ter meeting, which is the annual meeting of the Society, is held at some convenient point during the last week in December. The winter meeting of 1900 was held in Chicago last December. The Society will hold its next summer meeting in Denver, Colorado, August 26 and 27, 1901.

4. The *Journal* of the Society appears on the first of each month during the year. It has been greatly enlarged during the past decade, and every effort is put forth to make it worthy of the Society which it represents. It contains papers read before the various sections of the Society and in its general meetings, together with such abstracts relating to the progress of chemical science and industry, as seem desirable. The estimate in which the *Journal* is held in other countries is shown by the number of articles published in the *Journal* which are fully abstracted or copied entire by foreign periodicals.

The present officers of the Society are: *President*, F. W. Clarke, chief chemist, U. S. Geological Survey, Washington, D. C.; *Vice-Presidents*, the presiding officers of the various sections; *Secretary*, Albert G. Hale, Brooklyn, N. Y.; *Treasurer*, Albert P. Hallock, New York; *Editor*, Edward Hart, Easton, Pa.; *Librarian*, Edward G. Love, New York. The officers of the New York local section are: *Chairman*, Professor C. A. Doremus, College of the City of New York; *Vice-Chairman*, Professor M. T. Bogert, Columbia University; *Secretary* and *Treasurer*, Dr. Durand Woodman.

The total membership of the Society is about 1800, distributed mainly throughout the United States and other portions of the American continent. Some of its members are to be found in Cuba and other islands of the West Indies, others in various European countries, South America and Australia; in fact nearly every nation of the world is represented in its membership.

It is believed that this celebration, with its record of the history and achievements of the Society, and its representation of the character and strength of the organization of American chemists whom it represents, will not only mark an epoch in the progress of the Society itself, but will point the way to higher attainments and greater triumphs in all departments of chemical science and its applications in the New World.

SCIENTIFIC BOOKS.

Sur quelques microorganismes des combustibles fossiles. Par B. RENAULT. One vol., roy. 8vo, pp. 460, with 66 text figs.; atlas, folio, 30 plates with explanation sheets. Extrait du Bulletin de la Société de l'Industrie Minérale. Troisième série, tome XIII., 4e livraison, 1899. Tome XIV., 1re livraison, 1900. Saint-Etienne. 1900.

This is a superb work on a very difficult, but at the same time very important subject both for the geologist and the biologist. It has been many years in process of elaboration, and more than a dozen preliminary papers, dating back as far as 1892, announcing important results as fast as they were reached, have appeared by the same indefatigable investigator, mostly unaided, but also occasionally in association with MM. Bertrand and Roche, who are working somewhat along the same lines.

It is fashionable in our day to extol the wonders of the microscope, especially so since the modern bacteriological investigations began with their momentous practical consequences. The medieval philosophers had not probably any adequate conception of the real meaning of their fine alliterative phrase: *Deus magnus in magnis, maximus in minimis.* Spencer's 'soul of truth in things erroneous' also finds exemplification here, for the 'devils' of which men were once believed to be 'possessed,' in disease, epilepsy, insanity, etc., and which it was sought to 'cast out' by exorcism and prayer, have been shown by the microscope to be real living things—malignant spirits—the invisible germs of disease.

But while it has become clear that these modern revelations have not brought anything new to light, and that these devils were as numer-

ous, as rampant, and as malignant in biblical times as they are to-day, it is only quite recently that the world has gained any conception of their enormous antiquity, and if any one ever supposed that their chief mission was to punish man for his sins, the fact, now made clear by this and kindred investigations, that they existed in equal numbers and in all parts of the world in Tertiary, Secondary, and even Primary time, *i. e.*, ten to fifty millions of years before man made his appearance on the globe is calculated to shake that belief. The microscope, which has so wonderfully illuminated the hidden mysteries of the present and the invisible world in which we live, has now been leveled at the past and brought to bear upon that vast and hoary antiquity of which we could scarcely form a conception even if we were able to express it in terms of our chronology.

In this work M. Renault treats the microorganisms of past ages under eight different heads, chiefly in the descending order of their occurrence in geologic time, viz., 1st, those found in peat beds of recent origin; 2d, those found in lignite beds, chiefly of Tertiary age; 3d, those found in certain modern bituminous schists; 4th, those found in the so-called boghead formations; 5th, those found in cannel coal; 6th, those found in true coal of the Carboniferous formation; 7th, those found in certain ancient bituminous schists; 8th, those found preserved in flint or silica, chiefly of Carboniferous age.

Peat may be called coal in the making, and consists almost entirely of vegetable matter that has accumulated, often to considerable thickness, where this matter has undergone prolonged maceration. The bulk of it is formed of the remains of the plants that grew on the spot, and which, either from the weight of this constantly increasing superincumbent mass, or from other causes, slowly sink and become buried by successive renewals of the same materials. It takes place in marshes or swamps kept perpetually wet or submerged, under which conditions certain plants long retain their vegetable substance. Many of them, especially dicotyledonous leaves and certain mosses, are thus often preserved permanently, and from their remains much may be learned of the flora of the period at which the peat was formed. Certain seeds are also well adapted to permanent preservation in peat, and it is only recently that extensive investigations of the peat beds of northern Europe have been undertaken by this method. Mr. Leo Lesquereux published in 1844 the results of extensive researches made by him on the peat bogs of the Jura Mountains and Central Europe, and Axel Blytt, Nathorst, Andersson, Sernander, Munthe and others have thoroughly studied those of Scandinavia and other northern regions, while Mr. Clement Reid has in this way successfully worked out the problem of the origin of the British flora. Besides impressions of mosses, and of leaves and stems, and the numerous seeds of spermatophytes found in these beds, the siliceous spicules of many genera and species of diatoms have been detected and systematically treated.

But M. Renault has availed himself of the higher powers of the microscope and has made known to us a large number of other forms of microscopic life. The Bacteriaceæ are found abundantly in the peat of Fragny and Louradou in France, and he has illustrated species of *Bacillus*, *Micrococcus*, *Streptococcus*, *Cladothryx*, etc. The mycelium of numerous fungi also occur.

The principal lignites studied for this monograph have been those of Hérault in the Department of Ain, of Saint-Martin-du-Mont (Ain), of Célas, and Durfort (Gard), and of Sainte-Colombe (Yonne). The first of these, which are Eocene in age, yielded both animal and vegetable forms; Infusoria of the genera *Aspidisca*, *Cinetoconia*, *Ploesconia*, *Vorticellina*, etc., the conidia of fungi referable to the genera *Helminthosporium* and *Macrosporium*, and the mycelium of species of *Morosporium*. Diatoms also occur (*Frustulia*) and Micrococci. The other lignites from localities in France were less fruitful but contained some of the same forms. Besides these, however, M. Renault examined material from Vicenza in Italy and from Coronel in Chili. The latter especially was found to be rich in conidia of the genus *Helminthosporium* and in amœboid forms of the radiate type (*Orbulinella*, *Hedriocystis*, *Clathrulina*).

As an appendix to the treatment of the lignites the author has introduced the results of his investigation of a certain curious fossil combustible from the Lower Carboniferous (Culm) of Tovarkowo and Malevka in Russia, Government of Toula. It consists chiefly of the bark or cuticle of the ancient lepidophyte called *Bothrodendron*, which M. Renault considers distinct from *Lepidodendron*. M. Zeiller has carefully studied this form from the same localities, but the interesting point brought out by Renault is the presence over the whole surface of these paper-coal cuticles of bacteria (*Bacillus*, *Micrococcus*), of which a number of species are figured and described.

The bituminous schists studied for this monograph also proved rich in the remains of extinct microscopic life. Those of Menat, of Oligocene or Aquitanian age, and carrying dicotyledonous leaves of the genera *Planera*, *Liquidambar*, *Cinnamomum*, *Persea*, etc., yielded microscopic fungi (*Helminthosporium*), diatoms (*Amphora*), etc. Those of the Bois d'Asson in the basin of Manosque, of Tongrian age, revealed the presence of Amœboids (*Dactylodiscus*), fungi (*Helminthosporium*, *Macrosporium*, *Sirodesmium*) and diatoms (*Fragilaria*). Some much older schists (Upper Lias) from Anina in Hungary were found to contain fossil algæ resembling the Permian genus *Pila*, also species of fungi of the genera *Mucedites* and *Morosporium*.

The bogheads have formed the object of M. Renault's studies for many years. He has made the beds of Autun, his native city, celebrated by earlier researches. In the present work he has greatly extended his investigations and dealt with similar material from various parts of the world. The bogheads result from the accumulation at the bottom of chiefly Permian lakes of an enormous quantity of microscopic algæ, which were probably gelatinous. In the process of deposition, maceration, and entombment their composition was greatly modified by various influences, among which bacteria played a part. The most important of the algæ forming the bogheads of Autun was the *Pila bibractensis*, named by Bertrand and Renault in 1892. In the present paper the evidence of the agency of bacteria in causing the fermentation of the algoid mass is fully presented and the Micrococci are shown in varied forms.

In specimens of a similar character from the Permian of New South Wales found overlying the coal beds, and probably of Lower Permian age, there occurs another genus of algæ which has been named *Reinschia* for Paul F. Reinsch, a German investigator and pioneer in this branch of research. This same genus recurs in the bogheads of the Transvaal at Ermels. The Torbanite of Torbane Hill, Fifeshire, Scotland, which was the subject of a celebrated lawsuit over the question whether it could be classed as coal, and in which it was at last legally so classed, is treated by M. Renault as virtually a boghead, and yields a species of *Pila* (*P. scotica*). Crushed macrospores of this alga occur along with the globular thalli, and bacteria, although more difficult to find than in other bogheads, have been discovered, consisting of masses of Micrococci. The bogheads of Armadale in Linlithgowshire, Scotland, are formed of various gelatinous algæ, among which another new genus (*Thylax*) is represented.

Among the numerous samples of American cannel coal which I was instrumental in having sent to M. Renault many years ago, and which he has carefully studied, there are some that he classes with the bogheads, especially those from Beaver Dam, Ohio County, Kentucky. These consist chiefly of the remains of a species of *Pila* (*P. kentuckyana*), whose isolated globular thalli form groups of eight or ten and are not disposed in bands. Bacteria are visible in the interior of the thalli.

The coal-bogheads of Alexandrewski, Kourakino and Murajewnja, in Russia, coal basin of Moscow, have a lignitoid appearance, and contain, besides a new species of *Pila* (*P. Karpinskyi*), a new genus, *Cladiscothallus*, with a much branched, discoid thallus. Adhering to the walls and penetrating the interior pulpy mass of *C. Keppeni* is a peculiar *Micrococcus*, which M. Renault has named *M. petrolei*.

The passage from bogheads to cannel coals is a short step, although these last usually belong to the Carboniferous period. They contain, however, to a considerable extent, the same flora

and fauna. In the so-called Bryant cannel of England, M. Renault finds the *Pila scotica*, of Torbane Hill, with macrospores and affected with bacteria. Here occur filaments of a fungus which he calls *Anthracomyces*. The mycella invade the covering of the spores of the algæ. They are very fine but distinct under a high power (1000/1), and susceptible of clear illustration. Other cannels of the Old World present substantially the same features.

M. Renault has carefully studied the specimens of cannel coal sent him from America and the results are interesting. The specimens represented many localities in West Virginia and Kentucky, and the names he gives are: Cannelton and Davis Creek in West Virginia, and Beaver Dam (mentioned above), Little Laurel Creek, Natz Creek, Hunnewell, Georges Branch, Caney Creek, Blackwater Creek, Mercer Station, Magofin County and Buena Vista in Kentucky. Those of Beaver Dam and Little Laurel Creek he classes as bogheads, the rest he regards as true cannels. The Cannelton specimens are filled with spores of ferns and lycopods, the walls of which have Micrococci disseminated through them. Algæ are rare in most of the American material except that of the boghead type, but in that from Davis Creek, classed as cannel, they occur, and belong to the above-mentioned genus *Cladiscothallus*. The species, however, is not the same as that of the Russian bogheads, and M. Renault has done me the honor to name it *C. Wardi*. It is discoid and spread out in a single plane with numerous dichotomous branches. It does not seem to be affected with bacteria. The specimens from Buena Vista, Kentucky, are wholly destitute of algæ.

In the coal basin of Commentry, in central France, which has yielded such a magnificent flora and great numbers of insects, and which I had the pleasure of visiting in September last, there is at the Puits Forêt a combustible mineral substance substantially representing cannel coal. It has yielded to M. Renault's microscope a considerable number of organized bodie, consisting of spores of ferns and Equisetaceæs but no algæ. He also finds the macrospore of *Sphenophyllum* and pollen grains of gymnosperms, wood of *Calamodendron*, and transverse sections of leaves, probably of *Cordaites*. Throughout the mass are everywhere distributed numerous Micrococci, on the surface of the membranes of the spores, and pollen grains, in the fragments of indeterminable vegetable matter and in the general matrix. Similar conditions obtain in certain barren measures at Rive-de Gier in the basin of Saint-Étienne, Upper Loire.

M. Renault treated many specimens of carbonized wood from the coal measures of Zsily, Hungary, Bouble near Saint-Éloi (Puy-de-Dôme) and Decazeville in France, and found them more or less permeated with bacteria (*Micrococcus Carbo*, *Bacillus colletus*, *Cladothryx Martyi*). He also found filaments of saprophytic fungi.

The coprolites and certain fish bones and scales of the bituminous schists of Autun, Igornay and Lally proved a rich field for the microscope, large numbers of Micrococci, bacilli and fungi (*Mucedites*, *Anthracomycetes*) from these sources being illustrated in this work.

A still richer source of fossil microorganisms is the various Paleozoic flints that occur in certain coal basins and other deposits. It was from such that Brongniart described so many remarkable seeds and fruits of Carboniferous plants, chiefly from the basin of Saint-Étienne. They contain all manner of vegetable tissues, and M. Renault finds these permeated with bacteria and fungi. The silica has preserved everything with great exactness and the illustrations of microscopic organisms in this matrix are much clearer than those from the fossil combustibles. Some of these are older than the coal measures and are found in the Culm and even in the Devonian, as those of the Cypridine schists of Saalsfeld, in which silicified remains of *Cordaioxylon* are affected by a *Micrococcus* (*M. devonicus*). At Estnost, near Autun, the roots of a species of *Lepidodendron* (*L. estnostense*) have buried in their parenchymatous tissue the eggs of an insect or arthropod, which has been named *Arthroon Rochei*.

Further details cannot be given here, but this notice should not be concluded without calling attention to the geological and even economic value of the work. It goes far toward furnishing the solution of many of the

most difficult problems that the study of the origin of coal and other fossil combustibles presents. It should be carefully studied from that point of view.

Neither should the fact be left unstated that in these difficult and recondite researches M. Renault has advanced theories that are not accepted by all, but the criticism and, if need be, the disproof of which belongs to those who are engaged in the same line of investigation and are equipped for such a task.

LESTER F. WARD.

The Elements of Astronomy. By Sir ROBERT BALL. New York, The Macmillan Company. 1900. 183 pages, 23 figs., and 11 full-page plates. Price, 80 cents.

This little book contains a clearly written account of astronomical subjects, adapted to the needs of beginners. After a brief historical introduction and an explanation of the apparent diurnal motion of the celestial sphere, the Sun, as the heavenly body most important to us and most interesting to the novice, is rightly placed first. If any change were to be suggested here, it would be that this topic should receive fuller treatment and more complete illustration. The author's admirable *Story of the Sun*, which is both accurate and interesting, fits him to present this subject advantageously.

It is to be regretted that the eclipse photographs, which are supposed to show solar prominences and the corona, are so badly reproduced as to be almost worthless; and while the introduction of photographic illustrations directly from nature is very desirable, the public has a right to demand that such pictures in a work of more than ephemeral value shall have that degree of precision which modern art processes are able to give. In case the publishers have not at their command facilities for reproducing pictures with delicate details, a well-executed engraving, correctly interpreting such details, is to be preferred to a poor photograph. Good illustrations are given of the Full Moon, Saturn, Jupiter, the Dumbbell Nebula, and clusters in Hercules and in Perseus.

Since one of the objects of scientific study is to inculcate conceptions of precision, the indiscriminate grouping of stars of several orders of magnitude from Sirius (—1.5 mag.) to Capella (0 mag.) under the title 'first magnitude' stars (p. 7–8) is to be deprecated.

In an edition prepared for American readers it might be well, if a common name is to be used, to substitute The Dipper for The Plough in designating a part of Ursa Major which 'in this country' is familiarly known by the former title.

A similar remark applies to the statement on p. 57 that midsummer twilight in 'our' latitudes lasts all through the night, which lacks generality and is inappropriate in a science whose chief merit as a discipline for young readers is that it tends to broaden our conceptions by wiping out local distinctions.

The author's familiarity with mathematical processes gives him a firm grasp on everything of a geometrical nature, but also a beautiful simplicity and directness in his demonstrations, which does not always follow from individual comprehension. The chapter on the diurnal motion is simplified by the omission of some details which would have to be considered in a more extended treatise; but one cannot omit to note that quite apart from this, the method and language of the demonstration are uncommonly clear and convincing.

It is natural that we should expect the same clearness in those subjects which Sir Robert Ball has made peculiarly his own—such as precession and the tides—and the reader will not be disappointed here. The history of the Earth-Moon system and the chapter on gravitation will be found especially interesting.

It is permissible, even in an elementary treatise, that an author should develop somewhat those parts of the subject on which he is an authority and where he can speak better than any one else; and since a selection has to be made in a small work like this, it is just as well that the illustrations chosen should be those most familiar to the author; but there are other inequalities which cannot be commended.

A considerable space is devoted to an argument as to the exceedingly high surface-temperature of Jupiter, which is purely speculative,