

is, so far as at present known, a local, arbitrary, or accidental one, and has not yet been found to recur in any other portion of the globe.

(e) Droughts or floods may occur every year in some portion of an extensive region, so that it may become possible to predict the occurrence in a special section one year because one has occurred in another section a previous year. Thus, a serious drought in the lower Indian peninsula has, on five occasions, been followed by one in northern India the next year.

(f) If we had maps of the weather of the whole globe for every month for a long series of years we should, undoubtedly, be able to find many similar coincidences, so that a drought for a given section might be predicted from the rain-fall, the snow-fall, the temperature, the pressure, or other conditions in a distant part of the globe. As a rule, important climatic crises are the results of changes that have been going on slowly for a long time in distant parts of the earth. The general circulation of the air constitutes a complex system in which the areas of high pressure and dry clear air are the results of slowly descending winds moving toward the equator; the general rains are formed wherever a descending current of air, a mountain range, or other obstacle has an opportunity to push up the moister air of the earth's surface. From this point of view rainy and dry and cold and hot seasons depend largely upon the varying relations of the upper and lower currents to the continents and even to each other. The long-range prediction of the climate of any season must depend upon the prediction of the general character of the horizontal and vertical movement of the air. In our present geological epoch the continents are permanent features, and we consider only the changes that take place in the atmosphere, but in studying the climatic changes of earlier geological epochs we have to consider the changes in elevation of the continents themselves.

(g) Such apparent connections as that between snow-fall on the Himalayas and the subsequent drought in northern India are not to be thought of as cause and effect respectively. It might be argued that the layer of snow must be evaporated, or melted, thereby absorbing more heat than would have been required if it had fallen as rain and rapidly drained away; but this cooling influence is distributed over many weeks, and through the immense quantity of air that has passed over the snow-fields during the winter and the spring, and is thereby rendered too slight to have any great local influence in India. A broader view of the subject shows us that the winter snow-fall and the summer drought are simply two features of an extensive system of changes in which the whole atmosphere of the earth takes part. The whole globe may be divided into regions where the lower stratum is moving either horizontally or upward or downward, and where the upper stratum has similar diversities of movement. These systems of motion determine whether we shall have fair weather or rain, hot weather or cold, from day to day and accumulatively from month to month. Now these three movements are related to each other in such a way that the sum total of the energy involved throughout the atmosphere is sensibly constant, while the localities at which the upward and downward motions are taking place are undergoing perpetual changes.

The centres of high pressure over the oceans and continents slowly sway east and west or north or south; the paths of the storm-centres vary in a similar manner to suit the changes of these larger areas, and the centres themselves move rapidly or slowly in response to these same changes. The air that ascends between the northern and southern tropical regions of high pressure descends sometimes in high latitudes, giving them cold weather with rain or snow; at other times in low latitudes, giving them warm weather with droughts. It matters not whether the droughts in southern regions chronologically follow or precede the snows of the northern regions; in neither case can either one be spoken of as the cause of the other, but each is in its turn the result of changes in the so-called general circulation of the atmosphere.

This general circulation, with all its variations, diurnal, annual, and secular, is dependent upon the intrinsic density of each portion of the atmosphere and on numerous forces, such as the heat received from the sun, the attraction of the sun, moon, and earth, the resistance offered by the irregular surface of the earth, and the interaction of slow and rapidly moving masses of air. The proper study of this subject constitutes the application of hydrodynamics to meteorology.

The meteorological problem has some analogy to that offered

by the hydraulics of the Mississippi River, where cut-offs, cave-ins, mud-banks, and crevasses are continually forming and re-forming. We do not expect to be able to foretell when and where these will occur many years in advance, but we do keep a watch on the condition of the river; and when conditions are favourable for the formation of any important change, we watch the process until the catastrophe becomes more or less imminent, and then begin to make estimates, that may be called predictions, as to the exact time and place of the event.

In meteorology the best we can do at present in long-range predictions is to chart and study the occurrence of abnormal weather conditions over the whole globe; these phenomena must be interpreted in the light of all the knowledge we have of the mechanics of the atmosphere, for they are the results of purely mechanical operations covering the whole range of the mechanics of heat, gases, and vapours.

SCIENTIFIC SERIAL.

The Quarterly Journal of Microscopical Science, November. —On *Julinia*, a new genus of compound ascidians from the Antarctic Ocean, by W. T. Calman (plates 1-3). The colony is described as irregularly cylindrical in shape, measuring 7.85 cm. in length, and from 1.5 to 2.5 cm. in diameter; it was found floating on the surface of the sea in the north of Erebus and Terror Gulf; a considerable quantity was seen; no attaching fibres were found, but it was probably an attached form. The species is described as *Julinia australis*, and it is provisionally placed in the Distomidae. —Hermaphroditism in mollusca, by Dr. Paul Pelseener (Ghent) (plates 4-6). Hermaphroditism is found in the Amphineura, the Gastropoda, and the Lamellibranchia. It is not self-sufficient, is sometimes protandric; it would seem to the author to be not a primitive arrangement, but to be derived from the unisexual state, and to have been established upon the female organism. —Description of the cerebral convolutions of the chimpanzee known as "Sally," with notes on the convolutions of the brains of other chimpanzees and of two orangs, by W. Blaxland Benham (plates 7-11). —On the inadequacy of the cellular theory of development and on the early development of nerves, particularly of the third nerve and of the sympathetic, in Elasmobranchii, by Adam Sedgwick, F.R.S. More than ten years ago the author called attention to the inadequacy of the cellular theory of development: "Embryonic development can no longer be looked upon as being essentially the formation by fission of a number of units from a single primitive unit, and the coordination and modification of these units into a harmonious whole. But it must rather be regarded as a multiplication of nuclei and a specialisation of tracts and vacuoles in a continuous mass of vacuolated protoplasm." And "although opinions have changed on this important subject, and although there are some who think that they have escaped from the domination of this fetish of their predecessors, yet as a matter of fact the cellular theory of development is still rampant, still blinds men's eyes to the most patent facts, and still obstructs the way of real progress in the knowledge of structure." When a student begins his zoology he is told that "the various structures present in a protozoon are all parts of one cell, whereas in a metazoan the various parts are composed of groups of cells which differ from one another in structure." When in a later period of his studies he begins embryology, "the importance and distinctness of the cell meets him at every step, from the complete cleavage which he is led to believe is primitive, to the development of nerves according to the views of Hiss." If we take the so-called mesenchyme tissue of elasmobranch embryos, it is described as consisting of "branched cells lying between the ecto- and the endo-derm," while, as a matter of fact, "the separate cells have no existence," but "there is a reticulum of a pale non-staining substance holding nuclei at its nodes. And far from the development of nerves being an outgrowth of cell-processes from certain central cells, it is simply a differentiation of a substance which was already in position." This important memoir is so condensed as to make it extremely difficult to condense it further, but enough has been given to indicate its nature. —On *Benhamia vacifera*, n. sp., from the Gold Coast, by W. B. Benham (plate 12). This large species (20 inches) was found at Axim in the Fantee country, on the west coast of Africa.