structure, with the stipulation that the area studied should be British. The prize for the best essay was awarded to F. R. Cowper Reed, of Trinity College, who wrote on 'The Geological History of the Rivers of East Yorkshire' (London, Clay and Sons, 1901, 103 pp., map, 8 cuts). Thirty pages are given to a geological history of the region. River development began with the post-Cretaceous uplift and continued through a first cycle with important adjustments till an extensive peneplain had been formed. Near the close of Oligocene time came another uplift, affecting the British Isles and Western Europe. The rivers of the peneplain were thus revived and set to work sculpturing the existent topography; and at this time it is believed that a flat anticline was formed along the axis of the moorland north of the vale of Pickering, producing important changes in certain stream courses. A depression of moderate amount occurred near the end of the Pliocene; the area of greatest sinking then came to be occupied by the North sea, whose extent has since been increased by wave work along the shore. Then came the glacial period and its changes of level, when many valleys were clogged with till and many streams were reversed by ice blockades. Since the ice retreated, a small uplift and a small depression have occurred. The development of river courses is followed through these various land movements, special attention being given to the changes caused by the growth of subsequent branches along belts of weak strata, and by till and ice barriers. The essay is easily the most detailed and successful study of the rivers of northern England that has yet appeared.

THE VOGTLAND.

A DISTRICT of uplands and valleys, drained chiefly by the Elster, roughly located as in the southwest corner of Saxony, and known as the Vogtland, has been described by Wohlrab ('Das Vogtland als geographisches Individuum,' Forsch. deut. Landes u. Volkeskunde, XII., 1899, 101–185, map and plates). The essay is interesting as a partial recognition of the necessity of treating geographical forms with respect to their origin, yet it is hampered by the retention of certain traditional empirical methods and by the incomplete adoption of more modern rational methods. The gently undulating uplands of schists, surmounted by low ridges and knobs of harder rocks, are properly presented as a worn-down old-mountain surface; but the descriptions of its landscapes thus considered are all quoted, as if the author wished to leave to others the responsibility of so venturesome an explanation. No explicit mention is made of the slanting uplift of the region, whereby its streams were enabled to incise their modern valleys. Indeed, the occurrence of bold and rocky valley sides beneath the milder scenery of the rolling uplands is presented as if it were somewhat out of the order of nature, worthy of being looked on as a curiosity, instead of the well-understood and commonplace accompaniment of dissection recently revived by uplift after a long period of relative quiescence. The details of valley form are incompletely described, though incidental mention is made of the incipient flood plains on the convex banks of the meandering streams, opposite the steep valley slopes over the concave banks. Many arithmetical details are given concerning the form of ridges and valleys: for example, the mean slopes of many valleys are calculated; although when the upper course of a valley is shallow and broad, slightly depressed beneath the uplands, while the lower course is sharply incised, relatively narrow and steep-sided, it is as inappropriate to measure its mean slope as it would be to average the price of old scrap iron and new steel rails. All these details have a certain value, but their value would be greatly increased if a more thorough scheme of physiographic description served as the basis of the work.

W. M. DAVIS.

NOTES ON OCEANOGRAPHY.

AN OCEANOGRAPHICAL MUSEUM.

IN connection with the exhibit of the collections made by the Prince of Monaco at the Paris Exposition, a convenient summary of his scientific work has been published by Richard (Les Campagnes Scientifiques de S. A. S. le Prince Albert Ier de Monaco, 1900). Brief descriptions of the different vessels and types of apparatus employed during the voyages, and a more

detailed résumé of the results, are given. Of particular interest in the contents of the pamphlet is the account of the magnificent building which is now nearing completion on the rock of Monaco, and intended to contain the great zoological and other collections of the Prince. The foundation stone was laid on April 25, 1899, by the Emperor of Germany. An idea of the size of the structure may be had from the fact that the façade will have the length of one hundred meters. While the greater part of the exhibits will relate to the biological sciences, there will be considerable space given to the illustration of apparatus, of the physical conditions of life in the sea, and of the areal and bathymetric distribution of organisms, by means of charts, diagrams, photographs, water-color sketches, etc. Appended to Richard's work is a valuable bibliography of the publications of the Prince and of his collaborators on the collections of the 'Hirondelle' and the 'Princesse Alice.'

MARINE CURRENTS AND RIVER DEFLECTION.

THE cause of the strong left-hand deflection of the Mississippi River below Baton Rouge has long been a matter of discussion (Fig. 1). The decided asymmetry of the delta both above and below sea level is an associated problem. Wind

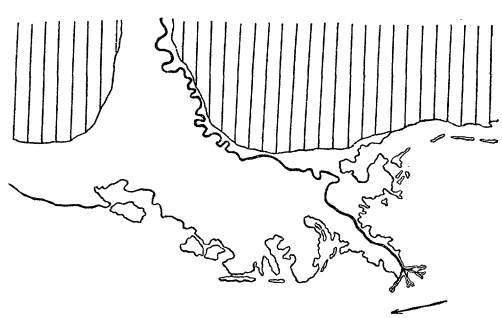

FIG. 1. The delta of the Mississippi. Cross-lining indicates older land. The arrow shows the general direction of the marine current prevailing at the river mouths.

direction, the influence of the Red River and crustal warping have been in turn appealed to in explanation of the facts. The formerly credited clockwise movement of the Gulf Stream in the Gulf of Mexico has likewise been held responsible. It is now generally agreed, however, that the prevailing direction of current movement is really westward past the mouths of the river. Haskell proved this by the use of the current meter on board the *Blake*. Lindenkohl's chart of densities plainly shows a transference of Mississippi water toward the west as it spreads out over the Gulf. The cause of the current is indicated in the prevailing easterly winds, as charted, for example, in the new Meteorological Atlas of Bartholomew. Corthell has noted a maximum speed of three knots for the west-flowing current.

In view of such strong and accumulating evidence for the current, it becomes of interest to inquire as to its influence on the form of the delta. The presentation of the case may suffice to call attention to a possible kind of interaction between river current and ocean current in the development of a very definite type of form.

Outside the river-bars, aggradation of the sea floor is progressing more rapidly on the west than on the east of the delta. The striking asymmetry of the delta is thus in part explained. The deeper water on the east will particularly facilitate the yearly advance of the bars on that side. But the direction of advance will be affected by a more positive cause. It is well known that the bar at each pass is breached during the flood season, and beyond the lower end of the new channel the delta is pushed forward for the remainder of the season. While the bar thus built in a new position is left essentially undisturbed by the river itself during the following half-year of low water, the transverse Gulf current (which is aided in the work by westward drift in the line of breakers on the bar) may be conceived as modifying the form of the bar during same period. The bar will be weakened on the left-hand extremity where the impact of the current is first felt, and strengthened on the right by the accretion of the silt traveling under the impulse of the current thus along the axis of the bar. The right-hand extremity of the bar will also tend to grow the faster in height and breadth, because of the sedimentation occurring in the low water season, since the river water over the bar is then borne upon the back of a west-flowing salt water wedge. The left-hand extrem-

ity of the bar, weak on account of the relative lack of deposition, and weakened by the transverse scour of the Gulf current, will invite the strengthening river-current of the next flood-time to break through the bar at that end. In this way, there will be a transference of the river axis, year by year, toward the left. In the meantime the delta has necessarily grown most rapidly to the right of the river-mouth.

The same phenomenon appears to be represented in the Rhône and the Ebro (Figs. 2 and 3).

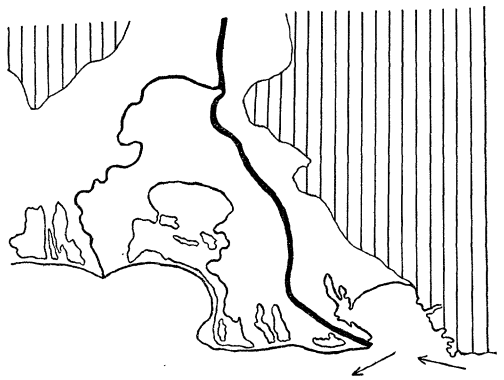

FIG. 2. The delta of the Rhône. Symbols as in Fig. 1.

In each there are a pronounced leftward deflection of the river axis and a corresponding asymmetry of delta, coupled with a prevailing marine current sweeping past the river mouth from left to right. In all three cases, we have departures from the usual scheme of deflection, where the axis of the river is directed down stream with respect to the marine current. The conditions for this exceptional behavior are: (1) a powerful river characterized by a stable channel, and a delta growing so rapidly as to preserve one or more distributing arms; (2) a nearly tideless receiving water-body with a relatively steady current transverse to the river axis; (3) a volume of river sediment greater than that of the shore-waste migrating toward the delta under the impulse of the littoral current.

The shape of the bottom, the feeble tidal currents and the influence of mud-lumps probably have a small effect on the shape of the delta as a whole, but no other explanation is doubtless so weighty as that found in the force of the earth's rotation. In the northern hemisphere, it tends to produce left-hand deflection of an *aggrading* river. It is true that the relative straightness of river distributaries would permit of but a small proportion of the deflective force of rotation as affecting a meandering stream; but, small as it is, this force may be competent to produce strong asymmetry of a delta, since the friction of water against water is of a low order. It happens that in the three cases above noted, the marine current runs in a direction which would control the delta-building in the same sense as that expected from the influence of the earth's rotation. What is needed, among other tests of the current hypothesis, is a set of examples where the deflection of the river and delta is in appropriate relation to the corresponding currents, but in a sense opposed to that expected as a result of the earth's rotation. One purpose in outlining the hypothesis here in its present brief form is to invite observation on this point. Another obvious test is experiment. Some rough trials with artificial deltas, made on the tidal flats of the Annapolis Basin, Nova Scotia, seemed to confirm the hypothesis, but other and more thorough experiments are needed. Whatever be the explanation finally arrived at, it seems highly probable that this repeated occurrence

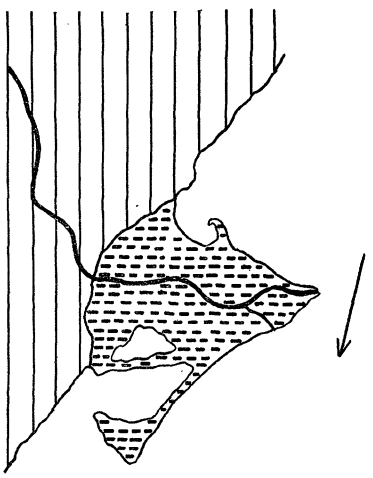

FIG. 3. The delta of the Ebro. Cross-lining indicates older land. Broken lines indicate alluvium. The arrow shows the general direction of the marine current prevailing at the river mouth.

of deltas, possessing similar and rather highly specialized features, cannot be referred to merely accidental conditions governing the forward growth of the deltas.

R. A. Daly.

Harvard University.

THE NEW MEXICO BIOLOGICAL STATION.

The Biological Station was founded as an independent institution at Mesilla in 1896. In 1899 it was moved to Las Vegas, and held a successful summer session in the New Mexico Normal University. A brief session was also held in 1900. The students in attendance have been mostly public school teachers. The results of the research work have been published in the *Annals and Magazine of Natural History.*

The Station will now be conducted as a part of the work of the biological department of the Normal University. The session of 1901 commenced on the 1st of June. A course in nature study is offered to public school teachers, and opportunities are afforded for research work along a number of different lines.

Las Vegas offers excellent opportunities for biological work. The summer climate is very good, and at no time is the heat excessive, as it is at lower altitudes in New Mexico and other parts of the Southwest. The altitude is about 6,400 feet, with mountains close by, rising above 11,000 feet.

Four distinct life-zones, the Upper Austral, the Transition, the Canadian and Hudsonian can be studied within 35 miles of Las Vegas. It results from this that the local fauna and flora are extremely rich in species; in the Hudsonian zone are forms of circumpolar distribution and others ranging to Alaska, though not to Asia or Europe; in the Canadian zone we find types identical with those of the mountains of the Northern States and of Colorado; in the Transition a varied assemblage typical, in part, of the foothill region of the Rocky Mountain range; in the upper Austral many species characteristic of the arid southwest, some ranging far southward and westward. With all this comes a certain percentage of local or endemic types, just how numerous further research must determine. Such are the snail *Ashmunella thomsoniana porteræ* and the magnificent butterfly *Argynnis nitocris nigrocærulea*, both found in Sapello Cañon.

The Gallinas River, flowing through Las Vegas, contains a crayfish (*Cambarus gallinus*), described as new last year, some interesting fishes (*Leuciscus* and *Rhinichthys*), and a variety of aquatic insects, algæ, etc. The Hot Springs, six miles away, contain some peculiar organisms, which have not yet been sufficiently examined.

In the Arroyo Pecos, and elsewhere in the immediate vicinity of the town, is an immense alluvial deposit of Pleistocene age, containing innumerable remains of mollusca and occasional mammalian fragments. Special facilities are offered to students of wild bees (*Apoidea*), the available collections and literature being very extensive. Facilities are also offered for the study of *Coccidæ* and other groups of insects. Students should, if possible, bring their own microscopes, slides, forceps and other accessories.

T. D. A. Cockerell.

ANNOUNCEMENT CONCERNING THE THIRTEENTH SUMMER MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA.

Sessions.—The thirteenth summer meeting of the Society will be held in Denver on Tuesday, August 27th, in the East Denver High School building. The Council will meet on Monday evening at the hotel headquarters. The Society will be called to order by the President, Mr. Charles D. Walcott, on Tuesday morning, immediately following the general session of the American Association for the Advancement of Science.

Program.—The preliminary list of papers will be mailed about August 1st, and no supplementary list will be sent. The Fellows are requested to send their abstracts on the printed form as promptly as possible, and not later than July 15th. By the rule of the Council abstracts are required. Papers offered for printing should be fully described on the blank forms, extra copies of which will be promptly sent on request.

Hotel Headquarters.—The Brown Palace Hotel has been selected by the local committee, A. A. A. S., as headquarters. The regular