

the Dip, and thirty-two of the Intensity, with fifty-two of the Declination.

The observations of the Declination were made with the ship's standard compass in the process of "swinging." Those for Dip and Intensity at the same time with the Lloyd-Creak (shortly L.-C.) dip circle, an instrument originally designed for sea observations of those elements, but which in field work on land has also been found to give results hardly inferior to those of the specially designed land instruments. The degree of accuracy hitherto obtained at sea as compared with land observations with the same instrument is also given.

The accompanying illustration shows the L.-C. circle mounted for observations on land and fitted on top with an arrangement proposed by the U.S. C. Survey for observing the Declination, but which also serves the purpose of placing the circle in the magnetic meridian. At sea the circle is mounted on a gimbal stand with the declination fitting removed, as the angle between the direction of the ship's head and the magnetic meridian is then obtained from the ship's standard compass.

A detailed description of the L.-C. circle is given in the

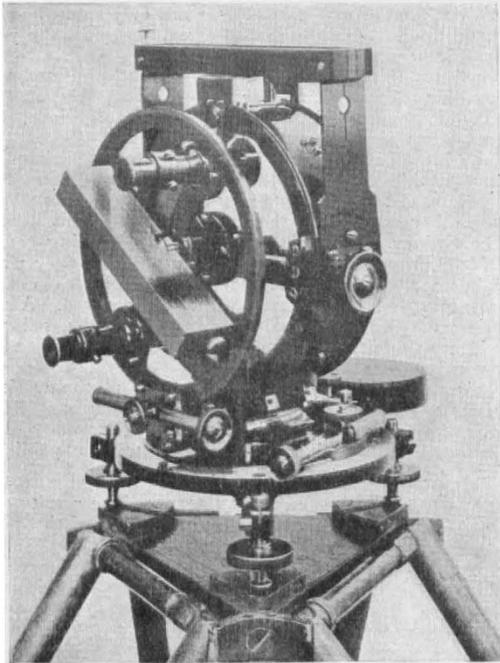


FIG. 1.—Lloyd-Creak Dip Circle, mounted for Observations on Land.

report with the methods adopted for observing therewith at sea in the U.S. surveying vessels, which are, however, not specially adapted to the work. A wood-built vessel, specially designed and devoted to magnetic work as a primary object, is required to obtain the full value from this instrument, and it is therefore pleasant to record that the magnetic survey of the North Pacific Ocean in such a vessel will be commenced this year by the United States.

THE NEST OF THE FIGHTING FISH.

IN most, if not in all, the members of the group of Oriental fishes typified by the so-called climbing perch (*Anabas scandens*), the males take charge of the eggs as they are extracted from the females and place them in a "nest" of mucus-covered bubbles, which they have previously prepared. A well-known representative of the family is the "fighting fish" (*Betta pugnax*), which takes its name from the circumstance that a semi-domesticated breed is kept by the Siamese for the sake of the sport offered by the combats of the males. Of this fish living specimens from Pinang have recently been in the possession of Mr. E. H. Waite,

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of the Sydney Museum, who has published an illustrated account of their nesting habits in the *Records of the Australian Museum* for December last (vol. v. No. 5). Mr. Waite has obligingly sent us a copy of his original photograph of the nest, which is herewith reproduced.

Mr. Waite states that he received these fish early in April last year, and that the male almost immediately proceeded to blow bubbles, which it produced by rising periodically to the surface and taking in gulps of air. A circular mass of mucus-clad bubbles, about 3 inches in diameter, was soon produced; and in course of time several other layers were formed, which resulted in the final production of a large dome-shaped structure, as shown in the photograph. The structure was completed on the third day, when the female commenced to lay her eggs, which were received between the pectoral and ventral fins as they were extruded, and were then suffered to sink slowly in the water. Here they were collected by the expectant male, decked in his resplendent breeding colours, and placed, after being coated with mucus, below the mass of bubbles, to which they adhered. From three to seven eggs are extracted at a time, and the process is continued until there are from one hundred and fifty to two hundred. When the laying is over, the female is kept away from the nest to prevent her devouring the eggs, which are carefully tended by the male, being constantly moved and from time to time re-coated with slime.

On the third day the eggs hatched, the larvæ remaining beneath the shelter of the bubbles. From time to time some fell off, when they were immediately replaced by the watchful male, but in a day or two the numbers which became de-



FIG. 2.—Nest of the Fighting Fish. About two-thirds natural size. From a photograph by Mr. Waite.

tached were too many for him to secure, although he frequently had seven or eight in his mouth at once. Some were, however, recovered from the bottom of the tank and returned to the shelter of the nest, but many were devoured by the female. Eventually all the larvæ died, and, although the fishes bred on two other occasions, none of the offspring were reared.

SOME RECENT WORK OF THE U.S. GEOLOGICAL SURVEY IN THE WESTERN STATES.¹

IF it be possible for envy to lurk in the breast of the scientific worker, then surely might we look for it in the geologist of these islands when he regards the lot of his fellow-worker across the Atlantic. In the breadth of field open to research, in the freshness of the land, and in the public support accorded to his labours, the geologist of the present day in the United States may justly claim preeminence. In the four memoirs before us, a mere random selection from the recent publications of the U.S.

¹ "Zinc and Lead Deposits of Northern Arkansas." By G. I. Adams and others. Pp. 115; with 17 plates and 6 figures.

"The Copper Deposits of the Encampment District, Wyoming." By A. C. Spencer. Pp. 107; with 2 plates (maps) and 49 figures.

"Economic Resources of the Northern Black Hills." By J. D. Irving and others. Pp. 222; with 20 plates and 16 figures.

"A Geological Reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho." By W. Lindgren. Pp. 123; with 15 plates and 8 figures.

Being "Professional Papers" Nos. 24, 25, 26 and 27 of the U.S. Geological Survey. (Washington, 1904.)

Geological Survey, all these stimulants are conspicuous. The memoir on the Bitterroot Range alone deals with an area of about 12,000 square miles, respecting which our scientific knowledge has been hitherto of the scantiest; while the other three, though professedly more limited in scope, treat in detail of areas ranging from about 450 to 560 square miles which may be taken as selected illustrations of parts of the vast region west of the Mississippi.

Of course, it is not area only that counts in geology; and in considering the magnificent distances of the Great West, we may take heart in that our own shreds of land have not been carved out of some wide monotonous tract covered by a single formation within which it might be the fate of an ardent geologist of limited means to find himself hopelessly tethered! It is, indeed, fortunate that in the geological map of the world the British Isles lie, as it were, athwart the index.

It is less easy to find consolation when we compare even the most presentable of our British geological publications with these beautifully printed and liberally illustrated memoirs, wherein the native asperities of the technical treatise are so smoothed and adorned that they are hardly perceptible. Take, for example . . . but comparisons are proverbially odious, and, moreover, the one in mind has been frequently made, with no good result, so let it pass!

It is noteworthy that all four treatises give the results of investigations which, although essentially scientific in scope, have centred around the economic resources of the specified districts. In all cases, also, the prospector and miner, working more or less at haphazard, had made considerable progress in developing the metalliferous deposits before the advent of the geologist, whose function has been to explain the general principles deducible from the discoveries already made, and to indicate the lines along which further exploration may proceed with the best chance of success. This is the proper course, for it is not until the average "practical man" begins to feel the need for professional advice that he is likely to pay much heed to such advice if it be proffered him. All the memoirs, and more especially that on the northern Black Hills, give full descriptions and many illustrations of the principal mine-workings, to which we need not further refer.

First on our list stands the description of the zinc and lead deposits of northern Arkansas, by G. I. Adams, assisted by A. H. Purdue and E. F. Burchard, with a palæontological appendix on the correlation of the formations by E. O. Ulrich. Though occurring mainly at a lower stratigraphical position, these metalliferous deposits appear to be very similar in mode of occurrence and in character of vein-stuff to the lead-ores of the Carboniferous Limestone of the north of England.

The principal locus of the deposits is in "the Yellville formation," a dolomitic limestone of Ordovician age; but they also range upward, less abundantly, into Lower Carboniferous Limestones. The Silurian system appears to be absent from the district described, and the Devonian is represented only by impersistent sandstone and shale, of which the maximum thickness does not exceed 40 feet. The region has been little disturbed; igneous rocks are absent; and the Ordovician rocks still maintain their nearly horizontal position. Nevertheless, there has been in some places much differential movement among the strata, probably as the result of compressive forces, whereby the thinner and more brittle beds have been brecciated and the fragments made to rotate or to shear past each other, producing the structure that in this country has been

termed "crush-conglomerate." These breccias have permitted the percolation of the ore-bearing solutions, and are sometimes enriched by metalliferous deposits, though usually only in the vicinity of the nearly vertical fissures which appear to have formed the principal channels of the mineralised waters. It is suggested that the ores represent the concentration of minerals originally disseminated in the country rock, and more especially in the Mississippian (Carboniferous) limestones, this concentration having been effected by waters which, after circulating through the upper belt of weathered rock, have passed downward to the "belt of cementation."

The next memoir carries us some 700 miles north-westward, to the southern border of Wyoming, and to a geological province of utterly different character. "The Copper Deposits of the Encampment District," by A. C. Spencer, describes a hilly region on the Continental Divide, ranging in altitude from about 6650 feet to 11,007 feet, occupied for the most part by a complex mass of pre-Cambrian rocks, broken into and altered by igneous intrusions, with Mesozoic formations lying upon the flanks of the ancient massif as foot hills and dipping away beneath the surrounding prairie. The pre-Cambrian group

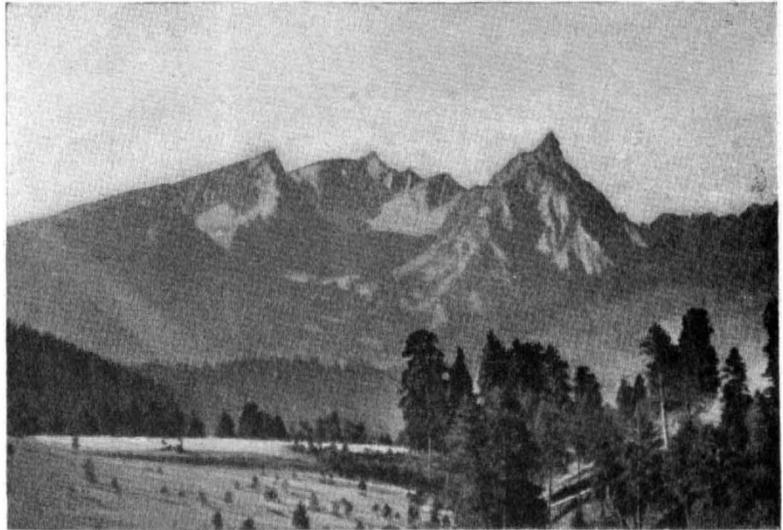


FIG. 1.—Trapper Peak, showing gradual slope of Gneiss Zone to the left and Glacial Amphitheatre in Granite at centre.

includes hornblende-schists derived from bedded volcanic rocks, limestones and shales, quartzite and slate, and a thick conglomerate, with intrusions of quartz-diorites, granites, and gabbros in great variety. The structure of the sedimentary rocks of this group is interpreted as a synclorium, striking east and west, with its component strata dipping invariably to the south. With respect to the conglomerate, it is noted that though locally almost unchanged from its original condition, it is more frequently metamorphosed, and that this metamorphism, both mechanical and chemical, has often been carried so far that the contained boulders and pebbles have been mashed into disc-like plates, and the rocks, by re-crystallisation, converted into a gneiss the origin of which would be entirely indeterminate except through the study of its gradual passage from the unaltered condition. Certain mineral transformations described in the gabbros are assigned to dynamic pressures insufficient to inaugurate actual crushing, and also unaccompanied by a notable degree of hydration. The copper-ores which constitute the chief mineral wealth of the district occur under diverse conditions, which are carefully described and classified. It is believed that a large part, though not all, of the metalliferous deposits had their original source in the gabbros, of which eighteen samples, representing various phases of the rock, were tested in the laboratory of the survey, and in each case yielded traces of copper.

In the richest lodes the ores appear to have been concentrated by ascending solutions.

In the third memoir we are transported some 500 miles north-eastward to consider the economic resources of the northern Black Hills of South Dakota. A brief sketch of the general geology of the district is given in part i. (28 pages) by T. A. Jaggar, jun., and the rest of the volume, forming part ii., by J. D. Irving and S. F. Emmons, deals fully with the economic resources. The dome-like structure of the Black Hills, with their laccolithic intrusions of igneous rock, is already well known. "They rise like an island in the midst of the Great Plains, with culminating peaks of pre-Cambrian granite intrusive in Algonkian schists, and these same schists and granite may be followed outward from the centre of the Hills to an encircling escarpment of Palæozoic rocks dipping away on the northern, southern, and eastern sides, and mantling over the schists to form an extensive forested limestone plateau on the west." The limestones have been crushed in places into "pseudo-conglomerates," and Dr. Jaggar suggests a similar origin for many supposed conglomerates or "intraformational breccias" that have been described in other parts of the continent.

The picture of the region presented in the first few pages of part i. is remarkably clear and impressive. The Cambrian series of shales, quartzite, sandstone, and



FIG. 2.—Upper Valley of Mill Creek, Bitterroot Range, looking East from Main Divide. Notice pronounced U-shape of Valley narrowing toward the lower part. The prevailing rock is granite.

thin limestones, 200-400 feet thick, which rest in bold unconformity upon the upturned edges of the Algonkian schists, include at their base an irregular conglomerate, evidently an ancient beach-deposit. This basal Cambrian conglomerate contains detrital gold, derived from the erosion of auriferous lodes in the Algonkian rocks, and, according to the present authors, has been further enriched by later infiltration. It thus constitutes in favoured localities a gold-producing ore second only in importance to the lodes in the underlying Algonkians. The last-mentioned lodes are usually fissured belts of rock along which the precious metal, accompanied by other minerals, has been more or less irregularly deposited by permeating solutions. Another important source of gold is described under the heading of "Refractory Siliceous Ores." These ores represent the replacement of portions of the Cambrian dolomitised limestones by silica and other minerals, including gold, that appear to have been carried upward in solution by waters ascending along vertical joints. These waters, when checked by a comparatively impervious bed, tended to spread out laterally along the dolomites, which were partially dissolved and replaced by other substances. This part of the memoir is illustrated with some beautiful plates of microscopic slides. Besides gold, the district has yielded ores of silver-lead, wolframite, and a little copper, with some traces of tin.

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The last memoir of our series, which takes us again 900 miles to the westward, is the description of a geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho, by Waldemar Lindgren, and is in some respects the most instructive of the series; but unfortunately we have no space in which to do it justice. It deals with a vast tract of mountainous country, for the most part exceedingly difficult to traverse, and as yet very imperfectly explored. A huge "batholith" of granite or quartz-monzonite 300 miles in length from north to south, and 50 to 100 miles in width, occupies the central part of this region, and has been locally pressed and deformed, especially along its eastern margin, into gneiss. Sedimentary rocks are comparatively restricted in their range, and the age of most of those which are exposed is doubtful, as no well defined fossils have been found; but it is believed that, along with complexes of pre-Cambrian age, the Triassic, Carboniferous, and possibly older Palæozoic systems are represented. In the west the country is overspread by the great Columbia River lavas of Tertiary age. The physiographic features of the region are of extreme interest, and are carefully discussed. It is shown that the Clearwater Mountains had already acquired a sharply accentuated topography before the outpouring of the Columbia River basalts, and that the lower portions of the principal valleys were flooded and dammed by the lava-flows. The most important structural feature of the region, however, is the great fault by which the Bitterroot Mountains have been elevated on the west and the Bitterroot valley carried down on the east. This fault-plane is described as being remarkably flat, though apparently normal. It is supposed to represent a twofold movement, by which the foot-wall has been raised and the hanging wall depressed. It indicates a vertical movement of from 4000 to 6000 feet, and the horizontal component is estimated to be at least two miles. The schistose belt of the granite underlies this plane, and the structure is considered to be an outcome of the disturbance. Movement appears to have continued along the fault up to recent times.

G. W. L.

ANTHROPOLOGICAL NOTES.

AN interesting paper by A. L. Kroeber on the types of Indian culture in California is to be found in vol. ii. of the *Publications* of the University of California—"American Archaeology and Ethnology, 1904." Ethnologically, California is characterised by the absence of agriculture and pottery, by the total absence of totemism or gentile organisation, by an unusually simple and loose social organisation in which wealth plays a rather important part, by the very rude development of all arts except basketry, by the lack of realism in art, by a slight development of fetishism and by the conspicuous lack of symbolism and ritualism, by the predominance among ceremonials of mourning and initiation rites, and by a considerable development of true conceptions of creation in mythology. The natives are of an unwarlike nature, and lack intensity and pride. It will therefore be seen that in almost every instance the Californian Indians are among the least characteristic of the Indians of North America, being lacking in the typical qualities of that race, and thus they are the most generalised of the peoples of that continent. In the same volume Dr. Kroeber gives an account of the languages of the coast of California south of San Francisco.

Drs. A. Bloch and P. Vigier have re-examined the hair