In the appendix to Captain Parry's "Arctic Voyage, 1821-3," p. 187, some observations of the sea horizon by Mr. Fisher are given. He found a variation of 18° in the Arctic region, the ice horizon being elevated in summer and depressed in winter. The variation of the place of the apparent horizon, as a question of unequal temperature, was discussed generally by M. Biot in 1809. But no detailed observations on the subject have, so far as I am aware, been yet made.

The correction for refraction in obtaining the heights of mountains by angles of depression to the water-line of points or lighthouses, or by angles of elevation from points the height of which has been ascertained, is taken empirically, in nautical surveying, as $\frac{1}{12}$ th the distance of the object observed. The results thus obtained are fairly accurate. For instance, when surveying the Gulf of Suez in 1871, the observations from the summit of Jebel Hooswah gave the results shown in the accompanying table.

T. H. TIZARD.

It may be mentioned that a trial instrument was made for the International Seismological Association by the Cambridge Instrument Company, and installed on the pier at Newcastle-on-Tyne. It did its work, but the position is not suitable for the purposes of correlation. The west coast of Ireland or of Norway would have been better. However, practical difficulties stood in the way for utilising either for the trial instrument. The present instrument, made by the same company, has been improved on the former, but has as yet no contrivance for registering the height or magnitude of the waves, which is so very desirable.

The principle of the instrument is very simple. It is based on Boyle's law, $PV = \text{constant}$. An iron pipe—in our case 625 ft. long—is led from the instrument, the diaphragm part, to and into the ocean to a depth beneath the trough of the assumed highest waves at low tide, say 15 ft. The sea-end of the pipe is open. The wave passing over it causes the water to rise in the pipe and compress the air beyond, whereby the

Place of observation	Object observed	Angle of elevation	Angle of depression	Refraction + or - $\frac{1}{12}$ dist.	Corrected angle	Dist.	Diff. of level	Height of		Dip.	Corrected height	
								Object observed	Theod.		Place of observation	Object observed
Summit of Jebel Hooswah	Water line of Tur point...	—	$1^\circ 27' 30''$	$+1' 21''$	$1^\circ 28' 51''$	16' 38	2573	0	5 ft.	237	2331	0
	„ at Tur	—	$1^\circ 20' 0''$	$+1' 31''$	$1^\circ 21' 31''$	18' 24	2633	0	„	292	2336	0
	„ Marabut point	—	$3^\circ 57' 0''$	$+0' 27''$	$3^\circ 57' 27''$	5' 48	2303	0	„	26	2272	0
	„ point this side of Marabut	—	$4^\circ 1' 0''$	$+0' 26''$	$4^\circ 1' 26''$	5' 35	2287	0	„	24	2258	0
	Water line to the right ...	—	$4^\circ 49' 0''$	$+0' 23''$	$4^\circ 49' 23''$	4' 60	2358	0	„	19	2334	0
	„ of station point	—	$16^\circ 12' 0''$	$+0' 6''$	$16^\circ 12' 6''$	1' 30	2295	0	„	1	2289	0
	„ of another point with station ...	—	$11^\circ 18' 0''$	$+0' 9''$	$11^\circ 18' 9''$	1' 85	2246	0	„	3	2238	0
	Water line of another point	—	$8^\circ 54' 40''$	$+0' 12''$	$8^\circ 54' 52''$	2' 40	2287	0	„	5	2277	0
	„ by Asses ears..	—	$6^\circ 14' 0''$	$+0' 17''$	$6^\circ 14' 17''$	3' 48	2311	0	„	11	2295	0
	Mean height 2292 ft. Max. height observations 2336. Minimum 2238. Range 98 ft.											

For greater distances and heights the angles from and to Jebel Serbal may be given as follows:—

Summit of Jebel Serbal	Water line of Gharib light-house	—	2 6 0	+ 2 47	2 8 47	33'48	7623	0	„	989	6629	0
	Water line of Zaffarana lighthouse	—	1 28 0	+ 4 53	1 32 53	58'55	9613	0	„	3025	6583	0
	Point to south-east of Zaffarana lighthouse ..	—	2 25 0	+ 2 24	2 27 24	28'9	7533	0	„	737	6791	0
	Abu Zenina point	—	1 58 0	+ 3 07	2 1 7	37'33	7994	0	„	1230	6758	0
	Water line Tur Spit ...	—	2 42 0	+ 2 4	2 44 4	24'90	7225	0	„	551	6659	0
	Summit of Jebel Hooswah	—	2 30 0	+ 1 29	2 31 29	17'92	4801	2292	„	285	6803	2292
Mean height 6706 ft. Max. 6803. Min. 6583. Extreme range 220 ft.												

The Undagraph.

LAST week the Dominion Astronomical Observatory installed at Chebucto, near Halifax, Nova Scotia, a wave-counter, which I have called an "undagraph." The site, a granite cliff 110 ft. high, on which is a lighthouse, faces the broad waters of the Atlantic. The coast hereabouts is bold and rocky.

Modern seismographs record tremors of the earth—microseisms—not attributable to earthquakes, and investigators have traced them to the action of the sea during storms. These microseisms manifest themselves particularly markedly in Ottawa and in Europe from autumn to spring, *i.e.* during the winter or stormy season. Their period ranges, say, from four to seven seconds, and the greater the storm or steeper the gradient of the "low" on the water along the coast, the greater is the amplitude of the microseisms.

In order to correlate the period of the waves of the ocean which pound upon the coast with the period of the microseisms, the above instrument has been in-

leather diaphragm is raised, and electric contact is made. By means of the armature of an electromagnet a toothed wheel is pushed forward, one tooth for every wave, and with one revolution, or 120 waves, the recording pen returns to its zero. The record presents a series of finely serrated oblique lines, each representing 120 waves. Clockwork with pen traces at the edge of the paper a time scale, making a break every hour, the linear measure of which is 6 cm. A fresh roll of paper is put on once a week. A small leak is provided in the diaphragm chamber, to cut out the effect of the slowly rising and ebbing tide, which, however, does not affect the rapid action by the waves.

The sea-end of the pipe gives the most anxiety, as it has to resist the immense force of the waves during storms. The greater part of the 625 ft. is of half-inch galvanised iron pipe, while the ocean end, about 100 ft., is of four-inch pipe, with reducing pipes between the preceding two. The bedding of the submerged part will be in about four tons of concrete

with iron girders surrounding the pipe. The whole subject is so new that we have to feel our way in this investigation. Here in Ottawa, three hundred miles from the nearest sea-coast, we have in a general way correlated microseisms recorded by the seismograph with the storms along the Atlantic coast from Cape Hatteras to St. John's, Newfoundland, a distance of 1500 miles, so that for an exhaustive study there should be quite a number of undagraphs installed. However, a beginning has been made at Chebucto, distant in an air-line about 620 miles from Ottawa, and the results will be published as soon as available.

OTTO KLOTZ.

Dominion Astronomical Observatory,
Ottawa, September 5.

Geographical Distribution of Phreatoicus.

THE occurrence of the isopod *Phreatoicus* in a fresh-water stream near Cape Town, in South Africa, as recorded in your issue of June 12 by Mr. Keppel H. Barnard, is of very considerable interest from the point of view of the geographical distribution of the group. Since I described the first species of the genus in 1884 our knowledge of this group has grown very rapidly, and there are now known three species of *Phreatoicus* in New Zealand, two subterranean and one from surface waters, and several species grouped under allied genera from Australia and Tasmania. The genus is shown both by its generalised character and by its distribution to be an ancient one. I have long considered that it is probably a fresh-water form that has developed in subantarctic lands, and its discovery in South Africa seems to confirm this. In New Zealand it appears to be confined to the more southerly portion, but it was not found in the subantarctic islands to the south of New Zealand when these were visited in 1907. It should, however, be looked for in other subantarctic islands, particularly St. Paul and Amsterdam Islands in the Indian Ocean, and the Falkland Islands and adjoining parts of South America.

CHAS. CHILTON.

Biological Laboratory, Canterbury College, N.Z.,
August 7.

The Characters of Hybrid Larvæ obtained by Crossing Different Species of the Genus *Echinus*.

I HAVE carried out this summer hybridisation experiments on certain species of echinoids, and, in view of the interesting condition in which this inquiry was left last year by other workers, I venture to think that my results may be worth recording.

In 1911, Shearer, De Morgan, and Fuchs, as the result of three seasons' crossing experiments at Plymouth, stated (*Journal M.B.A.*, ix., 2) that the hybrids between *Echinus miliaris*, on the one hand, and *E. esculentus* or *E. acutus*, on the other, showed, in respect of certain larval characters, a purely maternal inheritance. In 1912 the same workers, in a letter to *NATURE*, and later in *The Quarterly Journal of Microscopical Science*, published the result of their latest experiments, which was, briefly, that when *E. miliaris* was mother the inheritance was *paternal*. They found one culture which was exceptional. Debaisieux, working at the same time, and independently, first in London upon Plymouth material, and afterwards at Millport, obtained substantially identical results. These results he expressed in terms of dominant and recessive characters in the larvæ.

This disparity between the results of 1912 and those

of former years raised a number of interesting questions, and made urgent a repetition of the experiments—a work that at the suggestion of Prof. E. W. MacBride (whose encouragement and advice I gratefully acknowledge) I undertook to perform.

The species used by me were those mentioned above, and the symbols, **M** and **m**, **E** and **e**, **A** and **a**, may be used to represent the ♀ and ♂ gametes respectively of each of them, the zygotes being then written **Mm**, **me**, **Em**, **Ee**, &c. The larval characters, the inheritance of which was studied, were the green pigment masses of **Mm** plutei, on one hand, and, on the other, the posterior pair of ciliated epaulettes and the posterior pedicellaria of **Ee** and **Aa** plutei. Debaisieux found the first of these "recessive," the other two "dominant."

In London I succeeded in raising cultures of **Mm**, **Em**, and **Am** plutei only, the reciprocal crosses failing for want of ripe males. Plymouth sea-urchins were used, and sea-water from Lowestoft. The hybrids, without exception, showed maternal characters. But in these crosses the dominant characters of Debaisieux were also maternal characters. I accordingly made further experiments at the Millport Marine Biological Station during July and August, using *E. miliaris* and *E. esculentus* only for my crosses.

After many failures, four healthy cultures of the **Me** cross were reared, one culture to a stage at which the anterior epaulettes were formed, the other three to the stage of metamorphosis. In the first culture green pigment was absent from all the larvæ examined; in the other three cultures all the individuals (132) had posterior epaulettes, eighty-one had the posterior pedicellaria, none had green pigment. The reciprocal cross agreed in its characters with the one made in London.

There was a very notable difficulty in making the **Me** cross—a difficulty which would seem to be intrinsic, and unconnected with any defect in the egg, because it has occurred again and again in experiments in which the **Mm** and **Ee** controls have both yielded good cultures of plutei.

The *E. miliaris* used as parents were small, and the ovaries contained a large proportion of unripe eggs; but a majority of the apparently ripe eggs developed, when fertilised with sperm of their own species, while only a small proportion developed when *E. esculentus* sperm was used.

The mortality in the **Me** cultures finally examined was unusually low after the blastula stage, and could be assessed with considerable accuracy on account of the small number of individuals in a culture. Differential mortality would seem then to be improbable as accounting for the final character of a culture.

The sketch shows a hybrid pluteus (**Em**) as seen from the left side: *a*, anterior epaulettes; *p* posterior epaulette; *pp*, posterior pedicellaria.

H. G. NEWTH.

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