

LETTERS TO THE EDITOR.

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Reflection of Röntgen Radiation.

FOLLOWING the investigations of Laue, Friedrich, and Knipping, we were led to study the transmission of a narrow pencil of X-rays through rock salt, a crystal of simple cubic form. The results are of interest, for they show in a striking way a strong reflection from the internal crystallographic planes upon which the pencil fell at nearly grazing incidence. The pencil so reflected is of such intensity that the short exposure required to produce well-marked effects on a photographic plate is insufficient to give more than a trace of the most intense of the other pencils of radiation emerging from the crystal. A small cleaved fragment was placed with one pair of faces horizontal. Below this an X-ray tube was fixed to a stand capable of sliding in grooves along an arc of a vertical circle of which the centre was a point in the crystal and the plane was one of the three principal planes of the crystal. A narrow pencil of X-radiation could then be rotated in this plane approximately about the point of incidence on the crystal.

When the pencil was vertical it was, of course, perpendicular to one face, and parallel to the other two sets of mutually perpendicular principal planes in the crystal. A slight movement of the X-ray tube directed the pencil at nearly grazing incidence on one of the sets of vertical planes. The result was a well-marked spot on the photographic plate situated several centimetres above the crystal, on the same side of these crystallographic planes as the incident pencil. When the latter was made to rotate until it was incident on the other side of these planes, the emergent beam moved through the central direct image to the other side, being again on the same side of the crystallographic planes considered as the incident pencil. The angle turned through by the emerging beam was certainly within a very small possible error the same as that turned through by the incident pencil. We thus have very direct evidence of copious reflection near grazing incidence from cleavage planes within the crystal itself.

This suggested the probability of a similar reflection from the planes of cleavage of mica, and we proceeded to make a concave mirror of mica to test this. A letter from Mr. W. L. Bragg in NATURE of December 12, however, announces that this has just been accomplished. In our experiments with rock-salt the beam enters the crystal in a different manner, but the effect is undoubtedly similar. It is not a pure surface effect, but takes place in the body of the crystal. Whether all the photographic patterns obtainable by experiments like those of Laue, Friedrich, and Knipping are readily explained by reflection, as suggested by Mr. W. L. Bragg, our experiments do not yet permit us to say; but the results of observation of an isolated spot certainly can be accounted for by reflection from a large number of layers of atoms, parallel to one of the pairs of faces of the crystal.

Judging from recent experience we have had of the photographic action of X-rays, it appears probable that a beam reflected in such a way is of sufficient intensity to be detected and followed without any great difficulty by the ionisation method.

C. G. BARKLA.
G. H. MARTYN.

King's College, London December 14.

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Shinobu Hirota.

SHINOBU HIROTA, who returns to Japan at the end of this month, by his doctor's advice, came with me to this country in 1895, and within a week of his arrival the seismograph which he brought with him from Japan was at work at Shide. To convince those who had doubts as to the possibility of recording in Britain earthquakes which had originated even so far away as their antipodes, a second instrument was installed at Carisbrooke Castle. To look after this Hirota had, wet or fine, a daily walk of four miles. The fact that these two instruments gave similar records and also that from a single record we could tell the distance at which a megaseism had originated naturally attracted some attention. Directly it was shown that certain earth disturbances had interrupted cables, Colonies desirous of knowing the cause of these sudden isolations from the rest of the world set up seismographs.

This was the commencement of the British Association cooperation of seismological stations, now sixty in number. To bring this into being Hirota played an active part. He knows personally many of the directors, and has given instruction to their officers. In practical seismometry he has made many innovations, some of which will perhaps be looked upon as "mere dodges," but they have rendered instruments more sensitive. His multiplying levers made of grass stems gathered from "bents" give pointers exactly one-third the weight of their equivalent in aluminium, and yet twice, if not three times, as stiff. It was by using these that we got at Bidston, where Hirota went to set up an instrument, the first records of rock deformation due to tidal load.

In the workshop he is a good all-round workman, in the observatory and office he has kept most careful records, could calculate a chordal distance, make a zenithal projection or an observation for time, while for photographic work he holds a gold medal from the Photographic Society of the Isle of Wight. Above all this, his sharp eyes would find on a seismogram two records where at other stations only one had been discovered. In view of the great attention and large sums which have now been spent, particularly in foreign countries, on the new seismological department, I feel myself justified in giving recognition to an assistant pioneer in these new studies. Illness carries him back to his native country, where I trust he will have a speedy recovery. His work is embodied in annual seismological reports of the last seventeen years, and twenty-six circulars giving the records received from observatories cooperating with the British Association.

J. MILNE.

Shide, Newport, Isle of Wight.

The Self-testing of Dispersion Apparatus.

A SERIOUS inconvenience attaches to the standard method of testing a plane grating, echelon, or other dispersive apparatus, by crossing its dispersion with that of an auxiliary piece; for, unless the resolving power of the auxiliary dispersion is in some degree comparable with that of the piece to be tested, it is scarcely possible to identify ghosts which lie close to their primaries. When an extended research with crossed dispersions is in question, the case, in most laboratories, becomes even more difficult.

The difficulty, I think, may be removed by means of a simple and relatively inexpensive arrangement of two front-reflecting mirrors, so devised that the echelon (say) is crossed with its own dispersion. One of the mirror faces has one truly straight edge, at which the dihedral angle is 90° or less. This edge is in contact with the face of the second mirror, the

two mirrors being adjustably clamped together, so that they can be set exactly at right angles to one another. Now let them be placed so that their line of contact is inclined 45° to the horizon, while (in a roughly approximate sense) the vertical plane through that line of contact bisects *externally* the angle between the mirrors. Vertical lines imaged by successive reflection at the two mirrors will thus appear horizontal, and conversely.

In the case of an echelon grating, the train would bear a general resemblance to a Littrow spectroscope. The light would pass successively through a slit (shortened to a minute square), an objective, and an echelon, and after reflection at the mirrors would return through the echelon and objective, and be brought to a focus in the plane of the slit. For the full advantage of crossed dispersions to be thus realised, it is, of course, essential that the effective aperture of the echelon should be at least as high as it is wide, the width being measured parallel to the dispersion. In echelon gratings and Lummer-Gehrcke plates this generally holds good, though in many gratings the length of the rulings is insufficient for the corresponding condition to be satisfied.

The pair of mirrors described might be replaced by an accurately right-angled prism, with reflecting faces meeting in as sharp and clean a line as possible.

The suggested arrangement may be modified by allowing the beam to pass through a second objective and be brought to a focus in the usual way. A small right-angled prism can then be used to return the beam through the lenses and the echelon between them, and since the intersection of its reflecting faces should lie strictly in the plane of the first formed (singly dispersed) spectrum, it is easy to arrange so that this intersection, as finally viewed, is to one side of the useful field. In this case the prism need not be accurately right-angled, nor indeed is any great demand made on its other optical qualities; it may be some set-off against this that four transmissions through object-glasses are involved.

If an echelon grating of reflecting type is to be crossed with its own dispersion, a method essentially similar to the last-mentioned modification can be used. The apparatus, as arranged for single dispersion, having been auto-collimated, the beam would in the present case be twice brought to a focus, and would in all pass four times through one and the same objective.

C. V. BURTON.

Boar's Hill, Oxford, December 7.

Petrifactions of the Earliest European Angiosperms.

UNTIL the three specimens from the English Aptian in the British Museum were recognised as Angiosperms and described in my paper (Phil. Trans. Roy. Soc., series B, vol. cciii., pp. 75-100, plates v-viii, and kindly reviewed in NATURE, August 22, p. 641), Angiosperms were supposed not to have existed in northern Europe at that early date. Those three specimens came from two different localities, which minimised the chances of error, but it is highly satisfactory to have to record the discovery of another specimen from a new locality.

The new specimen is from the Lower Greensand of Kent, and belongs to the Maidstone Museum. While pursuing my study of the Lower Cretaceous flora I recently visited the Maidstone Museum, which has the best extant collection of Lower Greensand fossil plants from Mr. W. H. Bensted's famous Iguanodon Quarry. The collection includes a number of large pieces of silicified wood from other of the numerous quarries in the Lower Greensand in the district. All these I examined carefully, and the majority of pieces

proved to be Gymnospermic, but one of the large bits of petrified wood arrested attention. Mr. Allchin, the present curator of the museum, generously allowed me to have sections cut from it, which prove the specimen to be a portion of the trunk of a large woody Angiosperm. A detailed and illustrated account of its anatomy will follow in due course, but it may be remarked here that its general characters differ from those of the three other described species from this horizon, and it certainly represents a new species and possibly a new genus.

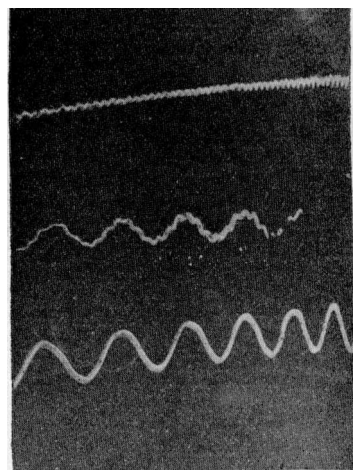
As the question of the origin of Angiosperms is one in the forefront of controversy at present, and is one, moreover, about which we have so remarkably little evidence, the discovery of this, which is only the fourth specimen of Aptian Angiosperms yet obtained from northern Europe, is satisfactory in confirming the conclusions reached from the study of the three British Museum specimens. MARIE C. STOPES.

Smoke Trace of Compound Vibrations of Tuning-fork.

I READ with interest the note by Mr. F. H. Parker on upper partials of a tuning-fork, which appeared in NATURE of November 28, p. 361.

As an alternative to taking the first upper partial to be 6.6 times the frequency of the prime, or confirming the relation by separate traces, may I suggest the plan of making a trace of the vibration compounded of the two?

The accompanying print is from one corner of a smoke trace used by me at a popular lecture in 1901. One curve shows the fundamental (128 per second), another the first upper partial, while the centre curve of the three shows the form of vibration executed when the first upper partial is sounding, together with the prime. The three sounds



may be heard by the audience, and the smoke traces of each obtained in their presence, and then projected by the lantern. The compound vibration is easily obtained by striking the fork on a hard surface, such as a counter, and so presents no difficulty whatever. The ratio of frequencies of first upper partial and prime for the rather slender fork in question is seen to be of the order 6.25. E. H. BARTON.

University College, Nottingham, December 7.

BREATH FIGURES.

AT intervals during the past year I have tried a good many experiments in the hope of throwing further light upon the origin of these figures, especially those due to the passage of a small blow-pipe flame, or of hot sulphuric acid, across the surface of a glass plate on which, before treatment, the breath deposits evenly. The even