anemone is an undoubted animal, yet it is not on a higher level than the sensitive plant; it only closes when touched. The argument here is a *reductio ad absurdum*. If you recognise consciousness in the lower animals you must also recognise it in plants. To which we may reply, "Why not?" They may have a very dim rudimentary consciousness. Deny consciousness to all animals except men, and you are confronted with greater difficulties than this. We all believe in evolution. Mr. Robinson himself accepts it. Consciousness must, therefore, have shown itself first in a rudimentary form. Evolution does nothing but develop the powers of which we find suggestions in the simplest forms of life. Nothing, therefore, can have its first beginning in the highest form of life; in the more intelligent animals it is difficult to believe that consciousness is entirely rudimentary. Mr. Romanes's monkey that got possession of the key of a chest and tried hard for two hours to unlock it must have had a fair allowance of self-consciousness. Dogs have dreams. Why may they not even when awake think over their recent fights and adventures? Animals learn by experience; pleasure and pain are the great educators for them as for us. Whittle their pleasure and pain down to nothing, eviscerate both the one and the other of all reality, and how could they steer their course amid the rocks and shoals of life?

Mr. Robinson ends by making a damaging admission. Men, he says, can educate animals and elevate them; but education can only bring out what is already present. There is, therefore, in animals, whether wild or domesticated, something beyond that which Mr. Robinson would concede to them.

Carboni fossili inglesi. By Dr. Guglielmo Gherardi. Pp. xvi+586. (Milan: Ulrico Hoepli, 1906.) Price 5s.

It is undoubtedly advantageous "to see ourselves as others see us," and the British coal-miner has an excellent opportunity of doing so by studying this attractive manual on British coals, cokes, and briquettes from the pen of an experienced Italian works-chemist. The book is divided into four parts. In the first the various coals are dealt with from a theoretical point of view, the methods of analysis, both rapid and exact, being described in detail. In the second part the British coals are described under the head of the various coalfields, numerous analyses being given, with full references to the sources from which they were obtained. In the third and fourth parts the manufacture of coke and of briquettes receives attention, the subject being one of special importance for the future development of Italian industries. The manual concludes with five maps of the coalfields, and with various appendices containing useful information for the coal merchant. The book, which is the first of its kind written in Italian, cannot fail to prove of value to Italian manufacturers desirous of securing the greatest heating effect with the least expense, by supplying them with accurate information regarding the nature of the coals they purchase. It is written with care and impartiality in a concise and lucid style, and, like all the volumes of the well-known series of "Manuali Hoepli," is produced in a tasteful manner at a modest price.

How to Find and Name Wild Flowers. By Thomas Fox. Pp. xvi+265. (London: Cassell and Co., Ltd., 1906.) Price 1s. 6d.

Does the natural system of botanical classification present many difficulties to the beginner? Is the Linnean system simpler? Can an easier method of identification than either of these two be devised? If

so, what are the advantages and disadvantages? To those interested in these questions, especially the last, this book is offered as an attempt to provide a solution. The primary means of identification are furnished by the month in which the flowers appear and their colour, after which the size and other details of the flower are taken as the most general guide. With what results? Side by side in the same category are found the frogbit, Italian catchfly, floating waterplantain, common feverfew, and the large-flowered winter-green. This series was taken at random, but is probably one of the most extreme instances. Does a non-technical method of discrimination compensate for this mingling of unallied plants? Will the learner be led to associate them together? Will not considerable difficulties arise with regard to the exact size, also with regard to the colour? As for comparison, after becoming conversant with a flora according to one system it is not easy to gauge the merits of another; but to those wishing to identify plants, and to whom the natural system offers great difficulty, this book may be recommended as an earnest endeavour to provide a substitute.

LETTERS TO THE EDITOR.

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American Chemists and the Jubilee of the Coal-tar Colour Industry.

IN justice to our American colleagues, I think it necessary to supplement the paragraph which appears in your "Notes" of last week (p. 496), and is similar to a statement published in the *Times* of September 6, by the following explanation:—

When the international movement was inaugurated here last February at the meeting held at the Mansion House, America was, of course, invited to participate in the scheme which had been adopted at the public meeting, and for the carrying out of which a fund had to be raised. In response to our invitation, a meeting of American chemists was convened in New York and a number of proposals considered, the final outcome being the scheme set forth in the paragraph published in your issue of last week (September 13). From this it would appear that the Americans had cut themselves adrift from the international movement, and had decided to have an independent celebration in honour of Sir Wm. Perkin and his work. From their point of view—the promotion of chemistry in their own country—there was, of course, very good reason for the line of action which they had decided upon taking, but it is also obvious that their scheme, as published, is purely local, and that if this represented their whole project there would have been every justification for the view taken by our executive committee, that the Americans wished to detach themselves from the European movement.

It is necessary, therefore, to add that the scheme published last week does not represent the latest phase of the American celebration. In addition to the objects set forth in that scheme, provision is made for receiving contributions to the Perkin research fund, founded here as part of our scheme, and loyally supported by all the contributing nations, the representatives of which at the last general meeting of the executive committee on July 27 unreservedly added their contributions to the general fund to be administered through our Chemical Society. At that meeting, as also at the general international meeting at the Royal Institution the previous day, the official representative of American chemists, Dr. Leo Baekeland, confirmed in public the cablegram which we had received from the American committee announcing its decision to cooperate with us and to contribute to our scheme.

The American programme, therefore, is not so purely

local as it appears when set forth without qualification. The objects which our Transatlantic colleagues are desirous of carrying out in the name of our distinguished countryman will, I am sure, have the entire sympathy of all English chemists, and, for my own part, I can only wish that every success may attend their celebrations next month. At the same time, I may point out that research in this country is very poorly endowed as compared with the munificent foundations for this purpose established by wealthy Americans. We may, therefore, while wishing that the American jubilee will be productive of all the results which they themselves desire, appeal with confidence to Americans to support also that other part of their own scheme which provides for the endowment of our Perkin research fund.

R. MELDOLA.

Blair Atholl, Perthshire, September 15.

Horizontal Pendulums and Earthquake Echoes.

I HAVE just finished reading Captain Dutton's book "Earthquakes in the Light of the New Seismology," the preface of which was written in April, 1904, while the date of publication is 1905. I mention these dates because a paper of mine, bearing particularly on chapter vii. of the book, was read before the Physical Society on March 13, 1903, and appeared subsequently in the *Proc. Phys. Soc.*, vol. xviii.; it also was published in the *Phil. Mag.* for October, 1903. I gather, however, that Captain Dutton has not seen the paper, and as I am not certain of his exact address I am addressing you.

To be candid, I say that Prof. Milne has not considered the effect of resonance sufficiently, if at all, in computing the tiltings represented by his seismograms. Certain screws are placed in the base-plate of a Milne seismograph partly for levelling purposes and partly to give the base a known tilt. Prof. Milne has argued thus (*vide* almost any British Association report): if a tilt of 1" given to the base displaces the end of the boom 1 mm., then a seismogram of 10 mm. amplitude indicates a tilt of 10", if it indicates a tilt at all. On this assumption Prof. Milne discusses the tilting theory and discards it (the theory), and also on this view Captain Dutton's seventh chapter is based. That it is a wrong view my diagrams as well as ordinary mathematics show.

I have also given a more prosaic explanation of Prof. Milne's "earthquake echoes" than is to be found in either the British Association reports or in Captain Dutton's book, pp. 235-6. The tilt represented by any seismogram is a function of the boom period, the wave period, the log. decrements of the free vibration of the boom, and of the earth wave, and is, in general, very much smaller than that which is given in the British Association reports. Earthquake echoes may be regarded as interference effects between the free and forced vibrations. I notice that in the diagrams in my paper referred to the fifteen-second wave diagram which shows these interference effects best has been turned round with regard to the others. With the exception of this one, the artificial vibrations all start to the right, and are continued regularly until the end of the diagram is reached, when obviously the swing of the boom dies away naturally.

C. COLERIDGE FARR.

Canterbury College, Christchurch, New Zealand,
July 21.

In a report to the British Association in 1899 I directed attention to the fact that as an earthquake dies its seismograms indicate that it does so in a series of more or less rhythmically decreasing impulses. These, I suggested, were more likely to result from reflection than from interference, and therefore they were provisionally called echoes. Four years later (*Phil. Mag.*, October, 1903) Dr. C. Coleridge Farr discussed the terminal wave group as interference effects between the free period of the recording boom and the period of the ground. Theoretical considerations show their existence, whilst an ingenious experiment carried out by Dr. Farr shows that it is not difficult to

reproduce wave groups strikingly similar to those shown in many seismograms. On the two sides of a pillar carrying a pendulum with a period of 16.5 seconds Dr. Farr attached two boxes filled with sawdust. Two chains connected by a rope passing over pulleys hung over the centre of each box. This arrangement was worked up and down at a fixed speed, so that while one side of the pillar was loaded the other was unloaded. By working this arrangement, tiltings were given to the column representing groups of waves with periods varying between twelve and twenty seconds. The resulting diagrams gave three results:—

(1) The amplitudes were greater than those due to steady loading.

The inference is that a horizontal pendulum does not correctly measure the amplitudes of the greater portion of a teleseismic disturbance, a conclusion long recognised by most seismologists. Why, therefore, it may be asked, are columns of figures relating to amplitudes continually appearing in earthquake registers? One reason is that they roughly give relative magnitudes for movements recorded at widely separated stations, and are, therefore, of great value in determining origins. When expressed in angular measure, if the corresponding periods of movement exceed two minutes it is likely that the pendulum has closely followed the tilting which has been recorded. Other reasons may be adduced to indicate that "amplitudes" have a value, and it is, therefore, desirable that they should be retained in registers.

(2) Although the period of the forced vibration was varied in different experiments, the resultant diagrams showed that the pendulum followed the tiltings of the pier.

The converse of this is found in the observation that pendulums with different periods will record the same periods for groups of waves in a given earthquake.

(3) The diagrams showed marked interference effects. For example, forced vibrations of fifteen seconds acting on a pendulum with a period of 16.5 seconds yield a series of throbbings very similar in appearance to many seen in a seismogram.

Although I entirely agree with Dr. Farr as to the existence of interference effects of this description, this by no means excludes the existence of reflection effects or echoes. To commence with, we will consider the first great echo, or Yuri Kaishi. The Yuri Kaishi, or return shaking, which frequently occurs about four minutes after the first shock, was recognised and christened long before the invention of modern seismographs. You feel it, you may see its effects, and, within a meizoseismic area, a seismograph is not required to give evidence of its existence. To regard it as an imaginary reinforcement of earth movement due to a want of synchronism in the period of the same and that of a horizontal pendulum is out of the question. The Yuri Kaishi rattles doors and windows, and causes people to leave their houses. My own view of the phenomena is that it is similar to what is seen when a bullet is dropped into the middle of a large tub of water. Waves travel outwards to the sides of the tub, where they are reflected, after which they converge at the centre from which they started. In nature, the reflecting surface may possibly be represented by the roots of mountain ranges. As these may be at varying distances from the origin of the disturbance, the reflections will give rise to complications at the focus. The transmitting medium I take to be that material beneath the heterogeneous superficial covering of our earth which transmits large waves with a constant velocity of about 3 km. per second.

A megaseismic primary and its echoes may be transmitted to very long distances, and as they travel may by reflection at other surfaces be still farther broken up into minor wave groups. Two wave groups within a megaseismic area might at a great distance from an origin be represented by four groups, and so on. This matter has not yet been carefully looked into, but evidence exists that wave groups increase in their number with distance from an origin (British Association Report, 1897, p. 68).

In support of the explanation I offer for the Yuri Kaishi it may be mentioned that the time interval between it and its primary is in those cases where we know the distance between an epifocal area and a supposed reflecting surface,