them had seen charred wood or bark in the holes. Presumably charcoal was formed only where the lava flow so completely covered the trees as to shut out the air, and the pieces found had been eroded by the Kalama River from wholly submerged molds."

Mr. Coville's conclusion as to the formation of the charcoal is probably correct. Mr. F. H. Knowlton, who studied the structure of the charcoal, recognizes the wood as Douglas spruce (*Pseudotsuga mucronata*). Attention was called (*Nat. Geog. Mag.*, Vol. VIII., p. 226) several years ago to the tree molds or tree wells by Captain P. Elliott. Through Mr. J. H. West, of Woodland, Washington, Mr. F. A. Walpole, one of Mr. Coville's assistants, secured a piece of the basaltic lava from one of these tree molds three feet in diameter. The piece of lava shows the impressions of the bark in great detail. In the hope of obtaining some evidence concerning the age of the lava flow associated with the tree molds and charcoal I entered into correspondence with Mr. West, who reports charred logs at least forty yards up the slope from the high-water mark of Kalama River. One of the charred logs is twenty-eight inches in diameter, and some of them are partly woody, not having been completely converted into charcoal. Near the River at one point the charred logs are found under six feet of sand and gravel, on which are now growing fir trees having a diameter of three feet. Some of the charred logs, therefore, appear to be at least 100 years old, for a fir three feet in diameter would probably require at least that length of time to attain its present size. If this be true it is probable that some of the charred logs are not the result of the last eruption of St. Helens, but of an earlier one. There is historical evidence furnished by Fremont (Memoirs, p. 282) to the effect that Mt. St. Helens and also Mt. Baker were in eruption November 23, 1843. At that time a light fall of ashes occurred at the Dalles, Oregon, on the Columbia, fifty miles from Mt. St. Helens, which was then noted as being in a state of eruption. Rev. Mr. Brewer collected some of the ashes and gave them to General Fremont, who visited the Dalles a year later. Mt. Baker is thought to have been in eruption at the same time, and the natives report that the fish in the Skagit River were killed by its ashes. Mr. S. F. Emmons gives (*Jour. of the Am. Geog. Soc.*, Vol. IX., p. 53) the testimony of a former Hudson Bay trader who saw an eruption of Mt. St. Helens in the winter of 1841–2.

It is hoped that the question may be settled some time in the near future by a geological survey of both Mt. St. Helens and Mt. Baker. While it may not be possible to establish the date exactly, the geological records upon the mountain slope are likely to be such as to give the relative age with certainty. The case of the cinder cone, ten miles northeast of Lassen Peak, California, may be noted as an example of the results of investigation in the field. Professor Harkness was of the opinion that the eruption occurred in January, 1850. The freshness of the material was so striking that Major Dutton and I, who visited the region in 1885, were at first of the same opinion, but fuller investigation, an account of which is published in the U. S. Geological Survey Bulletin No. 79, shows conclusively that the explosive eruption from the cinder cone must have occurred long before the beginning of the present century.

J. S. DILLER.

U. S. GEOLOGICAL SURVEY,
WASHINGTON, D. C., April 22, 1899.

THE PROSPECTIVE PLACE OF THE SOLAR AZIMUTH TABLES IN THE PROBLEM OF ACCELERATING OCEAN TRANSIT.

IT is not generally recognized that science, employing the mathematician and the engineer alike in the problem of shortening the duration of ocean transit, has accomplished as much by causing ships to go fewer miles as by causing them to go faster.

This generation is familiar with the part that has been played by steam propulsion in increasing the speed of ships, but, besides the increase in the rate of travel, modern motive power, by making possible a departure from the old meteorological routes, has had another and a greater effect in the progress of the universal policy of civilized nations to accelerate transit from place to place to the utmost possible extent. When the wind was the sole motor of ocean-going vessels the best economy was realized by passing through regions of favorable meteorological conditions without reference to the directness of the route. Thus, in sailing from Europe to the United States, it was customary to pass southward along the eastern shores of the Atlantic to the Cape Verde Islands, and thence westward through the trade-wind region along the route followed by Columbus on his first voyage to the New World, and finally northward into the region of prevailing westerly winds and along the western shores of the Atlantic to the point of destination. In making this voyage, ships traversed 4,400 miles in passing between ports that were only 2,400 miles apart on the surface of the earth.

Under steam, even if they go no faster, ships may yet get farther toward the port of destination in a given time because the winds and currents may be disregarded, and they may be navigated over the oceans along great circles of the earth.

The increasing recognition among mariners of the sound principle of conducting a ship along the arc of the great circle joining the points of departure and destination and the expanding sense of the advantages to be gained by a knowledge of this branch of nautical science have greatly heightened the value of methods which place the benefits of the knowledge and use of the great-circle track at the service of the mariner without the labor of the calculations which are necessary to find the series of courses to be steered. Inasmuch as great-circle courses alter continuously in proceeding along the track, it becomes necessary to know the latitude and longitude of the ship in order to determine the course to be followed. At the present day there are convenient means for determining at sea the longitude as well as the latitude, but before the early part of the present century these means did not exist, and great-circle sailing was impracticable. The general lack of the application of the principles of the great circle in later times, and even in the present generation, seems to have resulted not from the want of recognizing that the shortest distance between any two places on the earth's surface is the distance along the arc of the great circle passing between them, nor that the great-circle course is the only true course and that the courses in Mercator and parallel sailing are circuitous, nor yet to a due appreciation of the advantages to be gained by a knowledge of the great-circle course as a means for obtaining the most advantageous track in windward sailing; but to the tedious operations which have been necessary, and to the want of concise methods for rendering these benefits readily available.

The solution, every time the course must be determined, of a spherical triangle in which the two sides and the included angle are given is a formidable operation for a mariner as compared with the measurement on a compass diagram of the direction of the straight line representing the circuitous path of the ship's track on the Mercator chart. At page 662 of the ninth edition of a work on Practical Navigation by Captain Lecky, of the Royal Naval Reserve of Great Britain, there is a section entitled 'Great Circle Courses found from Burwood's Tables,' which has doubtless been 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.

*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.