violence of a storm arriving on our coasts, so that if meteorology, or that branch of it termed weather forecasting, is ever to become an exact science, we must endeavour to find out, by captive balloons or otherwise, what can never be determined by registration at the earth's surface alone, viz. the condition of the atmosphere *vertically* as regards temperature and humidity.

The author concludes his theoretical investigation into the mechanics of cyclones by a discussion of the causes of their motion over the earth's surface. He first of all shows that every cyclone possesses an inherent force tending to urge it towards the pole of the hemisphere in which it has been formed. This follows immediately from the fact that the deflecting force due to the earth's rotation varies with the cosine of the colatitude, and is therefore greater on the polar than on the equatorial side of a cyclone, a residual poleward component of force being thus brought to bear upon every portion of the cyclone. In addition to this, a cyclone, as soon as it is generated, must partake of the general motions of the atmosphere, which the author more especially deals with in his "Meteorological Researches," Part I., to which we have already made allusion; and since the general motions of the atmosphere are there considered to form two great cyclonic systems round the poles, all ordinary cyclones are simply cyclones within a cyclone, so that their general motion of translation is partly the result of the actual motion of the air in these large and perpetual, though perpetually changing, cyclones, and partly that of their inherent tendency to *press polewards*.

For example, as the author says, "in the trade-wind latitudes the wind at the earth's surface is westward . . . and hence the cyclones in these latitudes are carried westward, . . . and having a tendency towards the Pole, the resultant of the two is a westward motion, inclined a little towards the poles, or in the northern hemisphere a motion about west-north-west. After having arrived at the parallel of 30° or 35° in the tropical calm-belt, where there is no westward motion, the progressive motion is a Polar one mostly, but after progressing still nearer the Pole, into the middle and higher latitudes, the general eastward motion of the atmosphere here, which is great in the upper regions, carries now the cyclone toward the east, and the direction of the progressive motion, which is usually about east-north-east, is the resultant of this eastward motion and the motion round the Pole. All well-developed cyclones, therefore, having their origin near the equator, have mostly a progressive motion represented by a curve somewhat in the form of a parabola, having its vertex in the tropical calm belt at the parallel of 30° or 35°."

It is moreover shown that the general motions of the atmosphere must not only cause the cyclone to travel more or less with them, but also affect the inclination of the wind to the isobars, decreasing it in the front, and increasing it in the rear part.

With regard to further modifying causes, the author favours the views of Clement Ley regarding the effect of the distribution of aqueous vapour in determining the direction in which a cyclone propagates itself.

He does not indeed attempt to explain how they sometimes wander off on an entirely unlooked-for course, or else remain stationary for some considerable period; otherwise he might claim to have at least attempted a solution of the entire problem on which weather science depends. Clement Ley himself, in his admirable little work,¹ recently published by authority of the Meteorological Council, tells us that the reason why the course of a cyclone cannot be exactly foretold is because "in the first place the causes which determine the course of depressions are not fully known; in the second, place so far

as they are known, it is certain that the course of depressions is generally related to the distribution of pressure over a very large area." In fine before we know how the small cyclones are going to behave, we must in every case know the *form* of the larger cyclones round whose centres they travel.

E. DOUGLAS ARCHIBALD

(To be continued.)

THE GIZZARD-CONTENTS OF SOME OCEANIC BIRDS

THE following results of the examination of the gizzards of twenty sea-birds, which were caught by the officers of this ship in the South Atlantic and Southern Indian Oceans during the last quarter of 1881, may be of interest to some of the readers of NATURE.

With one exception all the birds belonged to the Petrel family—the Procellariidæ—and fifteen of them were of the well-known species—the Cape-pigeon or Cape-petrel (*Daption capensis*). The most frequent of the gizzard-contents of these twenty birds were the mandibles of a cephalopod, which were found in eighteen instances; the otoliths of some small osseous fishes occurred in five instances; and some curious stony masses, varying in weight from half a grain to five grains, were obtained also in five instances. The other substances, which were observed less frequently, were the vertebræ of a fish, feathers, Velellæ, the horny rings probably of some crustacean, and a small hard seed.

With reference to the seed just mentioned, I should observe that it was taken from the gizzard of a Cape-pigeon, about 550 miles to the east of Tristan d'Acunha, in the South Atlantic. The wide range of this species of petrel is well known; we ourselves first observed this bird rather to the southward of the island of Trinidad, which lies about 600 miles off the coast of Brazil; and thence we traced it as far as the island of Amsterdam, in the southern portion of the Indian Ocean. From our own observation, therefore, it is quite possible that a seed might be transported from Trinidad to Amsterdam, notwithstanding that these islands are from five to six thousand miles apart; and Mr. Mosely's surmise (*vide* a footnote in Mr. Wallace's "Island Life," p. 250) that various species of Procellaria and Puffinus may have played a great part in the distribution of plants, and may to some degree explain the similarity in the mountain floras of widely distant islands, would appear to receive some support from the single instance of this seed. With regard to the kind of plants to which the seed belongs, Mr. Moore, director of the Botanic Gardens, Sydney, kindly informed me that it possessed no character sufficiently distinctive to enable him to decide as to its probable source.

The stony masses found in the gizzards of five of the birds, all of which were caught in the South Atlantic, were of two kinds: one of the masses was of a dark colour and homogeneous texture, and rather porous; when heated it gave off black fumes with a smell of burnt organic matter, and was fusible with soda into a black glass; the other masses had the appearance of greasy quartz, scratching glass with ease; but when heated in a closed tube they blackened and evolved black fumes with a powerful odour of burnt animal matter; after the incineration they became white, and with the blowpipe were fused into a white glass after the addition of soda; no effervescence was exhibited on the application of an acid. The behaviour of these masses under heat is very similar to that described by Mr. Darwin in his "Geological Observations," in the case of a stony incrustation on St. Paul's Rocks, deposited, as he considered, from water draining through birds' dung.

H. B. GUPPY

H.M.S. *Lark*, Auckland, February 28

¹ "Aids to the Study and Forecast of the Weather," by W. Clement Ley, M.A., 1880.