Gyldén and their theory has been elaborated in the introductory chapter of his treatise on absolute orbits. The successive sections of the present paper are occupied with triple and n-ple systems of plane periplegmatic orbits. The method of discussion employed is essentially that used by Hill and the generalizations constructed are suggested very naturally by the examples of his memoir. The concluding paragraph of the note has to do with certain pairs of entangled orbits, periplegmatic or otherwise, whose determination depends either on elliptic functions or those new uniform transcendental functions recently discovered by Painleve to which he is devoting a series of memoirs in the *Acta Mathematica.*

Palladium: Mr. Joseph Wharton, Philadelphia.

The rare metal palladium belongs to the platinum group, yet in some respects resembles silver also. It usually occurs as a companion to platinum and thus exists in many places, but in such extremely small quantity that until lately the reworking of platiniferous residues from the various mines supplied most of what appeared.

The prevailing scarcity of platinum now directs attention to palladium as a practicable substitute; for it has many of the good qualities of platinum, while its price is rather lower.

Both platinum and palladium occur in all the numerous nickel mines found among the Laurentian and Huronian rocks in the province of Ontario, Canada; the quantity of each of those metals varying from a mere trace to one or more ounces per ton, the average for each metal being about one hundredth of an ounce per ton.

Those Canadian ores carry nickel, copper, silver, gold, platinum, palladium, iridium and rhodium. The percentages of the precious metals are extremely minute and the various processes by which all these metals are recovered are naturally complicated and delicate; yet as approximately 300,000 tons of these ores are treated annually by the Orford Copper Company, which owns most of those mines, that company now produces about 3,000 ounces of palladium annually. The reports of the Canadian government upon the metallic and mineral resources of the dominion have never mentioned palladium as one of those resources.

It is not known in what condition the palladium exists in that region, but as platinum has been found there in the form of platinum arsenide, it seems probable that palladium may occur in the same condition.

Among the valuable characteristics of this metal are its hardness, ductility and malleability; it is also so non-corrodible that a polished sheet of it may long remain exposed to chlorine and hydrogen sulphide gases without tarnishing or losing its polish.

Radium from American Ores: Professor A. H. PHILLIPS, Princeton, N. J.

The mineral from which the radium was separated was carnotite, a new mineral described in July, 1899, and found as yet only in the western part of Colorado and adjacent counties of Utah. In composition it is a potassium uranyl vanadate with three molecules of water of crystallization.

In October, 1902, twenty-five pounds of this ore were obtained from Richardson, Utah. This ore contained less than ten per cent. of carnotites. Its activity as compared to uranium nitrate was .40.

This was treated with concentrated acids, as it was thought that particularly nitric acid would dissolve the radium salts.

After washing the insoluble residue the solutions were concentrated. As the ore contained very little barium, some barium chloride was added as a carrier for the radium; the sulphates were then precipitated, barium separated and obtained free from other bases by the ordinary methods.

The barium carbonate dissolved in the least possible quantity of hydrochloric acid and fractioned by crystallization three times. The final product weighed a little less than one half gram and gave an activity compared to uranyl nitrate of 1,500. The residual chlorides were recovered and weighed very near two grams, and as measured by G. B. Pegram, of Columbia, their activity compared to uranium was 365.

With these results, had a ton of ore been used, and if it were possible to concentrate the activity into one gram of barium chloride, it would give an activity of approximately 60,000.

In February, 1904, 3.5 kilos of ore were obtained from Montrose County, Colorado. This ore before treatment gave an activity of 1.71 compared to uranyl nitrate. After treatment with dilute acids the residue gave an activity of 1.40. There was recovered from these acid solutions 3.8 grams of barium carbonate with an activity of 35.8. It was expected that the activity could be concentrated, or the radium separated from the insoluble residue by boiling with so-

dium carbonate, the work on this last specimen not having been completed. If a ton had been used in the solution and the radium concentrated it would yield a gram of barium chloride of an approximate activity of 11,300. Thus showing that while the radium is dissolved to a large extent in concentrated acids from the ores, even the dilute nitric acid dissolves it in considerable quantity, and undoubtedly, in the preparation of uranium salts, this radium would be carried by the uranium, which to a certain extent would explain the varied activity of some uranium salts.

It was thought that the above results were sufficient to prove that carnotite was a carrier of radium to a considerable extent, and would prove a valuable source of radium.

At the executive session which followed the preceding program the committee appointed at the last general meeting to prepare a plan for the appropriate celebration of the two hundredth anniversary of the birth of Benjamin Franklin reported the following plan:

For the evening of the first day, a meeting of the society with a reception of delegates and representatives accredited to the society; presentation of addresses; adjournment, followed by a general reception.

For the succeeding day in the morning, commemorative addresses on Franklin, covering his services—as citizen and philanthropist; as printer and philosopher, and as statesman and diplomatist; these exercises to be followed by a banquet in the evening.

That the society ask congress to strike a medal in honor of the occasion, of which a gold impression shall be presented by the president of the United States to the French Republic, and a number of bronze impressions shall be distributed under the direction of the president of the United States and that a certain number be placed at the disposal of this society for presentation to institutions and societies of learning, including those with which Franklin was connected.

That the following guests be invited to participate in the celebration: the president of the United States; the vice-president and other high officers of state; the governors of the states of which Franklin was the colonial agent; foreign ambassadors accredited to the United States; a special representative from the republic of France; special representatives from societies and institutions with which Franklin was connected; representatives from home and foreign scientific societies and institutions of learning with which the American Philosophical Society is in correspondence.

The report of the committee was approved and the committee continued with instructions to carry out the plan as proposed, with authority to make such modifications as may seem to it desirable, to fix the time and place for the celebration and with full power to do all things necessary or desirable for the appropriate celebration of the anniversary.

At the annual election the following persons were chosen members:

Maurice Bloomfield, Ph.D., LL.D., Baltimore.

Professor of Sanskrit and comparative philology at the Johns Hopkins University; editor of the 'Kashmirian Atharra-Veda,' 3 vols., 1901; translator of the Hymns of the Atharra-Veda in Max Müller's edition of the 'Sacred Books of the East' (Vol. 42); author of numerous papers in the *Journal of the American Oriental Society*, etc.

Henry Pickering Bowditch, M.D., LL.D. (Edin.), Sc.D. (Cantab.), Jamaica Plains, Mass.

Professor of physiology in Harvard University; one of the authors of the 'American Text-Book of Physiology'; author of numerous important contributions to physiology.

Edward Potts Cheyney, Philadelphia.

Professor of history at the University of Pennsylvania; author of 'Introduction to the Industrial

and Social History of England' (1901); 'Social Changes in England in the Sixteenth Century as Reflected in Contemporary Literature' (1895), 'Short History of England' (in press), etc.

Russell H. Chittenden, Ph.D., New Haven.

Professor of physiological chemistry in Yale University; director of Sheffield Scientific School, Yale; president of American Society of Naturalists, 1893; president of American Physiological Society, 1895; author of 'Studies in Physiological Chemistry,' 4 vols., and of many papers on physiological subjects in American and foreign journals; associate editor of the *American Journal of Physiology* and of *Journal of Experimental Medicine.*

Frank Wigglesworth Clarke, S.B., Sc.D., Washington.

Chief chemist in the United States Geological Survey; formerly professor of chemistry in Cornell University and in the University of Cincinnati; author of 'Elements of Chemistry,' 'Weights, Measures and Money of all Nations'; past president of American Chemical Society, chairman of International Committee on Atomic Weights.

John Chalmers Da Costa, M.D., Philadelphia.

Professor of surgery in Jefferson Medical College; author of a text-book on 'Modern Surgery' and of many contributions to medical periodical literature.

Kuno Francke, Ph.D., Cambridge, Mass.

Professor of German literature at Harvard University; author of 'Social Forces in German Literature' and of numerous monographs; curator of the Harvard Germanic Museum.

Adolphus W. Greely, U. S. A., Washington.

Brigadier-General and chief signal officer of the United States Army; distinguished meteorologist and Arctic explorer; gold medallist of the Royal Geographical Society and of the French Geographical Society; author of 'Chronological List of Auroras,' 'Diurnal Fluctuations of Barometric Pressure,' 'Report of the Proceedings of the United States Expedition to Lady Franklin Bay, Grinnell Land,' 2 vols., 4to, 1888; 'Three Years of Arctic Service,' 'American Weather,' 'Climatology of Arid Region,' etc.

Preston Albert Lambert, Bethlehem, Pa.

Assistant professor of mathematics at Lehigh University; author of text-book on 'Analytic Geometry and Differential and Integral Calculus.'

Edgar Odell Lovett, Ph.D., LL.D., Princeton.

Professor of mathematics in Princeton University; member of the American Mathematical Society, Société Mathématique de France, London Mathematical Society, Mathematical Society of Edinburgh, Circolo Matematico di Palermo; author of numerous important papers on mathematical and astronomical subjects.

Edward Leamington Nichols, Ph.D., Ithaca.

Professor of physics at Cornell University; editor of the *Physical Review;* author of 'The Galvanometer' (1894), 'A Laboratory Manual of Physics and Applied Electricity,' 2 vols., 'The Elements of Physics,' 3 vols., and of numerous papers on experimental physics.

Hon. Theodore Roosevelt, Washington.

President of the United States.

Samuel W. Stratton, Washington.

Director of the National Bureau of Standards, late professor of physics in the University of Chicago.

Harvey W. Wiley, A.M., M.D., LL.D., Washington.

Chief of the Bureau of Chemistry, United States Department of Agriculture; author of a 'Text-Book on Agricultural Chemistry' and of numerous papers on agricultural chemistry; past president of the American Chemical Society and of the American Society of Agricultural Chemists.

Foreign residents:

Friedrich Delitzsch, Ph.D. (Leipzig), Berlin.

Professor of Assyriology in the University of Berlin; director of the Babylonian section of the Berlin museum; author of 'Assyrisches Wörterbuch,' 'Assyrische Grammatik,' 'Wo Lag das Paradies?' and numerous other works.

Sir Richard C. Jebb, LL.D., D.C.L., Cambridge.

Regius professor of Greek at Cambridge; author of numerous contributions to classical literature, including 'Sophocles, with Critical Notes, Commentary and Translation,' 2 vols., 1883–96; president of London Hellenic Society.

Ernest Rutherford, F.R.S., Montreal.

Macdonald professor of physics at McGill University; author of numerous papers on various branches of physical science and particularly on the subject of radio-activity, and on the ionization of gases by Röntgen and Becquerel rays.

Jakob Heinrich Van't Hoff, Berlin.

Professor of chemistry in the University of Berlin; author of some epoch-making discoveries in physical chemistry and of numerous contributions to chemical literature, including 'Lectures on Theoretical and Physical Chemistry,' 'Studies in Chemical Dynamics,' 'Chemistry in Space,' etc.

Wilhelm Waldeyer, Berlin.

Rector magnificus of the university and professor of anatomy at Berlin; eminent anatomist and author of numerous contributions to the literature of anatomy.

Afternoon Session—2 o'clock.

President Smith in the chair.

A System of Passenger Car Ventilation: Dr. Charles B. Dudley, Altoona, Pa.

During the last ten years there has been developed by the various experts of the Pennsylvania Railroad Company, a system of passenger car ventilation, which bids fair to prove a reasonably successful solution of this difficult problem. The system in brief consists in taking air from the outside in through hoods covered with wire gauze to exclude coarse cinders, situated at diagonally opposite corners of the car, on what is known as the lower deck, near the top of the car. Thence the air passes through a vertical down-take through the floor to a space underneath the floor, which is bounded by the outside sill, the floor, the first intermediate sill, and the false bottom. This space underneath the floor, reaches the whole length of the car. From this space the air passes up through the floor, by means of slots in the floor, into the heater boxes where the air is warmed by the radiators. From the heater boxes the air passes out through a proper tubular aperture, situated underneath each seat, into the main aisle, from which point it distributes itself throughout the car, and finally passes out of the car through ventilators situated along the center line of the upper deck, which ventilators are so arranged that when the car is in motion, or the wind blows across the top of the car, they produce a suction on the car, helping to exhaust the foul air.

The amount of air taken through the car by the system when all the ventilators are open is about 60,000 cubic feet per hour, or approximately 1,000 cubic feet of fresh air per passenger. A passenger coach embraces about 4,000 cubic feet of space, so that the air in the car is changed fifteen times an hour.

The experiments indicating the amount of air as above were made with cars in motion in a train, and with heat in the cars. The control of the system is in the ventilators in the upper deck. By closing the valves in these ventilators, it is possible to diminish the amount of air under the same conditions as above to about half or a little more. This diminution applies during extreme cold weather, or when there are only a few passengers in the car. When the car is standing still, and there is heat in the car, nearly half the amount of fresh air that is obtained under full movement still passes through the car. When the car stands still, with no heat in the car and no lamps lighted, the amount of ventilation is still more diminished. Thus far no serious difficulties have been experienced in keeping the cars warm, even in the most severe weather, with the system of heating for which the ventilating system was devised, and the results have proved so satisfactory that the system has now been applied to about 800 passenger coaches on the Pennsylvania system east of Pittsburgh and Erie, and to nearly 200 coaches on the Pennsylvania lines west of Pittsburgh; also to some few cars on other railroads. It has not yet been applied to Pullman cars.

Atmospheric Nucleation: Professor Carl Barus, Providence, R. I.

There is considerable probability that material emanations from the sun enter

our atmosphere, and is believed that not only auroras, magnetic storms and other electrical phenomena are attributable to this cause, but that ordinary meteorological conditions, like the changes of the barometer, are thus powerfully influenced. The speaker has for several years been endeavoring to obtain direct evidence of this effect and he described the methods used for counting the number of active foreign particles (ions or nuclei) in the atmosphere.

The first method is based on the observed size of those brilliant optical phenomena called coronas and sometimes seen around the moon. These coronas are artificially produced in a vessel containing a sample of the air to be examined, and the number of particles may be computed from the coronal diameter. Lantern slides are shown giving results as obtained at Brown University, in Providence.

In a second method the speaker determined the number of nuclei from photographs of the fog particles condensed on the nuclei. Lantern slides showing fog particles even less than .0003 cm. in diameter were exhibited. The photography of these small water globules, each a perfect sphere, has never before been accomplished and the difficulties encountered were fully pointed out.

On the Collecting of Meteorites: Dr. ARISTIDES BREZINA, Vienna. (Read by Dr. Amos P. Brown.)

Matter of any kind should be collected, not only systematically but also synoptically, without starting from all points of view from which the matter in question may be arranged.

The author illustrates this thesis on a synoptical collection of meteorites formed since 1896 which consists of seven groups.

I. *Betyl Coins.*—The ancients supposed the stars to be domiciles of gods; falling-stars and falling meteorites signified the descending of a god or the sending of its image to earth.

These envoys were received with divine honors, embalmed and draped and worshipped in temples built for them.

These betyls are in the main:

The omphalos of Delphi, a black stone represented on coins of Eleuthernai, Makedonia, Myrina, Nakrasa, Neapolis, Parthia (the first six Arsacides), Rome, Syria (ten Seleucid Rings from Antiochus Soter to Alexander Bala).

The black conical stone fallen at Emisa and called El Gabal, the sun. Represented on coins of Emisa and Rome.

Zeus Kataibates on coins of Kyrrhos.

The conical stone fallen at Kypros and worshipped as image of Aphrodite Paphia.

The image of Artemis Ephesia fallen at Ephesos; represented on coins of Aizanis, Ankyra, Ephesos, Eumeneia, Nakrasa, Philadelphia, Provincia Asia, Rome, Tabai and Tiberiopolis.

The stone of Astarte on coins of Sidon and Tyros.

The pyramids of Apollon on coins of Ambrakia, Apollonia, Megara and Myrina.

The stones of Zeus Dolichenos or Herakles Sandan; coins of Tarsos.

Zeus Katios, a conical stone suspended by a chain; coins of Seleukeia.

Conical or quadratic stones on coins of Mallos or Rhosos, Perga and Synnada.

The conical stone of Aphrodite Urania on coins of Makedonia (Tetradrachms of Alexander the Great) and Uranopolis.

The simulacres of Artemis Anaïtis, Artemis Leukophrys, Artemis Pergaia, Astarte, Hera, Persephone, etc.

Coins representing related celestial bodies (comets).

In all, 250 coins from 60 towns or regions representing 22 gods.

II. *Historical meteorites* which were worshipped by primitive nations or which

formed standards in the development of meteoric science; prehistoric meteorites from tumuli or mounds, the oldest meteorite of known fall (Ensisheim, 16 November, 1492). Iron fallen with the zielid shower at Mazapil, meteor dust and terrestrial dust, etc., nineteen specimens.

III. Thirteen specimens illustrating *scattering of meteorites,* among them the stones of Lerici, Italy and Pultusk, Russia, fallen simultaneously (30 January, 1868, 7 hrs.) on the flying-line of the Pultusk-shower.

IV. One hundred and twenty-five specimens illustrating *melting and fusion, scorification, faulting and separating;* different kinds of crust, whole orientated individuals, metallic and molten veins, harnesses and fissures, products of heating, alteration-zones, wallborders bent and unbent, etc.

V. Seventy-two specimens illustrating *weathering and formation of new constituents;* different processes of oxidizing, natural dividing and uncovering of more resistant minerals, changing in limonite and nickel-minerals, etc.

VI. One hundred and thirty-six specimens illustrating *constituents of meteorites,* among them phosphor, diamond, graphite, crystals of nickel iron, cohenite, schreibersite, troilite, daubréetite, chromite, olivine, anortite, kosmochlore, enstatite, chondres of various kinds, etc.

VII. The systematic collection representing 9 classes in 58 groups and 280 localities of meteorites (irons and stones).

On the Occurrence of Artifacts Beneath a Deposit of Clay: Dr. CHARLES CONRAD ABBOTT, Trenton, N. J.

On the Breeding Habits of the Spade Foot Toad (Scaphiopus Solitarius): Dr. CHARLES CONRAD ABBOTT, Trenton, N. J.

Doliolum and Salpa: Professor WILLIAM KEITH BROOKS, Baltimore.

The Organization of the Germ Cells and its Bearings on Evolution: Professor EDWIN GRANT CONKLIN, Philadelphia.

Specific substances destined to give rise in the course of development to specific parts or organs are present in the unsegmented eggs of ascidians and snails and presumably also of other animals. These substances become localized at the time of the maturation and fertilization of the egg by an active flowing of the cell substances. Modifications of this localization, produced by modifications in the direction of the protoplasmic flow, do occur and lead to profound modifications of the adult (*e. g.,* dextral and sinistral forms). It only remains to extend by hypothesis similar modifications of egg localization to the eggs of different phyla in order to throw light upon one of the most difficult problems in evolution, viz., the origin of certain phyla, such as the vertebrates.

Summary of the Recent Movements to Teach Agriculture in the Schools: Professor L. H. BAILEY, Ithaca, N. Y. Read by title.

The Origin and Nature of Color in Plants: Professor HENRY KRAEMER, Philadelphia.

Colors in plants may be considered to be due to definite constituents which either themselves are colored or produce colors when acted upon by other substances. These substances are found in all parts of the plant, and in all of the cells excepting meristematic or dividing cells. They may be divided into two well-differentiated classes, namely, (1) those which are associated with the organized bodies in the cell, and (2) those which occur in the cell-sap or liquid of the cell.

The earliest color to appear in the developing plant is a yellow, and this is due to a principle which the author calls *etiophyl* to avoid confusion. This is associated

with a protoplasmic body termed by the author an *etioplast*. These bodies are more or less spherical or polygonal and are about one thousandth of a millimeter in diameter. They occur in the cells beneath the epidermal layer, and later, under the influence of light, appear to be transformed into chloroplasts, the bodies giving the color to the leaves and other green parts of the plant. Under certain conditions the chloroplastid may likewise undergo a transformation into a yellow orange-colored body, known as a chromoplast, the pigment associated with it being called by the author, chromophyl. These plastid pigments are distinguished from all other plant colors by their solubility in such solvents as benzol, ether, volatile oils, etc.

During the course of metabolism the plant cell manufactures other color substances which are not combined with the protoplasm or other organized bodies, but which are contained in the cell sap or liquid of the cell. These substances, unlike the plastid colors, are insoluble in the above-named solvents, but soluble in water and alcohol, which affords a means of separating them from the plastid colors. Most of the colors of flowers excepting yellow and orange are due to substances of this class. The colors of many fruits, as apple, cranberry, strawberry, blackberry, grape, etc.; of red and brown seaweeds; of vegetables, as turnip, radish, rhubarb, purple cabbage, etc., and also of autumn leaves belong to this class, that is, are cell-sap colors. The author's experiments tend to show that the color of autumn leaves, as beech, maple, oak, etc., are in the nature of cell-sap colors, rather than due to a compound associated with the plastids as has been supposed heretofore. His researches, furthermore, tend to show that there is considerable difference in the cell-sap colors, or dyes, from various plants, and while they are all more or less constant in their behavior toward sodium phosphate, yet their behavior with a dozen or more reagents shows that no two of them are precisely alike, or if they are alike are associated with substances which influence their behavior toward reagents. As illustrating this point it may be mentioned that while the color of red rose closely resembles that of the red portion of the turnip in many respects, it differs from it in that an alcoholic solution of red rose becomes cloudy or fluorescent on the addition of water and the color is intensified on the addition of salicylic acid. It is also interesting to note that in the kernel of black Mexican sweet corn contiguous cells may show different colors, as reddish, bluish-green and purplish, this being due to the nature of the other substances associated with the dye in the cell sap.

The author is inclined to look upon the chromoplastids of both flowers and fruits as having the special function of manufacturing and storing nitrogenous food materials, which are almost invariably contained in them, for the use of the germinating plant. He further considers the cell-sap colors, like other organized cell-contents, to be incidental to physiological activity and of secondary importance in the attraction of insects for the fertilization of the flower and dispersal of the seed.

SATURDAY, APRIL 9.

Morning Session—10 o'clock.

President Smith in the chair.

The Establishment of Game Refuges in the United States Forest Reserves: Mr. ALDEN SAMPSON, Haverford, Pa.

The author spent six months in the forest reserves of California and Washington, during the summer of 1903, as game preserve expert, sent out by the United States Biological Survey to study the problem of game refuges, and to select tracts

suitable for the purpose when the time for creating them shall come.

The general plan was outlined in what is known as the 'Perkins Bill,' which was passed by the United States senate in the spring of 1903, but did not come to a vote in the house. By its provisions the president would have power to designate certain tracts in the forest reserves where there may be no hunting; which shall serve as refuges and breeding grounds for wild animals. By this the extermination of the larger mammals will be prevented, and at the same time the hunting in the vicinity of these refuges will be maintained by the overflow of game, as is the case in the vicinity of the Yellowstone National Park. This is a type, on a large scale, of what it is desired to establish elsewhere.

These reserves will be mainly for the protection of deer which are to be found widely distributed. It is the intention to prevent the recurrence of that which happened in the case of the buffalo. Of the millions which once ranged over the plains, less than 1,000 now remain. It is hoped that their number will be increased. There remain two large herds of elk, one of about 16,000 in the Yellowstone Park, another of probably 3,000 in the Olympic Mountains in Washington; a band of 100 in California, besides which there are various small bands in different states. The antelope are nearly exterminated, as are the mountain sheep, but all of these, as well as the Rocky Mountain goat and various small animals and birds, will be preserved in the refuges when created. No fishing will be permitted within these tracts, so that the trout may breed unmolested. It is hoped that the control of the refuges will be placed under the Bureau of Forestry, with competent rangers to patrol them.

The paper read on this occasion set forth the various reasons which justify and demand the creation of game refuges in all parts of the country.

The Use of the Relative Pronouns in Standard English Writers: Professor Waterman T. Hewitt, Ithaca, N. Y.

The purpose of this paper is to present briefly the historical development and use of the relative pronouns in English since the time of Wycliffe. Mention is made of some of the best known English writers whose style is colored by certain special features in their use of subordinate sentences introduced by the relative pronouns. Then follows a discussion on the use of the relatives *that* and *which* with examination of their use in the Tyndale and King James's version of the Bible. Also in the Lord's Prayer as shown in translations from 1130 A. D. to the present time. Lastly the use of these pronouns in proverbs and children's rhymes is considered.

The Effect of the American Revolution Upon the English Colonial System: Mr. Sydney George Fisher, Philadelphia.

It is commonly supposed that England changed her methods of colonial government immediately after our revolution and learned to retain her colonies by the affectionate method without military force or coercion. This, however, is a great mistake. England became much more severe in her methods of colonial control after our revolution, and continued to carry out all the principles and policies against which we had rebelled.

England, after our revolution, governed Canada with the utmost severity, as Mr. Bourinot has described in his excellent books on Canadian history. Canada was allowed no local government, no county or township officers, and carefully prevented from imitating the New England town meetings, which were supposed by England to have been an important cause of

the American revolution. Our revolution caused England to tighten, not to loosen, her grip on her dependencies.

It was not until 1837 that the Canadian rebellion wrought a change in British colonial administration. Just at that time the whig party and free trade ideas were gaining a great ascendency in England, and as a result of these ideas and the Canadian outbreak in 1837 Great Britain gradually began to grant what is called 'responsible government' to the Canadian and Australian provinces. So that it is to the Canadian rebellion of 1837 rather than to our revolution that the present rather liberal and easy governments of Canada and Australia owe their existence. This change appears to have been an immense relief to the people of the Canadian and Australian provinces. The Canadians, after over seventy-five years of British rule, numbered, at the time of the rebellion of 1837, only 1,500,000, but in the succeeding sixty years of responsible government they have increased to 6,000,000. The Australian colonists have also gained a similar increase.

The Hedonic Postulate: Professor LINDLEY M. KEASBEY, Bryn Mawr, Pa.

Results of the American Ethnographical Survey: Professor MARION D. LEARNED, Philadelphia.

In the summer of 1902 the American Ethnographical Survey was organized to investigate the actual relations of the various race elements in our American population and their importance in American civilization. A sum of money was collected by the German American Alliance and the German American Historical Society, and a beginning made in Pennsylvania by an examination of the Conestoga region. The Conestoga expedition was composed of Professor M. D. Learned, director; Dr. G. D. Luetscher, Dr. Charles R. Miller, Dr. J. A. Bole, Mr. C. F. Brede, Mr. E. M. Fogel. Special attention was given to tracing the German settlements from 1709 on, and their relations to their English, Scotch-Irish and Welsh neighbors. A part of the expedition made a careful study of the community settlement of the Rappists, now located at Economy, Pa. A large amount of material was collected along the lines of early settlements and migrations, trades, industries and their effects upon the geographical distribution of the population, religion, education, politics, manners, customs, superstition, dress, language, literature and architecture. This material has been published in part in the following papers in the German American Annals:

1. 'The American Ethnographical Survey, Preliminary Report of the Conestoga Expedition,' by the director.

2. 'Benjamin Herr's Journal, 1830,' by the director.

3. 'An Old German Midwife's Record, 1791–1815,' by the director with C. F. Brede.

4. 'Industries of York and Lancaster Counties,' by G. D. Leutscher.

The following matter is in press and being prepared for the press:

1. 'History of the Rappist Settlement,' by J. A. Bole (in press).

2. 'The Official Report of the Survey.'

3. 'A Series of Race Maps, Showing the Distribution of the Race Elements at Different Periods.'

4. 'A Dialect Map, with Special Reference to the German Dialects.'

5. 'The Architectural Survivals.'

6. 'Studies in Literature, Language and Biography of the Region.'

Regulation of Color-Signals in Marine and Naval Service: Dr. CHARLES A. OLIVER, Philadelphia. Read by title.

The social features of the meeting were especially pleasant. In addition to the public reception on Thursday evening the

luncheons which were served in the hall of the society on Thursday and Friday afforded many opportunities for meeting old friends and making new ones. The culminating social event was the dinner given by the resident to the non-resident members at the Hotel Bellevue on Friday evening. On this occasion addresses were made by the president of the society, Professor Edgar F. Smith, of Philadelphia; Hon. George F. Baer, of Philadelphia; Professor Simon Newcomb, of Washington; Professor Edward S. Morse, of Salem; Professor George F. Barker, of Philadelphia; Professor William B. Scott, of Princeton; Professor Josiah H. Penniman, of Philadelphia; Mr. Henry LaBarre Jayne, treasurer of the society, and Dr. I. Minis Hays, one of the secretaries.

SCIENTIFIC BOOKS.

Vorlesungen über Experimentalphysik. Von August Kundt. Friedrich Vieweg und Sohn. 1903.

Few courses of lectures on general physics have been so well known as those of Professor Kundt at the University of Berlin. They were renowned throughout the world of students for their clearness of exposition, the enthusiasm both of lecturer and of listener, and the wonderful manner in which the facts of physics were illustrated by lecture-room experiments. Professor Kundt died in May, 1894, and steps were immediately taken to present to the world, in the form of a text-book of physics, his famous course of lectures. This has just been done, and the volume at hand from the press of Friedrich Vieweg is one of 851 pages illustrated with more than 500 figures in the text. There is an excellent portrait of Kundt, and a short but appreciative biography.

The lectures which are here reprinted are those given in the winter and summer semesters of 1888–9, which were noted by one of his students and afterwards were revised and worked over by Kundt himself. They are now published under the editorial supervision of Karl Scheel, who very wisely has made no attempt to add chapters, or even notes, with the idea of making the lectures describe the facts of physics which have come into prominence since the death of Kundt.

The course of lectures in general physics which has been given at the University of Berlin by a long line of distinguished men, including Helmholtz, Kundt and Kohlrausch, is one designed specially for students of medicine, or those who wish to become acquainted with the phenomena of physics, but who do not necessarily intend to follow more advanced work in physics, and who do not regard this course as of fundamental importance. This fact necessarily has a most important bearing on the character of the lectures given. In the majority of cases in American universities and colleges physics is now taught largely owing to its educational value, in the sense that in order for a student to follow the course intelligently he must exercise certain mental qualities which are of the utmost importance in any scheme of education. The character of text-book, therefore, which would best represent the needs of these two kinds of classes is quite different; and the main interest in this book of lectures of Kundt centers in his mode of presentation of the various branches of physics in order to meet the demands made by his conditions.

One can not do better in reviewing the book than to give a few details in regard to the number of lectures assigned to various subjects, and to note their order of arrangement. In all there are 150 lectures: 39 in mechanics and properties of matter, 17 in acoustics, 31 in heat (including five on the kinetic theory of gases), 43 in electricity and magnetism and 20 in light. This division is most interesting and, in some respects, surprising. In treating the subject of mechanics there are one or two introductory chapters followed by one in which are introduced the ideas of mass, force, work and energy; then the subjects of equilibrium and machines are introduced; gravitation and various pendulum problems are next discussed, and then the lectures return to the questions of centrifugal force and moments of inertia. There follow six lectures on liquids, seven on gases, three on solids and six on the bound-