another beach will have a constant supply, and for no obvious reason.

The causes which affect the movement of sand and silt are so numerous, and their resultant effects so well balanced, that if one of the former be increased or diminished the combined result may be completely reversed. I have just come across an interesting instance. For more than twenty years I kept a 6-ton boat in the tidal harbour here, where, when at her moorings, she took the ground in all weathers twice a day without any damage whatever. Since the erection of the new harbour arm, the silt has been cleared out of the harbour, leaving a hard bottom, and the coxswain of the lifeboat informs me that a boat moored in my old berth sprung a leak in a few days and had to be removed. The mode of accumulation of sand on the Torre Abbey beach is also changed in character. I cannot but think that it is a pity experiments are viewed with disfavour. The Torquay inlet and harbour works were eminently adapted for reproduction in an experimental tank. The then local surveyor, who had practically planned the new works, was anxious to carry the experiments out. We had begun to consider the details of the tank, when my intended colleague told me that superior authority "did not favour" the idea, and it was useless to proceed further.

I am now informed by practical seafaring men that the present plan must ultimately be amended, and clearly at considerable cost. Whether this be so or not, the question could have been decided in a tank in a few minutes, at the cost of, say, £15. The experimental tank for waves playing upon beaches was the suggestion of the late Mr. W. Froude, C.E., F.R.S.; so it is no mere fad of an unprofessional outsider.

Southwood, Torquay, February 19. A. R. HUNT.

### Torpid Cuckoo.

IN the last volume of NATURE (vol. xliv. p. 223) an account is given by "E. W. P." of a cuckoo which was brought up in a house, and which disappeared one day in November, and was found in the following March on a shelf in the back kitchen, "still alive, and asleep, with all its feathers off, and clothed only in down, the feathers lying in a heap round the body."

It is rather interesting to note that Aristotle, who firmly believed that some birds hybernate, seems to have come across cases of birds in a similar condition. In his "History of Animals" (Book viii., chap. xviii.), he says, "Many kinds of birds also conceal themselves, and they do not all, as some suppose, migrate to warmer climates; but those which are near the places of which they are permanent inhabitants, as the kite and swallow, migrate thither; but those that are farther off from such places do not migrate, but conceal themselves; and many swallows have been seen in hollow places *almost stripped of feathers*; . . . for the stork, blackbird, turtledove, and lark hide themselves, and by general agreement the turtledove most of all, for no one is ever said to have seen one during the winter. At the commencement of hybernation it is very fat, *and during that season it loses its feathers*, though they remain thick for a long while." I have adopted the translation in Bohn's edition. The italics are mine.

A. HOLTE MACPHERSON.

51 Gloucester Place, Hyde Park, W., February 22.

### A Swan's Secret.

Now that the breeding-season for birds is coming near, it would be interesting to note if the following sight I saw last spring is common to swans. A pair of swans built on an island on the River Wey, which runs through our grounds, and I stood on the bank opposite their nest, and watched for a view of the cygnets, which were just hatched out. The male bird presently picked up an empty half egg-shell lying beside the nest, and carefully carried it to the edge of the water, some 20 feet from where the nest was built, and proceeded to fill it with mud, and then pushed it into the river, where it sank to the bottom. He then fetched the only other remaining piece of shell, and did the same. On returning to his nest the last time, he placed a few sticks across the small track he had made, as if to conceal his actions. Evidently this process had been done to each piece of shell, as no other pieces were to be seen, although five cygnets were hatched out.

JESSIE GODWIN-AUSTEN.

Shalford House, Guildford, February 22.

### A Simple Heat Engine.

MR. FREDERICK SMITH described in NATURE of January 28 (p. 294) a simple heating machine, which he constructed with a nickel disk, so that when heated before a magnet it began to revolve. A similar heating machine was shown by Prof. Dr. T. Stefan, Vice-President of the Imperial and Royal Academy in Vienna, in the course of a lecture to his students, among whom I was, in the year 1885. A memoir on it appeared in the publications of the above-named Society. The machine was thus constructed: nickel plates were fixed on a wheel, like that of a water-mill, and a magnet was placed before it. By heating a nickel plate before the magnet, it was repulsed by the magnet, and a succeeding plate was attracted, so that the wheel commenced to rotate.

So much I thought it necessary to communicate about the priority of such a heating machine.

KONSTANTIN KARAMATE.

Buccari next Fiume, Austria, Nautical School, February 18.

### New Extinct Rail.

[*Telegram.*]

I HAVE just obtained from the Chatham Islands a nearly perfect sub-fossil skull of an extinct Ocydromine rail, closely resembling the Mauritian *Aphanapteryx*, five and quarter inches long, beak arched, slender, very pointed, for which I propose the specific name *Hawkinsi*. HENRY O. FORBES.

Canterbury Museum.

## *ON A RECENT DISCOVERY OF THE REMAINS OF EXTINCT BIRDS IN NEW ZEALAND.*

A DEPOSIT of moa bones, larger than has been found for many years, has just been discovered near the town of Oamaru, in the province of Otago, in the South Island of this colony. Their presence was indicated by the disinterring of a bone during the ploughing of a field, by the proprietor of which the circumstance was communicated to Dr. H. de Lautour, of Oamaru. This gentleman, who is well known through his papers on the diatomaceous deposits discovered by him in his district, at once inspected the spot. Finding that the deposit was large, he first secured, through the kindness of the proprietor, the inviolability of the ground, and then telegraphed the information to the Canterbury Museum. I lost no time in proceeding to Oamaru with one of my assistants, and superintended the digging out of the bones in a systematic manner. The site of the deposit was at Enfield, some ten miles to the north-west of the town, on ground elevated several hundred feet above the level of the sea, in a shallow bayleted hollow, into which the unbroken surface of the expansive slope gently descending from the Kurow hills to the open vale of the Waireka (a stream that rises further to the west) has sunk here for some 7 to 8 feet below the general level, and which, proceeding with a gentle gradient valleywards, becomes a ditch-like conduit for a tributary of the Waireka. In the centre of this depression, which does not exceed 10 to 12 yards in width, the ground was of a dark brown colour, damp and peaty. On removing the upper layer of soil for a depth of 3 to 4 inches round where the bones had first been brought to the surface, and whereon was strewn abundance of small crop-stones, a bed of very solid peat was reached, and firmly embedded in it were seen the extremities of numerous *Dinornis* bones, most of them in excellent preservation, though dyed almost black. Further digging showed that certainly many of the skeletons were complete, and had been but slightly, if at all, disturbed since the birds had decayed. Owing, however, to the close manner in which they were packed together, and especially in which the limbs were intertwined, it was rarely possible to extricate the bones in the order of their relations, or to identify with certainty the various bones of the same skeleton, each bone having to be extracted as

the circumstances of the moment directed. In many cases, again, only the pelvis and femora could be traced *in situ*, the vertebræ and remaining leg-bones being indistinguishable in the general agglomeration. It seemed evident that the birds had not died in an erect posture, but more probably with their limbs bent under them or in the same plane with the body. In some instances, beneath the sternum were found, lying quite undisturbed, the contents of the stomach, consisting of more or less triturated grass mingled with crop-stones. The quantity of these smoothed, rounded (chiefly white quartz) pebbles—in size from about that of a bean to that of a plum—mingled with the bones was enormous, and would, if collected, have formed more than a cart-load. Except where the bones were, there were no pebbles of any sort, no small stones nor even sand, anywhere around. The nearest place where pebbles of the same composition are to be found is, I was informed, several miles distant.

Four trenches, or pits, in all, were sunk. The dimensions of the first, which was excavated entirely in peat, did not exceed 3 feet square and 3½ to 4 feet in depth. When it was exhausted of its treasure, a second search was made about 20 to 25 feet higher up the hollow. The dimensions of this pit extended to about 7 feet square and to the same depth as the first. Two more trenches, a few feet apart, were dug at about 30 yards still further up the depression. They were not so large as the other two, but they extended down to about the same depth, 3½ to 4 feet, the bottom of both being (as it was in the second) a bluish clay, with which, in the pit furthest up, was sparingly mingled a small deposit of the finest silt. In the first pit portions of both *Cnemiornis* and *Hæpagornis* bones were found in abundance, and remains of several hundreds of moas of all ages. It was from the second pit, however, that the largest deposit of moa bones was obtained, and the most perfect specimen of food remains from beneath a sternum. Here, also, numerous bones of the giant buzzard and of the great extinct goose were exhumed, and a cranium as large as, if not slightly larger than, that of *Cnemiornis*, but of a species with complete bony orbits, as in the Cape Barren goose, and indistinguishable from *Cereopsis*. Bones from other parts of New Zealand, now in my possession, which I hope shortly to describe, indicate with certainty that several species of *Cnemiornis* formerly existed in this colony. Some of these bones are remarkable for their slender elegance, and indicate species less in size and lighter in build than *Cnemiornis calcitrans*. Among the bones so far examined, I have observed no remains of *Aptornis*, of *Ocydromus*, or of *Notornis*; but I possess an adult tibia of a rail smaller than *Porphyrio melanotus*, yet larger than any other existing New Zealand species. The tarso-metatarsus of a species of *Anas*, about the size of *Anas finschi*, the metatarsus and sternum of *Apteryx Oweni*, and crania of *A. australis*, are among the bones recovered at Enfield, in addition to the metatarsus of a *Biziura*, somewhat larger than *Biziura lobata*, the musk duck of Australia, an interesting species for which I have proposed the name of *Biziura de Lautouri*, after the gentleman to whom I am indebted for the acquisition of these bones. There are still other bones which I have not yet been able to identify. The *Dinornis* remains belong chiefly to the species *elephantopus* (of unusually large proportions), to *ingens*, and to *rheides*. Very fine specimens of pelves and sterna have been obtained, with numerous crania more or less perfect. In this second trench the excavation penetrated through the peat into a bluish clay charged with water (which was, indeed, reached in all the diggings at about 4 feet below the surface), and into this clay the bones just protruded, but no more. The osseous remains dug from the last two holes belonged to the same species as those from the others. Digging and probing the ground beyond the boundaries of the trenches showed us that we had exhausted their contents; while the probing of the ground in the neighbourhood for a considerable radius around, and in other peaty spots not far off, failed to afford indications of other deposits. The number of perfect femora of *Dinornis* brought away exceeded 600; a large number were so decomposed as to fall to pieces in the handling; while a great many others disintegrated, after removal from the ground, on exposure to the atmosphere. I believe I do not over-estimate, therefore, in saying that from 800 to 900 moas at least were entombed in this shallow hollow. So many moas (leaving out of the reckoning the other species of birds) could not by any possibility have found standing-room, however crowded together, in the entire area of the depression. It would appear evident, therefore, that they did not perish all at one time. To account for their burial in such numbers in areas so circumscribed seems to me at present impossible. That their bodies were entire when they were deposited is clear, from the presence in such abundance of the crop-stones, from the position of the bones, and from the finding of the intact contents of the gizzard. No stream of any size could find origin in the immediate neighbourhood, and no stream which could have transported the entire carcasses of birds of such huge proportions as *Dinornis ingens* or *D. elephantopus* could ever have occupied this ravine-head without leaving traces of its action on the surface which would be visible to-day, or without washing away the very fine silt mixed with the clay on which the bones lie, in the bottom of the most upland of our excavations. None of the bones are waterworn. This little hollow was, in the early days of its present proprietor, very wet and boggy, and several springs have origin in it. If the moas made this a highway from one part of the country to another, it seems difficult to believe that birds so powerful of limb, and standing at least 10 to 12 feet in height, could stick fast in so shallow a bog; and to conjecture why eagles of powerful flight, slender rails, small ducks, and comparatively light-footed kiwis also should become ensnared. Driven by fire in the surrounding bush—which may have covered the country then, for the plough has, I am informed, brought to light the stools of many large trees at no great distance, while logs of wood were found among the bones—did they, in a struggle for life in a narrow space, trample each other to death? The presence of the strong-winged *Harpagornis* in considerable numbers seems to militate against this explanation, and no calcined bones have been discovered. An explanation offered some years ago, to account for the presence of a great number of moa and other bird bones in a somewhat similar situation in the Hamilton swamp—that during severe winters these birds congregated at the springs rising warmer from below, and were overtaken by a severe and fatal frost as they stood in the water—appears unsatisfactory in the present case, as there are numerous springs and equally boggy ground near at hand, round which no remains can be found, and so close to the sea such excessive frosts are now unknown. That these were individuals who, during an excessive drought, arrived at the springs too far exhausted to revive—an occurrence common enough in Australia—and that the water there was charged with poison, have also been offered as explanations. But the permanence of glacier rivers, highest in the hottest seasons, precludes the idea of animals dying of thirst in this island, or at all events in this locality so near to the great snow river Waitaki. Poisoned water-holes or exhalations of carbonic acid might be a sufficient reason, yet in those springs elsewhere where bones have been found chemical analysis has failed to detect any substance harmful to life in their waters at the present day. Not a single indication of human intervention was observed. No bones were discovered which had been broken in their recent state; neither kitchen-middens, nor remains of ovens or of native encampments, occur anywhere near the deposit.

One piece of egg-shell dug out of the highest trench is not sufficient evidence on which to base the supposition that the spot was frequented as a nesting-place.

At Glenmark, in the north of this province, the historic spot where the original (somewhat larger than the present) find of *Dinornis reliquiæ* was dug out by my predecessor, the late Sir Julius von Haast, the bones of numerous species of birds besides moas were found. Their occurrence in the situations where they were discovered, and the way in which they were lying—entire bodies with their sterna covering crop-stones *in situ*—have been explained by the supposition that the moas were overtaken by a fierce and sudden storm, and their entire carcasses piled by wind and flood into vast heaps, an explanation against which the presence here also of the same powerful buzzard and other flying birds rises as an objection. Yet there is nothing either in the situation or the disposition of the bones to make it impossible; still I cannot help feeling that that cannot be the true explanation which satisfies only one instance out of so many assemblages of dead birds of nearly always the same species in situations almost similar. I hope, however, that when I have made a thorough examination of all the localities where, and the conditions under which, moa remains have been found, in the light of the personal experience gained in the exhumation of the present deposit, and when I have completed the identification (on which I am now engaged) of the smaller bird bones associated in them with the moa bones, some light may have been gained on this at present mysterious episode in the history of the ancient Avians of New Zealand.

HENRY O. FORBES.

Christchurch, New Zealand.

## *THE BLUE HILL METEOROLOGICAL OBSERVATORY.*[1]

THE *Annals* of this high class Meteorological Observatory for 1890 are of more than usual interest, since we have here presented not only the observations of the year, which are made with remarkable fulness and exactness, but also a well presented and discussed *résumé* by Mr. Clayton for the lustrum ending with 1890, together with an account of the hourly and other observations made at the Signal Service Station at Boston. The Observatory is situated about ten miles south of Boston, on the summit of a peaked hill 640 feet above the sea, and as the ground falls down from the buildings in every direction for several hundred feet, the Observatory occupies a unique position among Observatories in the investigation of some of the more important phenomena of meteorology.

The hourly means of atmospheric pressure show for all the months the double tide well marked. The chief maximum steadily recedes from 10 a.m. in winter to 8 a.m. in summer, and the chief minimum advances from 2 p.m. in winter to 5 p.m. in June. The evening maximum shows a slight tendency towards displacement in the same direction as the afternoon minimum, and the night minimum a similar displacement in the same direction as the morning maximum. A third barometric maximum, which is generally met with in middle latitudes, is particularly well marked at this place.

But the important position of this Observatory appears in the most striking manner on comparing the hourly barometric results of 1890 from the Blue Hill with those from Boston for the same year. The Blue Hill Observatory is situated on a true peak, but the station at Boston is in the mouth of the rather broadish valley which stretches northward from the town. The result is that, though the places are only about ten miles apart, the diurnal fluctuation at Boston is 0·017 inch greater than on the top of Blue Hill. In June, when this feature of the pressure is at the annual maximum, the following are the hourly results, where the plus sign indicates that pressure at Boston rose above its daily average by these amounts, expressed in thousandths of an inch, greater than did pressure on the Blue Hill above its daily average; and the minus sign that it fell lower by these amounts at the former than at the latter place.

| | Diff. | | Diff. | | Diff. |
|---|---|---|---|---|---|
| 1 a.m. | + 2 | 9 a.m. | + 6 | 5 p.m. | − 5 |
| 2 ,, | + 3 | 10 ,, | + 1 | 6 ,, | − 7 |
| 3 ,, | + 8 | 11 ,, | − 1 | 7 ,, | − 5 |
| 4 ,, | + 10 | Noon | − 4 | 8 ,, | − 5 |
| 5 ,, | + 10 | 1 p.m. | − 3 | 9 ,, | − 8 |
| 6 ,, | + 10 | 2 ,, | − 5 | 10 ,, | − 4 |
| 7 ,, | + 7 | 3 ,, | − 5 | 11 ,, | − 2 |
| 8 ,, | + 6 | 4 ,, | − 7 | Midnight | − 1 |

The explanation is that, during the night, cold air-currents flow down the sides of a valley and accumulate below, and thus a higher pressure is maintained in valleys during the night; but, on the other hand, during the day the valleys become more highly heated by the sun, and under the strong ascending currents thereby generated, pressure falls lower than in open situations. The amounts increase in proportion to the daily range of temperature, and as the mean velocity of the wind diminishes. This diurnal variation is greatest in the deep valleys of Switzerland and other mountainous regions, and, though small in amount is a well-defined and steady fluctuation in the valley of the Thames, as shown by a comparison of the Kew and Greenwich barometers. A weak point in the meteorological publications of the Signal Service of the United States is the all but complete absence of the results of the hourly phenomena of meteorology. In filling up this hiatus, the Blue Hill Observatory will prove of the greatest service, as offering a truly normal Observatory, at which, from its mere position, several disturbing elements affecting diurnal phenomena are eliminated.

During the whole year, the time of occurrence of the minimum temperature is very near sunrise; and it is interesting to note that the maximum occurs at all seasons from 2 to 3 p.m., approaching in this respect the time of the maximum at truly high-level Observatories, or at Observatories situated on peaks. For the five years, the mean monthly temperatures deduced from the maximum and minimum thermometers exceed those deduced from the hourly values every month, the smallest excess being 0°·2 in December, and the largest 1°·2 in August, the mean for the year being 0°·7.

The prevailing winds are north-westerly from February to April, southerly in May, and westerly and north-westerly for the other months. These winds are ruled by the different distributions of atmospheric pressure over the Atlantic and America in the respective months; these being in winter the low pressure round Iceland, and the high pressure over the United States and Canada; and in summer the high pressure in mid-Atlantic, together with the low pressure over the Middle States. The hourly frequency of each wind has been worked out for the lustral period, with results that are very suggestive. The period is sufficiently extended to give fairly good averages, from which accidental phenomena may be regarded as eliminated; and the result is more completely attained by the height of the Observatory above the surrounding country all round removing from the observations the more purely local causes of disturbance. The mean hourly frequency of each wind shows a clear tendency of the wind to veer around the compass each day. Thus, the greatest frequency of southerly winds occurs at 8 p.m., south-westerly at 10 p.m., westerly at 1 a.m., northerly at

[1] "Annals of the Astronomical Observatory of Harvard College," vol. xxx., Part 2, "Observations made at the Blue Hill Meteorological Observatory, Mass., U.S., in the Year 1890, under the direction of A. Lawrence Rotch, Esq." With Appendices. (Cambridge: University Press 1891.)