TRANSLATIONS.

On the Impregnation *and* Germination *of* Algæ. By M. Pringsheim. (Abridged from the Reports of the Berlin Academy.)

(Continued from page 72.)

Having thus fully described the mode of origin of what may be termed the sexual organs in *Vaucheria*, the author proceeds to describe the process of impregnation as it takes place in the *Fucaceæ*, and which he finds to be of a precisely analogous nature. Adverting to Thuret's observations and experiments, which showed that unless brought into contact with the *antheridia* of the male plant, the spores of these plants invariably perish without germination, he proceeds to relate his own researches on the same subject in *Fucus vesiculosus*. The result was fully to confirm Thuret's statements.

The density and opacity of the contents of the so termed spores in the *Fucaceæ*, render them much less fitted for microscopic examination than are those of *Vaucheria*, nevertheless the author arrived at some important conclusions.

In *Fucus vesiculosus*, however, it is not the spore which is impregnated. The so-termed spore of this plant is a large thick-walled cell, densely filled with granular contents, and supported on a unicellular peduncle. When mature the contents of this spore divide into eight segments, which the author terms "division-spores" (Theilsporen). When arrived at this stage the contents of the spore are expelled from the transparent thick spore-membrane, and through the opening of the conceptacle (Hüllenfrucht). This usually takes place when the plants have been left dry by the retreat of the tide. Under the same circumstances the antheridial sacs of the male plant are also ejected through the opening of the conceptacle.

When the tide returns and the plants are again covered with water, the *antheridia* burst exactly as described by Thuret and Decaisne, and allow the mobile spermatozoids to escape, which spread themselves in all directions, and reach the "division-spores" which have collected themselves around the orifice of the conceptacles in the female plant. These sporules, which at the moment of their escape were imbedded in a common gelatinous matrix (fig. 21), have in the mean while become

isolated by the disappearance of the jelly. It will then be seen that each sporule is also surrounded by a very thin colourless gelatinous layer (fig. 22); and it will be distinctly perceived that these eight portions of contents of the original cell have not as yet acquired any cellulose membrane. Should any doubt upon this point remain, it will be wholly dissipated upon close consideration of the two lowermost sporules in their natural position, and which are the last to leave the spore-case when its contents escape (fig. 21 *a*). These two portions are always produced at the extremity into a point, which shows the absence of a membrane with the greater certainty, since the change of form into the spherical, which these spores undergo when they become isolated, could not take place did any membrane exist. The spermatozoids, then, come into contact with these membraneless masses, covered only with a thin gelatinous layer. It is these masses, the "division-spores" of the *Fucus*, which after impregnation has been effected become the young plant. The first indication of commencing germination in them is the formation of a visible, tough membrane (fig. 23) around them, which also manifestly arises from a transformation of the gelatinous layer in which they are enveloped. The membrane is apparent about twenty-four hours after the contact with the spermatozoids.

So soon as the membrane is formed around the sporules, a number of minute *red-brown nuclear bodies*, which did not exist before, are visible at the periphery of the sporule, and *they are enclosed together with the mass of the sporule by the newly-formed membrane with whose inner surface they are in contact.* The author never failed to observe these minute, red-brown nuclei (fig. 23), in impregnated sporules which afterwards grew up into young plants. They make their first appearance almost simultaneously with the formation of the membrane at the periphery of the sporule, and do not disappear till afterwards, and in the further development of the impregnated sporule (fig. 24). The author looks upon these corpuscles, whose colour corresponds with that of the nuclei of the spermatozoids of *Fucus*, as originating in the spermatozoids.

The present case, therefore, he remarks, affords another instance of what was observed in *Vaucheria*, viz., that the act of impregnation does not consist in the operation of the spermatozoids upon *a previously perfectly-formed cell possessing a membrane*—an "embryonic cell"—which would be impregnated through its membrane, but rather in this, that one or several spermatozoids enter a still membraneless, granular mass, which afterwards, together with the spermatozoids,

acquires a membrane, and thus comes to represent the vegetable embryonic cell capable of immediate development.

The parent-spore in *Fucus* and the *sporangium* in *Vaucheria*, are morphologically equivalent to the central cell of the *archegonium* in Ferns and Mosses, to which the canal of that organ leads, and to the embryo-sac of phanerogamous plants. The author has hitherto in vain sought for an embryonic cell before impregnation has taken place, in the central cell of the *archegonia*. But, on the contrary, is pretty well convinced that in this case also the true embryonic cell is not formed around a portion of the contents of the central cell until *after* the entrance of the spermatozoids, and that it encloses the spermatozoids which have thus effected their entrance. May not the same process take place also in phanerogamous plants? May not the point of the pollen-tube which enters the embryo-sac enclose the spermatozoids, which together with the contents of the embryo-sac become the cell of the embryo, which is not developed until *after* impregnation?

After noticing the obvious analogies, thus indicated, between the process of impregnation and the probable mode of origin of the *first* embryonic cell in animals and plants, the author goes on to speak of the sexual organs in the *Florideæ*.

He says that his own observations, which fully agree with those of Thuret, Mettenius, Derbès, and Solier, show that Nägeli was in error in stating that the *antheridia*, or cells so termed in the *Florideæ*, contained spiral filaments. These organs, however, are nevertheless true *antheridia*, and the absence of spiral filaments in them only show what was evident in *Fucus* and *Vaucheria*, that the existence of spiral filaments can no longer be regarded as the sole morphological proof of the male function of an organ. On the contrary, it is indisputable *that there are several forms of self-moving corpuscles which, in plants, exercise the function of spermatozoa.*

Besides the spermatozoids of the Ferns, Mosses, Characeæ, &c., which approach in conformation the animal spermatoza, we are at present also acquainted with forms more nearly approaching zoospores, as in the *Fucaceæ;* and, lastly, with that, differing from either, peculiar to the spermatozoids of *Vaucheria*, whose nearest allies would perhaps be met with among the Lichens. But the cells of the so-termed *antheridia* of the *Florideæ*, manifestly resemble in the most striking manner the spermatozoids of the *Fucaceæ*, and still more those discovered by the author in *Sphacelaria*, which, in their structure, appear to constitute an intermediate form between the two. This correspondence in structure, renders it in the highest degree probable that these organs constitute the true

male sexual apparatus of the *Florideæ*, although they possess so little motile power. As far as regards the antheridian cells of *Polysiphonia*, the author can only confirm what is stated by Thuret. "I noticed," he says, "it is true, a gradual emptying of the originally full *antheridia*; but I observed the isolated antheridian cells close to the *antheridium* from which they had escaped, free indeed, though always motionless." Like Thuret and Mettenius, the author has never been able to perceive the cilia described by Derbes and Solier.

Another question equally important with the discovery of the *antheridia*, concerns *the existence of organs in the Florideæ which are impregnated by the antheridea, whose existence has been thus certainly proved.*

The author has been unable to solve this question, which he proposes as a very interesting subject for botanists residing constantly at the sea-side. He has endeavoured, however, by observation of the germination of tetraspores, and of the conceptacular spores of *Ceramium rubrum*, to approach its solution.

But few observations upon the germination of the *Florideæ* have been published, and an essential defect pervades the few that have been made, owing to the circumstance that observers have been satisfied with the development of a few cells from the spore, and have not sought to inquire whether the growth proceeding from the spore resembles the parent plant or not. In order to determine this point, those plants are undoubtedly the most favourable whose laws of growth are known, and the author therefore instituted his researches on the spores of the species of *Ceramium*, because he had investigated the formation of the stem of the *Ceramia* with the accuracy requisite for an inquiry of the kind. For this purpose, it is sufficient to know, with respect to the mode of development of the *Ceramia*, that they grow with a terminal cell, from whose continued horizontal division the separate joints arise; and that the first cells of the so-termed cortical layer arise from the formation of oblique walls which are developed in the cells constituting the joints, in a direction from above and inwards, downwards and outwards; these first cortical cells then subdivide repeatedly, and thus constitute the cortical tissue surrounding the central series of cells.

Now, the tetraspore of the *Ceramium* in its germination, follows the mode just pointed out, from its first division onwards. It is itself the first apical cell of the future plant, as is shown by its longitudinal multiplication in the same way as the other apical cells, and in the indications of the formation of the cortical cells in the mode above described. The

product of its germination is therefore indubitably a young *Ceramium*.

But it is otherwise with the conceptacular spore. From this arises a very irregular cellular growth, which in form and mode of origin, exhibits no similarity whatever with the body of the *Ceramium*.

From this conceptacular spore is manifestly produced a *prothallus* (Vorkeim), and it only remains to inquire whether this production is equivalent to the *prothalli* of Mosses or to the *prothallium* of Ferns. As the author has often seen the commencement of germination in the still *closed* conceptacular fruit of the *Ceramia*, without noticing any entrance into it, it appears to him not improbable that the impregnation of the *Florideæ* takes place in the prothallus arising from the conceptacular spore; unless it may be, that the *Florideæ* with closed conceptacular fruit, may behave differently in this respect from those whose conceptacles have a canal leading into the interior.

Though his researches have been very incomplete, he sees reason to believe [with Harvey and Thwaites], that the tetraspores of the *Florideæ* represent only gemmules of the sexual multiplication, whilst the conceptacular spores are either the true female sexual organs of those plants, or at any rate produce a structure which exercises the female sexual function in some way or another.

Among the *Fucoideæ* of Agardh, the existence of *antheridia* in the true *Fucaceæ* (*Angiospermeæ*, Kützing) is no longer an isolated fact. A second instance of *antheridia* filled with mobile spermatozoids, in structure and mode of development far more closely resembling the *antheridia* of *Fucus* than those observed by Thuret in *Cutleria*, was discovered by the author two years since in *Sphacelaria tribuloides*.

The terminal cell of *Sphacelaria*, which, during the youth of the branch as a vegetative organ, forms the joints by repeated horizontal division, when the branch has attained to a certain age, suddenly ceases to divide; it enlarges considerably, and constitutes the organ, closely filled with contents at the apex of the older branches, and which has been termed by algologists the *sphacela*. This *sphacela*, which is always terminal, is in fact nothing more than the enlarged terminal cell of the ramule. It is precisely the same also with the terminal cells of those peculiarly metamorphosed lateral ramules, which are known as the propagative buds (brutknospen) of the *Sphacelaria*, and which are capable of becoming new plants by direct growth. Within this transformed cell on the common branches, as well as on the propagative buds, are after-

wards formed one or several large cells, which do not usually include the whole contents of the *sphacela*. These cells are the *antheridia* of the *Sphacelaria*, and their contents, at first brown, gradually lose all colour and appear indistinctly organized, assuming the aspect of a fine-granular, mucoid substance, obscurely subdivided into separate, roundish, colourless corpuscles, and closely resembling the contents of the *antheridium* of a Moss previous to its opening.

Shortly after the *antheridium* has reached this stage of development, its membrane is suddenly protruded on one side into a long tubular prolongation, which breaks through the wall of the *sphacela* (fig. 25) and opens at the point. At the same time an active struggling and swarming movement in the contents of the *antheridium* begins to take place under the eye of the observer; and it is seen that the indistinct organization presented in the contents of the unopened *antheridium*, was due to the existence of closely-packed, minute, colourless corpuscles, crowded into the narrow space.

Most of these corpuscles quickly escape, and quite isolated from each other, through the tubular process, moving spontaneously and freely with great rapidity in all directions. Those left in the *antheridium* now having more space, exhibit a distinct locomotion, although less rapid than that of the corpuscles which have made their exit.

In the spermatozoids left within the *antheridium*, the author has observed motion for more than an hour, whilst the escaped spermatozoids cease to move after a few minutes.

The movement of the spermatozoids, though in some degree like that of zoospores, appears to differ in this respect, that the motion of zoospores is more uniform and continuous, and that of the spermatozoids interrupted and jumping.

The spermatozoids of *Sphacelaria* appear like very minute, clear cells without any dark or coloured *nucleus*, and so far present the most striking resemblance to the antheridian-cells of the *Florideæ;* but, on the other hand, they are furnished with two cilia, like the spermatozoids of the *Fucaceæ*, like which they move very actively. They appear, therefore, to constitute an intermediate form between the spermatozoids of the *Fucaceæ* and those of the *Florideæ*, though as regards the development of the *antheridia* within a single cell, and the mode in which the *antheridium* opens, they are manifestly more nearly allied to the former.

The author has little hesitation in assigning the female sex to those plants which bear lateral sessile spores, but does not seem to have confirmed this by direct observation. He remarks that it is very probable that *Sphacelaria tribuloides* also

affords *zoospores*, which escape from the cells forming the joints; but of this also he does not appear to have any certain proof. He describes *antheridia*, precisely like those of *Sphacelaria* and developed in the same way, in the terminal cells of the lateral ramules in the closely-allied *Cladostephus spongiosus*.

With respect to the fresh-water Algæ most nearly allied to *Vaucheria*, it is, perhaps, sufficiently clear from the author's observations on that species, that these plants, besides the asexual, gemmate multiplication by zoospores, also present a true sexual propagation. The most probable supposition would be that the *female organs* of these plants, as in *Vaucheria* are to be sought in the *quiescent-spores*, which have been found in many genera. But in the next place it remains, not only to discover the *antheridia* in these plants, but also to show the possibility of the *entrance* of the spermatozoids into the interior of the quiescent spores, through an *opening in the spore-membrane;* or as in the *Fucaceæ* the impregnation of the sporules externally to the parent body.

The author's observations on these points, though incomplete, may still be serviceable towards further research.

The asexual multiplication of *Achlya prolifera* is well known, but besides the zoospores this plant also presents quiescent spores contained in peculiarly shaped *sporangia*.

The author finds that these spores germinate in the same way as do those of *Vaucheria*. He found also that before the formation of the quiescent spores, and in some measure simultaneously with the division of the contents into the masses destined to become quiescent spores, a great many minute, oval, sharply-defined openings are formed by the absorption of the cell-wall of the *sporangium* in several places, which constitute so many open passages into the interior of the *sporangium* even whilst its contents are in progress of formation into quiescent spores. The object of these openings is clearly to allow of the entrance of the spermatozoids into the dividing spore-mass. In this case, also, the action of the spermatozoids must be exerted upon the contents of the *sporangium whilst undergoing division* and *not* upon *perfectly-formed* spores, for, long after the openings have been formed, the segments of contents of the *sporangium*, are not even separated, and far less do they represent fully-formed cells.

This process of development indicates a great similarity between *Vaucheria* and *Achlya;* but whilst in the summit of the tube in *Vaucheria* a single large zoospore is formed, in that of *Achlya* very many smaller zoospores are produced, and the same is the case with respect to the quiescent spores;

whilst in the *sporangium* of *Vaucheria* only a single, large quiescent spore is produced which is impregnated through a solitary orifice in the membrane of the *sporangium*, in the *sporangia* of *Achlya* numerous smaller quiescent spores arise, and the supposed impregnation takes place through numerous openings in the membrane of the *sporangium*, whose number probably corresponds with that of the spores. The analogy between the two cases is further rendered more apparent by the existence of very slender ramifying branches springing from the parent tube in close contiguity to the *sporangium* containing the quiescent spores, and which are so closely applied to the membrane of the latter as apparently to be adnate to it. The analogy between these ramules which were first pointed out by Braun, and the "hornlet" in *Vaucheria* cannot be overlooked. The author has often noticed them, and it has appeared to him that where they were in contact with the membrane of the *sporangium*, these ramules throw out short papillary lateral shoots, which were protruded through the openings of the membrane of the *sporangium* and caused the close adhesion of the ramules to that body.

Although, at present, it is but a mere supposition that the spermatozoids of *Achlya* are developed in these armules, the existence of the openings through which the spermatozoids may reach and impregnate the contents of the *sporangium*, has at least been discovered; and it has also been shown that the quiescent spores of *Achlya* germinate in the same way as do those of *Vaucheria*.

Among other fresh-water *Algæ* which, besides the asexual mode of multiplication by zoospores, also present quiescent spores; the author proceeds to communicate some observations, made upon *Œdogonium*, *Bulbochæte*, and *Coleochæte*. With respect to the *micropyle* of the *sporangia* in *Œdogonium*. he remarks that before the formation of the spore in the parent cell, a great accumulation of its contents takes place as in *Vaucheria*; and on many occasions in *Œdogonium tumidulum*, he has witnessed the sudden *rupture* of the membrane of the *sporangium*, on one side, through which the granulous and cutaneous layers are protruded (fig. 26.) But the latter does not, as in *Vaucheria*, throw off a portion, but is again withdrawn; and the whole contents of the cell, not yet surrounded by a membrane, are converted into the well-known quiescent spore of *Œdogonium*, most probably with the co-operation of spermatozoids which have entered through the opening in the *sporangium* thus formed. The *opening* in *Œdogonium* is

smaller than in *Vaucheria*, and it represents an oval, sharply-defined slit (fig. 27).

The passage for the spermatozoids into the parent-cell of the quiescent spore of *Bulbochæte* is formed in a different way; in this instance the membrane of the *sporangium*, likewise in consequence of the accumulation of its contents, is also ruptured; but in a transverse fissure, more or less above the middle (figs. 28, 29), so that the membrane is split into two perfectly separate parts, between which the open passage to the contents of the *sporangium* is rendered possible.

The *openings* of the *sporangia* in *Œdogonium*, and the transverse fissures of those in *Bulbochæte*, both of which afford an open passage into the interior of the *sporangium*, being thus made known, a phenomenon common to both plants demands the closest consideration.

Besides zoospores and quiescent spores, a third kind of spores are met with in these plants, which are formed in smaller cells, widely different from the common vegetative cells (fig. 30*a*). To this kind of spore A. Braun has applied the name of "*microgonidia*," noticing, at the same time, that the product of their germination is merely very minute, usually bicellular little plants. These *microgonidia*, which present precisely the same structure as the zoospores, always affix themselves in a remarkable way, either upon the *sporangium* or close to it. In *Œdogonium* they are found seated sometimes upon the membrane of the *sporangium*, sometimes upon that of the cell immediately contiguous to it, and in *Bulbochæte* invariably upon the *sporangium* (figs. 28, 29, 30). Hence they open, either at once or after they have pushed out one or two short cells, and pour out their contents. Although, at present, no indication of spermatozoids has been observed in them, still the remarkable concurrence of the *evacuation* of these *microgonidia*, immediately over, or at any rate very close to the opening of the *sporangium* in *Œdogonium* and of the *transverse fissures* in *Bulbochæte* necessarily leads to the supposition that the contents of the *microgonidia* penetrate into the *sporangia*, and the author has no doubt that it will be found that the impregnating morphological elements of *Œdogonium* and *Bulbochæte* exist in the little plants produced from the *microgonidia*. But this impregnation in *Bulbochæte* and *Œdogonium* differs essentially from that which is observed in *Vaucheria*, for in the former case the two kinds of sexual organs are not produced upon the fully developed plants, but a special structure, a prothallus as it were, simply bearing *antheridia* is

formed, to act the part of an impregnating apparatus. And connected with this supposed diversity in the mode of *impregnation* is probably the difference observable in the mode of *germination; for the germination of the quiescent spores* in *Bulbochæte* differs very essentially from that of spores of *Vaucheria*.

The curious development of the quiescent spores of the former plant is thus described by the author.

The thick-walled, wholly *red* spore became green at the border, the innermost layer of the cell-wall expanded and burst through the outer layers and the membrane of the *sporangium*. Thus the spore escaped from the *sporangium* covered only by the innermost thin layer of the cell-wall, whilst the ruptured walls either opened out like two lids (fig. 31), or the upper portion was elevated upon the escaping spore (fig. 30). This liberated cell in a few hours was elongated into an ovoid corpuscle (figs. 32, 33), whose contents shortly afterwards were divided by successive scissions into four parts, lying one behind the other (fig. 33).

In one or other of these portions of contents might now be perceived a lateral, clear space (fig. 33), whilst the membrane surrounding the four bodies thus constituted became more and more expanded, lost its consistence, and swelled out into a kind of jelly. At the same time a faint movement was perceptible in the *four reddish-green bodies*, becoming more and more marked as the membrane expanded. The structure of the bodies was now sufficiently obvious; each exhibited a clear space at one end, around which was a crown of cilia (fig. 34); they moved about as far as the space would allow with great activity, with a continued vibration of the cilia, and an uninterrupted turning on their axis.

Thus in the interior of the quiescent spore four zoospores were produced, which presented precisely the same structure, and were of the same size as the *usual* zoospores of *Bulbochæte*, from which they differed merely in the circumstance that they contained, at any rate some of them, a red oil, similar to that with which the quiescent spores are filled.

These zoospores, when liberated from the surrounding vesicle, attached themselves and germinated. This production of four zoospores within the quiescent spore of *Bulbochæte*, recalls the similar process in *Chlamidococcus pluvialis*, and shows that the quiescent forms of the *Volvocinæ* should be regarded simply as quiescent algan spores resulting from sexual impregnation.

In various species of *Coleochæte* the formation of zoospores,

from the contents of the quiescent spore, may be observed to take place in pretty nearly the same way as in *Bulbochæte*.

Thus it will be seen that two modes of development of quiescent algan spores, resulting from impregnation, exist. Whilst in one mode, that which obtains in *Vaucheria* and *Achlya*, the quiescent spore is developed at once into a young plant; in the other, *Bulbochæte*, *Coleochæte*, *Œdogonium*, it is merely the parent of swarming zoospores, which grow into young plants by direct germination.

That similar sexual conditions occur in the *Palmellaceæ* is almost certain; at any rate, in them also the existence of red, quiescent spores together with zoospores is indubitable. Thus in *Glœocapsa ampla* the author found, besides the individuals whose cells become zoospores, other cells which acquire thick walls, and become filled with red contents. These forms have been erroneously regarded as distinct species. They are in fact the female individuals of the plant.

Researches are still very much wanted as to the sexual conditions of other *Algæ*, such as the *Spirogyræ* and *Desmidiaceæ* on the one hand, and the *Oscillarina*, Kutz. on the other, in which nothing like *antheridia* have been observed, although the author indicates the basilar cells in *Rivularia* as showing some indications of such being their nature. In conclusion, he thus sums up the result to which he conceives his observations have led:—

1. That the phenomena presented in *Vaucheria* and *Fucus*, establish beyond doubt the material co-operation of the spermatozoids in the act of impregnation.

2. With respect to the essential nature of the act of impregnation; it appears that the spermatozoids do not impregnate an already perfectly formed cell, but that the act of impregnation consists in this, that one or several spermatozoids enter the, as yet, membraneless contents of a cell; that this amorphous substance is not surrounded with a membrane until after the entrance of the spermatozoids, which membrane at the same time encloses the spermatozoids that have effected an entrance. The true embryonic vesicle, therefore, does not exist before impregnation, but is formed subsequently to that act.

3. With respect to the conditions attending the fructification of the *Algæ;* that a sexual propagation takes place in them as well as an asexual multiplication or gemmation.

The *asexual multiplication* is effected by means of the

tetraspores in the *Florideæ*, by the *prolifications* and *propagative gemmules* which are found in the *Fucaceæ* and the other *Fucoideæ*, and by the zoospores which are widely distributed among the marine and fresh-water *Algæ*. The sexual function is probably fulfilled in the *Florideæ* by the cells of the *antheridia* and the *conceptacular spores;* in the *Fucaceæ* certainly by the spermatozoids and the contents of the so-termed "spores;" in the *Confervæ* by spermatozoids and the contents of the quiescent spores.

The spores of the *Fucoideæ* and the *quiescent spores of the fresh water Algæ*, however, are properly spore-fruits (*sporangia*), whose contents are fertilized sometimes *within*, sometimes *without* the *sporangium*.

The *Algæ*, moreover, are sometimes *diœcious*—and this is the case with the greater number—some *monœcious*. The individuals, lastly, which form the *asexual* organs of multiplication are usually *sexually sterile;* but at the same time in their vegetative parts *more strongly developed* than the fertile; this holds good both of the individuals with tetraspores among the *Florideæ*, as well as of the individuals of the fresh-water *Algæ*, which form zoospores. The latter condition, which has as yet not been noticed, promises to afford much aid in the classification of allied forms.

On the COURSE *of the* AMYLOID DEGENERATION. By RUDOLPH VIRCHOW. (Abstracted from the Archiv. f. Patholog. Anatomie und Physiologie. Bd. viii., p. 364.)

IN former communications on the subject of "amyloid degeneration" the Author was able to adduce, as instances of the affection, besides the *corpora amylacea* in the nervous system, only the waxy degeneration of the spleen, liver, and kidneys; but since then some more recent cases have afforded him the opportunity of extending his researches, and of making, as he thinks, a very important advance in the knowledge of the remarkable changes included under the term.

In all these cases there existed chronic, and very considerable disease in some part of the *osseous system*. Even in his former communication, respecting the "waxy spleen," he had noticed that it was especially in persons affected with chronic disease of the bones that this form of degeneration of the organ was presented, and he has since seen scarcely a single case in which the same complication did not exist. This frequent association cannot, he thinks, be explained except upon the supposition that the disease in the bone exerts a