observation which at first sight seemed to show the existence of residual diamagnetic polarity in a diamagnetic substance after exposure to a strong field, and remarks that this seemed an incomprehensible result. It appears to me that this result, should it be confirmed, is not incomprehensible on Weber's theory of diamagnetism, if we supplement that by a modification of the Ampère-Weber theory of ordinary magnetisation.

Suppose that the induced currents in the molecules of a diamagnetic substance are confined to definite channels, that there is little or no primitive current, and that the molecules are capable of being deflected. Then as the field is increased, each molecule is turned so that the plane of its channel becomes more and more nearly parallel to the lines of force. We may assume that this turning of the molecules is resisted, like the turning of the molecules of iron, and that when the field is withdrawn they return more or less completely towards their initial positions.

Experiments with iron and steel show that in the turning of the molecules the resistance while the field is being applied is on the whole greater than the restoring force, while the field is being removed: in fact something very like static friction acts on each molecule. There is what I have elsewhere called "hysteresis," or lagging behind, in the relation of the molecule's movement to the magnetising force. If this molecular quasi-friction also exists in diamagnetic substances, and if the molecular channels are turned at all, they will, during the removal of the field, be in less favourable positions for the induction of currents than they were in during the application of the field. There will consequently be a residue of current in each when the field is wholly withdrawn; and these residues will make the substance a permanent "diamagnet."

But the fact that this result would be comprehensible is no evidence of its truth, and apparently Dr. Lodge inclines to interpret the experiment referred to in an entirely different—indeed opposite—sense. Moreover, his other results show not residual *diamagnetism*, but residual *paramagnetism* in diamagnetic substances which have been immersed in a very strong field.

Now I think this result may also be interpreted in terms of the magnetic theory of magnetisation; and the purpose of this communication is to suggest an explanation which seems to me so probable that it may perhaps serve, until Dr. Lodge confirms these results, as a set-off against the suspicion he has cast on them by suggesting the presence of iron in his diamagnetic bodies.

When we begin to magnetise iron by a field which increases from zero, we find at first scarcely a trace of magnetisation. A curve showing the relation of intensity of magnetism to magnetising force starts off (as nearly as can be judged) tangent to the line along which the magnetising force is plotted, but soon, of course, takes a rapid bend as the permeability increases. This is very consistent with the idea that the molecular electromagnets are held back from turning by a sort of static friction which requires the field to reach a finite value (different perhaps for different molecules) before the process of turning begins. But what has happened before this process begins? Diamagnetic induction has been going on in each molecule that has not begun to turn; and hence, if the molecular configuration is rigid for a magnetising force of any finite magnitude, the substance is diamagnetic in that and all weaker fields.

If this be the case in iron (and the experimental evidence certainly points to the existence of a finite frictional resistance to the turning of the molecules) that metal is really diamagnetic in excessively weak fields, because the molecules are fixed by friction; then very paramagnetic in stronger fields, because the molecules are turning; and, finally, diamagnetic in a field strong enough to turn the molecules as far as they will go, and to induce currents in them which swamp the primitive Ampèrian currents.

Next, imagine a substance whose molecules are held by friction in a very tight grip, so that no moderate magnetising force is able to alter their configuration. The substance is then diamagnetic, and when the field is withdrawn there is no residual polarity. But let a field be applied strong enough to begin turning the molecules. This will cause a decrease of diamagnetic susceptibility. And when the field is withdrawn the molecules remain deflected, and the substance is a permanent *paramagnet*.

Now this is exactly what Dr. Lodge has observed in his copper, coke, wood, and so forth. They behaved as diamag-

netics while in the field, but showed paramagnetic polarity when withdrawn from it.

My suggestion, then, is that in diamagnetics, as in paramagnetics, there are strong primitive Ampèrian currents circulating in the molecular channels. That in a strongly paramagnetic substance such as iron there is comparatively little molecular rigidity, so that the molecules begin to turn even in very weak fields; the induction of currents in their channels then plays a very insignificant part in the magnetisation. That in a diamagnetic substance, on the other hand, the molecules stick so fast that in any moderate field they have scarcely begun to turn; the induction of currents goes on independently of the existence of the primitive currents, and is then practically the whole affair. But if the field be made strong enough the molecules begin to turn, not in the way spoken of in the earlier part of this communication (where it was assumed that the induced currents swamped the primitive currents), but in the way in which the molecules of iron turn. Then common magnetisation becomes superposed on diamagnetic induction. And when the field is withdrawn the molecules are left with a paramagnetic alignment, and with their primitive Ampèrian currents strengthened, if anything, since they have been facing more favourably during the withdrawal of the field.

There is nothing to show that the primitive Ampèrian currents are not as strong and as numerous in copper or bismuth as in iron. If they are, and if we could only apply a field strong enough to force them into alignment, we might expect to find, in substances so hard to magnetise, a permanence in the residual magnetism which would put steel to the blush.

University College, Dundee, March 27

J. A. EWING

Ferocity of Rats

I HAVE recently had occasion to chloroform a number of wild rats for the purpose of procuring their blood. The rats are sent to me by a ratcatcher, who places from six to twelve in the same trap or cage. It usually happens that, within a few hours after their imprisonment, some of their number are killed and eaten by the others; while they all exhibit scars as the result of their struggle for existence in confined quarters.

A few days ago I placed two wild rats in a cage, and for a long time endeavoured unsuccessfully to catch the larger one under a bell-jar let in through a doorway in the top of the cage. The rat perfectly well understood my object, and for about ten minutes succeeded by his agility in thwarting it. This animal, therefore, must have been in as great a state of alarm as it is possible that a rat could be. Nevertheless, after the ten minutes' chase inside the cage—during which he had been many times very nearly caught—he appeared to be suddenly seized with a violent outburst of ferocity against his fellow-prisoner; for he fell upon the smaller rat, drove it into a corner of the cage, and killed it by biting its throat. By means of a glass rod I drove him away, drew the dead body of his victim beneath the doorway in the roof of the cage, and held the bottom of the bell-jar just above the dead rat. I had not long to wait before the living one again fell upon his victim and began to devour the carcass. It was then an easy matter to lower the bell-jar over both the living and the dead, when, by pouring chloroform in at the open top of the bell-jar, I quickly reduced the murderer to a state of insensibility. But up to the very last moment of consciousness this animal continued to bury his fangs in the body of the little rat, and even after his head had dropped away in stupor the jaws still continued to move as if he were enjoying the feast in his dreams.

Now, I do not believe that any instance of ferocity at all approaching this could be found in any other animal. But it has been suggested to me that the fact may have been due to a kind of emotional insanity produced by extreme terror. I therefore write to ask whether any of your readers can supply me with additional facts bearing upon the subject. In particular, is it the habit of wild rats when not confined, or when in a state of nature, to devour one another? Or do they only do so when shut up together in a cage? GEORGE J. ROMANES

The Recent Weather

THE enclosed extract from the log of one of the "excellent" observers for the Meteorological Office may be interesting to some of your readers, as bearing upon the large amount of

easterly winds and severe weather which were experienced at the time.

HENRY TOYNBEE,
Marine Superintendent

Meteorological Office, London, March 27

Extracts from Meteorological Log of the Ship "Timaru," Capt. D. Fullarton

1886 March 15; Noon Position, Lat. $48^{\circ} 31' N.$, Long. $8^{\circ} 16' W.$

"A great many small land birds about us; put about 60 into a coop, evidently tired out."

1886 March 17; Noon Position, Lat. $48^{\circ} 30' N.$, Long. $7^{\circ} 34' W.$

"Over 50 of the birds cooped on the 15th died, though fed. Sparrows, finches, water wagtails, two different small kinds of birds, names unknown to me, one kind like a linnet, and a large bird like a starling. In all there have been on board over 70 birds, besides some that hovered about us for some time and fell into the sea exhausted."

Variable Stars

I HAVE to express my indebtedness to Mr. Castell-Evans (NATURE, March 25, p. 486) for drawing my attention to Prof. Meldola's valuable memoir of 1878. Occasionally I cannot help passing over a paper of great interest; and, much to my regret, I did not read Prof. Meldola's until to-day. According to his theory there is "... actual combustion taking place in the atmosphere of a slowly-cooling star previously at a temperature of dissociation." The previous existence of elements is assumed throughout the memoir; and it is these which undergo "actual combustion," and of course give rise to compounds capable of the dissociation referred to. Prof. Meldola proceeds to show that dissociation of compounds and actual combustion of elements may very well lead to a "periodically unstable chemical equilibrium."

For my part I was not writing about combustion, but about polymerisation; not about compounds, but about elements; and nothing was said about dissociation. Chemical effect, moreover, was expressed by an equation totally different in form from dissociation equations.

There is thus a perfect distinction between my work and that of Prof. Meldola. He is, so far as I am aware, the originator of the theory that the variability of a star may depend on actual combustion of elements, followed by dissociation of compounds. I regard this theory as having considerable value, and great probability. But it has obviously nothing whatever to do with my own.

EDMUND J. MILLS

Glasgow, March 27

Colours in Clouds

I AM afraid I cannot give any further details to aid Mr. Backhouse. My object was to point out that the presence of coloured fringes is not very rare, though they require suitable means to see them.

I do not think the dark blue tone is very material. Mr. Backhouse will, however, see that it implies a general absence of glare and illumination of the atmosphere in the neighbourhood of the cloud, and that is exactly the condition which I artificially made by a suitable dark glass, which stopped the glare. It is the dilution of the tints with white light which makes them faint or invisible. Of course it may be said that the dark glass will weaken the tints as well as the general light, but as a fact the tints do show better through a proper one, and reduction of glare does make colour more marked.

Nor do I think that the square or rhomboidal form is important, for I think that is only the result of the air-currents which cause the light cloud.

These colours will be oftener seen in projections from banks near the horizon, if my view be correct of the height at which they are formed, because it is only when the bank or mass of thick cloud hiding the sun is low that we see well above it. Mr. Backhouse gives enormous heights at which water could only visibly exist as minute ice-crystals, such as cause halos.

J. F. TENNANT

37, Hamilton Road, Ealing, W., March 27

The Distribution of Appendicularia

IN regard to Prof. Herdman's query concerning the distribution of *Appendicularia* it may be mentioned that this form was

frequently met with near the surface of the sea during the observations for H.M. Trawling Commissioners along the east coast of Scotland. From previous observations it would seem to be prevalent, especially in summer and autumn, all round our shores, as well as to stretch far into the neighbouring seas.

W. C. MCINTOSH

St. Andrew's Marine Laboratory, March 23

THE TECHNICAL INSTITUTE

IN considering the sixth Annual Report of the Council of the City and Guilds of London Institute to the Governors, we cannot but be impressed with the substantial advance made in each of the several branches of the Institute's work.

The past year has seen the completion of the great Central Institution in Exhibition Road, the University of the system of technical education, and London may be congratulated on at last possessing an institution which is, as pointed out in the Report, comparable with, and in some respects superior to, a German Polytechnic School. Considering the thorough manner in which the workshops and laboratories in the several departments have been equipped, we think the Institute is justified in claiming that parents will be enabled to secure in England for their sons technical instruction of the same high class as has been for so long provided in the great technical colleges abroad, and moreover better adapted to the special circumstances of home industry. The Report further expresses a patriotic hope that students trained in the Central Institution will gradually occupy the places in manufacturing works, and especially in chemical works, both in Great Britain and the colonies, which have of late been almost monopolised by the Germans and Swiss.

Besides the regular courses of instruction, special series of lectures are given by the Professors of the Institution at 5 o'clock, and we have reason to know that such courses as Prof. Henrici's on the Differential and Integral Calculus for engineering students, and those by Prof. Armstrong on Carbon Compounds, and by Prof. Ayrton on Industrial Applications of Electricity, now being given, fulfil a distinctly-felt want. The same may also be said of the special courses, including that on Iron-Girder Bridge Construction, by Prof. Unwin, to be given in July.

At the Finsbury Technical College the year has been marked by the appointment of Dr. Silvanus Thompson to the office of Principal, a post the duties of which have hitherto been discharged by Mr. Philip Magnus, the Director and Secretary of the Institute, but which the enormous increase in all the branches of the Institute's work has compelled him to relinquish. It is satisfactory to note that the great success already achieved by this College, both with respect to its Day and Evening Departments, has continued, and the Institute has determined to considerably increase the accommodation at a cost of 17,500*l.* In the Evening Department greater prominence has been given to courses of instruction for persons engaged in the various branches of the building trade, laboratories for instruction in plumbing, in gas-fitting, and in metal-plate work having been arranged, as also a class for builders' quantities. There are now between 600 and 700 persons attending the courses in the Evening Department.

The branch of its work by which the Institute is most widely known, the system of technological examinations, develops rapidly. According to Mr. Magnus's present Report, 3968 candidates presented themselves for examination in May last, of whom 2168, or nearly 55 per cent., were successful in passing. Examinations were held in forty-two subjects. In four subjects included in the programme, viz. salt manufacture, oils and fats, silk manufacture, and mechanical preparation of ores, the number of candidates was below the minimum for