

M. Trillat for his applications of formaldehyde to industry, and to MM. Sévène and Cohen for their use of phosphorus sesquisulphide in the manufacture of matches in the place of ordinary phosphorus; the Cuvier Prize to M. Antoine Fritsch for his treatises on European Birds and on Palæontology, the Wilde Prize to M. Delépine, for his experimental researches on aldehydes; the Vaillant to M. Henri Gautier, for his work on alloys and on the atomic weight of boron; and to M. F. Osmond, for his researches on iron and steel; the Frémont Prize to M. Ch. Frémont, for his results on the testing of the resistance of metals; the Gegner Prize to Mme. Curie; the Delalande-Guérineau Prize to M. Maurain and M. Lacombe, for their work on the measurement of an arc of meridian at Quito; the Jérôme Ponti Prize to MM. P. Girod and Massénat; the Tchihatchef Prize to M. de Loczy, for work on the Physical Geography and Geology of Eastern China; the Houllévine Prize to M. Wallerant, for his researches in Crystallography. The Boileau Prize is divided between M. Sautréaux, M. Delemer and M. Nau; the Cahours Prize between M. Mouneyrat, M. Metzner and M. Defacqz.

The Saintour Prize is awarded to M. Debureaux, the prize founded by the Marquis De Laplace to M. Macaux, and the prize founded by M. Félix Revot to MM. Macaux, de Schlumberger, Martinet and Harel.

UNITED STATES GEOLOGICAL SURVEY.

THE work of the Geological Survey of the United States comes before us in almost overwhelming amount, and yet, as we take note of the publications, we have no sentiment but that of admiration for the evidence they give of brilliant, useful and painstaking research: research, too, of very varied character.

Bulletins.

A dozen numbers of the *Bulletin*, dated 1898 and 1899, have all been received since midsummer of this year.

Nos. 156 and 162 on the Bibliography of North American Geology for 1897 and 1898, contain the titles with, in many cases, brief notes of the contents of all geological publications dealing with the United States and Canada. Seven hundred and forty-two articles are recorded for 1897, and 941 for 1898. Here, indeed, is the index to a vast amount of information, which to be made available for general reference requires, ultimately, to be tabulated and summarised under many subjects.

Bulletin No. 154 is "A Gazetteer of Kansas," containing a list of all hamlets, post villages and townships, with, as far as possible, notes of their area, population and altitude; the whole prefaced with general statistics. No. 160 is the third edition of "A Dictionary of Altitudes in the United States," a work of 775 pages, arranged alphabetically, according to the localities in the several States. In Nos. 155 and 161 we find records of the earthquakes which happened in California in 1896, 1897 and 1898. A scale, divided into ten numbers, is given for estimating the intensity of shocks. Thus No. vi. notes "general awakening of sleepers; general ringing of bells; swinging of chandeliers; stopping of clocks; visible swaying of trees; some nervous persons run out of buildings; window glass broken"; while No. x. tells of "Great disasters; overturning of rocks; fissures in the surface of the ground; mountain slides."

We pass on to other Bulletins, and in No. 152 have "A Catalogue of the Cretaceous and Tertiary Plants of North America," by Mr. F. H. Knowlton; and in No. 152, "A Bibliographic Index of North American Carboniferous Invertebrates," by Mr. Stuart Weller. These works must prove of the greatest value for reference. They are clearly printed, the synonyms are recorded, and there are lists of works on the subjects dealt with.

Other numbers of the *Bulletin* are of a different character. In No. 151 we have an account of "The Lower Cretaceous Gryphæas of the Texas Region," by Messrs. R. T. Hill and T. W. Vaughan. Fossil oysters have always been regarded as a troublesome and variable group, mainly, as the authors believe, because they have not been properly understood and classified. These fossils are, however, important, not merely from a zoological, but from a stratigraphical point of view, as shown by certain deep borings for artesian water in Texas. Abundant material is to be found in that country for their study. They lie strewn upon the surface in such numbers that they are

sometimes used for road material or collected and burned into lime. Extensive masses of indurated strata are composed of them. The pebbles in the streams are largely made up of oysters. They represent many genera and species, and are of all sizes, from individuals less than an inch in length to shells which weigh 5 lbs. and more. They are found at various horizons throughout 4000 and more feet of rocks constituting the Cretaceous system in Texas. There is thus ample material for a study of the fossils from a phylogenetic and morphologic standpoint, and the authors here give their special attention to the Gryphæas. The work is admirably illustrated, and it is not obscured in any way by the indiscriminate naming of specimens.

No. 157, on "The Gneisses, Gabbro-schists and Associated Rocks of South-western Minnesota," by Mr. C. W. Hall, No. 158, on "The Moraines of South-eastern South Dakota," by Mr. J. E. Todd, and No. 159, on "The Geology of Eastern Berkshire County, Massachusetts," by B. K. Emerson, are all well illustrated, full of information of local importance and of much that is of general interest.

Indiana Report.

The geology and natural resources of Indiana are treated of by Mr. W. S. Blatchley, the State geologist, in the twenty-fourth annual report of the department (1899). The volume is one of 1078 pages, and is largely occupied with a catalogue, by Mr. S. Coulter, of the flowering plants and of the ferns and their allies indigenous to Indiana. A considerable portion is also taken by a descriptive and illustrated catalogue of the mollusca of the State, by Mr. R. E. Call. These include a large number of *Union*s. The dragon flies of Indiana are enumerated and described by Mr. E. B. Williamson, and there are notes on the batrachians and reptiles of Vigo county, by Mr. W. S. Blatchley. The economic resources of Indiana include coal, petroleum, natural gas, stone and clays. The amount of natural gas is restricted, and a failure of supply is expected. A great increase of activity in the coal regions is noted. There is estimated to be forty billions of tons of coal in Indiana, of which one-fifth is reckoned as workable under present conditions. Excellent coal for steam and household purposes and for blast-furnaces is obtained. Dr. A. F. Foerste contributes an article on the Middle Silurian rocks of the Cincinnati anticlinal.

U.S. Annual Reports.

Parts i., iv. and vi., and portions of Part ii. of the nineteenth annual report were noticed in *NATURE* for April 19. We have since received Parts ii., iii. and v., four volumes, including an atlas. Part ii., which comprises 958 pages and 172 plates, is somewhat heavy and unwieldy as a work of reference. Of articles not previously noticed, one by Mr. C. W. Hayes deals with the physiography of the Chattanooga district in Tennessee, Georgia and Alabama. The city of Chattanooga lies almost in the centre of this district, and the term physiography is used in a purely geographical sense. The article is an essay on denudation, written according to the principles of modern geography. The author deals with the formation of three successive peneplains, and shows how the drainage has been modified and diverted until the present topographic features were developed. The peneplains are considered as the product of subaërial erosion. The term geomorphology is used for the description, classification and correlation of the land forms; and geomorphogeny for the natural processes by which these forms have been developed. The author gives definitions of other physiographic terms, which are being introduced at a somewhat alarming rate.

Another article in Part ii. is on the Geology of the Richmond Basin, Virginia, by Messrs. N. S. Shaler and J. B. Woodworth. The area is important from an economic point of view as it contains the only free-burning coal immediately adjacent to tide-water in the eastern portion of the United States. The strata are of Jura-Trias age, the fossils from the lower portion of them being more closely related to the Rhaetic deposits of Europe than to those of any other horizon. The beds are grouped as the Newark formation, and they rest locally on a surface of igneous and crystalline rocks. Natural coke occurs in the strata, and is due to the intrusion of igneous rocks; it is denser than artificial coke. The bituminous coals are sharply parted from the cokes as the effects produced by the igneous rocks end abruptly. Mr. F. H. Knowlton contributes some notes on fossil coniferous wood from the Richmond Basin.

In Part v. the subject of Forest Reserves is elaborately dealt with by Mr. Henry Gannet and others. An endeavour is made to estimate the present amount of woodland distributed in the different States. Texas has the largest area, of about 64,000 square miles, while Arkansas has the largest percentage of woodland. The question of the protection of forests is one that is engaging much attention, so that the statistics and general information here brought together must be of great value. The report is illustrated by an atlas.

Of the Twentieth Annual Report we have received Part i. and Part vi. (2 vols.). Part i. contains the report of the Director, Mr. Charles D. Walcott, an admirable record of systematic work, which evidently receives the sympathy and substantial support of Congress. The appendix contains details of triangulation and spirit-leveling, and the work is accompanied by maps showing the progress of the surveys. Part vi. is on the Mineral Resources for 1898, the subject being under the direction of Mr. David T. Day. The total value of the mineral productions is the largest ever recorded in the history of the United States. All the metals, except nickel, made large gains, copper, lead, zinc, aluminium and antimony reaching their maximum, both in production and value. The amount of pig-iron produced was greater than in any other year, but the value was less. The non-metallic products also show an increase, especially bituminous coal, and in a lesser degree stone, petroleum and natural gas. The coal product amounted to about two hundred millions of tons.

Monographs.

Monograph No. 32, Part ii., is a large and handsome volume on the Geology of the Yellowstone National Park, by Mr. Arnold Hague and numerous colleagues. It opens with an account, by Messrs. J. P. Iddings and W. H. Weed, of the Gallatin Mountains, which consist of sedimentary strata ranging from Cambrian to Carboniferous, Jura-Trias, and Cretaceous (Laramie). Disturbances at the close of the Laramie formation were accompanied by igneous intrusions in the form of large laccolites, mainly andesitic in character. Electric Peak and Sepulchre Mountain are described as parts of a Tertiary volcano which was faulted across the conduit, the amount of vertical displacement having been more than 5000 feet.

Mr. Hague describes a mountainous area in the southern part of the Park, comprising ridges formed partly of Palæozoic but chiefly of Cretaceous rocks. The irregular outline of the mountains is due to the rhyolites of the Park Plateau that abut against the slopes of the upturned sedimentary strata. The Snake River hot springs are situated near the contact of the rhyolite with the Madison (Carboniferous) limestone, whence the travertine of the springs is derived. Mr. Iddings gives a particular account of the Miocene volcano of Crandall Basin, which arose on a ridge of Palæozoic rocks and on remnants of Eocene breccias and lava flows. The volcano consisted of andesitic breccias capped by basalt flows and traversed by dykes. It must have risen 13,400 feet above the limestone floor. The igneous rocks of the Absaroka range, and others which lie within Yellowstone Park, are specially dealt with by Mr. Iddings. The Cambrian fossils are described by Mr. C. D. Walcott, the Devonian and Carboniferous by Mr. G. H. Girty, the Mesozoic by Mr. T. W. Stanton, and the Fossil Flora (Laramie and Tertiary) by Mr. F. H. Knowlton.

Monograph No. 33 contains an account of the geology of the Narragansett Basin, a tract which includes Providence on the north and Newport on the south, being parts of Rhode Island and Massachusetts. The section on general geology is contributed by Mr. N. S. Shaler, while the detailed accounts are furnished by Mr. J. B. Woodworth and Dr. A. F. Fierste. Mr. Shaler remarks that the region originally contained an extensively developed series of pre-Cambrian rocks, which "may for convenience be referred to that limbo of ill-discriminated formations, the Upper Archæan (of Dana), or Algonkian." On these lie remnants of the Olenellus-beds of the Lower Cambrian, and above these are granites which have broken through the Cambrian, and have in turn been much eroded. On top lie the Carboniferous strata, which occupy the greater part of the basin and attain a thickness of several thousand feet. The general proposition is that this and other basins which lie along the Atlantic coast from Newfoundland to North Carolina are old river valleys which have been depressed below the sea-level, filled with sediments—the sedimentation increasing the depth of the depression—and afterwards corrugated by the mountain-building forces. The memoir is well illustrated with maps, sections and pictorial plates.

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Monograph No. 34 is on the glacial gravels of Maine and their associated deposits, by Mr. George H. Stone. The subject is treated with a wealth of letterpress (499 pages) and illustrations. It is essentially a local memoir, but as the result of careful observations commenced so long ago as 1876, it is a most valuable record of facts on water-assorted glacial drift, useful to those studying glacial features, terraces, eskers and the probable effects of subglacial and englacial streams.

In Monograph No. 36 the Crystal Falls iron-bearing district of Michigan is described by Messrs. J. Morgan Clements and H. Li. Smyth. This is the third of a series of reports on the iron-bearing districts of Lake Superior. The iron-ore (hematite and limonite) occurs in the Upper Huronian series. It is associated with white and reddish chert, and lies between carbonaceous slates in synclinal troughs. The memoir, however, deals with the structure, stratigraphy and physiography of a large area, approximately 540 square miles, and not only with Archæan and Huronian, but more particularly with various volcanic and intrusive rocks, microscopic sections of which form a main feature in the illustrations. A general introduction is written by Mr. C. R. Van Hise, and a final chapter on the Sturgeon River tongue in the south-eastern part of the district is by Mr. W. S. Bayley.

Monograph No. 37 is on the Fossil Flora of the Lower Coal-measures of Missouri, by Mr. David White, and is illustrated by seventy-two plates of Carboniferous plants, and one of a coal-seam.

Monograph No. 38, a large volume of 817 pages, numerous maps and other illustrations, is given up to a description of the Illinois Glacial Lobe, by Mr. Frank Leverett. This ice-tract formed the south-western part of the great ice-field that formerly extended from the high lands east and south of Hudson Bay over the basins of the Great Lakes and the north-central States as far as the Mississippi Valley. It overlapped a previously glaciated region on the south-west, whose drift was derived from ice which moved southward from the central portion of Canada. The evidence for separating the drift of the Illinois glacial lobe from the outlying and underlying drift is briefly stated. Remarkable instances of the transportation of limestone ledges are noted. These ledges in some instances occupy an area of several acres. They have been moved westward from the crest of rock ridges without completely destroying their stratification. Descriptions are given of well-defined soils and weathered zones which occur between successive accumulations of drift; various moraines and associated sheets of till are described, and there is a general discussion on the influence of the drift on drainage systems. The thickness of the Illinois drift is estimated at from 100 to 130 feet, and its bearing on water-supply is fully considered. Reference is made to gas-wells. In some the gas appears to be derived from the decay of vegetable matter in the drift; in most cases, however, it is probable that the underlying rocks contribute the gas, which is pent up beneath compact drift beds. A final chapter treats of soils, and these are classified into residuary soils, boulder-clay soils, gravelly, sandy and bluff-loess soils, silts slowly pervious to water, fine silts nearly impervious, and peaty or organic soils. The residuary soils show variations which correspond in a rude way with variations in the structure of the rocks, whether shale, limestone or sandstone, from which they are derived.

ON THE RELATIONS OF RADIATION TO TEMPERATURE.¹

THE key to this subject is the principle, arrived at independently by Balfour Stewart and Kirchhoff about the year 1857, that the constitution and intensity of the steady radiation in an enclosure is determined by the temperature of the surrounding bodies, and involves no other element. It was pointed out by Stewart² that if the enclosure contains a radiating and absorbing body which is put in motion, the temperature being uniform throughout, then the constitutions of the radiation in front of it and behind it will differ on account of the Doppler effect, so that there will be a chance of gaining mechanical work in the restoration of a uniform state. There must thus be some kind of thermodynamic compensation, which might arise from æthereal friction, or from work required to

¹ A paper read by Dr. J. Larmor, F.R.S., before Section A of the British Association at Bradford, September, 1900.

² *Brit. Assoc. Report*, 1871; cf. also *Encyc. Brit.*, art. "Radiation" (1886), by Tait.