cessor, and came first to Leipzig in 1811, the very year we are concerned with; so that in that year both men may have held office, and consequently if an author's name had to be supplied Baltzer might easily have made a worse guess.

Both guess-work and circumstantial evidence, however, are quite unnecessary. After these facts were received from Leipzig, the library catalogue of University College, London, was turned up at De Prasse's name. No "Demonstratio," it is true, rewarded the searcher: but as a work with the miscellaneous-looking title, "Commentationes Mathematicæ," 4to, Lips. 1804–12, was found entered, the librarian was communicated with. In a day or two an obliging reply came to hand to the effect that the lair had indeed been found, the 15 quarto pages sought (or, at least, as many as are essential) being pp. 89–102 in the second fasciculus. The full title of the whole work is "Commentationes Mathematicæ, auctore Mauricio de Prasse, Math. prof. ord. in univers. liter. Lipsiensis." The first fasciculus contains 54 pages, and is dated 1804; the second contains 66 pages, viz. pp. 55–120, and is dated 1812. Of the eight separate "Commentationes" the "Demonstratio" is the seventh. Doubtless, copies of this collection of mathematical papers are to be found at several of the libraries above referred to. The work at any rate does not appear to be rare: the writer already possesses a copy, for which he paid the not extravagant sum of 2*s.* 8*d.*

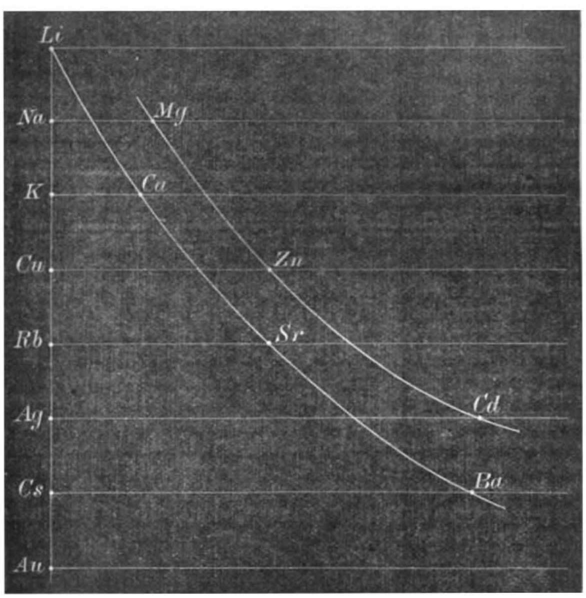
The moral on the surface of this tale may be, "Verify your references"; it is not the only moral, however. Baltzer, in his first preface, felt called upon to direct attention to the many inaccuracies and even errors ("manche ungenauigkeiten und selbst unrichtigkeiten") of Spottiswoode's pioneer treatise; yet if the leaf following the said preface be turned over, a footnote of five lines is found containing five "ungenauigkeiten" (say), one of which—being that referred to in the narrative of the "Demon"—might well be put in a worse category. *Humanum est errare.*

THOMAS MUIR.

Bothwell, Glasgow, December 26, 1887.

The Periodic Law.

IN none of the chemistry books or magazines to which I have access can I find any reference to a curious property of the chemical elements in connection with the Periodic Law. If instead of placing the elements as usual in seven vertical columns we arrange them at distances corresponding to the differences of their atomic weights, it will be found that they are disposed in curious curves. The following diagram will make my meaning



clearer. Arranging the monads in a vertical column, and taking it for a base line, place Ca at a distance from K corresponding to the difference of their atomic weights; also treat Sr and Ba in the same way in relation to Rb and Cs. It will then be found that they are arranged on a curve terminating in Li, which is known to unite in itself the properties of the metals of the alkalies and those of the alkaline earths. Mg, Zn, and Cd also range themselves on a curve when measured from Na, Cu, and Ag.

Ranging the tetrads vertically, we have O, S, Cr (Se?), and Mo, in almost a straight line, also P, V (As?), Nb and Sb. Many other curious relationships develop themselves if we plot off the elements vertically as well as horizontally. Is there any explanation of these curious curves? or is it simply accident? and if already known where can I find an account of them?

DONALD MURRAY.

Herald Office, Auckland, N.Z.

[Would not the position of Be (Beryllium) rather affect the apparent parallelism in these curves?—ED.]

The Leaps of *Lepus*.

WHILE rambling in the winter-time over the snow-covered plains in this region, I have recently interested myself in ascertaining how far, on a level surface, a hare or rabbit may leap at each spring, at a time when either of these animals is put to its best speed. Two species of *Lepus* are quite abundant in this vicinity, viz. the Mexican hare (*L. callotis callotis*), and the sage hare, which is really a medium-sized rabbit (*L. sylvaticus Nuttalli*), while the first-mentioned is a big hare. It is not uncommon to find here, in certain localities, a stretch of perfectly level prairie extending for a distance of 3 or 4 miles, and when this is covered by an even layer of 1 inch or more of snow, it offers an admirable surface on which to take account of the distance which may separate any two tracks of one of these animals, either one made by a hare or one made by one of the rabbits. On such a prairie as I have just referred to, I have on numerous occasions fired at these animals when they have been running, and at the same time beyond the range of my fowling-piece; such a shot almost invariably has the effect of so alarming the game as to make it run at its very best rate of speed, and upon coming up with the tracks they have left on the snow at such times, I have been surprised at the distances they can clear at each individual leap. Under these conditions I once measured the spaces cleared by an old Mexican hare, and found the first two equalled 12 feet apiece, while the third effort was rather more than 13 feet, and I have never known this species to exceed this, although I have tested not a few of them. Of course the rabbit cannot compete with such magnificent gymnastics as this: it will, however, when thus frightened, make leaps of fully 6 feet; and on one occasion I measured one on the dead-level prairie, which was rather more than 7 feet. At their common rate of going, the hare rarely clears more than 4 feet at any single leap, while the rabbit is satisfied with rather more than 2 feet, and, when quietly feeding about the sage-brush, the tracks made by an individual of either species may actually overlap each other.

R. W. SHUFELDT.

Fort Wingate, New Mexico, December 6, 1887.

A NEW MAGNETIC SURVEY OF FRANCE.[1]

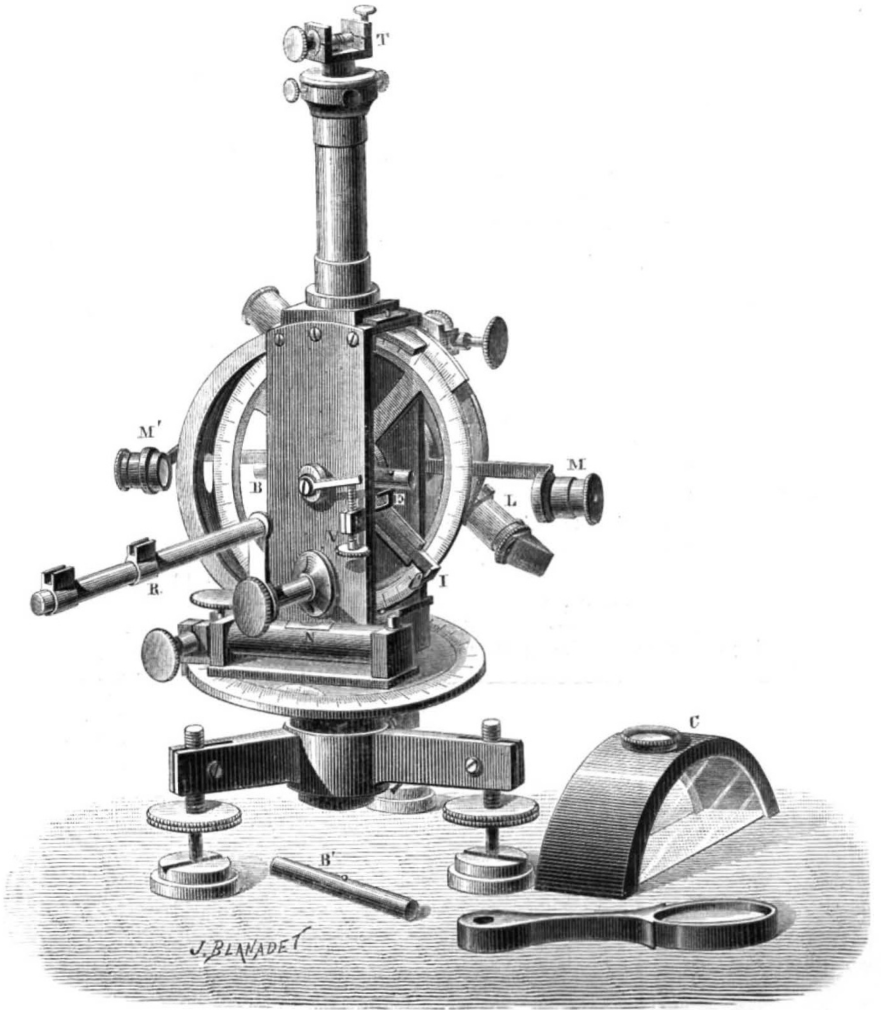
THE first systematic series of magnetic observations made in France was undertaken by Lamont, who in 1856 and 1857 determined the absolute value of the different elements at forty-four stations. The results are contained in his "Untersuchungen über die Richtung und Stärke der Erdmagnetismus an Verschiedenen Puncten des Südwestlichen Europa," and are reduced to three mean epochs: declination to March 1854; horizontal component to June 1848; and dip to the August of the same year. In 1868 and 1869 the Rev. Father Perry made a second series of observations of the intensity and direction of the earth's magnetic force at thirty-three stations in France (Phil. Trans., vols. clx. and clxii.). Determinations of declination have also been made at about twenty stations by MM. Marié-Davy and Descroix in 1875; and declination, dip, and intensity have been observed by M. de Bernardières at various points along

[1] "Détermination des Éléments Magnétiques en France." Ouvrage accompagné de nouvelles Cartes Magnétiques dressées pour le 1er Janvier. 1885. Par M. Th. Moureaux, Météorologiste-Adjoint au Bureau Central, Chargé du Service Magnétique à l'Observatoire du Parc Saint-Maur. (Paris: Gauthier-Villars, 1886.)

the Mediterranean littoral. These observations comprised all that was known respecting the distribution of the magnetic elements and rate of secular change in France prior to the appearance of the important work which forms the subject of this notice.

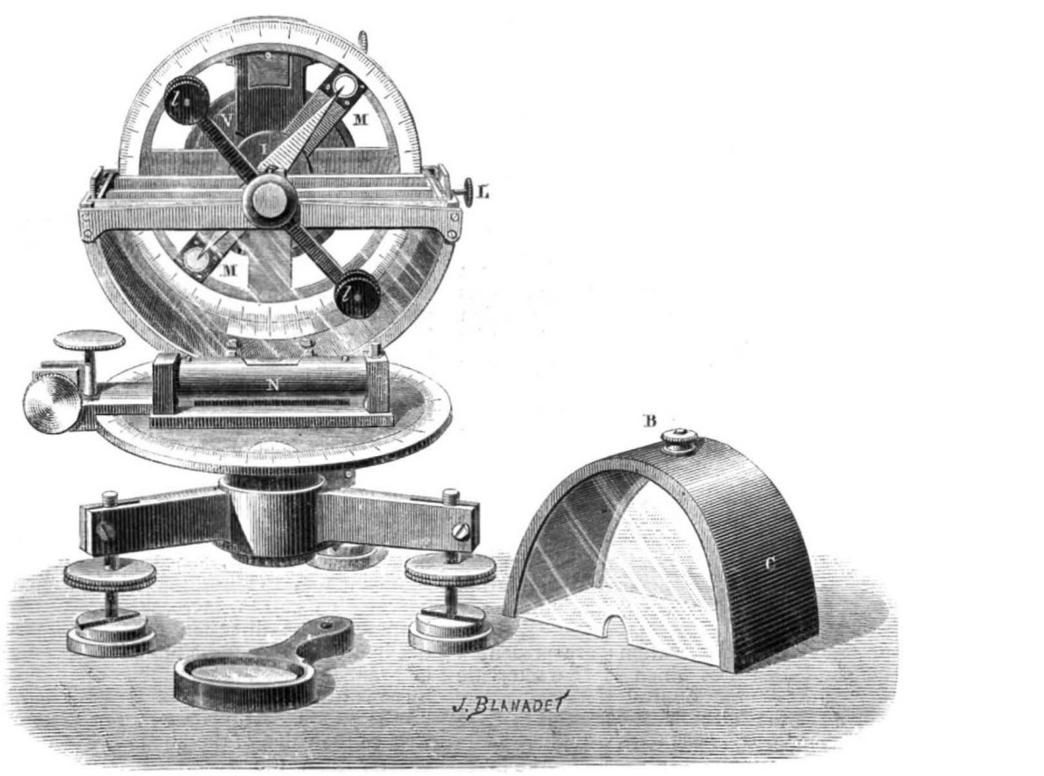
The observations of M. Moureaux were undertaken at the instigation of M. Mascart, the Director of the Meteorological Observatory of the Parc Saint-Maur, and were made during the years 1884 and 1885. A few observations made in 1882 by M. Mascart and M. Moureaux in the neighbourhood of the Pyrenees are also included. A description of the instruments employed, of the methods of observation, together with a detailed account of the results obtained from about eighty stations, fairly well distributed over France, constitute the subject-matter of this memoir.

As the instruments employed by M. Moureaux differ in some important particulars from those which are ordinarily employed for field-work by us, it may be desirable to point out their peculiarities. The instruments which are mainly made use of in this country, and which have been employed by English observers who have made magnetic surveys in other parts of the world during the last quarter of a century, are of what is known as the Kew pattern,



Portable Magnetometer. B, magnet; E, apparatus for steadying magnet; N, level; M M', reading microscopes; L, telescope; T, torsion head; R, bar for deflection experiments.

and embody the results of the experience of such practical magneticians as Lloyd, Sabine, Airy, Welsh, Balfour Stewart, Whipple, and others. Indeed it may be said that almost every observer who has made any extensive series of measurements of terrestrial magnetism has influenced the construction of the Kew magnetometer, and there is no question that this instrument, although not absolutely perfect, has now reached a very high degree of excellence. In some respects, however, the magnetometer employed by M. Moureaux possesses advantages over the Kew pattern, and these are especially evident in surveys over rough and difficult country, and where the means of transport are limited. In the matter of weight alone there is a considerable difference. A Kew magnetometer, in its box complete, and exclusive of the deflection bar, which is now usually carried in a hollow leg of the tripod, weighs nearly 50 pounds, whereas that of the French observers weighs only about 9 pounds. A further advantage possessed by the French model is that it is also an alt-azimuth instrument, and hence the observer is less dependent upon the knowledge of true time, afforded by his chronometer, in determining the geographical meridian in a declination observation than he is with the English instrument. In the magnetic survey of Scotland made by Welsh in 1857-58 it was necessary to make use of a special altazimuth instrument, or of a sextant and artificial horizon, in order to determine the sun's altitude at the time of observation, and a similar method was employed by the Rev. Father Perry in the course of the magnetic survey of France to which reference has already been made. Thanks to the admirable arrangement of our Post Office by which signals giving Greenwich mean time are sent to all the postal telegraph stations in the United Kingdom, it is possible for an observer engaged in magnetic work in the British Isles to determine the error and rate of his chronometer with an accuracy sufficient to enable him to dispense with the labour and trouble involved in the use of an altazimuth instrument. But unfortunately Greenwich mean time is not yet flashed all over the world, and a surveyor making use of the Kew magnetometer in distant countries would be under the necessity of making independent observations for solar altitude, and hence of adding to his *impedimenta* some such arrangement as those used in former surveys. Nor does this diminution in weight of the French instrument materially influence the accuracy of the observations, at all events so far as declination is concerned. It is hardly possible with the English instrument, even under favourable conditions, to obtain a declination observation which shall be accurate to within 2′. And yet, so far as an analysis of the data given by M. Moureaux enables us to judge, his instrument, of which the circle is only 0·08 m. in diameter, gives results which are in at least as close accordance with the truth. The method of observation which M. Moureaux adopts in determining the magnetic meridian allows him to read the position of both ends of the magnet both when erect and inverted in its stirrup. The magnets are solid and cylindrical in form, 6·5 cm. in length and 0·4 cm. in diameter, and weigh about 7½ grammes, and are suspended by a single thread



Iclinometer. M M, reading microscopes; L, lifting apparatus for needle; I, dipping needle; C, cover; N, level.

of silk 0·11 m. in length. The ends of the magnets are made slightly concave, and are polished so as to reflect the cross-wire placed in each of the microscopes, through which the readings for position are made. Each determination of geographical meridian is the mean result of from four to six independent observations, which rarely differ among themselves by more than 1′ of arc.

The same magnet which serves for the observation of declination is used as in the Kew instrument for the determination of the horizontal component, which is done, as with us, by finding the relation $\frac{H}{M}$ by Gauss's method of deflections, and the product HM by the method of vibrations, whence H can be deduced. For this particular determination it seems to us that the Kew model is distinctly to be preferred. Indeed, in the observation of deflections the Kew instrument leaves very little to be desired, provided that care is taken to avoid sudden alterations of temperature, say by exposure to sunshine. The main error in the estimation of the period of vibration of the magnet also arises from the uncertainty of its temperature when observing in the field. But in the French instrument no special pains are taken either to ascertain or to correct for temperature. M. Moureaux indeed is of opinion that, under the conditions of observation, the error committed by neglecting the correction is not greater than that which results from the difficulty of knowing whether the temperature of the magnet is represented by that of the outside thermometer. This is no doubt true of the instrument employed by the French observer, but in the Kew pattern special attention is paid to this point, and, although the arrangement leaves something to be desired, there is no doubt that with care the temperature may be determined with a fairly close approximation to truth. Moreover, the method of determining the time of vibration of the magnet as generally practised by English observers also appears to us to be preferable to that adopted by M. Moureaux, although this has the advantage of occupying little time and therefore of minimizing the effect of any alteration in temperature during these observations and those of the deflections.

As regards inclination, there can, we think, be little doubt that the Kew pattern of dip circle, as made by Dover, is distinctly preferable to that used in the French survey. Indeed in the latter instrument it would seem to be difficult to avoid draughts and dust, the two great enemies to accuracy in field work. Only one needle of 0·065 m. in length was used by M. Moureaux, and the memoir gives no direct evidence of the degree of accuracy of which it was capable. Still M. Moureaux's instrument has the merit of portability, since, when packed in its box, it weighs less than 2 kilos.

As regards the plan of operations, we cannot speak too highly. Every care seems to have been taken, by a preliminary study of the ground, to select stations which should be as free as possible from any local disturbance, such as the proximity of railway-lines, manufactories, &c. It would, however, have added to the completeness of M. Moureaux's work if to the description of the stations there had been given some account of their general geological character and of that of the districts in the immediate neighbourhood, since, as is well known, the presence of igneous rocks or of rocks containing magnetic oxide of iron is the chief cause of local disturbance.

M. Moureaux began operations at each station, as a rule, at the commendably early hour of 7 a.m., so as to secure the determination of the magnetic meridian when the diurnal variation in declination was at about its morning minimum and nearly stationary. The observations for the geographical meridian were made between 8.30 and 9 a.m.; that is, at about the best period for the observation. The determination of the horizontal component was next made, a set of swings being taken before and after the deflection observations, all of which were completed by about 10.30 a.m. Between this time and noon was occupied in the dip observations. When the circumstances of travel or of weather made a departure from this plan necessary, the observations of declination were made either at the time of maximum of diurnal variation or at about the time of evening minimum—say between 5 and 6 p.m.

The results of the various observations are presented with that elegance and clearness which is characteristic of the publications of the Bureau Central Météorologique. They are all referred to the Parc Saint-Maur as a base station, by direct comparisons with the photographic curves of the registering apparatus at work in the magnetic observatory; and are reduced to the mean epoch January 1, 1885, by adding the difference between the values obtained at the different stations and Parc Saint-Maur at the time of observation to the corresponding values at Parc Saint-Maur on January 1, 1885, obtained from the mean of the observations made there in December 1884 and January 1885. This method presupposes that the diurnal variation is of the same order throughout the whole of France, which is not strictly true, but the error resulting from this mode of treatment is probably not greater than the errors of the observations themselves.

The final values are then tabulated and compared with the values obtained for the same places as deduced from the curves given by Lamont, and in this way a measure of the secular change is obtained. The results are finally plotted in the form of maps on Mercator's projection, giving lines of equal declination, force (horizontal component), and dip, and there is, lastly, a map of magnetic meridians. As to the methods employed in the construction of these maps there are unfortunately no details. It would seem that the lines are simply freehand curves, so drawn as to best represent the observational results. There is at least no evidence that the results have been combined, as is the practice among English magneticians, so as to obtain the most probable direction of the lines by calculation, and therefore independently of bias on the part of the map-maker. M. Moureaux moreover offers us no direct means of comparing the values as taken out from his curves with the actual values obtained at the various stations. The maps, however, show certain points of interest which may be thus briefly summarized:—

(1) In the north of France the declination varies about 30′ for each degree of longitude; this proportion decreases in the south. The difference in declination between two points at a given distance apart on the same parallel increases with the latitude, and the isogonal lines are closer together in the north than in the south. The most remarkable feature in the declination map is the form of the curves in Brittany and more especially in the neighbourhood of Rennes. Their regularity is broken in such manner as to suggest that they are modified by the particular trend of the coast-line. Throughout the whole of the north-west portion of France the declination is less than would be expected from the direction and character of the lines over the rest of the Continent. A comparison with Lamont's map for 1854 shows that the declination has diminished during the thirty years by about 3° 58′ in the north, and by about 3° 19′ in the south of France. The mean annual decrease in declination seems to increase pretty regularly from south-south-east to north-north-west, or in a direction approximating to that of the magnetic north; hence the curves of equal declination have not been displaced, by time, parallel to themselves, but have gradually approached to the direction of the geographical meridian.

(2) The map of lines of equal horizontal component shows that the minimum, 0·18460 (C.G.S. units), is observed at Dunkirk, and the maximum, 0·22124, at Perpignan, or a difference of 0·03664 for the interval of 8° of latitude which separates the two points. The maximum rate of decrease of the horizontal component takes place in a direction approximating to that of the magnetic meridian. The decrease is more rapid in the south than in the north, and the interval between two consecutive curves increases pretty regularly with the latitude. The direction of these lines, like those of declination, seems to be modified towards the north-west of France, in such manner that the line corresponding to 0·190 is nearly straight and does not bend to the south as do the others. At places in the extreme north-west of France the value of the horizontal component is therefore greater than the general direction of the other lines would indicate should be the case. A comparison with Lamont's map for 1848 shows that the horizontal component has increased from about 0·008 to 0·010 in absolute value during the thirty-six years. The lines of equal horizontal component have not been displaced parallel to themselves, but are more inclined towards the east, so as to approach the direction of the geographical parallels. The secular change is at its maximum in the west, and diminishes slightly towards the east.

(3) The map of isoclinals shows that these lines have sensibly the same orientation as the lines of equal horizontal component; *i.e.* these are very nearly normal to the direction of the magnetic needle. Whilst the inclination diminishes in general towards the south, the interval between two consecutive curves decreases pretty regularly with the latitude. The direction of the lines corresponding to 66° and 67° seems to be slightly modified as they cross the north-west part of France, as are the lines of equal horizontal component. During the thirty-six years which have intervened since the date of Lamont's map, the dip has decreased by about 1° 35′ in

the north and by about 2° in the south, and, like the lines of horizontal component, the isoclinals have not been displaced parallel to themselves, but in a direction approximating to that of the parallels of latitude. The secular change is least in the north east and gradually increases towards the south, and attains its maximum along the Pyrenees and towards the Gulf of Genoa.

M. Moureaux is to be congratulated on the results of his work, for his countrymen have hitherto scarcely contributed their fair share to our knowledge of terrestrial magnetism. Even the surveys of their own country have been made for them by Germans and Englishmen. Now that Frenchmen themselves have made a beginning, it is to be hoped that the continuity of the work will not be interrupted, for it is only by systematic survey work of the kind so successfully accomplished by M. Moureaux that our knowledge of the magnetic state of the earth and of the laws which regulate its changes can be elucidated.

T. E. THORPE.

TIMBER, AND SOME OF ITS DISEASES.[1]

IV.

BEFORE proceeding further it will be of advantage to describe another tree-killing fungus, which has long been well known to mycologists as one of the commonest of our toadstools growing from rotten stumps, and decaying wood-work such as old water-pipes, bridges, &c. This is *Agaricus melleus* (Fig. 15), a tawny yellow toadstool with

FIG. 15.—A small group of *Agaricus* (*Armillaria*) *melleus*. The toad-stool is tawny-yellow, and produces white spores; the gills are decurrent, and the stem bears a ring. The fine hair-like appendages on the pileus should be bolder.

a ring round its stem, and its gills running down on the stem and bearing white spores, and which springs in tufts from the base of dead and dying trees during September and October. It is very common in this country, and I have often found it on beeches and other trees in Surrey, but it has been regarded as simply springing from the dead rotten wood, &c., at the base of the tree. As a matter of fact, however, this toadstool is traced to a series of dark shining strings, looking almost like the purple-black leaf-stalks of the maidenhair fern, and these strings branch and meander in the wood of the tree, and in the soil, and may attain even great lengths—several feet, for instance. The interest of all this is enhanced when we know that until the last few years these long black cords were supposed to be a peculiar form of fungus, and were known as *Rhizomorpha*. They are, however, the subterranean vegetative parts (mycelium) of the Agaric we are concerned with, and they can be traced without break of continuity from the base of the toadstool into the soil and tree (Fig. 16). I have several times followed these dark mycelial cords into the timber of old beeches and spruce-fir stumps, but they are also to be found in oaks, plums, various Conifers, and probably may occur in most of our timber-trees if opportunity offers.

The most important point in this connection is that *Agaricus melleus* becomes in these cases a true parasite,

FIG. 16.—Sketch of the base of a young tree (*s*), killed by *Agaricus melleus*, which has attacked the roots, and developed rhizomorphs at *r*, and fructifications. To the right the fructifications have been traced by dissection to the rhizomorph strands which produced them.

producing fatal disease in the attacked timber-trees, and, as Hartig has conclusively proved, spreading from one tree to another by means of the rhizomorphs underground. Only this last summer I had an opportunity of witnessing, on a large scale, the damage that can be done to timber by this fungus. Hundreds of spruce-firs with fine tall stems, growing on the hill sides of a valley in the Bavarian Alps, were shown to me as "victims to a kind of rot." In most cases the trees (which at first sight appeared only slightly unhealthy) gave a hollow sound when struck, and the foresters told me that nearly every tree was rotten at the core. I had found the mycelium of *Agaricus melleus* in the rotting stumps of previously felled trees all up and down the same valley, but it was not satisfactory to simply assume that the "rot" was the same in both cases, though the foresters assured me it was so.

By the kindness of the forest manager I was allowed to fell one of these trees. It was chosen at hazard, after the men had struck a large number, to show me how easily the hollow trees could be detected by the sound.

[1] Continued from p. 229.