read with profit by thousands, for it states that "to find the great-circle courses from the azimuth tables you have only to regard the latitude of the port bound to as declination, and the difference of longitude, turned into time, as the hour-angle. The latitude of the ship you take from the top of the page as usual." But the author goes on to remark that, as Burwood's solar azimuth tables extend only to twenty-three degrees of declination, this ready-made method is only applicable when the place of destination is within the tropics.

It may be of value, therefore, to point out that the solar-azimuth tables are universally applicable for finding great-circle courses, because all great circles pass into the tropics, and, if the problem of finding the courses is with reference to a great-circle track between a point of departure and a point of destination, both lying outside of the tropics, it is only necessary to find a point lying on the prolongation of the great-circle arc beyond the point of actual destination and within the tropics, and treat this point as the place of destination in finding the courses.

The longitude of the selected point within the tropics may be found without any calculation by simply prolonging the straight line representing the great circle upon a gnomonic chart. By this combination of the gnomonic chart and the azimuth tables the courses upon a great circle track may be determined with very great facility.

To illustrate, take the problem of finding the initial course on a voyage by the great circle route from Bergen, in latitude 60° N. and longitude 5° E., to the Strait of Belle Isle, in latitude 52° 1′ 2″ N. and longitude 55° W. On a copy of a gnomonic chart, such as Godfray's, draw a straight line between the geographical positions above stated and extend it beyond the latter into the tropics. It will be found to intersect the 20th degree parallel of latitude in longitude 90° W., or 95° from the meridian of the point of departure. Entering the azimuth table at latitude 60°, under declination 20°, and opposite hour-angle 95° or 6h. 20m., we find the required course to be N. 75° 31′ W.

G. W. Littlehales.

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*SOME NEW AMERICAN FOSSIL FISHES.**

The following new occurrences of fossil fishes were reported: (1) A species of *Cladodus*, scarcely distinguishable from *C. striatus* Ag. in the Corniferous Limestone of Ohio. (2) *Thelodus*-like scales from same horizon. (3) A pair of naturally associated pectoral spines of *Machæracanthus* from the Hamilton, near Buffalo, N. Y. (4) A ptychopterygian pectoral fin from Naples Shale of the same locality. (5) Two new species of *Diplodus* from Upper Devonian near Chicago, Ill. (6) Teeth of *Phœbodus* from Keokuk Limestone of Iowa and Permian of Nebraska. (7) Largest known spine of *Stethacanthus* (length over 35 cm.) from Keokuk Group, Iowa. (8) A complete fin, spines and shagreen scales of a new and very large species of *Acanthodes*, a genus not hitherto met with in the United States, from Coal Measures of Mazon Creek, Ill. (9) *Pholidophorus americanus* sp. nov., also belonging to a genus new to this country, founded on very perfect material discovered by N. H. Darton, of the U. S. Geological Survey, in the Jura of the Black Hills, South Dakota.

Photographs of the new Jurassic fishes were exhibited and their specific characters summarized as follows: Gracefully fusiform, upwards of 15 cm. long, the head forming about one-fourth the total length and slightly less than maximum depth of trunk; dorsal arising behind pelvic fins; scales not serrated, thin, smooth, nearly rhomboidal, overlapping; flank series not

* Abstract of a paper read before the Boston Society of Natural History, March 15, 1899.

especially deepened. This places them among the more primitive members of the genus, and hence would seem to indicate a Lower Jurassic horizon.

The distribution of American Devonian fishes was discussed with reference to those of other countries. During the Lower Devonian there was none, and in the Upper scarcely any intermingling of United States and Canadian vertebrate faunas, but those of Canada and Great Britain belonged to a distinct province. Corniferous fishes of Ohio and New York are most nearly related to those of the Middle Devonian of continental Europe, especially the Eifel, Bohemia, etc. The Hamilton faunas of New York and the Mississippian region, including Manitoba, are the direct successors of the Corniferous, but the Chemung of both eastern and western regions (or its equivalent) contains a remarkable mixture of indigenous types and intruders from all directions. Intercommunication between eastern Canada and Great Britain, Spitzbergen, etc., became general for the first time during this period. The transition between Devonian and Carboniferous faunæ is now known to be more gradual than was formerly supposed.

The only natural basis of family classification among *Arthrodires* was held to be through comparison of the sutures of cranial and dorsal shields, the differences in dentition being of only secondary importance. Degeneracy of the latter in *Titanichthys*, etc., is paralleled by that in certain toothless whales (*Mesoplodon*, etc.). Cranial osteology of *Homosteus* and *Heterosteus* compel their removal from *Coccosteidæ* to form a separate family called *Homosteidæ*. In this family the so-called antero-dorso-lateral corresponds to the like-named element in *Dinichthys* and *Titanichthys* plus the clavicular. The latter plate functioned as a support for the gills, and hence may be interpreted as a modified branchiostegal apparatus, but in no sense as a part of the shoulder-girdle. There is no evidence that any of the *Arthrodires* possessed pectoral fins. The obvious resemblance of this group to Ostracoderms, with implied relationship, is lost sight of through its removal by Woodward to the Dipnoi, and there seems to be sufficient evidence for regarding the *Arthrodira* as a distinct sub-class, of equal rank with Lung-fishes, Teleostomi, etc., as already suggested by Dean.

CHARLES R. EASTMAN.

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*RAPIDITY OF SAND-PLAIN GROWTH.**

THE undisturbed character of the stratified deposits making up the sand-plains, taken in connection with the absence, or at most, the very slight development of constructional back-sets, indicates, as was early pointed out by Davis, a stationary ice margin during the period of deposition. It follows, therefore, that their formation must have been extremely rapid, and the natural conclusion is that they represent the deposits of a single summer's period of melting, an interval not over eight months in length.

It occurred to me that a calculation based upon the conditions now existing in the large glaciers of Alaska might give some indication as to the probability of such estimates, or at least would be of interest in this connection.

To make this calculation it is simply necessary to divide the bulk of the sediments by the daily discharge of detritus by the glacial stream which deposited them. This involves factors which are usually very difficult to determine, but at the sand-plain near the railroad station at Barrington, R. I., the conditions are almost ideally perfect, and admit of the determination with considerable accuracy of both the bulk of

* Abstract of paper read before Boston Society of Natural History, February 15, 1899.