a separate brochure. Photographs of the exhibits from Harvard, Mount Wilson, Heidelberg, and other observatories show that astronomy was fairly well represented at the exhibition.

TRACING THE SOLAR CORONA IN LUNAR OBSERVATIONS.—In the December number of the *Bulletin de la Société astronomique de France* M. Em. Touchet makes the interesting suggestion that observers may be able to trace the radiations of the solar corona in observations of the moon. The note was submitted to the Academie des Sciences in 1906, but did not appear in the *Comptes rendus*, and even now M. Deslandres considers the difficulties of realisation are about equal to those surrounding the photography of the corona in full sunlight.

The suggestion is that when the sun rises on the moon, the lunar surface, owing to the absence of atmosphere, would first be illuminated by fairly strong coronal light, then by the chromospheric radiations, and lastly by the photosphere. With the observer's spectroscope slit delicately adjusted on the position of lunar strip lighted by the corona, one might possibly find, in addition to the ordinary lunar spectrum, a narrow spectrum composed of that of the earth-light and the corona. M. Touchet realises that the difficulties are enormous, but suggests that, with a clear atmosphere, large dispersion, and the large apertures now available at Mount Wilson, for example, they might not prove insuperable.

ANNUAL PUBLICATIONS.—The "Companion to the Observatory," published by Messrs. Taylor and Francis at 1*s.* 6*d.*, contains the usual features, and should be secured by every astronomical student actually engaged in making observations. The increase in the number of variable stars makes the publication of the complete list impossible. As the compilers of the "Annuaire du Bureau des Longitudes" have discontinued the computation of the variable-star ephemerides, the editors of the "Companion" can no longer rely upon that source of information.

M. Flammarion's "Annuaire Astronomique" also follows its usual form, and is a most useful work of reference to all interested in the popularisation of astronomy. Its review of the past year's astronomy and meteorology is also useful, while the special articles therein comprised are very interesting; among them we might mention notices on Halley's comet and the Paris floods of 1910.

AMERICAN HYDROGRAPHY.[1]

THE first impression which one gains in turning over the pages of these seven reports is that, if genius be, as Dr. Johnson asserted, an infinite capacity for taking pains, then the compilers of these statistical records possess that attribute in a very high degree. One turns over page after page of systematically prepared data, unquestionably the outcome of innumerable observations which have been carefully and religiously made through long periods of time, and one cannot but admire the patient, painstaking zeal of these scientific workers who have concentrated their energies on this special field of enterprise, in the service of their country, for the development of its resources and the expansion of its commerce.

The work is carried on under the auspices of the Geological Survey of the United States, and this relationship of hydrography to geology calls to mind the proud reply of the "Scarabee" to the Poet at the Breakfast Table:—"I am often spoken of as a Coleopterist," he said, "but I have no right to so comprehensive a name. The genus Scarabæus is what I have chiefly confined myself to, and ought to have studied exclusively. The beetles proper are quite enough for the labour of one man's life. Call me a Scarabeeist if you will: if I can prove myself worthy of that name, my highest ambition will be more than satisfied."

Hydro-electric Plant (developing 26,600 horse-power) on Puyallup River, near Electron, Washington.

This is the true scientific spirit: the concentration of thought and energy on one special branch of study to the exclusion of even cognate interests; the patient accumulation of facts and data, and their careful analysis and tabulation, within a purview sufficiently restricted for the capacity of the individual investigator—by these means alone is the practical knowledge of the world increased and its avenues of progress extended.

In order to appreciate the full utility of these records it is essential to recall the fact that the development of water-power in every civilised country is rapidly becoming an economic necessity. With the steady depletion of coal, lumber, oil, and natural supplies of fuel there arises a corresponding need for the exploitation of other sources

1 Surface Water Supply of the United States, 1907-8. Bulletins prepared under the general direction of M. O. Leighton, viz., Paper No. 241, North Atlantic Coast; No. 243, Ohio River Basin; No. 244, St. Lawrence River Basin; No. 245, Upper Mississippi and Hudson Bay Basins; No. 248, Western Gulf of Mexico; No. 249, Colorado River Basin; No. 252, North Pacific Coast. (Washington: U.S. Geological Survey, 1910.)

of energy available for and adaptable to manufacturing purposes. Among these water-power stands pre-eminent, especially since the introduction of electricity, which has provided an easy and convenient means for the transmission of its energy. Then, in regard to flood prevention, domestic water supply, irrigation, and land reclamation there are obvious grounds for regarding the study of periodic flow in rivers and streams as a consideration of the highest importance. The damage arising from floods in the United States exceeds a hundred million dollars annually, and more than 70 million acres of the richest land are rendered practically worthless by reason of prevailing conditions of overflow and swamp. Amelioration of these natural defects can only be brought about by the collection of trustworthy data and a careful and thorough study of all the circumstances attending the phenomena in question.

Records of stream flow necessarily call for frequent and prolonged observation. They must embrace all stages and cover, if possible, the absolute maximum and the absolute minimum of discharge. This involves, in most cases, a period of at least five or ten years, and in some instances twenty years or more. It is regrettable that the compilers of these volumes have had to avow that a number of their records are of insufficient duration, owing to unforeseen reduction in grants and the consequent abandonment of certain gauging stations. The national exchequer is surely not so impoverished as to be under the necessity of exercising retrenchment in regard to so important a branch of the public service.

Three methods of stream-flow measurement have been adopted by the Hydrographical Department, according to the local physical conditions, the degree of accuracy desired, the funds available, and the length of time devoted to observation.

The first, most theoretical, and least used method is that of measuring the slope and cross-section of a stream, and then using the Kutter expansion of Chezy's formula. Owing to the difficulty of obtaining accurate data, and more particularly to the uncertainty attaching to the coefficients in the formula, results obtained by this method can only be regarded as approximately correct.

The second method is that of measuring the discharges over dams and weirs. Here the problem is complicated by variations in profile and crest, by leakages through the dams, backwater at high stages, log and ice obstructions, and local diversions of water for power purposes. On this account comparatively few stations are maintained at weirs and dams.

The system chiefly employed is that of measuring the velocity of the current, principally by the Price current meter, rarely by means of free floats, and, at the same time, determining by a series of ordinates from a datum line the cross-sectional area of the stream.

The following comments on the relative merits of the systems are interesting.

"Practically all discharge measurements made under fair conditions are well within 5 per cent. of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous tests and experiments have been made to test the accuracy of current-meter work. These show that it compares very favourably with the results from standard weirs, and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where uncertainty regarding the coefficient and complicated conditions of flow prevail."

Then there is, of course, the human element and the personal factor which enters into all experimental work. It is interesting to know that, "with relatively few exceptions, the observers perform their work honestly." Yet even honesty of purpose cannot eliminate every element of error, though the effect of numerous readings is obviously to minimise any inadvertent inexactitudes. Individualism counts for something, too, but, on the whole, errors arising from these and other causes become self-compensating and virtually negligible.

Merely to enumerate all the river basins comprised within the purview of the Hydrographical Survey would involve more space than can be spared for the purpose. From the noble Mississippi, with its drainage area of 1,240,000 square miles, including wholly, or in part, thirty States, besides a small portion of the Dominion of Canada, down to the modest Siletz, with its length of 50 miles and its basin of 320 square miles, there are measured and described all sorts and conditions of streams with names as musical as Menonimee and Wapsipinicon, as dissonant as Umpqua and Puyallup, prosaic as Muddy and fantastic as Devil's. The whole area of the country is to be covered by a dozen bulletins, of which the present seven form part. B. C.

PALAEONTOLOGICAL PAPERS.

THE troublesome question of fucoids has exercised Mr. Otto M. Reis ("Zur Fucoidenfrage," *Jahrb. k.k. geol. Reichsanstalt*, Bd. lix., published 1910, p. 615), an author well known for his researches on ruin-marble and cone-in-cone. He accepts an organic origin for the fucoids collected by him in the northern Apennines and the Alps, and points out that the clay, which might be regarded as a mere infilling of a worm-tube, is in some cases so arranged as to form a true wall to the tube. The granulations on the surface of many fucoids may be regarded as due to clay-lumps used in the construction of the worm-tube. *Terebella figulus* is cited (p. 628) as an example of a worm that kneads up fine clay into bricks, as it were, which it places from its mouth on to the growing margin of its tube. The author expects criticism, since he sets aside the algal theory of the origin of fucoids in the Flysch, and ascribes the structures to boring and tubicolous worms.

Mr. E. W. Vredenburg (Records, Geol. Survey of India, vol. xxxvi., 1908, p. 241) has described certain "pseudofucoids" of eastern Baluchistan as casts of worm-burrows and tracks of marine organisms, here following the work of Nathorst.

Mr. M. D. Zalessky records (*Bull. Acad. imp. Sci. St. Pétersbourg*, No. 6, 1910) in a brief English paper the discovery of coal-balls in the Carboniferous of the Donetz basin, containing well-preserved plants, from the study of which much may be expected. Their mode of occurrence precisely resembles that of the English examples studied by Williamson.

Mr. Vredenburg (Rec. Geol. Surv. India, vol. xxxvi., p. 171) describes species of Orbitoides from the upper part of the Upper Cretaceous of India, including megaspheric and microspheric forms. As usual, this author interestingly connects his palæontological work with zonal considerations and with questions of Indian stratigraphy, which here occupy twenty-five pages of the paper.

The important manuscript work on dendroid graptolites, left by Dr. R. Gurley, has been revised and issued by Mr. R. S. Bassler (Bull. 65, U.S. National Museum, 1909). The forms described, including many species of Dictyonema, are from the Niagaran (Middle Gotlandian) Dolomites of Hamilton, Ontario. With one or two exceptions, like the Inocaulis on p. 48, the figures of these difficult fossils are limited to the forms of the rhabdosomes.

Proceeding to molluscs, Dr. A. Schmidt has examined the Anthracosiidæ of the Upper Carboniferous beds of Mährisch-Ostrau (*Jahrb. k.k. geol. Reichsanstalt*, Bd. lix., published in 1910, p. 733). The forms illustrated have naturally an interest for English geologists, and the paper both supports and supplements the work of Dr. Wheelton Hind. Dr. Schmidt points out the general tendency towards a uniform type of shell among the later members of this fresh-water group, while the animals very probably remained quite distinct. The reduction of hinge-teeth seems related to prolonged fresh-water conditions. The author doubts if the fresh-water shells of the Mesozoic era had fresh-water Palæozoic ancestors, since the Permian forms had already proceeded far towards uniformity of type, and probably altogether passed away. However, a mollusc described by Mr. L. J. Wills in a paper on the Keuper of Worcestershire, to be quoted later, seems possibly a survival of Naiadites. In the same volume of this *Jahrbuch* (p. 407, published in 1909) Dr. A. Till continues his work on the jaws of fossil cephalopods. In the absence of any guide to their correlation, these objects are