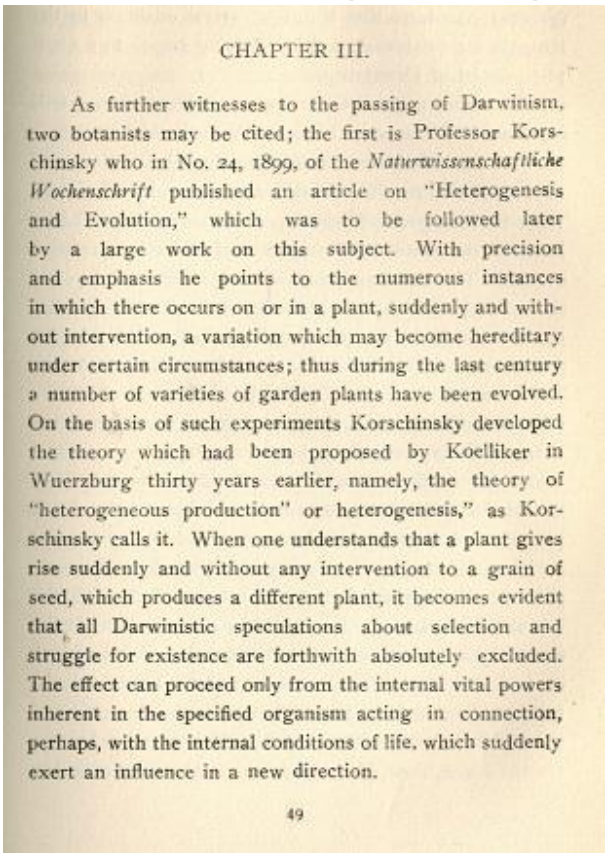
All of these images can be enlarged for greater detail



CHAPTER III.

As further witnesses to the passing of Darwinism, two botanists may be cited; the first is Professor Korschinsky who in No. 24, 1899, of the *Naturwissenschaftliche Wochenschrift* published an article on "Heterogenesis and Evolution," which was to be followed later by a large work on this subject. With precision and emphasis he points to the numerous instances in which there occurs on or in a plant, suddenly and without intervention, a variation which may become hereditary under certain circumstances; thus during the last century a number of varieties of garden plants have been evolved. On the basis of such experiments Korschinsky developed the theory which had been proposed by Koelliker in Wuerzburg thirty years earlier, namely, the theory of "heterogeneous production" or heterogenesis," as Korschinsky calls it. When one understands that a plant gives rise suddenly and without any intervention to a grain of seed, which produces a different plant, it becomes evident that all Darwinistic speculations about selection and struggle for existence are forthwith absolutely excluded. The effect can proceed only from the internal vital powers inherent in the specified organism acting in connection, perhaps, with the internal conditions of life, which suddenly exert an influence in a new direction.

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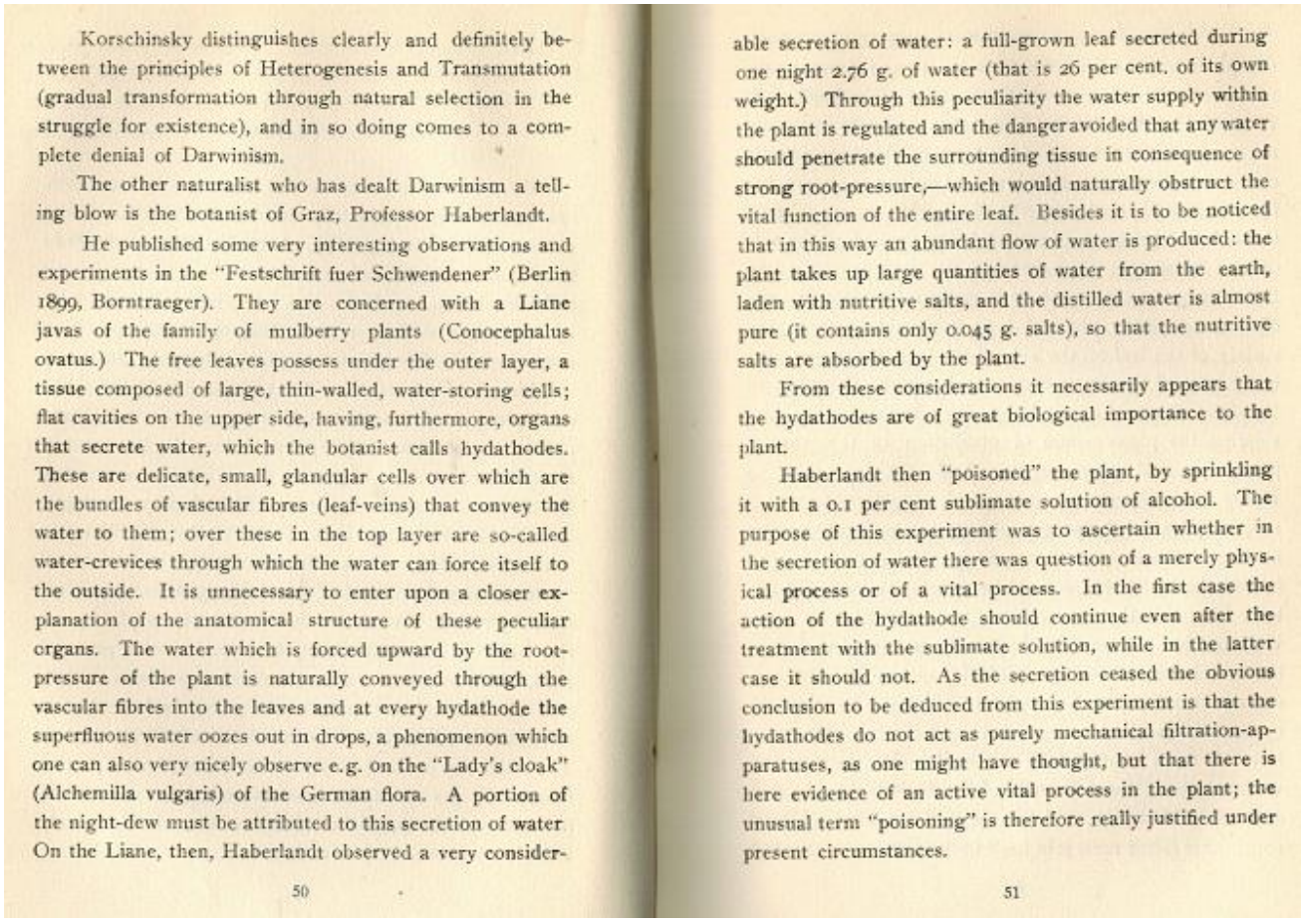

Korschinsky distinguishes clearly and definitely between the principles of Heterogenesis and Transmutation (gradual transformation through natural selection in the struggle for existence), and in so doing comes to a complete denial of Darwinism.

The other naturalist who has dealt Darwinism a telling blow is the botanist of Graz, Professor Haberlandt.

He published some very interesting observations and experiments in the "Festschrift fuer Schwendener" (Berlin 1899, Borntraeger). They are concerned with a Liane javas of the family of mulberry plants (Conocephalus ovatus.) The free leaves possess under the outer layer, a tissue composed of large, thin-walled, water-storing cells; flat cavities on the upper side, having, furthermore, organs that secrete water, which the botanist calls hydathodes. These are delicate, small, glandular cells over which are the bundles of vascular fibres (leaf-veins) that convey the water to them; over these in the top layer are so-called water-crevices through which the water can force itself to the outside. It is unnecessary to enter upon a closer explanation of the anatomical structure of these peculiar organs. The water which is forced upward by the root-pressure of the plant is naturally conveyed through the vascular fibres into the leaves and at every hydathode the superfluous water oozes out in drops, a phenomenon which one can also very nicely observe e.g. on the "Lady's cloak" (Alchemilla vulgaris) of the German flora. A portion of the night-dew must be attributed to this secretion of water. On the Liane, then, Haberlandt observed a very considerable secretion of water: a full-grown leaf secreted during one night 2.76 g. of water (that is 26 per cent. of its own weight.) Through this peculiarity the water supply within the plant is regulated and the danger avoided that any water should penetrate the surrounding tissue in consequence of strong root-pressure,—which would naturally obstruct the vital function of the entire leaf. Besides it is to be noticed that in this way an abundant flow of water is produced: the plant takes up large quantities of water from the earth, laden with nutritive salts, and the distilled water is almost pure (it contains only 0.045 g. salts), so that the nutritive salts are absorbed by the plant.

From these considerations it necessarily appears that the hydathodes are of great biological importance to the plant.

Haberlandt then "poisoned" the plant, by sprinkling it with a 0.1 per cent sublimate solution of alcohol. The purpose of this experiment was to ascertain whether in the secretion of water there was question of a merely physical process or of a vital process. In the first case the action of the hydathode should continue even after the treatment with the sublimate solution, while in the latter case it should not. As the secretion ceased the obvious conclusion to be deduced from this experiment is that the hydathodes do not act as purely mechanical filtration-apparatuses, as one might have thought, but that there is here evidence of an active vital process in the plant; the unusual term "poisoning" is therefore really justified under present circumstances.

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Let me dwell for a moment on this result, for, although it may be somewhat foreign to our present purpose and to the further observations of Haberlandt, it is very significant in itself. The water moves in the plant in closed cells, as the cells of the aqueous gland are entirely closed, but the organic membrane, as every one knows, has the peculiar physical property of allowing water to pass through, the pressure, of course, being applied on the side of least resistance; when therefore the water is forced into the cells by root-pressure, it is easily intelligible that according to purely physical laws it should come to the surface of the leaf on the side of the least resistance, that is, by way of the water-crevices. Even the defenders of "vital force" would not find any reason in this for not considering the phenomenon of distillation in this case a purely physical phenomenon. And still according to Haberlandt's experiments it is not. The sublimate could at most only impede the process of filtration, but should under no circumstances have destroyed it. But it does destroy it, and the hydathode dies. The conclusion certainly follows from this that this process is connected with some vital function. Even if the hydathode is treated with sublimate solution, all the conditions for mechanical filtration still remain: the earth has moisture which can be taken up by the roots so that root-pressure still exists. The water is in all cases conveyed to the hydathodes through the vascular fibres, the cell walls of the hydathodes are still adapted for filtration, and yet they do not filter. Hence some other factor must join itself to the physico-mechanical



process of filtration and affect or destroy it, and this factor can be found only in the protoplasm, the vital element of the cells; for we know that the sublimate acts with pernicious effect on it and in such a manner that it destroys its entire power of reaction; it kills it, as we say.

The experiment under discussion has, therefore, great significance for our view of the vital processes in the plant; it proves beyond doubt that these processes are in no way of a purely mechanical nature, but that there is something underlying all this, a hitherto inexplicable something, which we call "life." In all vital activities, physical and chemical processes certainly do occur; they do not, however, take place spontaneously but are made use of by the vital element of the plant to produce an effect that is desirable or necessary for the vital activity of the plant. If the vital element is dead, no matter how favorable the conditions may be for chemical and physical processes, these do not take place and the effect necessary for life is not obtained. It is very remarkable after all that according to the experiment of Haberlandt this peculiar relation should become apparent in a process that is so open to our investigation as the filtration of water through the cell-wall of a plant.

After what has been said I consider this simple experiment of Haberlandt of great significance; for it is a direct proof of the existence of a vital force. One may resist to his heart's content, but without avail; vital force is again finding its way into science. More and more cognizance



is being taken of the fact that 60 and 70 years ago people jumped at conclusions very imprudently when they believed that the first artificial preparation of organic matter (urea, by Woehler) had proven the non-existence of a vital force. Since then there has been great rejoicing in the camp of materialists who scoffed at the "ignorant" who would not as yet forsake vital force. "Behold," they said, "in the chemist's retort the same matter is produced chemically that is produced in the body of the animal, without the direction of a hidden vital force, which, if it is not necessary in the one case, neither is it necessary in the other." Any one who had given the matter careful consideration could even at that time have known where the "ignorant" really were. That in both cases chemical processes take place is clear and undisputed, but the materialists forgot entirely that even in the laboratory it was not the mere contact of the elements that produced the urea; a chemist was needed and in this case not any one arbitrarily chosen, but a man of the genius and knowledge of a Woehler to watch over the process, and utilize and partly direct the laws of chemistry in order to obtain the desired result. Hence it was even then absurd to deny vital force as a consequence of that experiment. Since, however, it was well-adapted for materialistic purposes, this denial was proclaimed with the sound of trumpet throughout the land, and repeated again and again with surprising tenacity, with the result that even thoughtful investigators rejected vital force almost universally in the seventies and eighties.



It has always been a problem to me how this could have happened. It can, indeed, be explained only on the supposition that naturalists were adverse to the introduction of anything into nature, that appeared to them mystical and mysterious. Nor is such a procedure at all necessary: vital force is by no means a mysterious, ghostly power that soars above nature, but a force of nature like its other forces, as mysterious and as definite as they are, only that it dominates a specified group of beings, namely, living organisms. It may readily be compared with any other natural phenomenon. For instance, the phenomenon of crystalization has its well determined sphere of activity, viz., the mineral world. It employs definite mathematico-physical laws to obtain a specified result, and even acts differently in different mineral substances in so far as it produces in the one case this, in the other case that form; but still it should be a similarly directed force which has the effect of producing these peculiar forms. Precisely similar is it with vital force. It has its determined sphere of activity, the kingdom of living organisms; it acts according to definite physico-chemical laws in producing a specified result; it acts differently in different living organisms; it is therefore a force of nature as clear yet as mysterious as the force of crystallization or as any other force of nature. Hence one has no cause to complain of its mysteriousness, for all other forces of nature are just as much, or if you will, just as little mysterious as vital force. The only thing to be maintained is this, that living organisms are domi-

nated by a special force with special phenomena and special activities, even as in mineral substances there is a special dominant force which produces special phenomena and exercises special activities.

It is possible to produce crystals in the laboratory, but no one will be so foolish as to maintain that in nature crystals are not formed in consequence of a very definite force inherent in the mineral-substances; nor will any one deny the existence of the force of crystallization because it does not appear in living organisms.

Nor have I ever despaired of a return of the theory of vital force. A change of opinion has really taken place during this decade; at present the voices for a vital force are constantly growing stronger and it will most probably not be very long before it will be again universally recognized, not as something preternatural, of course, but as a force of nature on an equal footing with the other forces of nature, with activities, just as mysterious and just as well-attested as the activities of the other forces of nature.

Haberlandt's experiment, however, had also an indirect consequence that is of far-reaching importance. He observed that within a few days new water-secreting organs of an entirely different structure and of different origin were formed on the leaves that had been sprinkled with sublimate. Over the bundles of vascular fibres, little knots as large as a pin head arose in larger numbers out of a tissue underlying the top layer; out of these the water now oozed every morning. Closer investigation disclosed the



fact that these organs develop only on young immature leaves where groups of peculiar, perishable gland-hairs are found; beneath these dead mucous glands the substitute secretive organs originate in the inner tissue. It is of no importance to state in what particular cells they originate.

Suffice it to say that they are colorless capillary tubes originating in various cells; projecting like the hairs of a brush, containing living protoplasm and evanescent chlorophyl. It is also important to note that this new organ is immediately connected with the water-conducting system consisting of bundles of vascular fibres. Haberlandt furthermore indicates especially that these organs when viewed in connection with the process of secretion give evidence of an active vital principle as well as of simple mechanical filtration.

These substitute organs are all indeed well adapted to their purpose and adequately replace the old secretive organs, but they so easily dry out and are so little protected that after a week they become parched and die because wound-cork forms under them. The leaf no longer produces new hydathodes, but on its lower side it produces growths that function as vesicles, by means of which it continues to sustain itself.

Haberlandt furthermore records a phenomenon perhaps analogous to this on the grape-vine, but with this exception the case described by him is unique. In order to pass any further judgment regarding it, we should have to ascertain whether the whole phenomenon is not a case



of so-called adaptation; if so, processes should be found in nature, analogous to the poisoning of the hydathodes in this experiment, which result in the destruction of the hydathodes so that in consequence the plant would have gained the power of making good the loss, by means of the substitute organs. Such processes, however, (even through poisoning or through parasites) would be very highly improbable. Equally incredible is the alternative possibility that the new organs would be produced by the plant not as a substitute but as a supplementary apparatus when the old ones would not suffice for secretion in case of very large absorption of water. This also must doubtlessly be rejected, as Haberlandt has observed.

Powers of adaptation should, of course, according to Darwinism, be gradually acquired in the struggle for existence, as in that case they should also have stability; but since this is not possessed by the new organs, the presumption is that they do not possess the character of adaptation. They are therefore new organs that originated after an entirely unnatural and unforseen interference with the normal vital functions and in consequence of a self-regulating activity of the organism.

What then is there in the whole phenomenon worthy of notice with regard to the theory of Descent?

1. An immediately well adapted new organ has here originated very suddenly without any previous incipient formation, without gradual perfection and without stages of transition.



2. In its formation struggle for existence and natural selection are entirely excluded, neither can find any application whatever even according to the newer exposition of Weismann. Haberlandt himself draws this conclusion.

3. If this phenomenon of a suddenly appearing change can take place in the course of the development of the individual, there can be no obvious reason why it should not take place in the same manner (without natural selection or struggle for existence) in the course of the phylogenetic development.

It is manifestly of the greatest importance that in this case a direct, experimental proof has been given that an organ has originated suddenly and without the aid of Darwinian principles. Haberlandt's article is nothing less than a complete renunciation of Darwinism on the part of Haberlandt, a renunciation which we greet with great satisfaction.

In fact one such observation would really suffice to set aside Darwinism and prove the utter insufficiency of its principles to give explanation of the origin of natural species. On the other hand, this observation plainly proves two things: first, that the above mentioned doctrine of Koelliker, now held by Korschinsky is a move in the right direction for the discovery of the causes of descent; and secondly, that the principal cause of the evolution is not to be sought in environment and blind forces but in the systematically working, internal vital principle in plants and animals. With that, however, an important part of the foundation of the mechanical-materialistic view of the world is demolished.