

#### Apogamy in *Pteris serrulata* (L. fil.) var. *cristata*.

CASES of apogamy are so rare and so intrinsically interesting, that it may be worth the while to record at once the following fact:—

About a fortnight ago, while preparing prothallia for imbedding in paraffin, my attention was called by a student to a specimen obtained from a pot containing a fine plant of *Pteris serrulata cristata*.

The prothallium was of somewhat unusual form, perfectly destitute of archegonia and antheridia, but yet had midway between base and apex a peculiar protuberance. This I suspected to be a young sporophyte apogamously developed.

The prothallium was imbedded in the usual way, and yesterday it was cut into a series of sections. These demonstrate conclusively, I think, that the prothallium was apogamous, for while there is no trace of an archegonium, I find, in the first place, a row of scalariform tracheides, and in the second place—except over a limited area, where I believe the apex of the root has been separated off by the appearance of a conical split—there is no sharp distinction between the cells of the sporophyte and gametophyte.

It should be added that my examination of the sections was necessarily a hurried one, and that at present it is impossible to be certain that the prothallium was developed from a spore of *P. serrulata cristata*. The ferns of the garden and house where the prothallium grew, however, included no known apogamous forms.

It is not unlikely that I may be unable to follow the matter further, and this must be my excuse for making public, without further investigation, this interesting fact. A. H. TROW.

University College of South Wales and  
Monmouthshire, February 27.

#### Fireballs.

THE large meteor of February 21 last, mentioned in NATURE of March 1 (p. 419), was also observed by me at Bristol. The time was noted at 7h. 18m., and the meteor was estimated as bright as Jupiter, but its light was much dimmed by the fog, low on the northern horizon, where it appeared. Its direction of flight was not well determined, the path being short and rapidly traversed in a place barren of visible stars, but it was roughly recorded as from  $252^{\circ} + 53^{\circ}$  to  $253\frac{1}{2}^{\circ} + 49^{\circ}$ . Comparing it with the description by Mr. Greig at Dundee, and with notes from North Lincolnshire and other places, it seems the meteor disappeared at a height of about thirty miles over Bolton, Lancashire; but the place and height of its first appearance are not satisfactorily indicated. The probable radiant is in Ursa Major. A good observation from Ireland, or the north-west part of England, would be very useful in assigning the precise path.

A fine example of a fireball, visible in sunshine, was afforded by the meteor of February 8, oh. 28m. p.m., which appears to have been very widely observed in this country. Its real path was from a point above the Irish Sea, west of Southport, where its approximate elevation was seventy-five or eighty miles, and from thence it passed rapidly over Lancashire into Yorkshire, finally disappearing near Leeds at a height of twenty miles, or possibly less. Its radiant point was in Hercules, and the direction of its motion from west by south to east by north. This daylight fireball may have had its origin in the same system as that which supplied the brilliant fireball seen in the evening twilight of February 7, 1863, the radiant of which was about  $270^{\circ} + 35^{\circ}$ .

Bristol, March 4.

W. F. DENNING.

#### Astronomy in Poetry.

A *propos* of the subject of "Astronomy in Poetry," permit me to quote one verse from "The Faërie Queene" of Spenser:—

Yet all these were, when no man did them know,  
Yet have from wisest ages hidden be:  
And later times things more unknown shall show.  
Why then should wilsesse man so much misweene,  
That nothing is but that which he hath seene?  
What if within the Moones fayre shining sphaere,  
What if in every other starre unseene  
Of other worlds he happily should heare,  
He wonder would much more: yet such to some appeare.

I have followed the spelling and the punctuation of the text of the "Globe" edition (1879).

Kendal, Westmorland.

G. W. MURDOCH.

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#### RECENT PUBLICATIONS OF THE AMERICAN GEOLOGICAL SURVEY.

TO initiate and to be left behind—that seems to be the fate of England in the latter half of the nineteenth century. In science, at any rate, it is too often so. A sight of the volumes—fourteen in number, the earliest dated in 1891—with which our table is loaded, a glance at those which are already ranged upon our shelves, indicate that this is emphatically true of the work of the Geological Survey. We mean no reproach to British men of science or to the British surveyors. The State despises the one and starves the other; and the "people love to have it so"; for what care they for learning or research, unless it will obviously put money into the pocket? But this is a large question, and our space will not suffice even for an adequate notice of the volumes before us. These consist of one bound octavo volume on the mineral resources of the United States (the eighth of a series), nine paper-covered numbers of the *Bulletin*, slightly larger in size, ranging from thirty to five hundred and fifty pages; two volumes, still larger, of the Annual Report (eleventh), and yet two volumes of Monographs of quarto size.

Passing by the first as of commercial rather than of scientific interest, we come to the *Bulletin*. Four of the numbers, smaller than the others, though they make up to full 220 pages, have little in common. No. 90 is a report of work done in the Division of Chemistry and Physics, mainly during the years 1890–91. It contains several studies and analyses of special minerals, including a research on certain micas, vermiculites and chlorites, and a note on the colloidal sulphides of gold, in which it is suggested that the separation of free gold in the upper strata of the earth's crust may have been effected by the action of sulphuretted hydrogen on chloride of gold, at no very great depth, though at one less than that at which pyrites is formed. The report concludes with a number of analyses of miscellaneous rock specimens. No. 91 is a "Record of North American Geology for 1890," a very useful bibliography of papers, &c., classified not only under names of authors, but also under subjects. No. 93 is a pamphlet by Mr. S. H. Scudder, on "Some insects of special interest, chiefly from Colorado," and No. 94, which is about the same length, is by Mr. E. S. Holden, on "Earthquakes in California in 1890 and 1891."

The larger volumes of the *Bulletin* are all "Correlation Papers," or memoirs written on some one geological period, by a specially qualified author, "for the purpose of summarising existing knowledge with reference to the geologic formations of North America, and especially of the United States; of discussing the correlation of formations found in different parts of the country with one another and with formations in other countries; and of discussing the principles of geological correlation in the light of American phenomena." Of these four memoirs the largest (No. 86), written by Prof. C. R. van Hise, deals with the "Archæan and Algonkian" systems.

By these names the author designates the vast mass of rocks which lies beneath the *Olenellus* zone of the Cambrian system. In dealing with the subject he has adopted the following method:—Each chapter treats of some important district. It gives full abstracts of the more important papers bearing on the geology of that district, which is followed by a bibliographical list, and concluded by a summary of the results. More than four hundred pages are thus occupied, and the work is ended by a long chapter (about eighty pages) on "general successions and discussion of principles."

The author employs the term Algonkian for "the pre-Olenellus clastics and their equivalent crystallines," and Archæan for the completely crystalline rocks below

them. The latter system, accordingly, "has no limit downward. It is the oldest system, and surely includes, if such rocks exist, all of the original crust of the earth." The upward limit also is not easily defined, but "it is frequently easy in the field to say, with a great degree of probability, what rocks are Archæan and what post-Archæan." Thus the former system includes the original Huronian of Logan, which the author inclines to think separable into two divisions, the lower of which comes nearer than the upper to assuming a crystalline character. It also covers the Animikie and the Keweenaw of Irving; in short, a vast group of rocks which are generally clastic in origin, and seldom more than sub-crystalline in character, in certain of which undoubted traces of life—though very rarely—have been found. The origin of the Archæan system is considered to be a problem yet unsolved. Its rocks are highly crystalline, and if any have been formerly sediments all traces of a clastic origin have been completely lost. It certainly constitutes a complex, probably to no small part of igneous origin, and the author evidently inclines to the view "that this earliest crystalline complex was produced under conditions differing from those of the rocks of any subsequent period." He would employ the term Laurentian in a more restricted sense than that in which it was used by Logan for the gneissoid part of the Archæan, while he dismisses most of the six pre-Cambrian rock systems of the late Sterry Hunt and his school as hypothetical existences to which the atmosphere of the laboratory was more congenial than the air of the field.

In a subject so difficult as these pre-Cambrian rocks, where so many things are yet unsettled, Prof. van Hise cannot expect to satisfy all readers. Speaking for ourselves, we think he is disposed to attribute too much potency to dynamic metamorphism—an agency which is being rather "boomed" at the present time—and to admit on too slight evidence that in "Silurian, Devonian, and even later times, completely crystalline schists have been produced over large areas"; for in the past this assertion has been so often made, and so often proved to be erroneous, that on the principle, "once bit twice shy," we are disposed to be a little sceptical. But whether we accept or whether we demur to the author's conclusion, we gladly welcome his volume as a contribution to the history of the pre-Cambrian rocks which will be invaluable to students, and is full of sagacious criticism and suggestive remarks.

The next Correlation Paper (No. 85), written by Mr. I. C. Russell, deals with the Newark system, which occupies a series of rather elongated outcrops in the Eastern States, and runs along the shore of the Bay of Fundy. The fragmental rocks of this system, which includes the well-known New Red Sandstone of Connecticut, vary from coarse to fine; a few thin seams of coal and limestone are also present. Dykes and sheets of basalt, &c. occur in almost every area. The system is limited by an unconformity, both above and below, and is not easily correlated precisely with those of Europe, but the reptiles, amphibia, and crustacea correspond generally with those of the Keuper, the fishes with the Mesozoic rather than with the Palæozoic, and the plants with the Upper Trias or Rhætic, so that it evidently represents an early portion of Mesozoic time.

A third Correlation Paper (No. 82), by Mr. C. A. White, deals with the Cretaceous. This system occupies in the interior a very wide zone (the southern half being the less uniform in outline) which extends roughly from latitude 28° to 60°. Further north are some outlying patches; near the Pacific coast is a long string of the same, and in the Southern States east of the Mississippi a crescentic area. The rocks, especially in the Interior Basin, have been affected in many places by great displacements both during and after Cretaceous times, but though over a

large part of this region they have been elevated from about one to five thousand feet above the sea, they generally lie almost horizontally; these displacements are more frequent in the Lower than in the Upper Cretaceous. Also much volcanic material was extruded during this period as well as after its close. In the Interior Basin marine deposits alternate with freshwater, but the latter predominate, showing that the land was more often above than below sea level.

The Eocene forms the subject of another Correlation Paper (*Bulletin* No. 83), by Dr. W. B. Clark. The rocks of this period occur in the same regions as the Cretaceous, but occupy much less extensive areas in the western half of the continent, while they are more largely developed in the south-east, extending from the Mexican frontier to New Jersey State. The last, as is well known, are marine, and comparable with the deposits on the other side of the Atlantic, but the correlation of the various groups of the Interior Basin, including the transitional Laramie deposits, is very difficult, probably because the flora and fauna of these inland waters, as they were changing from brackish to fresh, present so few points of comparison with other regions. Still, Dr. Clark's clear summary of the main results of investigation, and of the succession of the strata, will be very helpful to the student.

The last *Bulletin* before us (No. 84), by Messrs. W. H. Dall and G. D. Harris, describes the Neocene. This term is supposed to include the Tertiaries other than Eocene. We have not troubled to inquire to whom belongs the honour of its paternity. If it does not mean New-new, then words respectively more applicable to persons and things are combined. Perhaps the one half was intended to apply to the animals, the other to the rocks; or perhaps—what is more usual with geologists—nobody troubled himself to think whether the term was sense or nonsense. The memoir, however, is full of valuable and interesting information, for it deals with the final shaping of the American continent and the development of its fauna; but with this bare mention we must be satisfied.

Of the two volumes of Monographs, one (No. xvii.) has a melancholy interest, for it is the last work of "the Nestor of American palæobotanists," Leo Lesquereux, left barely complete at his death. The memoir on the "Flora of the Dakota Group" has been edited by Prof. F. H. Knowlton. The Dakota group appears to correspond more closely with the Cenomanian of Europe; thus its plants have an exceptional interest, since they "pertain to an epoch in which, by the appearance of the dicotyledons, the character of the flora of the globe has been modified as by a new creation. The cause or reason of this marked change remains still unexplained." The flora described by Prof. Lesquereux consists of 460 species, of which 429 are dicotyledons. Sixty-six plates illustrate their remains, and the volume concludes with an analysis of the results of the investigation, which is of interest to more than palæobotanists. We must, however, restrict ourselves to stating Prof. Lesquereux's conclusion: that the flora of North America is not the result of migration in past geological times, but an indigenous one. All the plants of the American Cenomanian (except those of *Ficus* and the *Cycads*) might still find a congenial climate in the United States between latitudes 30° and 40°—that is to say, in localities at most a very few degrees (perhaps five) further to the south. Since the Cenomanian epoch the land surface between the Rocky Mountains and the Alleghanies has suffered no physical change of importance, for the general absence of drift deposits from these vast plains indicates that they were not greatly affected even by the glacial epoch. "The result has been a prolonged uniformity of climate and, of course, the preservation of the original types of the flora, subjected to some modification of their original

characters, without destroying them or forcing their removal by the introduction of strange or exotic forms."

The second volume of the Monographs (No. xviii.) describes the Gastropoda and Cephalopoda of the New Jersey Marls and accompanying beds; the Lamellibranchiata and Brachiopoda having been already the subject of a memoir (No. ix.). These deposits are generally glauconitic; the fossils are casts, often ill-preserved, so that the determination of them has been not seldom attended by great difficulties; they bear a superficial resemblance to those from the Cambridge Greensand of England, and the rock contains a certain proportion of phosphate of lime, though these casts do not appear to be, strictly speaking, phosphatised. The Marls, as is well known, are mostly Cretaceous in age, no part representing the Neocomian, but the uppermost beds are referred to the Eocene. Beneath the last are indications of a very slight break: so that systems which in our own country and the adjacent parts of Europe are separated by a wide gap, in this region are practically continuous. The beds—which may possibly be Neocomian—beneath the Marls, called the Raritan clays, are brackish or even fresh water in origin; the Marls themselves are marine, but shallow water deposits. The Cretaceous members contain the usual cephalopods, which come chiefly from the lower Marls, as indeed do most of the other fossils. Among these are seven species of Ammonites, four of Scaphites, and three of Baculites; Turritiles, Heteroceras, Ptychoceras, and Belemnites are each represented by one species. None, however, appear to be individually common, and most are rare. The Eocene contains one Nautilus and one *Aturia*. The Gastropoda are fairly numerous, 136 in the Cretaceous and 52 in the Eocene. As the former volume showed, the Lamellibranchiata are more strongly represented in the Cretaceous than in the Eocene, and in the former deposit dominate over the Gastropoda; the Brachiopoda are in neither numerous. The illustrations in this volume exceed fifty plates.

The eleventh annual report is in two parts. The first, after the usual official matter, contains two lengthy memoirs; the first, almost a volume in itself, by Mr. W. J. McGee, entitled the "Pleistocene History of North-Eastern Iowa," the second, by Mr. A. J. Phinney, on the "Natural Gas Field of Indiana," with an introduction by the former author. In the "Pleistocene History" Mr. McGee gives a very full and interesting account of the drifts of a large area of Iowa, with maps illustrative of the conclusions which he considers them to justify. The region appears to have been twice invaded by ice, the earlier glaciation being "the longer and the more energetic." Glacial striæ, however, are very rarely found, in consequence, probably, of the incoherence of the rock masses to this region. As memorials of these invasions of the ice-sheet, an upper and lower till can generally be distinguished; and the latter sometimes shows crumplings, interpreted as memorials of the pressure of the second ice-sheet; between these tills a kind of "forest-bed" is frequently to be found. By each advance of the ice-sheet, rivers were dammed and great lakes formed on its margin, in the waters of which materials were deposited from the ice and from other sources, much of this being a stiff clay, locally named "gumbo." During the first invasion the land sank; perhaps sufficiently to allow of an invasion of the sea. A similar but less extensive subsidence took place in consequence of the second invasion. These depressions aided in the formation of the lakes. A summary this, necessarily very imperfect, but it may suffice to indicate the general conclusions at which the author has arrived.

The second memoir contains a vast amount of information concerning the natural gas and oil wells of Indiana, and is prefaced by a general sketch of the distribution of bituminous deposits. The commercially valuable bitu-

mens occur (not in America only) in the Lower Silurian rocks, and continue to comparatively recent times, but the most important are found in the Silurian and Devonian systems, and in the Tertiary series. In the first the products are chiefly gas; in the second both are found, petroleum probably predominating; while in the third nearly all the known forms occur.

The second part of the report deals exclusively with irrigation. Maps and details of the arid region of the United States are given, from which it appears that this extends from their northern frontier to the 32nd parallel of latitude, and from the eastern slopes of the Sierra Nevada approximately to the 100th parallel of longitude, thus including the great Inland Basin and the Rocky Mountains. On the ranges, however, there is a considerable amount of precipitation. As stated by Major Powell, in evidence before a Committee of Congress, the rainfall on the mountains may vary from 25 to 60 inches per annum, while in the valleys below it is generally less than 15, and sometimes even as small as 3 inches.

These publications, as this imperfect sketch may indicate, are full of varied and valuable information, and are richly illustrated with maps, plates, and woodcuts. If we might venture on a general criticism, it would be that the authors not seldom exhibit a tendency to "spread themselves" too much, to be over-diffuse in style, and to enter upon general disquisitions, which, however interesting, are a little out of place in official publications. Space also seems occasionally to be wasted in giving information which would be more appropriate in a text-book of geology. As the volumes are primarily designed for the people of the United States, the authors may be presumed to know best the desires of their own public, but this redundancy is sometimes a little wearisome to outsiders. Possibly the recent reduction of the vote for the support of the Survey, which we trust will not be permanent, may be intended as an expression of this feeling. Very probably some economies might be effected, but it will be an ill-day for this branch of science if the work of the Geological Survey of the United States is seriously cramped.

T. G. BONNEY.

#### MEASUREMENTS OF LOW VAPOUR PRESSURES.

THE two well-known methods of measuring vapour pressures are the statical and the dynamical. In the former the pressure exerted by a vapour is measured when the substance is kept at a given temperature, while in the latter the temperature is ascertained at which the liquid boils when under a given pressure. The present volume is mainly concerned with the description of, and the results obtained by, a dynamical method of estimating very low pressures for mixed as well as for pure substances; the pressure range extending, in general, from about zero to a maximum which is below 70 mm.

Before proceeding to the description of this method, the author seeks to clear away certain discrepancies which have been recorded regarding the results of vapour pressure observations as given by the statical and dynamical methods. Dynamical observations on the fatty acids, published by himself in 1885, differed considerably at low pressures from those obtained by Landolt in 1868 from statical measurements. From the fact that the differences varied regularly with the chemical nature of the acids, it appeared possible that at very low pressures the two methods led to different results. A historical summary of work on this subject is

1 "Studien über Dampfspannungsmessungen." In Gemeinschaft mit Paul Schroter und andern Mitarbeitern von Georg W. A. Kahlbaum. Basel: Benno Schwabe, 1893.