modification of the spermary of the host is simply a concomitant circumstance of the parasitism. It seems hard to believe that the simple presence of the packets of Crustacean ova in the brood sac of an Amphiura would lead to a destruction of the ova of the brittle-star, but it does not seem impossible that the adult Crustacean could have spayed the Amphiura.

The character of this phenomenon is so unusual that one hesitates to accept it on insufficient data. There are gaps in my observations which may be serious to the theory. In the first place, it has not been observed that the Crustacean spayed the Amphiura. The ovarian gland of the brittle-star is destroyed, and indications point to the Crustacean as the culprit. Secondly, it is not known that the parasite enters the *brood sac* through the genital slits to deposit the ova. Thirdly, the difficulties of determination whether the ova are in the body cavity, stomach walls, or brood sac, are very great. I believe it is probable that they are in the brood sac. Lastly, the family name of the strange parasite who repays hospitality so ungraciously is unknown. There is no doubt that it is a Crustacean, as I have traced the egg through a nauplius into an adult.

As this condition of life is believed to be a novel one, and needs verification, the writer takes this opportunity to call the attention of marine zoologists to it, and to request correspondence from anyone who may have made similar observations. Before we can definitely accept the conclusions towards which my observations lead, there is a call for re-examination and verification of the observations. The most important question is to determine whether or not the ova of the Crustacean live in the brood sac.

Cambridge, Mass., U.S.A. J. WALTER FEWKES.

Raised Beaches *versus* High-Level Beaches.

IF you can find space for the subjoined list of shells from the ancient beach on the Thatcher rock in Torbay, it may prove acceptable to such geologists as interest themselves in the question recently resuscitated by Prof. McKenny Hughes, as to whether the ancient Devonshire beaches are "raised," as commonly supposed, or merely high-level, as some hold them to be.

Added to the late Mr. Godwin Austen's "Hope's Nose" list, my list runs up the total number of species from the two beaches to forty-six, and this without reckoning Mr. Godwin Austen's *Cardium tuberculatum*, which I think must have been an oversight for *C. echinatum*. This number has not, I believe, been beaten by any British raised beach hitherto.

When the Thatcher beach was accumulated, the northern shell *Trophon truncatus* was abundant in the neighbourhood; so was *Tellina balthica*, a shell which only occurs, I believe, in this vicinity, in or near the tidal harbours of Torbay.

The Thatcher collection evidences the great antiquity of the beach, a considerable change of temperature, differences in the rock-components of the coast-line, and variation in its contour. Of these subjects I hope some day to treat, but in the meantime the facts so far as they have been ascertained are presented to geologists in the following list of shells for them to deal with as they please:—

Ostrea edulis
Pinna rudis
Mytilus edulis
M. modiolus
Nucula nucleus
Cardium echinatum
C. edule
C. norvegicum
Cyprina islandica
Astarte sulcata
Venus exoleta
V. fasciata
V. gallina
Tellina balthica
Lutraria elliptica
Mactra subtruncata
Solen vagina
Mya arenaria
Saxicava rugosa

Patella vulgata
Trochus zizyphinus
Lacuna puteolus
Litorina obtusata
L. rudis
L. litorea
Turritella terebra
Scalaria turtonæ
Natica alderi
Adeorbis subcarinatus
Cerithium reticulata
Purpura lapillus
Buccinum undatum
Murex erinaceus
Trophon truncatus
Fusus gracilis
F. jeffreysianus
Nassa reticulata
N. incrassata
Pleurotoma striolata
P. brachystoma
P. turricula
Cylichna cylindracea

42 species.

The shells have been identified in odd lots and at different times by the late Mr. Gwyn Jeffreys, Mr. J. T. Marshall, and Mr. D. Pidgeon, to whom my warmest thanks have been due. The bulk of the work has, however, been done by the last-named gentleman, without whose hearty co-operation, both in searching the beach material and naming the shells and fragments found therein, the list would have been shorn of much of its goodly proportions. A. R. HUNT.

Torquay, December 28, 1887.

Vegetation and Moonlight.

THE letter of your Trinidad correspondent, given in NATURE, vol. xxxvi. p. 586, referring to a Committee appointed to determine moon influence, has a practical interest for me. Among the wood-cutters in Cape Colony, both east and west, there is a fixed belief, which no arguments can turn, that to cut timber at, or shortly after, full moon, is to cut it when the sap is up; and when, consequently, it is out of season. The same belief prevails in various parts of Southern India, notably in Travancore. I have always combated the belief, pending time and opportunity to test it, indulging in the provisional hypothesis that the bush-workers' belief may be due to the fact that they can only work by night at or near full moon; and that at night trees should contain more sap than by day, when watery exhalation is active.

It seems possible that in the habitually cloudless nights of certain countries the moon may exert influences not noticeable elsewhere. It is well known in Cape Colony that fish, pork, and other provisions go bad if left exposed to moonlight; though possibly this may be due to the light acting as a guide to insects. D. E. HUTCHINS,

Cape Colony, December 8, 1887. Conservator of Forests.

Centre of Water Pressure.

DR. ROUTH has done me the favour of pointing out that in the first volume of his "Rigid Dynamics" he has given the following very simple result with regard to the centre of pressure of a triangle occupying any position in a liquid:—"This point is the centre of gravity of three particles at the middle points of the sides, with masses proportional to their depths."

This result of Dr. Routh's is one of many very remarkable theorems of integration published by him in the *Quarterly Journal*, No. 83, 1886. GEORGE M. MINCHIN.

A New Magnetic Survey of France.

IT should not be difficult to do foreigners justice without belittling our own countrymen, and *a fortiori* without robbing any of the latter of their birthright.

In Prof. Thorpe's paper in last week's NATURE there occurs the sentence, "Even the surveys of their own country (France) have been made for them by Germans and Englishmen." This sentence taken in connection with the opening paragraph of the paper conveys the unfortunate impression that Von Lamont, the author of the "Untersuchungen über die Richtung und Stärke des Erdmagnetismus . . ." and of numerous other similar works, was a German, the truth being that he was merely a "Scot abroad" (see NATURE, vol. xx. p. 425). T. M.

Bothwell, Glasgow, January 14.

TIMBER, AND SOME OF ITS DISEASES.[1]

V.

IT has long been known that timber which has been felled, sawn up, and stored in wood-yards, is by no means necessarily beyond danger, but that either in the stacks, or even after it has been employed in building construction, it may suffer degeneration of a rapid character from the disease known generally as "dry-rot." The object of the present paper is to throw some light on the question of dry-rot, by summarizing the chief results of recent botanical inquiries into the nature and causes of the disease—or, rather, diseases, for it will be shown that there are several kinds of "dry-rot."

[1] Continued from p. 254.

The usual signs of the ordinary dry-rot of timber in buildings, especially deal-timber or fir-wood, are as follows. The wood becomes darker in colour, dull yellowish-brown instead of the paler tint of sound deal; its specific weight diminishes greatly, and that this is due to a loss of substance can be easily proved directly. These changes are accompanied with a cracking and warping of the wood, due to the shortening of the elements as water evaporates and they part from one another: if the disease affects one side of a beam or plank, these changes cause a pronounced warping or bending of the timber, and in bad cases it looks as if it had been burnt or scorched on the injured side. If the beam or plank is wet, the diseased parts are found to be so soft that they can easily be cut with a knife, almost like cheese; when dry, however, the touch of a hard instrument breaks it into brittle fibrous bits, easily crushed between the fingers to a yellow-brown, snuff-like powder. The timber has by this time lost its coherence, which, as we have seen, depends on the firm interlocking and holding together of the uninjured fibrous elements, and may give way under even light loads—a fact only too well known to builders and tenants. The walls of the wood-elements (tracheides, vessels, fibres,

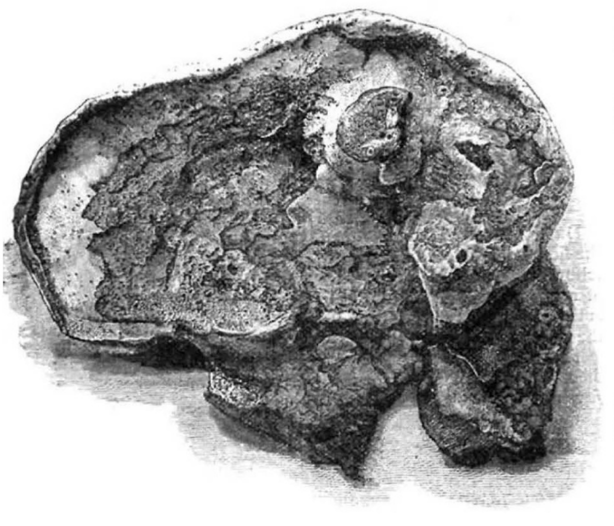

FIG. 17.—Portion of the mycelium of *Merulius lacrymans* removed from the surface of a beam of wood. This cake-like mass spreads over the surface of the timber, to which it is intimately attached by hyphæ running in the wood-substance. Subsequently it develops the spore-bearing areolæ near its edges. The shading indicates differences in colour, as well as irregularities of surface.

or cells, according to the kind of timber, and the part affected) are now, in fact, reduced more or less to powder, and if such badly diseased timber is placed in water it rapidly absorbs it and sinks: the wood in this condition also readily condenses and absorbs moisture from damp air, a fact which we shall see has an important bearing on the progress of the disease itself.

If such a piece of badly diseased deal as I have shortly described is carefully examined, the observer is easily convinced that fungus filaments (mycelium) are present in the timber, and the microscope shows that the finer filaments of the mycelium (hyphæ) are permeating the rotting timber in all directions—running between and in the wood elements, and also on the surface, much as in the case shown in Fig. 17. In a vast number of cases, longer or shorter, broader or narrower, cords of grayish-white mycelium may be seen coursing on the surface and in the cracks: in course of time there will be observed flat cake-like masses of this mycelium, the hyphæ being woven into felt-like sheets, and these may be extending themselves on to neighbouring pieces of timber, or even on the brick-work or ground on which the timber is resting. These cord-like strands and cake-like masses of felt, with their innumerable fine filamentous continuations in the wood, constitute the vegetative body or mycelium of a fungus known as *Merulius lacrymans*. Under certain circumstances, often realized in cellars and houses, the cakes of mycelium are observed to develop the fructification of the fungus, illustrated in Fig. 18.

To understand the structure of this fructification we may contrast it with that of the *Polyporus* or *Trametes* referred to in the last article; where in the latter we find a number of pores leading each into a tubular cavity lined with the cells which produce the spores, the *Merulius* shows a number of shallow depressions lined by the sporogenous cells. The ridges which separate these depressed areolæ have a more or less zigzag course, running together, and sometimes the whole presents a likeness to

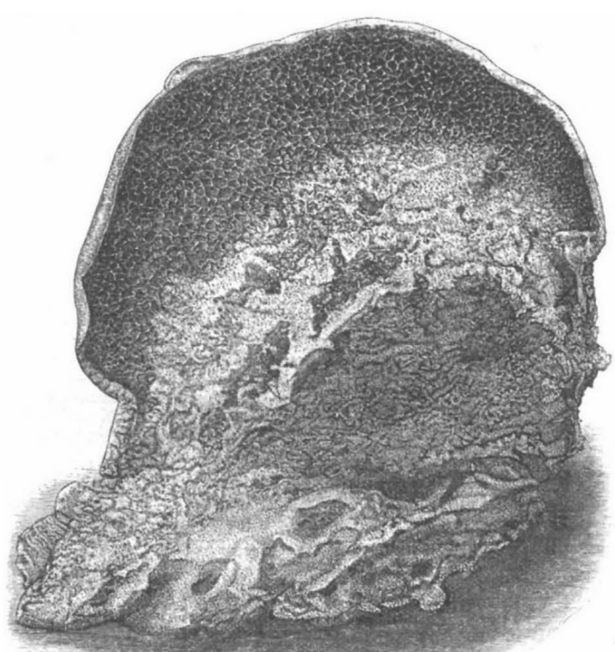

FIG. 18.—Mature fructification of *Merulius lacrymans*. The cake-like mass of felted mycelium has developed a series of areolæ (in the upper part of the figure), on the walls of which the spores are produced. In the natural position this spore-bearing layer is turned downwards, and in a moist environment pellucid drops or "tears" distil from it. The barren part in the foreground was on a wall, and the remainder on the lower side of a beam: the fungus was photographed in this position to show the structure.

honey-comb; if the ridges were higher, and regularly walled in the depressed areas, the structure would correspond to that of a *Polyporus* in essential points. The spores are produced in enormous numbers on this areolated surface, which is directed downwards, and is usually golden-brown, but may be dull in colour, and presents the remarkable phenomenon of exuding drops of clear water, like tears, whence the name *lacrymans*. In well-grown specimens, such as may sometimes be observed on the roof of a cellar, these crystal-like tears hang from the areolated surface like pendants, and give an extraordinarily beautiful appearance to the whole; the substance of the glistening *Merulius* may then be like shot-velvet gleaming with bright tints of yellow, orange, and even purple.

It has now been demonstrated by actual experiment that the spores of the fungus, *Merulius lacrymans*, will germinate on the surface of damp timber, and send their germinal filaments into the tracheids, boring through the cell-walls, and extending rapidly in all directions. The fungus mycelium, as it gains in strength by feeding upon the substance of these cell-walls, destroys the wood by a process very similar to that already described (compare Fig. 14, Article III.).

It appears, however, from the investigations of Poleck and Hartig, that certain conditions are absolutely necessary for the development of the mycelium and its spread in the timber, and there can be no question that the intelligent application of the knowledge furnished by the scientific elucidation of the biology of the fungus is the key to successful treatment of the disease. This is, of course, true of all the diseases of timber, so far as they can be dealt with at all, but it comes out so distinctly in the present case that it will be well to examine a little at length some of the chief conclusions.

Merulius, like all fungi, consists of relatively large quantities of water—50 to 60 per cent. of its weight at least—together with much smaller quantities of nitrogenous and fatty substances and cellulose, and minute but absolutely essential traces of mineral matters, the chief of which are potassium and phosphorus. It is not necessary to dwell at length on the exact quantities of these matters found by analysis, nor to mention a few other bodies of which traces exist in such fungi. The point just now is that all these materials are formed by the fungus at the expense of the substance of the wood, and for a long time there was considerable difficulty in understanding how this could come about.

The first difficulty was that although the "dry-rot fungus" could always be found, and the mycelium was easily transferred from a piece of diseased wood to a piece of healthy wood provided they were in a suitable warm, damp, still atmosphere, no one had as yet succeeded in causing the spores of the *Merulius* to germinate, or in following the earliest stages of the disease. Up to about the end of the year 1884 it was known that the spores refused to germinate either in water or in decoctions of fruit; and repeated trials were made, but in vain, to see them actually germinate on damp wood, until two observers, Poleck and Hartig, discovered about the same time the necessary conditions for germination. It should be noted here that this difficulty in persuading spores to germinate is by no means an isolated instance: we are still ignorant of the conditions necessary for the germination of the spores of many fungi—*e.g.* the spores of the mushroom, according to De Bary; and it is known that in numerous cases spores need very peculiar treatment before they will germinate. The peculiarity in the case of the spores of *Merulius lacrymans* was found by Hartig to be the necessity of the presence of an alkali, such as ammonia; and it is found that in cellars, stables, and other outhouses where ammoniacal or alkaline emanations from the soil or elsewhere can reach the timber, there is a particularly favourable circumstance afforded for the germination of the spores. The other conditions are provided by a warm, still, damp atmosphere, such as exists in badly ventilated cellars, and corners, and beneath the flooring of many buildings.

Careful experiments have shown beyond all question that the "dry-rot fungus" is no exception to other fungi with respect to moisture: thoroughly dry timber, so long as it is kept thoroughly dry, is proof against the disease we are considering. Nay, more, the fungus is peculiarly susceptible to drought, and the mycelial threads and even the young fructifications growing on the surface of a beam of timber in a damp close situation may be readily killed in a day or two by letting in thoroughly dry air: of course, the mycelium deeper down in the wood is not so easily and quickly destroyed, since not only is it more protected, but the mycelial strands are able to transport moisture from a distance. Much misunderstanding prevails as to the meaning of "dry air" and "dry wood": as a matter of fact, the air usually contains much moisture, especially in cellars and quiet corners devoid of draughts, such as *Merulius* delights in, and we have already seen how dry timber rapidly absorbs moisture from such air. Moreover, the strands of mycelium may extend into damp soil, foundations, brick-work, &c.; in such cases they convey moisture to parts growing in apparently dry situations.

A large series of comparative experiments, made especially by Hartig, have fully established the correctness of the conclusion that damp foundations, walls, &c., encourage the spread of dry-rot, quite independently of the quality of the timber. This is important, because it has long been supposed that timber felled in summer was more prone to dry-rot than timber felled in winter: such, however, is not shown to be the case, for under the same conditions both summer- and winter-wood suffer alike, and decrease in weight to the same extent during the progress of the disease. There is an excellent opportunity for further research here however, since one observer maintains that in one case at any rate (*Pinus sylvestris*) the timber felled at the end of April suffered from the disease, whereas that felled in winter resisted the attacks of the fungus: internal evidence in the published account supports the suspicion that some error occurred here. The wood which succumbed was found to contain much larger quantities of potassium and phosphorus (two important ingredients for the fungus), and Poleck suggests that this difference in chemical constitution explains the ease with which his April specimens were infected.

It appears probable from later researches and criticism that Poleck did not choose the same parts of the two stems selected for his experiments, for (in the case of *Pinus sylvestris*) the heart-wood is attacked much less energetically than the sap-wood—a circumstance which certainly may explain the questionable results if the chemist paid no attention to it, but analyzed the sap-wood of one and the heart-wood of the other piece of timber, as he seems to have done.

The best knowledge to hand seems to be that no difference is observable in the susceptibility to dry-rot of winter-wood and summer-wood of the same timber; *i.e.* *Merulius lacrymans* will attack both equally, if other conditions are the same.

But air-dry and thoroughly seasoned timber is much less easily attacked than damp fresh-cut wood of the same kind, both being exposed to the same conditions.

Moreover, different timbers are attacked and destroyed in different degrees. The heart-wood of the pine is more resistant than any spruce timber. Experimental observations are wanted on the comparative resistance of oak, beech, and other timbers, and indeed the whole question is well worth further investigation.

When the spore has germinated, and the fungus hyphæ have begun to grow and branch in the moist timber, they proceed at once to destroy and feed upon the contents of the medullary rays; the cells composing these contain starch and saccharine matters, nitrogenous substances, and inorganic elements, such as potassium, phosphorus, calcium, &c. Unless there is any very new and young wood present, this is the only considerable source of proteid substances that the fungus has: no doubt a little may be obtained from the resin-passages, but only the younger ones. In accordance with this a curious fact was discovered by Hartig: the older parts of the hyphæ pass their protoplasmic contents on to the younger growing portions, and so economize the nitrogenous substances. Other food-substances are not so sparse; the lignified walls inclose water and air, and contain mineral salts, and such organic substances as coniferin, tannin, &c., and some of these are absorbed and employed by the fungus. Coniferin especially appears to be destroyed by the hyphæ.

The structure of the walls of the tracheides and cells of the wood is completely destroyed as the fungus hyphæ extract the minerals, cellulose, and other substances from them. The minerals are absorbed at points of contact between the hyphæ and the walls, reminding us of the action of roots on a marble plate: the coniferin and other organic substances are no doubt first rendered soluble by a ferment, and then absorbed by the hyphæ. This excretion of ferment has nothing to do with the excretion of water in the liquid state, which gives the fungus its specific name: the "tears" themselves have no solvent action on wood.

It will be evident from what has been stated that the practical application of botanical knowledge is here not only possible, but much easier than is the case in dealing with many other diseases.

It must first be borne in mind that this fungus spreads, like so many others, by means of both spores and mycelium: it is easy to see strands of mycelium passing from badly-diseased planks or beams, &c., across intervening brick-work or soil, and on to sound timber, which it then infects. The spores are developed in countless myriads from the fructifications described, and they are extremely minute and light: it has been proved that they can be carried from house to house on the clothes and tools, &c., of workmen, who in their ignorance of the facts are perfectly careless about laying their coats, implements, &c., on piles of the diseased timber intended for removal. Again, in replacing beams, &c., attacked with dry-rot, with sound timber, the utmost ignorance and carelessness are shown: broken pieces of the diseased timber are left about, whether with spores on or not; and I have myself seen quite lately sound planks laid close upon and nailed to planks attacked with the "rot." Hartig proved that the spores can be carried from the wood of one building to that of another by means of the saws of workmen.

But perhaps the most reckless of all practices is the usage of partially diseased timber for other constructive purposes, and stacking it meanwhile in a yard or outbuilding in the neighbourhood of fresh-cut, unseasoned timber. It is obvious that the diseased timber should be removed as quickly as possible, and burnt at once: if used as firewood in the ordinary way, it is at the risk of those concerned. Of course the great danger consists in the presence of many ripe spores, and their being scattered on timber which is under proper conditions for their germination and the spread of the mycelium.

It is clearly an act approaching those of a madman to use fresh "green" timber for building purposes; but it seems certain that much improperly dried and by no means "seasoned" timber is employed in some modern houses. Such wood is peculiarly exposed to the attacks of any spores or mycelium that may be near.

But even when the beams, door-posts, window-sashes, &c., in a house are made of properly dried and seasoned deal, the danger is not averted if they are supported on damp walls or floors. For the sake of illustration I will take an extreme case, though I have no doubt it has been realized at various times. Beams of thoroughly seasoned deal are cut with a saw which has previously been used for cutting up diseased timber, and a few spores of *Merulius* are rubbed off from the saw, and left sticking to one end of the cut beam: this end is then laid on or in a brick wall, or foundation, which has only stood long enough to partially dry. If there is no current of dry air established through this part, nothing is more probable than that the spores will germinate, and the mycelium spread, and in the course of time—it may be months afterwards—a mysterious outbreak of dry-rot ensues. There can be no question that the ends of beams in new houses are peculiarly exposed to the attacks of dry-rot in this way.

The great safeguard—beyond taking care that no spores or mycelium are present from the first—is to arrange that all the brick-work, floors, &c., be thoroughly dry before the timber is put in contact with them; or to interpose some impervious substance—a less trustworthy method. Then it is necessary to aërate and ventilate the timber for *dry* timber *kept dry* is proof against "dry-rot."

The ventilation must be real and thorough however for it has been by no means an uncommon experience to find window-sashes, door-posts, &c., in damp buildings with the insides scooped out by dry-rot, and the aërated outer shells of the timber quite sound: this is undoubtedly often due to the paint on the outer surfaces preventing a thorough drying of the deeper parts of the wood.

Of course the question arises, and is loudly urged, Is there no medium which will act as an antiseptic, and kill the mycelium in the timber in the earlier stages of the disease? The answer is, that mineral poisons will at once kill the mycelium on contact, and that creosote, &c., will do the same; but who will take the trouble to thoroughly impregnate timber in buildings such as harbour dry-rot? And it is simply useless to merely paint these specifics on the surface of the timber: they soak in a little way, and kill the mycelium on the outside, but that is all, and the deadly rot goes on destroying the inner parts of the timber just as surely.

There is one practical suggestion in this connection, however; in cases where properly seasoned timber is used, the beams laid in the brick walls might have their ends creosoted, and if thoroughly done this would probably be efficacious during the dangerous period while the walls finished drying. I believe this idea has been carried out lately by Prof. Hartig, who told me of it. The same observer was also kind enough to show me some of his experiments with dry-rot and antiseptics: he dug up and examined in my presence glass jars containing each two pieces of deal—one piece sound, and the other diseased. The sound pieces had been treated with various antiseptics, and then tied face to face with the diseased pieces, and buried in the jar for many months or even two years.

However, I must now leave this part of the subject, referring the reader to Hartig's classical publications for further information, and pass on to a sketch of what is known of other kinds of "dry-rot." It is a remarkable fact, and well known, that *Merulius lacrymans* is a domestic fungus, peculiar to dwelling-houses and other buildings, and not found in the forest. We may avoid the discussion as to whether or no it has ever been found wild: one case, it is true, is on record on good authority, but the striking peculiarity about it is that, like some other organisms, this fungus has become intimately associated with mankind and human dwellings, &c.

The case is very different with the next disease-producing fungus I propose to consider. It frequently happens that timber which has been stacked for some time in the wood-yards shows red or brown streaks, where the substance of the timber is softer, and in fact may be "rotten": after passing through the saw-mill these streaks of bad wood seriously impair the value of the planks, beams, &c., cut from the logs

Prof. Hartig, who has devoted much time to the investigation of the various forms of "dry-rot," informs me that this particular kind of red or brown streaking is due to the ravages of *Polyporus vaporarius*. The mycelium of this fungus destroys the structure of the wood in a manner so similar to that of the *Merulius* that the sawyers and others do not readily distinguish between the two. The mycelium of *Polyporus vaporarius* forms thick ribbons and strands, but they are snowy white, and not gray like those of *Merulius lacrymans*: the structure, &c., of the fructification are also different. I have shown in Fig. 19 a piece of wood undergoing destruction from the action of the mycelium of this *Polyporus*, and it will be seen how the diseased timber cracks just as under the influence of *Merulius*.

Now *Polyporus vaporarius* is common in the forests, and Hartig has found that its spores may lodge in cracks in the barked logs of timber lying on the ground—cracks such as those in Fig. 1 (see p. 182). In the particular forests of which the following story is told, the felling is accomplished in May (because the trunks can then be readily barked, and also because such work cannot be carried on there in the winter), and the logs remain exposed to the sun and rain, and vicissitudes of weather generally, for some time. Now it is easy to see that rain may easily wash spores into such cracks as those referred to, and the fungus obtains its hold of the timber in this way.

The next stage is sending the timber down to the timber-yards, and this is accomplished, in the districts referred to, by floating the logs down the river. Once in the river, the wood swells, and the cracks close up; but the fungus spores are already deeply imprisoned in the cracks, and have no doubt by this time emitted their germinal hyphæ, and commenced to form the mycelium. This may or may not be the case: the important point is simply hat the fungus is already there. Having arrived at the

FIG. 19.—A piece of pine-wood attacked by the mycelium of *Polyporus vaporarius*. The timber has warped and cracked under the action of the fungus, becoming of a warm brown colour at the same time; in the crevices the white strands of felt-like mycelium have then increased, and on splitting the diseased timber they are found creeping and applying themselves to all the surfaces. Except that the colour is snowy white, instead of gray, this mycelium may easily be mistaken for that of *Merulius*. The fructification which it develops is, however, very different. (After R. Hartig)

timber-wharves, the logs are stacked for sawing in heaps as big as houses: after a time the sawing up begins. It usually happens that the uppermost logs when cut up show little or no signs of rot; lower down, however, red and brown streaks appear in the planks, and when the lowermost logs are reached, perhaps after some weeks or months, deep channels of powdery, rotten wood are found, running up inside the logs in such a way that their transverse sections often form triangles or V-shaped figures, with the apex of the triangle or V turned towards the periphery of the log.

The explanation is simple. The uppermost logs on the stack have dried sufficiently to arrest the progress of the mycelium, and therefore of the disease: the lower logs, however, kept damp and warm by those above, have offered every chance to the formation and spread of the mycelium deep down in the cracks of the timber. I was much impressed with this ingenious explanation, given to me personally by Prof. Hartig, and illustrated by actual specimens. It will be noticed how fully it explains the curious shape of the rotten courses, because the depths of the cracks are first diseased, and the mycelium spreads thence.

Obviously some protection would be afforded if the bark could be retained on the felled logs, or if they could be at once covered and kept covered after barking; and, again, something towards protection might be done by carting instead of floating the timber, when possible. At the same time, this is not a reliable mode of avoiding the disease by itself; and even the dry top logs in the saw-yard are not safe. Suppose the following case. The top logs of the stack are quite dry, and are cut into beams and used in building; but they have spores or young mycelium trapped in the cracks at various places. If, from contact with damp brick-work or other sources of moisture, these spores or mycelia are enabled to spread subsequently, we may have "dry-rot" in the building; but this "dry-rot" is due to *Polyporus vaporarius*, and not to the well-known *Merulius lacrymans*.

There can probably be no question of the advantage of creosoting the ends of such rafters, beams, &c.; since the creosote will act long enough to enable the timber to dry, if it is ever to dry at all. But the mycelium of *Polyporus vaporarius* makes its way into the still standing timber of pines and firs; for it is a wound-parasite, and its mycelium can obtain a hold at places which have been injured by the bites of animals, &c.: it thus happens that this form of "dry-rot" is an extremely dangerous and insidious one, and I have little doubt that it costs our English timber-merchants something, as well as Continental ones. Nor are the above the only kinds of "dry-rot" we know. Hartig has described a disease of pine-wood caused by *Polyporus mollis*, which is very similar to the last in many respects, and the suspicion may well gain ground that this important subject has by no means been exhausted yet.

H. MARSHALL WARD.

SCIENCE IN ELEMENTARY SCHOOLS.[1]

NOTHING could be more unsatisfactory than the present position of the knowledge and teaching of science in our elementary schools. Notwithstanding all the advantages that have been offered to pupil-teachers for the study of science, as a body they appear to be in a most deplorable state in this respect. Though success in the examinations of the Science and Art Department are now taken into account in placing the students of the training colleges for their teaching certificates, and average school-boys when they have been fairly taught are quite competent for these examinations, yet very few of the teachers have availed themselves of this privilege, and it does not appear that the training colleges have helped them in this respect. Very little, indeed, can be expected while the ordinary pupil-teacher is described, as he is in Mr. Oakeley's report on the working of the Training Colleges, as deficient in many elementary branches, notably mathematics. It is satisfactory, however, to notice that the quality of the candidates for admission to the Training Colleges is improving, and that these institutions are growing in teaching capacity and in popularity. The reports of the examiners for admission are not, with regard to the subject in hand, pleasant reading. One cannot expect good answering in science from candidates who are quite unable to paraphrase an ordinary piece of poetry, or to explain a common English expression. Accordingly we find that in Euclid, algebra, and mensuration, though a few papers were especially meritorious, the vast majority of the answers were very inferior. Few, if any, attempted the easy riders in Euclid, and the examiner remarks that he fears that the pupil-teachers receive but little assistance

[1] "Report of Committee of Council on Education (England and Wales), 1886-87."