

While townetting during the last few days about the North Cape, we have had some large hauls of Copepoda; and it occurred to us last night, while watching the midnight sun off the entrance to the Lyngen Fjord, that one gathering might be spared from the preserving bottle and devoted to the saucepan. We put out one of the smaller townets ($3\frac{1}{2}$ feet long, mouth 1 foot in diameter) from 11.40 p.m. to midnight, the ship going dead slow, and traversing in all, say, a mile and a half during the 20 minutes. The net when hauled in contained about three tablespoonfuls of a large red Copepod (*Calanus finmarchicus*, I think), apparently a pure gathering—what Haeckel would call a monotonous plankton. We conveyed our material at once to the galley, washed it in a fine colander, boiled it for a few minutes with butter, salt, and pepper, poured it into a dish, covered it with a thin layer of melted butter, set it in ice to cool and stiffen, had it this morning for breakfast on thin bread-and-butter, and found it most excellent. The taste is less pronounced than that of shrimps, and has more the flavour of lobster. Our 20 minutes' haul of the small net through a mile or two of sea made, when cooked in butter, a dishful which was shared by eight people, and would probably have formed, with biscuit or bread, a nourishing meal for one person. It would apparently, in these seas, be easy to gather very large quantities, which might be preserved in tins or dishes, like potted shrimps.

W. A. HERDMAN.

S.V. *Argo*, Tromsø, Norway, July 13.

Are Seedlings of *Hemerocallis fulva* specially Variable?

I SHALL be grateful to any of your readers who will write and let me know their experiences as to the variability of seedlings of *Hemerocallis fulva*, or who will raise it from seed in fair quantity, and kindly communicate to me their results, which shall be duly acknowledged.

My reason is this: there is in the formation of the pollen in this plant a peculiarity which, according to Weismann's views, should lead to exceptional variability in the seedlings; but, so far as I know, we have no evidence on the subject.

MARCUS M. HARTOG.

Royal University, Dublin, July 9.

The Green Sandpiper.

ON Sunday last, July 12, I saw flying round a large pool in Essex, a specimen of the *green sandpiper*. It flew leisurely round the pool, and seemed as if it were not far from its summer home. I think, therefore, that the bird must be nesting in the county, and probably in the neighbourhood.

Can any of your correspondents inform me whether the nest has been found anywhere, in recent years, in England?

ARGYLL.

Argyll Lodge, Kensington, July 17.

LIQUIDS AND GASES.¹

ALMOST exactly twenty years ago, on June 2, 1871, Dr. Andrews, of Belfast, delivered a lecture to the members of the Royal Institution in this hall, on "The Continuity of the Gaseous and the Liquid States of Matter." He showed in that lecture an experiment which I had best describe in his own words:—

"Take, for example, a given volume of carbonic acid at 50° C., or at a higher temperature, and expose it to increasing pressure till 150 atmospheres have been reached. In the process, its volume will steadily diminish as the pressure augments; and no sudden diminution of volume, without the application of external pressure, will occur at any stage of it. When the full pressure has been applied, let the temperature be allowed to fall, until the carbonic acid has reached the ordinary temperature of the atmosphere. During the whole of this operation, no break of continuity has occurred. It begins with a gas, and by a series of gradual changes, presenting nowhere any abrupt alteration of volume, or sudden evolution of heat, it ends with a liquid.

¹ Lecture delivered by Prof. W. Ramsay, F.R.S., at the Royal Institution, on Friday, May 8.

"For convenience, the process has been divided into two stages—the compression of the carbonic acid, and its subsequent cooling. But these operations might have been performed simultaneously, if care were taken so to arrange the application of the pressure and the rate of cooling, that the pressure should not be less than 76 atmospheres when the carbonic acid had cooled to 31°."

I am able, through the kindness of Dr. Letts, Dr. Andrews' successor at Belfast, to show you this experiment, with the identical piece of apparatus used on the occasion of the lecture twenty years ago.

I must ask you to spend some time to-night in considering this remarkable behaviour; and, in order to obtain a correct idea of what occurs, it is well to begin with a study of gases, not, as in the case you have just seen, exposed to high pressures, but under pressures not differing greatly from that of the atmosphere, and at temperatures which can be exactly regulated and measured. To many here to-night, such a study is unnecessary, owing to its familiarity; but I will ask such of my audience to excuse me, in order that I may tell my story from the beginning.

Generally speaking, a gas, when compressed, decreases in volume to an amount equal to that by which its pressure is raised, provided its temperature be kept constant. This was discovered by Robert Boyle in 1660; in 1661 he presented to the Royal Society a Latin translation of his book, "Touching the Spring of the Air and its Effects." His words are:—

"'Tis evident, that as common air, when reduced to half its natural extent, obtained a spring about twice as forcible as it had before; so the air, being thus compressed, being further crowded into half this narrow room, obtained a spring as strong again as that it last had, and consequently four times as strong as that of common air."

To illustrate this, and to show how such relations may be expressed by a curve, I will ask your attention to this model. We have a piston, fitting a long horizontal glass tube. It confines air under the pressure of the atmosphere—that is, some 15 pounds on each square inch of area of the piston. The pressure is supposed to be registered by the height of the liquid in the vertical tube. On increasing the volume of the air, so as to double it, the pressure is decreased to half its original amount. On decreasing the volume to half its original amount, the pressure is doubled. On again halving, the pressure is again doubled. Thus you see a curve may be traced, in which the relation of volume to pressure is exhibited. Such a curve, it may be remarked incidentally, is termed an hyperbola.

We can repeat Boyle's experiment by pouring mercury into the open limb of this tube containing a measured amount of air; on causing the level of the mercury in the open limb to stand 30 inches (that is, the height of the barometer) higher in the open limb than the closed limb, the pressure of the atmosphere is doubled, and the volume is halved. And on trebling the pressure of the atmosphere the volume is reduced to one-third of its original amount; and, on adding other 30 inches of mercury, the volume of the air is now one-quarter of that which it originally occupied.

It must be remembered that here the temperature is kept constant; that it is the temperature of the surrounding atmosphere.

Let us next examine the behaviour of a gas when its temperature is altered, when it becomes hotter. This tube contains a gas—air—confined at atmospheric pressure by mercury, in a tube surrounded by a jacket or mantle of glass, and the vapour of boiling water can be blown into the space between the mantle and the tube containing the air, so as to heat the tube to 100°, the temperature of the steam. The temperature of the room is 17° C., and the gas occupies 290 divisions of the scale. On blowing in steam, the gas expands, and on again equalizing pressure, it