other than local causes of the meteorological disturbances which produce famines. Indeed, the inference that most of the unusual variations of weather in tropical climates are induced by corresponding variations in the *absolute* heating power of the sun, in the *same manner* that the seasonal variations are induced by those changes of heating power which depend on the relative *motions* of that body, seems almost irresistible, if it may not be regarded as already partly proved. The importance of this conclusion, if true, will be readily admitted, for it will be at once apparent, that if the absolute variations of the sun's heat are fitful in their occurrence, and do not obey definite periodical laws, it will perhaps never be possible to predict by more than a few days in advance the unseasonal variations of weather induced by them, while if such laws can only be discovered, the possibility of our being able to predict their consequences is equally certain."

OCCURRENCE OF FOSSILIFEROUS TERTIARY ROCKS ON THE GRAND BANK AND GEORGE'S BANK

AMONG the most important results of the investigations made by the party connected with the United States Fish Commission, stationed at Gloucester, Mass., during the present season, is the discovery of fragments of a hitherto unknown geological formation, apparently of great extent, belonging probably to the miocene or later tertiary. The evidence consists of numerous large fragments of eroded, but hard, compact, calcareous sandstone and arenaceous limestone, usually perforated by the burrows of *Saxicava rugosa*, and containing in more or less abundance fossil shells, fragments of lignite, and in one case a spatangoid sea-urchin. Probably nearly one-half of the species are northern forms, still living on the New England coast, while many others are unknown upon our coasts, and are apparently, for the most part, extinct. From George's Bank about a dozen fossiliferous fragments have been obtained, containing more than twenty-five distinct species of shells. Among these one of the most abundant is a large thick bivalve (*Isocardia*) much resembling *Cyprina islandica* in form, but differing in the structure of the hinge. This is not known living. *Mya truncata*, *Ensatella Americana*, and the genuine *Cyprina* are also common, together with a large *Natica*, a *Cyclocardia* (or *Venericardia*) allied to *C. borealis* (Con.), but with smaller ribs, *Cardium islandicum*, and also various other less common forms. These fragments came from various parts of the bank, including the central part, in depths varying from 35 to 70 fathoms, or more.

From Banquereau, N. S., we received one specimen of similar rock, containing abundant fragments of a large bivalve, and about a dozen other species, among which are *Fusus* (*Chrysodomus*) *decemcostatus*, *Latirus albus*, Jeff. (?), unknown species of *Turritella*, &c. From the Grand Bank two similar specimens were received. One of these, from thirty-five fathoms, lat. 44° 30′, long. 50° 15′, contained numerous specimens of *Cyprina islandica* in good preservation.

In gathering these specimens from the fishermen and working out the specimens Mr. W. Upham has been very active. It will probably be possible hereafter, when these specimens shall have been more fully examined, and more obtained, to give a pretty long list of species, especially from George's Bank.

At present it appears probable that these fragments have been detached from a very extensive submerged tertiary formation, at least several hundreds of miles in length, extending along the outer banks, from off Newfoundland nearly to Cape Cod, and perhaps constituting, in large part, the solid foundations of these remarkable submarine elevations. A. E. VERRILL

THE BALLOON EXPERIMENTS AT WOOLWICH

THE military balloon experiments at Woolwich have been so far successful, that last week an aëronaut was lifted some 700 feet, to a height, therefore, sufficient for reconnoitring purposes. There is nothing of novelty in this, as a matter of aërial navigation, although it is the first instance, we believe, of any one in this country being raised from the earth by the agency of pure hydrogen, but it is, nevertheless, something to have achieved in the circumstances under which Capt. Templar has been working. Everybody knows that hydrogen is gifted with extraordinary lifting power, just as every chemist is aware that the gas may be produced in the way Capt. Templar produced it, namely, by passing a jet of steam over iron turnings. But the problem under solution was not to send up a hydrogen balloon so much as to discover whether the thing could be done in a haphazard fashion, and with such simple means as an army in the field would be provided with. It is one thing to make hydrogen in the laboratory, and another to make a sufficient supply of it just whenever the commander of an army may order a balloon reconnaissance to be made.

Capt. Templar has practically proved that this can be done. He requires a supply of steam, an improvised furnace of some sort, and a tube filled with iron turnings; given these, he can provide hydrogen sufficient to lift a scout high into the air. The tube at present employed by Capt. Templar is six or eight inches in diameter, and some half-dozen feet long; it is filled loosely with iron turnings and placed in a furnace where it becomes red hot. Steam is now passed through the tube, and hydrogen issues forth, the oxygen from the decomposed steam going to form ferrous oxide. So completely do the iron turnings do their work under these circumstances, that not only is the surface of the metal acted upon, but it is oxidised well-nigh throughout.

Naturally enough, the hydrogen comes away with a good deal of vapour, and, if pure gas is desired, some desiccating arrangement will have to be employed; but so far Capt. Templar has used none. His balloon, which is of lawn, dressed with boiled oil and glue, will contain about 10,000 cubic feet, but last week not more than 9,000 feet of hydrogen was introduced. The gas was generated from the tube at the rate of something like 1,000 cubic feet per hour, and there can be little doubt that, during the long period of filling, a large quantity of the vapour that was mixed with the hydrogen condensed, and ran out of the balloon in the form of water. Pure hydrogen should have a lifting power of 70 lb. per 1,000 feet, or perhaps a little more, but it is hardly likely that gas produced in a rough-and-ready fashion in the field will possess this degree of buoyancy. Still, Capt. Templar was successful in lifting balloon, aëronaut, ballast, and 700 feet of rope—for the ascent was a captive one—by means of 9,000 cubic feet of hydrogen, prepared in the way we have mentioned.

Another point is worthy of note in connection with the experiment. The fabric of the balloon kept the hydrogen imprisoned for a much longer period than had been anticipated. A dozen hours scarcely impaired the buoyancy of the balloon, and by adding yet another waterproof coating it is anticipated that the balloon will remain inflated for four-and-twenty hours.

The next step will be to discover how far it is possible to compress hydrogen so manufactured into cylinders for conveyance in transport waggons, so that a supply of hydrogen may be at hand whenever an ascent is determined upon in the field. Capt. Templar is sanguine of compressing the gas to a fourth of its volume, and thus decreasing its bulk considerably, when the balloon-train is on the march. How far this is practicable experiment only can prove.