towards the north-east, though it still extended from the south-south-east to north-north-west. By 10h. 55m. it had broken up into four irregular streaks of clouds of various breadths and parallel to each other, the only portion of the original arch being a narrow streak extending from the south-east to the meridian, where it faded away. This was the "beginning of the end," for the remnant of the original arch and the other clouds in a short time disappeared below the eastern horizon, leaving the sky beautifully clear.

I should much like to know whether any other observer was fortunate enough to observe this remarkable cloud; I say remarkable because, though I have been a pretty constant observer of the heavens for the last eight years, I have never noticed anything of the kind before. B. J. HOPKINS

10, Malvern Road, Dalston, E., July 24

Triple Rainbow

IN the afternoon about 5.30 a week or ten days ago, I noticed a rainbow of the ordinary type, and quite complete, which lasted about five minutes; the portion to the right hand then faded away, as well as the upper and lower portions apparently of that part of the bow visible to the left hand; but the middle portion of the remainder of the bow divided apparently into three parts, each one complete in their prismatic colouring, and yet none of them parallel to each other.

There was a slight difference in size, possibly in favour of that portion belonging to the original bow, and which constituted the outermost of the three arcs.

This portion of the phenomenon lasted for about five minutes, and was also similarly observed by a gentleman walking with me at the time.

Unfortunately some large trees prevented us from seeing the lower portion of the three arcs, where presumably they should have been united into one. R. P. GREG

Coles, Buntingford, Herts, July 23

A Remarkable Meteor

IN regard to the meteor seen by your correspondent P. F. D. at Hendon on the 6th inst., at 8.53 p.m., in a clear sky and broad daylight, I have the following entry in my diary under the same date: "Meteor going south-east through Cassiopeia at seven minutes to nine; daylight." It was indeed a remarkable meteor. The sun had set about half an hour. I happened at the time to be looking intently at that part of the north-east sky in which it appeared. What struck me most was the brilliant sparkling silvery light given off by the fragments into which it divided just before disappearing. I estimated that it would strike the horizon about the south-east point. B. G. JENKINS

Dulwich, July 21

The Function of the Sound-Post in the Violin

MAY I be permitted to correct a careless expression in my letter appearing in your last issue on this subject? The passage I refer to is this: "If the bridge [of the violin] were placed near one end of the instrument, the case would be different," *i.e.* the tone would be louder. I ought rather to have said: "If the bridge were placed nearer to a firm support, the case would be different." The statement is perfectly true as it stands with a sound-board which is equally thin all over, or where the edges are thicker than the middle. It is not true with a construction like that of the violin, where the edges are extremely thin and flexible. A sonorous wave always transmits itself best from the stronger part of the surface to the weaker.

R. HOWSON

Sand

MR. MELVIN is at fault in assuming that my paper on sand was "an attempt to distinguish by the aid of the microscope whether sand had been formed by the action of wind or of surf." Its primary object was to show that chalk-flint had scarcely any place in its formation; but few particles of it appearing even from the midst of rolled shingle whether that be ancient or modern. Other problems of course may be determined or solutions suggested by an extensive examination of ancient deposits, compared with those now forming. I have shown that quartz is he great staple of "sand." The size of its particles, whether rounded by attrition or flat, rough, and angular, must be accounted for by observing the conditions under which it exists in modern formations. A large series is being examined by me, and a record will be made of the result. As yet I have no theory whatever. I simply record *facts*. J. G. WALLER

68, Bolsover Street, W., July 18

ON MOUNTING AND PHOTOGRAPHING MICROSCOPIC OBJECTS

WE have received from Mr. E. Wheeler of Tollington Road, Holloway, a collection of mounted microscopic objects, comprising anatomical, botanical, entomological, and other preparations, and we have much pleasure in testifying to the general excellence of the work. One of the objects—a vertical section of the human small intestine—deserves special mention. It shows the glandular cells especially well. The nerves and ganglia of Auerbach's plexus can be seen, and interspersed among the epithelial cells of the villi and Lieberkuhnian follicles are numerous goblet cells.

Space will not allow more than a bare mention of the other objects, including a large transverse section of the stem of Lepidodendron from coal, transverse sections of the stems of spruce fir (*Abies excelsa*) and mare's tail (*Hippuris vulgaris*), the former showing resin canals and sections of bordered pits in the wood cells; Spirogyra in various stages of conjugation, from the first modification of the conjugating cells to the maturation of the zygospores; various Diatomaceæ, including the rare *Coscinodiscus excavata*; injected preparations of intestine of cat and toe of white mouse, and various entomological objects. They are all well prepared, and represent a stock which Mr. Wheeler informs us amounts to fifty thousand objects.

Although the legitimate use of professionally-mounted objects such as these may tend in no small degree to the diffusion of scientific knowledge, the microscopist who employs his instrument for no better purpose than the examination of bought slides will derive little benefit from the pursuit. He should be able to prepare objects for himself, and although there is abundance of accessible information on every detail of the art, it is believed that there is yet a useful work to be accomplished. By showing the facility with which this can be done without resort to the multiplicity of processes usually considered necessary, we shall endeavour in this article to show how any possessor of a microscope may make for himself preparations which, though they may not equal by many degrees the productions of the best professional mounters, yet have a far higher educational value, as their preparation will afford information which could not be otherwise acquired.

The necessary materials and instruments are few and inexpensive. For the support of the objects a supply of the usual 3″ × 1″ glass slides with ground edges, and of thin cover glasses (preferably circular) of various sizes should always be at hand. These when bought will be dirty, and it saves time to clean them all at one operation.

For securing the cover to the slide various cements are used, but of these two only need be mentioned, as they will be sufficient for all ordinary purposes. Gold size is undoubtedly the most reliable cement, but it takes days or sometimes even weeks to harden. It is, however, exceedingly tenacious and tough, and does not become brittle with age. It should always be used in cases where objects are mounted dry or in liquid, but when viscid media are employed, the medium helps to secure the cover, and there is no danger of leakage. Under these circumstances the use of asphalte varnish is recommended. The Brunswick black of the oilshops is a common form of this varnish, but is not so good as the preparation supplied by the opticians. When the varnish is to be used, it must be warmed by standing it in a cup of hot water, and the slide should be warmed also if this can be done without injury to the object. The varnish should then be applied with a camel-hair brush. It dries in a few hours at the ordinary temperature, or in a few minutes at the temperature of a cool oven, but it has not the tenacity of gold size, and is liable to become brittle with age. To keep the cover in place during the hardening of the cement, spring clips will be required. One very useful form can be made by bending a piece of brass wire into the shape shown in Fig. 1, and fixing it by means of glue into the end of a piece of cedar (end of cigar box) a little larger than the slide.

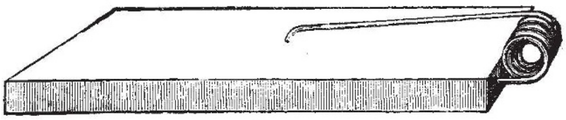

FIG. 1.

When the object is of considerable thickness or when it would be injured by the pressure of the cover glass, a wall or cell of some kind must be raised round it. In general a very shallow cell made by drawing a ring of gold size or asphalte on the slide is sufficient, and a stock of these cement cells of various sizes should be always ready for use. For their manufacture and for finishing the slides a turntable should be provided. This in its simplest (and in the writer's opinion its best) form consists of a heavy brass disk 3½ inches in diameter, capable of rotation in a horizontal plane on a central steel pin. The slide is held in a central position on this table by two spring clips. Then on whirling the table round and applying to the slide a brush charged with varnish, a neat circle will be struck out.

When cells of greater depth are required, solid rings must be cemented to the slide.

For the performance of such dissections as are necessary, the mounter will require two or three small scalpels, one or two razors, a pair of small scissors with sharp points, and two pairs of forceps, one large, with its points roughened where they meet, and one small and slender, with smooth points. Small camel-hair brushes and common sewing-needles fixed in cedar handles like those used for the brushes are indispensable.

Pipettes of various sizes are useful for transferring small quantities of liquids or catching small aquatic animals. They are easily made from pieces of glass tube of various sizes, some being left widely open and others drawn off to a point at one end, which may be left straight or bent at a small angle. The most useful form of pipette is made by tying a piece of sheet indiarubber across the bell of a very small thistle funnel, the stem of which may be either left widely open or drawn to a point as with other pipettes. Pressure with a finger on the indiarubber will displace a quantity of air, and when the open end is placed under water and the pressure removed a quantity of the liquid will be drawn up and can be removed and delivered drop by drop or in a rapid stream. If (the indiarubber being pressed down) the open end of the tube be brought near any small animal in the water and the pressure suddenly relieved, there will be such a rush of water into the tube that the strongest swimmer can be easily captured.

Two or three section-lifters of various sizes and a dozen watch-glasses for holding staining solutions will complete the list.

The objects of mounting are twofold: (1) to render visible structures that could not be seen without such preparation, and (2) to preserve the bodies so prepared as permanent objects for future study.

Various fluid media are employed for the preservation of objects, and much of the mounter's success in his art depends upon a knowledge of the medium most suitable for each particular object. In Figs. 2 and 3 an attempt has been made to show how largely the visibility or invisibility of particular structures is determined by the nature of the medium in which they are mounted.

Both of these figures represent longitudinal sections of the stem of the spruce fir cut from the same shaving of a deal plank, the only difference being that the former (Fig. 2) was mounted in air, and the latter, after staining, was mounted in balsam. In the former case the bordered pits in the wood cells are perfectly shown, but the boundaries of the cells themselves and the medullary rays are indistinct and confused, while in the latter case the wood cells and medullary rays are clearly defined, but the penetration of the highly refractive balsam which has

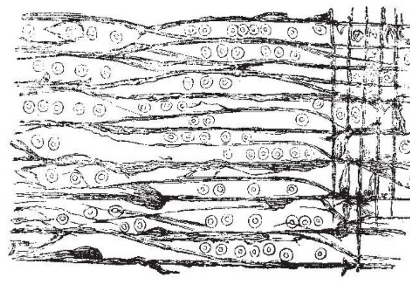

FIG. 2.—Longitudinal section of stem of spruce pine mounted dry, ¼″ objective.

affected this change has reduced internal reflection so far, and rendered the whole section so transparent, that the pits have become almost invisible.[1]

The same truth was forcibly brought home to the writer a few years ago in cutting some sections of fossil coniferous wood (siliceous), which during the latter stages of grinding down displayed the characteristic glandular cells, &c., admirably, but when mounted in balsam became almost perfectly invisible. They were too opaque to be mounted dry, and the only liquid in which they were well displayed was distilled water. The sections mounted in balsam were by no means spoiled though, for the transparency which obliterated all structure when viewed by ordinary light rendered them peculiarly suitable for examination

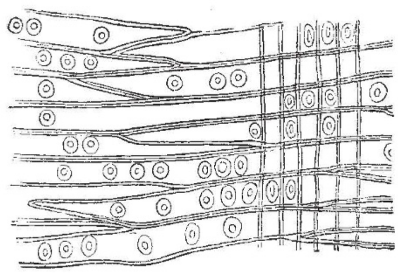

FIG. 3.—Longitudinal section of stem of spruce pine mounted in balsam, ¼″ objective.

by polarised light, and when so viewed all their structure returned and they became most beautiful objects.

It would be impossible in these articles to describe all the media employed in mounting microscopic objects, and all that will be attempted is to give instructions for mounting objects dry (that is, in air), in balsam, and in glycerine jelly.

The dry method is employed for such objects as are unaffected by air, and are either intended to be viewed as opaque objects by reflected light, or are sufficiently transparent without previous preparation to be examined by transmitted light. The object of this method is, in fact, simply to afford mechanical support to the object, and to protect it from dust and moisture.

It is necessary that the objects should be perfectly dry

[1] In Fig. 3 the pits are shown much too plainly.

before they are sealed down, or moisture will rise and dim the cover glass, and fungoid growths may make their appearance to the entire ruin of the specimen. A simple and efficacious mode of desiccation is to place the objects on a piece of blotting paper, cover them with an inverted tumbler or bell glass, and place the whole on the top shelf of a kitchen dresser or other warm place for a few days, or in extreme cases weeks. When an object has to be kept perfectly flat during drying, it may be placed between two ordinary slides held together by a letter-clip or American clothes peg.

To illustrate the general method of procedure, we will suppose that the first "mount" is to be a section of deal. Such sections can often be obtained in the ordinary operation of smoothing a plank with a very sharp plane. A piece about half an inch square is to be cut from the thinnest shaving, and dried by two or three days' exposure to warm air, as previously described. Next place it in the centre of a shallow cement cell, take a clean cover a little smaller than the outside diameter of the cell, apply a little gold size round its edge, and place it on the cell. Keep the cover pressed down by a clip and set it aside for a few days in a warm place for the size to dry. The only object of using the cell *in this case* is to prevent the liquid gold size running in between the glasses by capillarity. When the size is dry, fix the slide on the turntable and apply a ring of gold size extending a little way on to the surface of the cover and beyond the cell on to the slide. When this has dried a second coat should be given, and a final ring of asphalte will complete the sealing. It only then remains to label the slide.

We will consider in detail one more case—a preparation of sole's skin to show the overlapping ctenoid scales. As this object is of considerahle thickness, it must be mounted in a cell cut or punched out of a piece of thin cardboard and stuck to the slide with gold size or marine glue, and being opaque and intended for examination by reflected light, a black background should be provided for it by gumming a piece of black paper to the bottom of the cell or varnishing it with asphalte. A large piece of the colourless skin from the under side of the sole must be carefully washed with a camel-hair brush in several changes of warm water to remove the mucus, and then placed between two pieces of glass held together by a strong clip and laid aside for a fortnight to dry. A carefully selected portion is then to be cut out and cemented to the bottom of the cell by a very small quantity of marine glue. The cover may then be applied and the slide finished as before.

Having mounted these objects, no difficulty will be experienced in treating in a similar manner wings of insects, entire lichens, and small fungi, fructification of ferns, equisetums, &c., and vegetable hairs, scales, pollen, and seeds. The objects may be dried in their natural condition or under pressure, according to circumstances.

The calcareous and siliceous skeletons of Foraminifera and Radiolaria are usually mounted dry, but space will not allow a description of the processes adapted for freeing them from the dirt and debris with which they are usually associated.

Wood, bone, and hard vegetable tissues are sometimes mounted dry, but as they require to be cut into very thin sections, their preparation will be described in another place.

Heads of insects mounted dry to show the eyes, antennæ, mouth-organs, *i.e. in situ*, require very careful drying, and some support, such as wax, to secure them in the cell in the most favourable position for observation.

Objects of too perishable a nature to be mounted dry, or too opaque to reveal their structure when so mounted and viewed by transmitted light, are most commonly preserved in a thick liquid resin known as Canada balsam. This substance owes its value chiefly to its great penetrating power and high refractive index, by which internal reflection and scattering of light are greatly reduced, and bodies immersed in it are made remarkably transparent. These properties, however, render it entirely unsuitable for mounting objects intended to be viewed by reflected light.

Pure Canada balsam is now seldom used, it being much more convenient for most purposes to replace its natural solvent, turpentine, by a more volatile substance, such as benzole. To prepare the solution the balsam should be exposed to the heat of a slow oven for about two days, until on cooling it becomes hard. Its colour will darken during this process, but the temperature must never be allowed to rise sufficiently to darken it beyond a deep amber colour, and must not be continued long enough to render it brittle. The hardened balsam is then to be mixed with about an equal volume of benzole and allowed to stand, with occasional stirring, until all dissolved. This yields a pale, amber-coloured liquid which flows readily at ordinary temperatures and may be used cold. It should be kept in a wide-mouthed bottle with a large stopper ground accurately to the *outside* of the neck, and a glass rod should be left standing in it.

Before an object can be put up in balsam several preliminary processes are necessary to free it from air and water, and these will be best considered by describing in detail the preparation of some one object—say, a small insect—the common flea.

The creature must be killed without destroying any of its parts, either by immersion in boiling water or by covering it with a watch-glass, under which is then inserted a small piece of blotting paper soaked in chloroform. In a few moments it will be dead, and may then be placed in a 5 per cent. solution of caustic potash for ten or twelve days.[1] This will thoroughly soften and partly dissolve the viscera, the remains of which may be removed by placing the insect between two glass slides and squeezing it flat under water. The effect of this pressure is to squeeze the softened viscera out of the thorax and abdomen through the anus, and the spiracles on each side, or, if the pressure be violent, through an opening which is forced at the extremity of the abdomen, or between the thorax and first abdominal somite. The flattened flea should then be very carefully washed with soft camel-hair brushes, and soaked for two days in two or three changes of water to remove every trace of potash. It is then to be placed between two slides held together by a clip, and put aside in a warm place for a week to dry.

FIG. 4.

The water has now been eliminated, and the next process is to soak the flea for a day or two in spirit of turpentine, which will penetrate all its interstices and displace the air, thereby rendering it beautifully transparent, and preparing the way for the penetration of the balsam.

It only now remains only to mount it in the balsam. A small table, with a brass top $3\frac{1}{2}$ inches long, 2 inches wide, and 3-16ths of an inch thick, is very useful for supporting the slide. On its centre should be engraved or scratched an oblong space 3 inches long by 1 inch wide with a central point and two or three concentric circles to serve as guides for centring the slide and cover respectively. A cleaned slide should be held in the centre of the table by a spring clip of the shape shown in Fig. 4, so placed in this case that its edge is a quarter of an inch to the left of the centre of the slide. The flea is then to be taken out of the turpentine by means of a section

[1] Common shallow earthenware ointment pots with lids are very convenient for holding solutions in which objects have to be soaked for any length of time.

lifter, and properly arranged on the centre of the slide. A drop of balsam is next taken up on the glass rod and allowed to fall upon the object and spread a little way beyond it. A half-inch circular cover glass, previously cleaned, is taken up with a pair of smooth-pointed forceps, and its lower edge allowed to rest against the spring. It is then slowly and very steadily lowered, guided by a mounted needle held in the left hand. In this way a wave of balsam will be driven before it, and will reach the edges of the cover without including any air. Very often the object is displaced by this wave, but this can generally be remedied by a slight pressure with a needle on the side of the cover to which the object has moved. When it is again by this means worked to the centre of the slide, a little firmer pressure should be applied to the centre, so as to press it down and squeeze out all excess of balsam.

(To be continued.)

ON THE OLD CALENDARS OF THE ICELANDERS[1]

THE old Icelandic system of measuring time, which to some extent still holds its ground in the island, has the peculiarity of being based on the week as its fundamental unit of measurement, although it recognises a year consisting of fifty-two weeks, the 364 days of which were included in twelve months of thirty days each. To the last of these months, which belonged to the summer, four days were added under the name of *Sumar-auke* or "summer addition." In accordance with this arrangement every given day of a month always fell on one and the same day of the week, as in the lunar year's calendar the first day of each month coincides with the period of new moon.

The Icelandic year was further divided into two half years, viz. summer and winter, known as "*misseri*," the former of which began on a Thursday in April, thence called "summer day," and the latter on a Saturday in October, the "winter day." These "*misseri*" were more used than the year itself to measure time, and Icelanders gave the name "*Misseristal*," or half-year's reckoning, to their calendar, while they habitually counted by the weeks of these winter or summer measures in referring to the everyday occurrences of the passing year, just as they spoke of *winters* and not years, the former being assumed to include the summers which directly followed them in the ordinary course of nature. By an analogous mode of reasoning they spoke of "nights" instead of days in referring to the twenty-four hours of night and day. This custom no longer exists among the modern Scandinavian nations, but traces of it still survive among ourselves in the expressions "fortnight" and "se'nnight," which are undoubted survivals of an ancient northern mode of reckoning time, unknown to southern peoples. This proof of the prevalence of a system of counting by nights among the common ancestors of the Icelanders and Anglo-Saxons makes it the more remarkable that the modern Scandinavians alone among European races should have a separate word to express the twenty-four hours of a day and night, as *dygn* in Swedish, and *dögn* in Dano-Norwegian, which have been derived from the O.N. *dagr*, day.

Each of the Icelandic "*misseri*" was divided into two parts, known as "*mál*," measures. Of these the second half of winter began on a Friday in January, distinguished as "midwinter day," while "midsummer day" fell on a Sunday in July, which was the first day of the second half of the *Sumar-mál*. This last of the four quarters contained ninety-four days, owing to the addition of the four nights of the "Sumar-auke," while the other three contained only ninety days each.

[1] "Om Islændernes gamle Kalendere." By Herr Geelmuyden. *Naturen*, No. 4, 1883.

The errors of this method of computation, which gave only 364 days to the year, were early detected, for, as we learn from an interesting manuscript of the twelfth century, known as the "Rimbegla," which is preserved in the Royal Library of Copenhagen, the first reform of the Icelandic calendar was effected by the learned Thorstein Surtr, who, as the grandson of Thorolf Mostrarskegg, one of the original colonists, could scarcely have belonged to a later period than the middle of the tenth century. In accordance with the naïve mode of narration common to the chroniclers of the time, the "Rimbegla" calls in dreams and visions to explain the introduction of a more correct method of counting time among the Icelanders. Thus we are told that when, after long pondering on the reason why the summer was falling back into spring, Thorstein Surtr bethought himself of a way by which the *misseri* might be brought again to their ancient courses, he dreamt that he was standing on the Law-Hill of the Althing, and that while all other men slept, he was awake, but when he seemed to himself to be sleeping, all others were watching. This dream was interpreted by the wise Osyv Helgason to imply that while Thorstein spoke at the Law-Hill, all men must keep silence, and that when he ceased speaking all must proclaim aloud their approval of his words. Accordingly, when he proposed at the Thing that in every seventh summer seven nights should be added to the four nights of the "Sumar-auke," all men agreed to the change without question or hesitation. By the adoption of Thorstein's suggestion, the Icelandic year acquired 365 days, similar to that of the ancient Egyptians, although by retaining the early mode of intercalation in the summer term, the old relations between the days of the month and week remained unchanged. From this time forth the expression "Sumar-auke" was applied equally to the original four annual intercalary days, and to the seventh year's week added by Thorstein, which has retained the term to the present age. In the modern calendar the word "aukanætr," added nights, has, however, replaced the older appellation of "Sumar-auka."

Soon after the introduction of Christianity into Iceland in 1000, the national calendar was brought into closer relations with the Julian system, on which the clergy everywhere based their determinations of the festivals of the Church, and by adding a week to the old "Sumar-auke" five, instead of four, times in twenty-eight years, the average year acquired an addition of one-fourth of a day, and was thus made to approximate more nearly to the Julian year.

In the "Rimbegla" full directions are to be found for comparing the periods of the beginning and ending of the ancient *misseri*, or seasons, with the divisions of the year observed in other Christian lands, while this authority is, moreover, the only source from which we obtain a clear insight into the methods originally adopted for determining for any given year the amount of the irregularities, known as "Rimspiller," which necessarily occurred in a system that took no account of the Julian leap-year. It is curious to observe that while in Iceland, as elsewhere in the middle ages, the fixed and movable festivals of the Church were made to regulate the divisions of time, and to fix the periods of political and social events, the old Icelandic modes of computing time were never eradicated. But although the people continued to count by "*misseri*," winters, weeks, and nights, the beginnings and endings of the "*misseri*" were fixed in Christian times by the dates of the great Church festivals, which similarly controlled all national events, and thus we find that the exact date of the annual "Riding to the Thing," and the duration of the session of the Althing, were regulated by the day of the week on which the Festival of St. Peter and St. Paul (June 29) happened to fall.

The twelve months are spoken of in the older Edda under their respective names, but from the earliest