Between April and May, however, the isotherm of -55° passes into the upper atmosphere, where, comparatively speaking, warm conditions prevail in the advective layer from May to September. As this method of plotting the results shows clearly the temperature variations throughout the year at high levels, I thought the diagram might be interesting to your readers.

R. M. DEELEY.

Inglewood, Longcroft Avenue, Harpenden.

The Weather of 1911 and the Ultra-violet Radiations of the Sun.

IN connection with Dr. Shaw's attempt to explain the remarkable weather of this summer (NATURE, November 30), I should like to direct attention to a point of view which in general, but especially in the past summer, deserves the attention of meteorologists. My remarks are based on a series of experiments which I carried out, together with Prof. Lenard (P. Lenard and C. Ramsauer, "Über die Wirkung sehr kurzwelligen ultravioletten Lichtes auf Gase und eine sehr reiche Quelle dieses Lichtes," Heidelberger Akademie, five parts, 1910-11).

Dr. Shaw states that all conditions necessary for a heavy rainfall appeared to be present, without rain falling. But he has not paid attention to an important condition: for the production of rain nuclei must be present, which can serve as centres of condensation when all other necessary conditions are fulfilled. The absence of such nuclei is in my opinion the chief cause of the remarkable weather of this year.

In the work just quoted we have clearly separated, for the first time, the different actions of ultra-violet light on gases, and explained the complicated effects due to their simultaneous existence. We distinguish three actions of ultra-violet light on dust-free gases:—

(1) The formation of electrical carriers of molecular size, caused by selective absorption of the light; the power which these carriers possess of producing condensation is, according to our experiments, very small compared to that of the nuclei, originally neutral, mentioned under (3).

(2) Chemical action, *e.g.* formation of ozone in oxygen; this effect is connected with but small absorption of the light.

(3) Formation of condensation nuclei, *i.e.* formation of solid or liquid products by the direct action of the light on the gases; *e.g.* formation of drops of hydrogen peroxide from water vapour, as found by Mr. C. T. R. Wilson, or by subsequent reaction of the products formed with the other components of the air, *e.g.* formation of ammonium nitrate and nitrite from ozone and ammonia. The size of these nuclei depends on the intensity of the light and their time of formation. Their chief property is their great power of acting as centres of condensation, and the larger they are the more active in this respect. They possess originally no electric charge, but easily acquire one if carriers of electricity are simultaneously produced by coming together with these; the presence of a charge has no effect on their power of acting as condensation nuclei.

This gives us the chief source of nuclei in the earth's atmosphere. If we neglect the purely local formation of nuclei in large centres of industry, then the ultra-violet, and to a minor degree the kathode, radiation of the sun is chiefly responsible for the nuclei which are meteorologically so important. This production of nuclei extends from the uppermost down to fairly low-lying layers of the air, as the active rays are only absorbed to a small extent, and is chiefly conditioned by the amount of oxygen and ammonia present.

Thus the lack of nuclei, and the consequent fine weather of this year, can be attributed to a much diminished ultra-violet radiation of the sun. This is in accord with the now existing minimum of general activity of the sun, as characterised by the minimum of sun-spots and northern lights. This view is not contradicted, but confirmed, by the high temperature on the surface of the earth, as this is principally conditioned by the increased clearness, *i.e.* transparency to heat radiations, of the atmosphere.

CARL RAMSAUER.

Radiologisch-Physikalisches Institut, Heidelberg,
December 9.

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"Draysonia."

IN NATURE of November 16 you have done me the honour of inserting a review of my book "Draysonia." As the reviewer appears to have been under some misapprehension, I beg you will in justice do me the favour of inserting a few words of explanation.

I am well aware of my inability to do full justice to the late General Drayson in attempting to bring his theory under public notice. But it is evident that your reviewer, after perhaps a hasty glance at "Draysonia," has not considered it worthy of close perusal; otherwise he would scarcely have assumed that a naval officer who has had the "Nautical Almanac" in use for more than seventy-one years (and has made nautical astronomy an occupation and recreation) "confuses precession with aberration," and is therefore "scarcely fitted" to deal with the subject.

Your reviewer may possibly be a professional astronomer (who perhaps dislikes anything unorthodox and not in accordance with the text-books), and, if so, he will be aware that in the later "Nautical Almanacs" the word "precession" in the catalogue of stars has been substituted for the old and better term "annual variation," which was used in the "Nautical Almanac" and by our old astronomers for as many years as I can remember up to 1894 or 1895, when the change was made. Previous to this the word precession had been mainly confined to precession of the equinoxes (dealt with in section 6 of "Draysonia"), which at present is about $50''$ and is totally distinct from what astronomers term aberration, but which I prefer to call annual motion of the pole.

Your reviewer further states that I have computed the precession of many stars by Drayson's method, and that, if this proves anything, it proves the correctness of the "Nautical Almanac." This is a mistake and is an inversion of my process. Instead of having, as he stated, calculated the so-called precession of many stars, I have used the precessions, so accurately given in the "Nautical Almanac," in order to find therefrom the amount of the annual motion of the pole; and I have shown that the so-called annual precessions of the stars, all varying in amount and direction, both in right ascension and declination, are exactly accounted for by one single movement of the pole of about $20''$, which produces the apparent annual precession as obtained by observation and recorded in the "Nautical Almanac," the accuracy of which I have never impugned.

I am unable to understand why your reviewer questions my statement that Mr. Stone, the late Radcliffe observer at Oxford, made the error of sidereal time erroneous to the extent of 41.51s. in 1892. A reference to the Royal Astronomical Society's notes of March, 1894, will show that I am correct.

ALGERNON DE HORSEY.

Melcombe House, Cowes, November 19.

I AM quite willing to admit that I have misunderstood the gallant Admiral, and accept unreservedly his statement that he does understand the difference between precession and aberration. In my own defence you will perhaps permit me to quote the passage which misled me.

"Possibly I shall be told that I have found a mare's nest, and that it has been known all along that the right ascension of a star and its annual precession in declination are functions of the annual motion of the pole, and that such motion can be found in the 'Nautical Almanac,' and is properly termed aberration."

The italics are mine. To my mind this sentence admits of only one construction; and, if I have been so unfortunate as to misconstrue it, I have no doubt I have not correctly apprehended the author's meaning in other places, and therefore it is of little use to discuss the several points raised.

THE REVIEWER.

Dust Explosions.

PROF. GALLOWAY'S brief article on dust explosions in NATURE of November 30 is very timely; but readers of it would receive the impression that the true cause of the explosion at the Tradeston Flour Mills, Glasgow, in 1872, was first made known in the report of Profs. Rankine and Macadam. This is not the case: the fact that flour-mill ex-

plosions are actually dust explosions was first stated in England by Mr. Watson Smith, editor of the Journal of the Society of Chemical Industry, in a letter which appeared in *The Glasgow Herald* on July 12, 1872, immediately after the Tradeston disaster. The priority of Mr. Watson Smith was recognised at the time by the Royal Society of Edinburgh, and later (in 1882) by Sir Frederick Abel in a lecture at the Royal Institution.

It is interesting to know that nearly six years ago Mr. Watson Smith read a paper at Liverpool (the scene of the latest dust explosion) in which stress was laid on the fact that any kind of carbonaceous dust might, under certain conditions, become a source of danger (see Journ. Soc. Chem. Ind., January 31, 1906).

ALBERT SHONK.

10 Dartmouth Road, Hendon, December 5.

I MUCH regret that I had entirely forgotten the fact, stated in Mr. Shonk's letter, that Mr. Watson Smith had attributed the disaster at the Tradeston Flour Mills to an explosion of dust in a letter to *The Glasgow Herald*, published before the report of Profs. Rankine and Macadam appeared, or I would certainly have mentioned it in the article referred to.

W. G.

The Feeding Habits of Crepidula.

WITH reference to the note on *Crepidula* in NATURE of December 7 (No. 2197, p. 187) it may be of interest to your readers to know that during some recent researches on this animal I have been able to confirm the necessity for investigating how far the presence of the slipper-limpet (*Crepidula fornicata*) is a menace to successful oyster-culture on the Kent and Essex coasts. It has been believed by various naturalists that *Crepidula* takes the same kind of food as the oyster, but on this point there exists no definite information. During an investigation of this matter I discovered the manner in which the animal feeds, from which there can be no doubt whatever as to the nature of its food. The mode of feeding in *Crepidula* is the same in principle as that of the oyster, that is, there is an ingoing and an outgoing current of water kept up in the mantle-cavity, while between the two currents the gill acts as a strainer, retaining even very fine particles of suspended matter, which eventually—by one of two ways—reach the mouth.¹

Thus it is established beyond doubt that *Crepidula* feeds on the same material as the oyster, that is, on the food-material found on or floating near the sea-bottom, and the danger apprehended from this intruder is confirmed: *Crepidula* is competing successfully with the oyster for food and space. Whether there is enough food and space for both *Crepidula* and oysters is another matter which must be determined by local researches. Thus the problems for the Kent and Essex oyster-farmers are to keep up the food supply of oysters and to reduce the numbers of *Crepidula* and the many other animals which take the same food as oysters.

J. H. ORTON.

Marine Biological Laboratory, Plymouth,
December 10.

Tadpole of Frog.

AT the beginning of April last I collected some frog ova for the purpose of making observations on development. Tadpoles appeared about April 9, and from time to time from that date until July 17, when young frogs were developed, I took batches away for preservation and sectioning. On July 17 only one tadpole was left of the original stock, and that one, though in water out of doors and with a supply of waterweed, has not developed farther, but is a tadpole still and is still alive. Some years ago I had a similar case with a frog tadpole. Can any of your readers suggest the reason of this phenomenon?

T. FLOWMAN.

Nystuen, Bycullah Park, Enfield, December 8.

¹ It is proposed to publish a full account of how *Crepidula* feeds in the next number of the Journal of the Marine Biological Association.

MICROKINEMATOGRAPHY.

WITHIN the last few months we have been shown a new application of the kinematograph, which indicates yet another stage of technical attainment, and another field in which it may supplement our knowledge. Its range has been extended to the representation of objects as seen through high powers of the microscope. Apart from any positive increase to knowledge which may be obtained by its means, this is a technical achievement of a very high order. In the usual microscopic preparation it is impossible to obtain a high degree of illumination, and the greater the magnification the less the illumination becomes. It is only by artificially increasing the contrast by means of stains and so forth that we can obtain a clear differentiation of even a motionless object. To take in one minute some thousands of successive photographs of a living, unstained object, magnified six hundred or a thousand times, an object, moreover, which is moving rapidly, and therefore continually altering its focal plane, is a task which might easily seem impossible.

M. Comandon, however, has succeeded in this extremely difficult problem. The illumination-difficulty he avoided by using what is known as the ultra-microscope or dark-ground illumination, in which the object is seen against a black background, being lit itself by rays of light striking it from the side, and thence deflected upwards towards the lens of the microscope. This method gives an extremely brilliant contrast-illumination of the outlines of the object against a black ground and makes it possible to take on a properly sensitised film photographs of exceedingly short exposure. The resulting picture naturally shows comparatively little of the internal structure of the object under examination; the bulk of the rays of light are deflected from its surface. But it is surprising how much does appear. The nucleus of a cell, for example, is frequently quite distinct, and some structures, such as the kineto-nucleus of a trypanosome, can sometimes be seen perfectly clearly and be followed as the organism moves from place to place. A large number of films prepared under the direction of M. Comandon has been exhibited during the present year by Messrs. Pathé Frères, and the realism and vitality of these kinematograph pictures can scarcely be imagined by anyone who has not seen them thrown on the screen.

An interesting film is one which displays the blood actually circulating in the vessels of the living body. The preparation, which is from the tail of the tadpole, shows a number of tiny blood-vessels, which measure about one-hundredth part of a millimetre in diameter. Crowded together in the larger of these, the individual corpuscles of the blood can be seen to pass out one by one into minute branches, for which they seem almost too large, and within which they make their way here and there through the surrounding tissue, not apparently without occasional difficulty. Even in the larger vessels, along which the bulk of the corpuscles are hurrying, the rate of progress varies considerably, and the direction may actually be reversed for a time and the blood apparently flow backwards. The coloured corpuscles of the blood, from which it derives its red tint, have, of course, no independent motion of their own, and are simply carried along by the stream in which they are suspended. But the colourless cells or leucocytes have such independent motion, and in another film we are shown a white cell gradually altering its shape, throwing out a long filament into which the rest of the corpuscle slowly flows, until the whole cell has altered its posi-