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 thise 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.

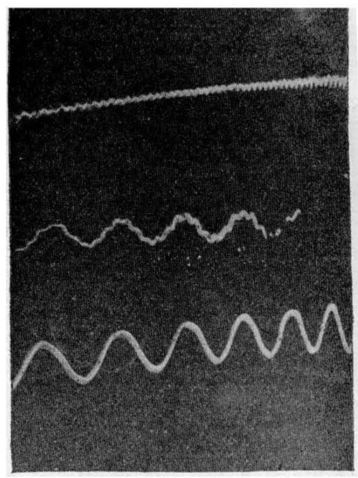
The new specimen is from the Lower Greensand of Kent, and belongs to the Maidstone Museum. While pursuing my study of the Lower Cretaceous flora I recently visited the Maidstone Museum, which has the best extant collection of Lower Greensand fossil plants from Mr. W. H. Bensted's famous Iguanodon Quarry. 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 accompanypanying 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 deposit consists of a multitude of small lenses easily seen with a hand magnifier. In the track of the flame or sulphuric acid the lenses are larger, often passing into flat masses which on evaporation, show the usual colours of thin plates. When the glass is seen against a dark ground, and is so held that regularly reflected light does not reach the eye, the general surface shows bright, while the track of the flame or acid is by comparison dark or black. It will be convenient thus to speak of the deposit as bright or dark—descriptive words implying no doubtful hypothesis. The question is what difference in the glass surface determines the two kinds of deposit.

In Aitken's view (Proc. Ed. Soc., p. 94, 1893; NATURE, June 15, 1911), the flame acts by the deposit of numerous fine particles constituting nuclei of aqueous condensation, and in like manner he attributes the effect of sulphuric (or hydro-fluoric) acid to a water-attracting residue remaining in spite of washing. On the other hand, I was disposed to refer the dark deposit to a greater degree of freedom from grease or other water-repelling contamination (NATURE, May 25, 1911), supposing that a clean surface of glass would everywhere attract moisture. It will be seen that the two views are sharply contrasted.

My first experiments were directed to improving the washing after hot sulphuric or hydrofluoric acid. It soon appeared that rinsing and soaking prolonged over twenty-four hours failed to abolish the dark track; but probably Mr. Aitken would not regard this as at all conclusive. It was more to the point that dilute sulphuric acid (1/10) left no track, even after perfunctory washing. Rather to my surprise, I found that even strong sulphuric acid fails if employed cold. A few drops were poured upon a glass (¼-plate photographic from which the film had been removed), and caused to form an elongated pool. say, half an inch wide. After standing level for about five minutes—longer than the time required for the treatment with hot acid—the plate was rapidly washed under the tap, soaked for a few minutes, and finally rinsed with distilled water, and dried over a spirit lamp. Examined when cold by breathing, the plate showed, indeed, the form of the pool, but mainly by the darkness of the *edge*. The interior was, perhaps, not quite indistinguishable from the ground on which the acid had not acted, but there was no approach to darkness. This experiment may, I suppose, be taken to prove that the action of the hot acid is not attributable to a residue remaining after the washing.

I have not found any other treatment which will produce a dark track without the aid of heat. Chromic acid, *aqua regia*, and strong potash are alike ineffective. These reagents do undoubtedly exercise a cleansing action, so that the result is not entirely in favour of the grease theory as ordinarily understood.

My son, Hon. R. J. Strutt, tried for me an experiment in which part of an ordinarily cleaned glass was exposed for three hours to a stream of strongly ozonised oxygen, the remainder being protected. On examination with the breath, the difference between the protected and unprotected parts was scarcely visible.

It has been mentioned that the edges of pools of strong cold sulphuric acid and of many other reagents impress themselves, even when there is little or no effect in the interior. To exhibit this action at its best, it is well to employ a minimum of liquid; otherwise a creeping of the edge during the time of contact may somewhat obscure it. The experiment succeeds about equally well even when distilled water from a wash-bottle is substituted for powerful reagents. On the grease theory the effect may be attributed to the cleansing action of a pure free surface, but other interpretations probably could be suggested.

Very dark deposits, showing under suitable illumination the colours of thin plates, may be obtained on freshly-blown bulbs of soft glass. It is convenient to fill the interior with water, to which a little ink may be added. From this observation no particular conclusion can be deduced, since the surface, though doubtless very clean, has been exposed to the blow-pipe flame. In my former communication, I mentioned that no satisfactory result was obtained when a glass plate was strongly heated *on the back* by a long Bunsen burner; but I am now able to bring forward a more successful experiment.

A test-tube of thin glass, about ½ inch in diameter, was cleaned internally until it gave an even bright deposit. The breath is introduced through a tube of smaller diameter, previously warmed slightly with the hand. The closed end of the test-tube was then heated in a gas flame urged with a foot blow-pipe until there were signs of incipient softening. After cooling, the breath deposit showed interesting features, best brought out by transmitted light under a magnifier. The greater part of the length showed, as before, the usual fine dew. As the closed end was approached the drops became gradually larger, until at about an inch from the end they disappeared, leaving the glass covered with a nearly uniform film. One advantage of the tube is that evaporation of dew, once formed, is slow, unless promoted by suction through the mouth-tube. As the film evaporated, the colours of thin plates were seen by reflected light. Since it is certain that the flame had no access to the internal surface, it seems proved that dark deposits can be obtained on surfaces treated by heat alone.

In some respects a tube of thin glass, open at *both* ends, is more convenient than the test-tube. It is easier to clean, and no auxiliary tube is required to introduce or abstract moisture. I have used one of 3/10 in. diameter. Heated locally over a simple spirit flame to a point *short of softening*, it exhibited similar effects. This easy experiment may be recommended to anyone interested in the subject.

One of the things that I have always felt as a difficulty is the comparative permanence of the dark tracts. On flat plates they may survive in some degree rubbing by the finger, with subsequent rinsing and wiping. Practically the easiest way to bring a plate back to its original condition is to rub it with soapy water. But even this does not fully succeed with the test-tube, probably on account of the less effective rubbing and wiping near the closed end. But what exactly is involved in rubbing and wiping? I ventured to suggest before that possibly grease may penetrate the glass somewhat. From such a situation it might not easily be removed, or, on the other hand, introduced.

There is another form of experiment from which I had hoped to reap decisive results. The interior of a mass of glass cannot be supposed to be greasy, so that a surface freshly obtained by fracture should be clean, and give the dark deposit. One difficulty is that the character of the deposit on the irregular surface is not so easily judged. My first trial on a piece of plate glass ⅜ in. thick, broken into two pieces with a hammer, gave anomalous results. On part of each new surface the breath was deposited in thin laminæ capable of showing colours, but on another part the water masses were decidedly smaller, and the deposit could scarcely be classified as black. The black and less black parts of the two surfaces were those which had been contiguous before fracture. That there should be a well-marked difference in this respect between parts both inside a rather small piece of glass is very surprising. I have not again met with this anomaly; but further trials on thick glass have revealed deposits which may be considered dark, though I was not always satisfied that they were so dark as those obtained on flat surfaces with the blow-pipe or hot sulphuric acid. Similar experiments with similar results may be made upon the edges of ordinary glass plates (such as are used in photography), cut with a diamond. The breath deposit is best held pretty close to a candle-flame, and is examined with a magnifier.

In conclusion, I may refer to two other related matters in which my experience differs from that of Mr. Aitken. He mentions that with an alcohol flame he "could only succeed in getting very slight indications of any action." I do not at all understand this, as I have nearly always used an alcohol flame (with a mouth blow-pipe) and got black deposits. Thinking that perhaps the alcohol which I generally use was contaminated, I replaced it by pure alcohol, but without any perceptible difference in the results.

Again, I had instanced the visibility of a gas flame through a dewed plate as proving that part of the surface was uncovered. I have improved the experiment by using a curved tube through which to blow upon a glass plate already in position between the flame and the eye. I have not been able to find that the flame becomes invisible (with a well-defined outline) at any stage of the deposition of dew. Mr. Aitken mentions results pointing in the opposite direction. Doubtless, the highly localised light of the flame is favourable.

RAYLEIGH.

PALÆOLITHIC MAN.

THE fossil human skull and mandible to be described by Mr. Charles Dawson and Dr. Smith Woodward at the Geological Society as we go to press is the most important discovery of its kind hitherto made in England. The specimen was found in circumstances which seem to leave no doubt as to its geological age, and the characters it shows are themselves sufficient to denote its extreme antiquity. It was met with in a gravel which was deposited by the river Ouse near Piltdown Common, Fletching, Sussex, at a time when that river flowed at a level eighty feet above its present course.

Although the basin of the stream is now well within the Weald and far removed from the chalk, the gravel consists largely of iron-stained flints closely resembling those well known in gravel deposits on the downs, and among these there are many waterworn "eoliths" identical with those found on the chalk plateau near Ightham, Kent.

With the flints were discovered two fragments of the molar tooth of a Pliocene elephant, and a waterworn cusp of the molar of a Mastodon. The gravel is therefore partly made up of the remains of a Pliocene land-deposit. Teeth of hippopotamus, beaver, and horse, and part of the antler of a red deer were also found, with several unabraded typical early Palæolithic (Chellean) implements. The latter seem to determine the age of the gravel as Lower Pleistocene.

The human remains, which are in the same mineralised condition as the associated fragments of other mammals, comprise the greater part of the brain-case and one mandibular ramus which lacks the upper portion of the symphysis. The skull measures 190 mm. in length by 150 mm. in width at its widest part, and the bones are of nearly twice the normal thickness. Its brain capacity is about 1070 c.c. The forehead is much steeper than in the Neanderthal type, with only a feeble brow-ridge; and the back of the skull is remarkably low and broad, indicating an ape-shaped neck. The mandible, so far as preserved, is identical in form with that of a young chimpanzee, showing even the characteristically simian inwardly curved flange of bone at the lower border of the retreating symphysis. The two molars preserved are of the human pattern, but comparatively long and narrow.

At least one very low type of man with a high forehead was therefore in existence in western Europe long before the low-browed Neanderthal man became widely spread in this region. Dr. Smith Woodward accordingly inclines to the theory that the Neanderthal race was a degenerate offshoot of early man and probably became extinct, while surviving modern man may have arisen directly from the primitive source of which the Piltdown skull provides the first discovered evidence.