elements of physics and chemistry, and, in addition, having studied the structure and properties of the healthy body, he can, on entering the technical school, from the very first turn his attention to professional details. Knowing already the anatomy of a cat or dog, he knows a great part of human anatomy, and need do little but acquaint himself with the surgical and medical anatomy of certain regions. Knowing normal histology, he can at once turn his attention to the microscopy of diseased tissues. Well instructed in physiology, he can devote himself to its practical applications in the diagnosis and treatment of disease. The demand for an improvement in medical education, which has been so loudly heard in England and this country for some years, is (the more I think of it, the more I feel assured) to be met, not, as has been the case in England, by putting more general science into the medical-school curriculum, but by confining *that* more strictly to purely professional training, and by providing, as we have attempted to do here, non-technical college-courses for undergraduates, which, while giving them a liberal education, shall also have a distinct relation to their future work. Personally I regard it as the most important of my duties, to prepare students to enter medical schools in this city or elsewhere.

To advance our knowledge of the laws of life and health; to inquire into the phenomena and causes of disease; to train experimenters in pathology, therapeutics, and sanitary science; to fit men to undertake the study of the *art* of medicine, — these are the main objects of our laboratory. I do not know that they can be better summed up than in the words of Descartes, which I would like to see engraved over its portal: "If there is any means of getting a medical theory based on infallible demonstrations, that is what I am now inquiring."

THE CLOSING REPORT OF HAYDEN'S SURVEY.

Twelfth annual report of the U. S. geological and geographical survey of the territories: a report of progress of the exploration in Wyoming and Idaho for the year 1878. Washington, *Government printing-office*, 1883. 2 vols. 8°. With portfolio of maps and panoramas.

IN two stout octavo volumes, with an accompanying portfolio of maps, Dr. Hayden presents the twelfth and last annual report of the Geological survey of the territories. While the late reorganization and consolidation of the surveys which have been occupied in the scientific exploration of the west is indubitably a very marked step in advance, it is not without a measure of regret that we realize that Dr. Hayden's familiar and always welcome annual report now reaches us for the last time. It is perhaps only those having some experience of similar work who can fully appreciate the energy and maintained scientific enthusiasm necessary for the conduct of an organization such as that which under Dr. Hayden has built so broad a foundation for our geological knowledge of the western part of the continent.

The volumes now issued constitute the report for 1878, the concluding season of field-work. Great care has evidently been given to the editing and printing of the report; and the number and good quality of the illustrations and maps are noteworthy features. Of plates alone, in the two volumes, there are over two hundred and fifty; and most of them are excellent specimens of lithographic art.

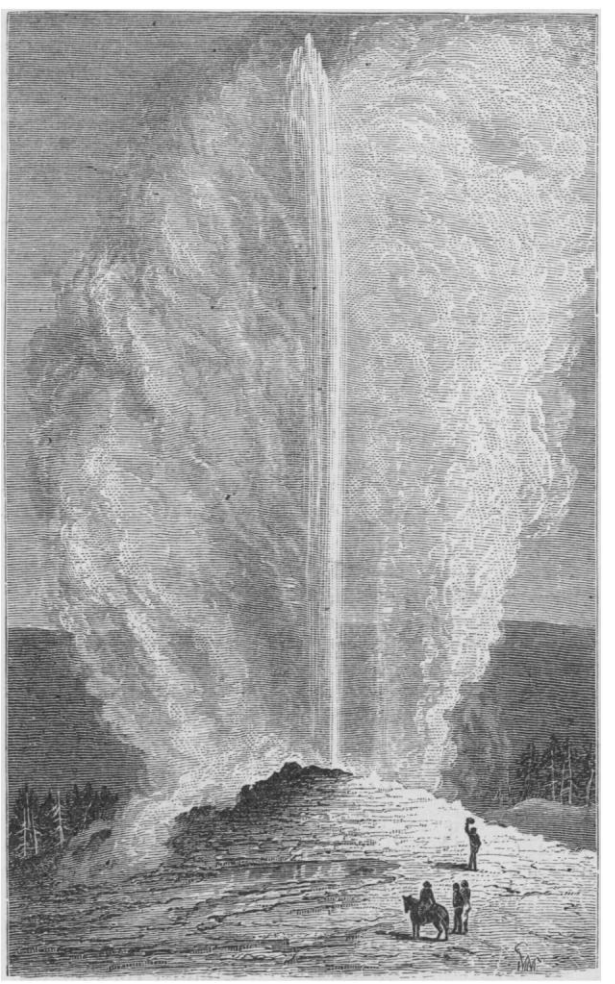
The first volume is devoted chiefly to paleontology and zoölogy, while the second may be regarded as a memoir on the Yellowstone national park. Dr. C. A. White, in his report, under the title of 'Contributions to invertebrate paleontology, No. 2,' presents the second part of his descriptions and illustrations of cretaceous fossils. This is followed (as parts 4 to 8 of the contributions) by papers on tertiary, Laramie, Jurassic, triassic, and carboniferous fossils. The article on the Laramie, including, besides the descriptions and plates of a number of forms, a systematic enumeration of the invertebrate fossils of the group, assumes the character of a synopsis of its fauna invaluable to the student of this period of geological history. Mr. Orestes St. John's very comprehensive and systematic report on the Wind River district could be done justice to only in a separate note of some length.

Mr. S. H. Scudder's report on the tertiary lake-basin of Florissant is next in order. From this place a number of fossil plants and a few fishes and birds have been obtained: but it is specially remarkable for the wonderfully numerous remains of insects which it affords; "having yielded in a single summer more than double the number of specimens which the famous localities at Oeningen, in Bavaria, furnished Heer in thirty years." The fossils occur in fine-grained volcanic ash-beds, which, together with coarser materials of the same origin, constitute the deposits of the old lake-basin. The age of the beds is apparently about that of the oligocene, and the climatic conditions may have resembled those of the northern shores of the Gulf of Mexico at the present day. A complete description of the insects will be awaited with much interest. Mr. Packard's monograph of the phyllopod Crustacea of North America, having been already noticed in *Science*,[1] need only be mentioned. In the latter part of the first volume, Dr. R. W. Shufeldt treats of the osteology of the Cathartidae

[1] Vol. ii. p. 571.

and North-American Tetraonidae, the burrowing owl, horned lark, and shrike.

On the Yellowstone national park, or reservation as it may perhaps more fitly be called, much has already been written, both of a scientific and popular character; but the second volume of the present report is the first proximately complete account of its physical and geological features. The first scientific exploration of this wonderful region was that of the survey of the territories in 1871 and 1872; and it is largely due to the personal efforts of Dr. Hayden that the district was set apart as a national park. Though reports more or less garbled, of its geysers and hot-springs, were from an early period in circulation in the west, they were not generally credited; and it is a remarkable fact, that this region, in the midst of so much active exploration of the west, continued so long practically unknown. It remained for the ubiquitous western 'prospector' to afford some intelligible account of its character between 1863 and 1869; and Dr. Hayden's first exploration followed not long thereafter.



OLD FAITHFUL GEYSER IN ACTION, 1871.

The reservation is situated mainly in north-western Wyoming, but embraces also portions of Idaho and Montana. It is about 65 by 53 miles in extent, with a computed area of 3,312 square miles, of which nearly 200 square miles are occupied by lakes. To the north and east are bounding ranges of lofty and rugged mountains; but, apart from the cañons of the rivers, the region itself does not abound in grand scenery, consisting chiefly of high rolling plateaus covered with dark coniferous forest, but, along the borders of the streams, opening out into the attractive park-like country characteristic elsewhere of many of the sub-alpine valleys of the Rocky Mountains. The mean elevation, being about eight thousand feet, renders it subject to frosts throughout the summer, and quite unfit for agriculture: indeed, the frequent reference to snow-storms as interfering with the operations of 1878 would alone be sufficient to indicate the sub-arctic character of the climate.

The geology of the park is reported on by Mr. W. H. Holmes, who carries with him throughout a clear appreciation of the bearing of observed facts on the causes and history of the remarkable events of which this portion of the 'great divide' has been the theatre. While most of the formations known in the north-west are represented in the park, a glance at the map shows that those of volcanic origin cover by far the greatest area; and it is in connection with these that its special features have been developed. Volcanic conglomerates of tertiary age are particularly prominent, and attain in some places a very great thickness. Rhyolite preponderates, but basalts also frequently occur; and the existence of large masses of obsidian or volcanic glass is a point both of mineralogical, and, from the use made of it by the Indians, ethnological interest.

From the deeply eroded valley of the Yellowstone, almost all the facts as to the pre-tertiary history of the park are drawn; and the line of this river appears to have been determined by a great fault for which a minimum estimate of the displacement is given at 15,000 feet. This fault was probably synchronous with the general Rocky Mountain uplift, and is presumed to be in more or less direct causal connection with the subsequent remarkable history of the district. It is not a simple fissure, but a break along which the edges of the strata have been much dragged and contorted, particularly on the dropped side; appearing, in fact, to have the character of a great flexure pushed to fracture. On its northern side rises the Yellowstone Range; while to the south, in the depressed area, are found the evidences of that prodigious volcanic activity of which the actual thermal phenomena are the last lingering stages.

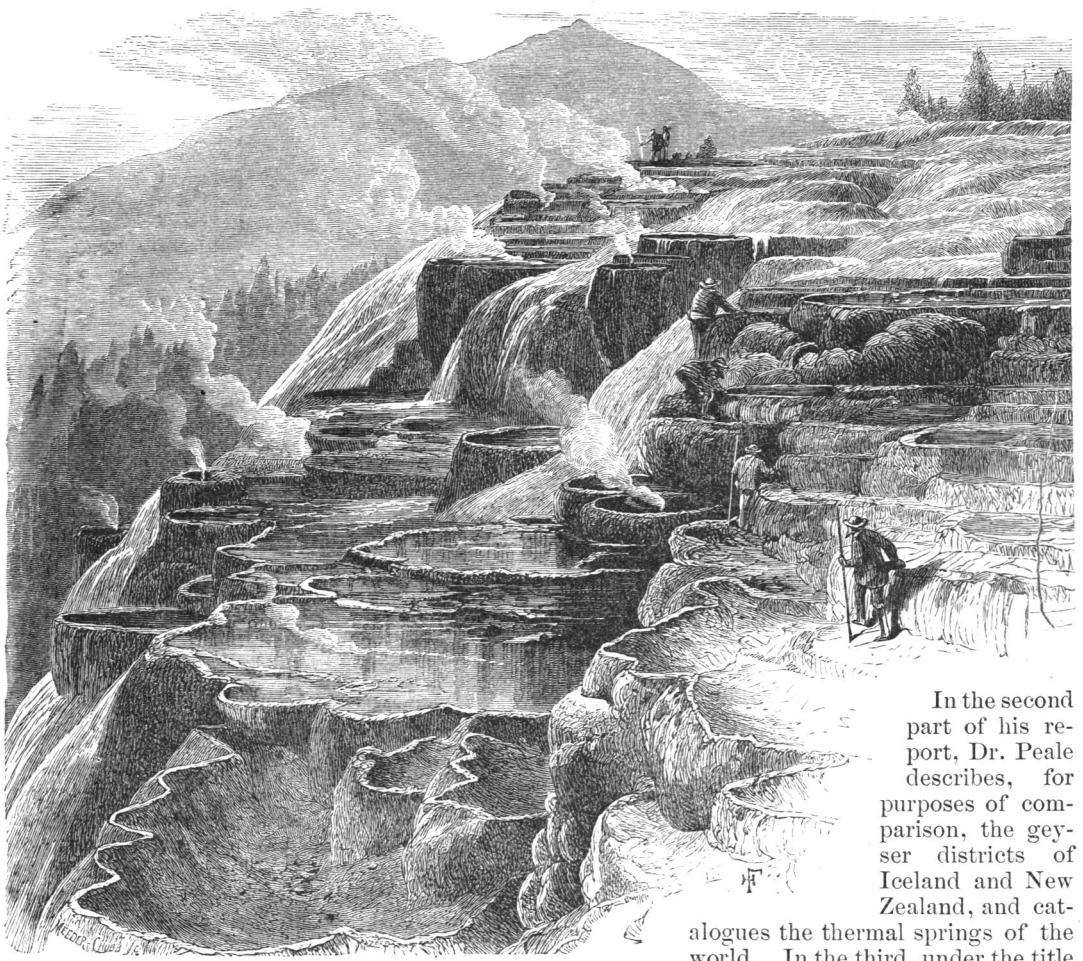
From the older tertiary rocks of the park have been collected a number of plants which Professor Lesquereux refers to the Fort Union group; but, before the inauguration of the volcanic periods, these beds, together with the paleozoic rocks, had been deeply scored by erosion. The earlier flows of trachyte and rhyolite poured into the then existing valleys till they were, in many cases at least, entirely obliterated, and the successors of these first rivers forced to cut new channels having little or no reference to the position of the old. Subsequent lava-flows again filled these later valleys, and, through the succeeding basaltic and conglomeritic epochs of activity, this process appears to have been repeated many times. The entire period of volcanic activity must have been of extremely long duration, and may have lasted through a great part of the tertiary. From the volcanic conglomerates of Amethyst Mountain, plants of upper miocene or lower pliocene age have been identified. Very much yet remains, however, to be discovered in the history of this prolonged period, which, in its succession of volcanic outbursts alternating with epochs of quiet river-work, much resembles that of the classic tertiary volcanic region of central France, and may, when fully disclosed, tell as interesting a story. In Amethyst Mountain some of the latest stages are well exemplified, and we have, perhaps, the finest series of buried erect forests ever discovered. The volcanic rocks, here characteristically conglomeritic, show a thickness of five thousand feet, and are charged almost throughout with the silicified remains of ancient forests. The lower layers are comparatively fine grained, but are followed by conglomerates which become coarser and more breccia-like in ascending, but are throughout interbedded with sandstones, and shaly layers largely tufaceous in character, and appear to be partly water-bedded and partly sub-aerial. The intervals between successive eruptions have been sufficient to allow the surface to become clothed again and again by a heavy forest-growth, each of which has been destroyed and buried in turn.

GRAND CAÑON OF THE YELLOWSTONE.

There can be little doubt that the hot-springs have been continuously in existence since the volcanic period; and actual evidence of their great antiquity is found in the occurrence of fragments of the characteristic calcareous deposit in some of the higher river-terraces, since the formation of which the Yellowstone has cut for itself a cañon a thousand feet in depth.

For an account of the hot-springs and geysers as found at the present day, we must, however, turn to the second section of the report, in which Dr. Peale treats the subject in an exhaustive manner, tabulating over two thousand springs and seventy-one

geysers. The springs show some evidence of linear arrangement, but dispose themselves for purposes of investigation in a series of groups, which are systematically described, mapped, and illustrated. The eruptions of the principal geysers are tabulated with the purpose of investigating the regularity, or otherwise, of the eruption periods; and, in collecting and reviewing all that has already been observed on this point, Dr. Peale has had by no means a light task. So many accounts have already appeared of the more remarkable geysers and springs, that their main features have become more or less familiar to all, in so far as they can be made so by description. The Giant, Castle, Grand, Old Faithful, Giantess, Bee-Hive, and others of the best known geysers, are included in the upper geyser basin of the Fire-Hole River; and the flow of heated water is here so great as to notably affect the temperature of the stream itself. In this area alone, not quite four square miles in extent, 440 springs are known, of which 26 are veritable geysers, some, during these paroxysms of eruption, producing columns of 150 to 250 feet in height.



BASINS AT MAMMOTH HOT-SPRINGS OF GARDINER'S RIVER.

In the second part of his report, Dr. Peale describes, for purposes of comparison, the geyser districts of Iceland and New Zealand, and catalogues the thermal springs of the world. In the third, under the title of 'Therma-hydrology,' the general features of hot-springs are discussed: their physical and thermal conditions, formations and deposits, and geyseric phenomena, are reviewed, bringing out many points of interest. The geysers of all parts of the world are essentially similar in character. Those of the park are remarkable for the development of chimneys, or cones, at their orifices, — a fact attributed to the greater antiquity of the now existing vents, but which, it appears

equally probable, may arise from the greater dryness of air in the park region as compared with that of Iceland and New Zealand.

The chemical investigation of the Yellowstone springs is not yet sufficiently complete for their satisfactory classification; but they are broadly divided by Dr. Peale into those of calcareous, siliceous, and aluminous character. The so-called aluminous springs, being those highly charged with mud, or matter in a state of suspension, will doubtless eventually be relegated to one or other of the first-named classes. The possible therapeutical value of the springs is as yet practically untested; and it is to be remarked in this connection, that the climate is such as in any event to be unfavorable to those suffering from debilitating diseases. A few experiments on the color of the waters are recorded; but these, it must be confessed, are unsatisfactory, as the samples had been long in bottle; and, apart from this, it is doubtful whether the waters of the park offer peculiarities so marked as to throw any important light on a subject which has already been elaborately studied by physicists and chemists.

The older theory of geyser action requiring a steam-chamber which blew off, from time to time, through a water-trap connecting with a tubular orifice, and implying a quite exceptional co-ordination of circumstances, became virtually untenable when geysers were discovered in such considerable numbers in different regions. Bunsen's explanation, depending on the superheating of water under pressure in fissures, or more or less tubular receptacles, seriously modified in action by local circumstances, is considered sufficient to account for the observed phenomena.

Appended to this report, is a valuable bibliography of the park, and of the literature treating of geysers and hot-springs generally.

In the latter part of the volume, Mr. Gannett reviews the geographical work on which the excellent maps accompanying the report are based.

Notwithstanding the amount of precise information now made available on this region, much yet evidently remains to be discovered. The field-work on which the report on the park is based extended over about two months only; and the observations have too often been of what Mr. Holmes regretfully describes as the 'twenty-five-mile-a-day kind.' Armed with the present report, embodying the results so far obtained, each scientific visitor for a long time to come may well hope to add some important new facts. The definition of the catchment areas from which the various groups of springs are supplied, and the circulation of the underground waters, may be specially noted as an important point scarcely yet touched.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Princeton science club.

Nov. 8. — Dr. L. W. McCay reported that the Perrot method for estimating P_2O_5 can only give accurate results providing chlorine be absent. This, however, is seldom the case in apatites, superphosphates, etc. He therefore proposes a modification, — dissolving the tri-argentic phosphate from the filter-paper with dilute nitric acid, thereby leaving the chloride, and proceeding at once to titrate the silver according to Vallhardt. He reserves for himself the privilege of developing the subject.

Jan. 10. — Dr. Halsted opened a discussion as to whether Euclid was a suitable text-book for elementary geometrical instruction; — Mr. Fine read a paper on Synthetic solution of a class of problems in maxima and minima on the partition of a segment of a circle; — Professor Macloskie, Notes on biological articles in recent scientific serials; — Dr. McCay, Analysis of beer made in state of New Jersey; — Mr. McNeill, Determination of co-ordinates of certain stars by the meridian circle; — Professor Scott, The lamprey (the peculiar flattened shape of the spinal cord in the lamprey arises late in larval life, and is an acquired peculiarity. In the embryo the dorsal roots of the spinal nerves are all connected by a commissure, which also connects the tenth, ninth, and seventh nerves together, and with the spinal nerves. This commissure apparently forms the lateral nerve. The third nerve arises independently, and would seem to be of segmental value); — Professor Osborn, A method of double injection of anatomical specimens (by first injecting the veins through the arteries with blue gelatine, then injecting the arteries with plaster of paris, which is stopped at the capillaries, the veins and arteries can be readily distinguished); — Professor Young, The cause of the unusual sunsets, On the spectrum of the Pons-Brooks comet.

Ottawa field-naturalists' club.

Jan. 17. — The paper of the evening was by Mr. E. Odlum, M.A., of Pembroke, 'On the sand-plains and changes of water-level of the Upper Ottawa;' the portion of the river specially referred to being a stretch of some forty miles opposite the town of Pembroke, and extending from the head of the Coulonge Lake to the entrance of the reach known as the Deep