is not confined to the inoculation spot, but spreads to the neighboring parts until it attains a diameter of from 0.05 to 1 cm.

In a few days it becomes more and more manifest that the skin thus changed is necrotic, finally falling off, leaving a flat ulceration which usually heals rapidly and permanently without any involvement of the adjacent lymphatic glands. Thus the injected tubercular bacilli quite differently affect the skin of a healthy guinea pig from one affected with tuberculosis. This effect is not exclusively produced with living tubercular bacilli, but is also observed with the dead bacilli, the result being the same whether, as I discovered by experiments at the outset, the bacilli are killed by a somewhat prolonged application of a low temperature or boiling heat or by means of certain chemicals. This peculiar fact I followed up in all directions, and this further result was obtained—that killed pure cultivations of tubercular bacilli, after rinsing in water, might be injected in great quantities under healthy guinea pig's skin without anything occurring beyond local suppuration. Such injections belong to the simplest and surest means of producing suppurations free from living bacteria.

Tuberculous guinea pigs, on the other hand, are killed by the injection of very small quantities of such diluted cultivations. In fact, within six to forty-eight hours, according to the strength of the dose, an injection which is not sufficient to produce the death of the animal may cause extended necrosis to the skin in the vicinity of the place of injection. If the dilution is still further diluted until it is scarcely visibly clouded, the animals inoculated remain alive and a noticeable improvement in their condition soon supervenes. If the injections are continued at intervals of from one to two days, the ulcerating inoculation wound becomes smaller and finally scars over, which otherwise it never does; the size of the swollen lymphatic glands is reduced, the body becomes better nourished, and the morbid process ceases, unless it has gone too far, in which case the animal perishes from exhaustion. By this means the basis of a curative process against tuberculosis was established.

Against the practical application of such dilutions of dead tubercle bacilli there presented itself the fact that the tubercle bacilli are not absorbed at the inoculation points, nor do they disappear in another way, but for a long time remain unchanged, and engender greater or smaller suppurative foci. Anything, therefore, intended to exercise a healing effect on the tuberculous process must be a soluble substance which would be liberated to a certain extent by the fluids of the body floating around the tubercle bacilli, and be transferred in a fairly rapid manner to the juices of the body; while the substance producing suppuration apparently remains behind in the tubercular bacilli, or dissolves but very slowly. The only important point was, therefore, to induce outside the body the process going on inside, if possible, and to extract from the tubercular bacilli alone the curative substance. This demanded time and toil, until I finally succeeded, with the aid of a forty to fifty per cent. solution of glycerine, in obtaining an effective substance from the tubercular bacilli. With the fluid so obtained I made further experiments on animals, and finally on human beings. These fluids were given to other physicians to enable them to repeat the experiments.

The remedy which is used in the new treatment consists of a glycerine extract, derived from the pure cultivation of tubercle bacilli. Into the simple extract there naturally passes from the tubercular bacilli, besides the effective substance, all the other matter soluble in fifty per cent. glycerine.

Consequently, it contains a certain quantity of mineral salts, coloring substances, and other unknown extractive matters. Some of these substances can be removed from it tolerably easily. The effective substance is insoluble in absolute alcohol. It can be precipitated by it, though not, indeed, in a pure condition, but still combined with the other extractive matter. It is likewise insoluble in alcohol. The coloring matter may also be removed, rendering it possible to obtain from the extract a colorless, dry substance containing the effective principle in a much more concentrated form than the original glycerine solution. For application in practice this purification of the glycerine extract offers no advantage, because the substances so eliminated are unessential for the human organism. The process of purification would make the cost of the remedy unnecessarily high.

Regarding the constitution of the more effective substances, only surmises may for the present be expressed. It appears to me to be derivative from albuminous bodies, having a close affinity to them. It does not belong to the group of so-called toxalbumins, because it bears high temperatures, and in the dialyzer goes easily and quickly through the membrane. The proportion of the substance in the extract to all appearance is very small. It is estimated at fractions of one per cent., which, if correct, we should have to do with a matter whose effects upon organisms attacked with tuberculosis go far beyond what is known to us of the strongest drugs.

Regarding the manner in which the specific action of the remedy on tuberculous tissue is to be represented, various hypotheses may naturally be put forward. Without wishing to affirm that my view affords the best explanation, I represent the process myself in the following manner:

The tubercle bacilli produced when growing in living tissues, the same as in artificial cultivations, contain substances which variously and notably unfavorably influence living elements in their vicinity. Among these is a substance which in a certain degree of concentration kills or so alters living protoplasm that it passes into a condition that Weigert describes as coagulation necrosis. In tissue thus become necrotic the bacillus finds such unfavorable conditions of nourishment that it can grow no more and sometimes dies.

This explains the remarkable phenomenon that in organs newly attacked with tuberculosis, for instance in guinea pigs' spleen and liver, which then are covered with gray nodules, numbers of bacilli are found, whereas they are rare or wholly absent when the enormously enlarged spleen consists almost entirely of whitish substance in a condition of coagulation necrosis, such as is often found in cases of natural death in tuberculous guinea pigs. The single bacillus cannot, therefore, induce necrosis at a great distance, for as soon as necrosis attains a certain extension the growth

of the bacillus subsides, and therewith the production of the necrotizing substance. A kind of reciprocal compensation thus occurs, causing the vegetation of isolated bacilli to remain so extraordinarily restricted, as, for instance, in lupus and scrofulous glands.

In such cases the necrosis generally extends only to a part of the cells, which then, with further growth, assume the peculiar form of riesen zelle, or giant cells. Thus, in this interpretation, follow first the explanation Weigert gives of the production of giant cells.

If now one increased artificially in the vicinity of the bacillus the amount of necrotizing substance in the tissue, the necrosis would spread a greater distance. The conditions of nourishment for the bacillus would thereby become more unfavorable than usual.

In the first place the tissue which had become necrotic over a large extent would decay and detach itself, and where such were possible would carry off the enclosed bacilli and eject them outwardly, so far disturbing their vegetation that they would much more speedily be killed than under ordinary circumstances.

It is just in looking at such changes that the effect of the remedy appears to consist. It contains a certain quantity of necrotizing substance, a correspondingly large dose of which injures certain tissue elements even in a healthy person, and perhaps the white blood corpuscles or adjacent cells, thereby producing fever and a complication of symptoms, whereas with tuberculous patients a much smaller quantity suffices to induce at certain places, namely, where tubercle bacilli are vegetating and have already impregnated the adjacent region with the same necrotizing matter, more or less extensive necrosis of the cells, with the phenomena in the whole organism which result from and are connected with it.

For the present, at least, it is impossible to explain the specific influence which the remedy, in accurately defined doses, exercises upon tuberculous tissue, and the possibility of increasing the doses with such remarkable rapidity, and the remedial effects which have unquestionably been produced under not too favorable circumstances.

Of the consumptive patients whom he described as temporarily cured, two have been returned to the Moabit Hospital for further observation.

No bacilli have appeared in their sputum for the past three months, and their phthisical symptoms have gradually and completely disappeared.

CAN WE SEPARATE ANIMALS FROM PLANTS?

By ANDREW WILSON.

ONE of the plainest points connected with the study of living things is the power we apparently possess of separating animals from plants. So self-evident appears this power that the popular notion scoffs at the idea of science modestly disclaiming its ability to separate the one group of living beings from the other. Is there any danger of confusing a bird with the tree amid the foliage of which it builds its nest, or of mistaking a cow for the grass it eats? These queries are, of course, answerable in one way only. Unfortunately (for the querists), however, they do not include or comprehend the whole difficulty. They merely assert, what is perfectly true, that we are able, without trouble, to mark off the higher animals from the higher plants. What science inquires is, whether we are able to separate *all* animals from *all* plants, and to fix a definite boundary line, so as to say that all the organisms on the one side of the line are assuredly animals, while all the others on the opposite side of the line may be declared to be truly plants. It is exactly this task which science declares to be among the impossibilities of knowledge. Away down in the depths of existence and among the groundlings of life the identity of living things becomes of a nature which is worse than confusing, and which renders it a futile task to attempt to separate the two worlds of life. The hopelessness of the task, indeed, has struck some observers so forcibly that they have proposed to constitute a third kingdom—the *Regnum Protisticum*—between the animal and the plant worlds, for the reception of the host of doubtful organisms. This third kingdom would resemble the casual ward of a workhouse, in that it would receive the waifs and strays of life which could not find a refuge anywhere else.

A very slight incursion into biological fields may serve to show forth the difficulties of naturalists when the task of separating animals from plants is mooted for discussion. To begin with, if we suppose our popular disbeliever to assert that animals and plants are always to be distinguished by shape and form, it is easy enough to show him that here, as elsewhere, appearances are deceptive. What are we to say of a sponge, or a sea anemone, or corals, of zoophytes growing rooted from oyster shells, of sea squirts, and of sea mats? These, each and all of them, are true animals, but they are so plant-like that, as a matter of fact, they are often mistaken by seaside visitors for plants. This last remark holds especially true of the zoophytes and the sea mats. Then, on the other hand, we can point to hundreds of lower plants, from the yeast plant onward, which show none of the ordinary features of plant life at all. They possess neither roots, stems, branches, leaves, nor flowers, so that on this first count of the indictment the naturalist gains the day.

Power of movement, to which the popular doubter is certain to appeal, is an equally baseless ground of separation. For all the animals I have above named are rooted and fixed, while many true plants of lower grade are never rooted at all. The yeast plant, the *Alga* that swarms in our ponds, and the diatoms that crowd the waters, exemplify plants that are as free as animals; and many of them, besides, in their young state especially (e. g., the seaweeds), swim about freely in the water as if they were roving animalcules. On the second count, also, science gains the day; power of motion is no legitimate ground at all for distinguishing one living being as an animal, while absence of movement is similarly no reason for assuming that the fixed organism must of necessity be a plant. Then comes the microscopic evidence. What can this wonder glass do in the way of drawing boundary lines between the living worlds? The reply again is disappointing to the doubter; for the microscope teaches us that the tissues of animals and plants are built upon

kindred lines. We meet with cells and fibers in both. The cell is in each case the primitive expression of the whole organism. Beyond cells and fibers we see the wonderful living substance, *protoplasm*, which is alike to our senses in the two kingdoms, although, indeed, differing much here and there in the results of its work. On purely microscopic grounds, we cannot separate animals from plants. There is no justification for rigidly assuming that this is a plant or that an animal on account of anything the microscope can disclose. A still more important point in connection with this protoplasm question consists in the fact that as we go backward to the beginnings of life, both in animals and plants, we seem to approach nearer and nearer to an identity of substance which baffles the microscope with all its powers of discernment. Every animal and every plant begins existence as a mere speck of this living jelly. The germ of each is a protoplasm particle, which, whatever traces of structure it may exhibit, is practically unrecognizable as being definitely animal or plant in respect of its nature. Later on, as we know, the egg or germ shows traces of structure in the case of the higher animals and plants; while even lowly forms of life exhibit more or less characteristic phases when they reach their adult stage. But, of life's beginnings, the microscope is as futile as a kind scientific touchstone for distinguishing animals from plants as is power of movement, or shape, or form.

A fourth point of appeal in the matter is found within the domain of the chemist. Chemistry, with its subtle powers of analysis, with its many-sided possibilities of discovering the composition of things, and with its ability to analyze for us even the light of the far distant stars, only complicates the difficulties of the biologist. For, while of old it was assumed that a particular element, nitrogen, was peculiar to animals, and that carbon was an element peculiar to plants, we now know that both elements are found in animals, just as both occur in plants. The chemistry of living things, moreover, when it did grow to become a staple part of science, revealed other and greater anomalies than these. It showed that certain substances which were supposed to be peculiar to plants, and to be made and manufactured by them alone, were also found in animals. Chlorophyll is the green coloring matter of plants, and is, of course, a typical product of the vegetable world; yet it is made by such animals as the hydra of the brooks and ponds, and by many animalcules and some worms. Starch is surely a typical plant product, yet it is undoubtedly manufactured, or at least stored up, by animals—a work illustrated by the liver of man himself, which occasionally produces sugar out of its starch.

Again, there is a substance called *cellulose*, found well nigh universally in plants. Of this substance, which is akin to starch, the walls or envelopes of the cells of plant tissues are composed. Yet we find those curious animals, the sea squirts, found on rocks and stones at low-water mark, manufacturing cellulose to form part and parcel of the outer covering of their sac-like bodies. Here it is as if the animal, like a dishonest manufacturer, had infringed the patent rights of the plant. On the fourth count, then—that of chemical composition—the verdict is that nothing that chemistry can teach us may serve definitely, clearly, and exactly to set a boundary line or to erect a partition wall between the two worlds of life. There yet remains for us to consider a fifth head—that of the food.

In the matter of the feeding of the two great living worlds we might perchance light upon some adequate grounds for making up the one kingdom from the other. What the consideration of form, movement, chemical composition, and microscopic structure could not effect for us in this way, it might be supposed the investigation of the diet of animals and plants would render clear. Our hopes of distinguishing the one group from the other by reference to the food on which animals and plants subsist are, however, dashed to the ground; and the diet question leaves us, therefore, when it has been discussed, in the same quandary as before.

Nevertheless, it is an interesting story, this of the nutrition of animals and plants. A large amount of scientific information is to be gleaned from such a study, which may very well be commenced by our having regard to the matters on which a *green* plant feeds. I emphasize the word "green" because it so happens that when a plant has no chlorophyll (as green color is named in the plant world) its feeding is of diverse kind to that which a green plant exhibits. The mushroom or other fungus may be taken as an illustration of a plant which represents the non-green race, while every common plant, from a bit of grass to an oak tree, exemplifies the green-bearing order of the vegetable tribes.

Suppose we were to invite a green plant to dinner, the *menu* would have to be very differently arranged from that which would satisfy a human or other animal guest. The soup would be represented for the plant's delectation by water, the fish by minerals, the joint by carbonic acid gas, and the dessert by ammonia. On these four items a green plant feeds, out of them it builds up its living frame. Note that its diet is of inorganic or non-living matter. It derives its sustenance from soil and air, yet out of these lifeless matters the green plant elaborates and manufactures its living matter, or protoplasm. It is a more wonderful organism than the animal, for while the latter can only make new protoplasm when living matter is included in its food supply, the green plant, by the exercise of its vital chemistry, can transform that which is not living into that which is life-possessing.

The green plant, in other words, raises non-living into living matter, while the animal can only transform living matters into its like. This is why the plant is called a constructive organism, while the animal is, contrariwise, named a destructive one. The result of the plant's existence is to build up, that of the animal's life is to break down its substance, as the result of its work, into non-living matter. The animal's body is, in fact, breaking down into the very things on which the green plant feeds. We ourselves are perpetually dissipating our substance in our acts of life and work into the carbonic acid, water, ammonia, and minerals on which plants feed. We "die daily" in as true a sense as that in which the apostle used the term. And out of the debris of the animal frame the green plant builds up leaf and flower, stem and branch, and all the other tokens of its beauty and its life.

If, then, an animal can only live upon living matter—that is to say on the bodies of other animals or of plants—with water, minerals and oxygen gas from the air thrown in to boot, we might be tempted to hold that in such distinctive ways and works we had at last found a means of separating animals from plants. Unfortunately, this view may be legitimately disputed and rendered null and void, on two grounds. First of all, the mushrooms and their friends and neighbors, all true plants, do not feed as do the green tribes. And secondly, many of the green plants themselves can be shown to have taken very kindly to an animal mode of diet.

A mushroom, thus, because it has no green color, lives upon water, oxygen, minerals, and organic matter. You can only grow mushrooms where there is plenty of animal matter in a state of decay, and as for the oxygen, they habitually inhale that gas as if they were animals. Non-green plants thus want a most characteristic action of their green neighbors. For the latter in daylight take in the carbonic acid gas, which is composed of carbon and oxygen. Under the combined influence of the green color and the light, they split up the gas into its two elements, retaining the carbon for food and allowing the oxygen to escape to the atmosphere. Alas! however, in the dark our green plant becomes essentially like an animal as regards its gas food, for then it is an absorber of oxygen, while it gives off carbonic acid. If to take in carbonic acid and to give out oxygen be held to be a feature characteristic of a plant, it is one, as has been well said, which disappears with the daylight in green plants, and which is not witnessed at all in plants that have no green color.

So far, we have seen that not even the food of plants and animals can separate the one kingdom of life from the other. The mushroom bars the way and the green plant's curious behavior by night and by day respectively, in the matter of its gas food, once more assimilates animal life and plant life in a remarkable manner. Still more interesting is the fact, already noticed, that even among the green tribes there are to be found many and various lapses from the stated rules of their feeding. Thus what are we to say of the parasitic mistletoe, which, while it has grown leaves of its own, and can, therefore, obtain so much carbon food from the air on its own account, nevertheless drinks up the sap of the oak or apple which forms its host, and thus illustrates the spectacle of a green plant feeding like an animal, on living matter? Or, what may we think of such plants as the sundew, the Venus' fly trap, the pitcher plants, the side saddle plants, the butterworts and bladderworts, and others of their kind, which not only capture insects, often by ingenious and complex lures, but also digest the animal food thus captured? A sundew thus spreads out its lure in the shape of its leaf studded with sensitive tentacles, each capped by a glistening drop of gummy secretion. Entangled in this secretion, the fly is further fixed to the leaf by the tentacles which bend over it and inclose it in their fold. Then is poured out upon the insect's body a digestive acid fluid, and the substance of the dissolved and digested animal is duly absorbed by the plant. So also the Venus' fly trap captures insects by means of its leaf, which closes upon the prey when certain sensitive hairs have given the signal that the animal has been trapped. Within the leaf the insect is duly digested as before, and its substance applied to the nutrition of the plant. Such plants, moreover, cannot flourish perfectly unless duly supplied with their animal food. Such illustrations of exceptions to the rule of green plant feeding simply have the effect of abolishing the distinctions which the diet question might be supposed to raise between animals and plants. We may return to the sundews and other insect catchers; meanwhile, I have said enough to show that to the question, "Can we separate animals from plants?" a very decided negative reply must be given. Life everywhere exhibits too many points of contact to admit of any boundary line being drawn between the two great groups which make up the sum total of organic existence.—*Illustrated London News*.

THE RECOVERY OF SILVER AND GOLD FROM PLATING AND GILDING SOLUTIONS.

IN view of the rapid development and extension of the methods of electro-plating with silver and gold, and of the large amount of spent liquors containing silver or gold thus produced, it has long been desirable to find methods by which these metals can be recovered from the spent liquors. The processes hitherto adopted generally necessitate the tedious and unpleasant evaporation of the cyanide liquors, or else involve a series of chemical operations which are somewhat difficult to carry out, so that actually the used-up baths are sold to some firm which undertakes this recovery as a particular branch of its business.

A process invented by Stockmair and Fleischmann, and worked out by them in the chemical laboratory of the Bavarian Industrial Museum, is, however, exceedingly simple, and is employed in many establishments.

In order to remove silver from a potassium cyanide silver solution, it is only necessary to allow a clean piece of plate zinc to remain in the liquid for two days; even better results are obtained by the use of iron conjointly with the zinc. In the first case, the silver often adheres firmly to the zinc, while in the second it always separates out as a powder. It is then only necessary to wash the precipitated powder, which usually contains copper (since spent silver solutions always contain copper), dry it, and then dissolve it in hot concentrated sulphuric acid, water being added, and the dissolved silver precipitated by strips of copper. The silver thus obtained is perfectly pure. If the amount of copper present is only small, it can usually be removed by fusing the precipitated powder with a little niter and borax.

In this way a spent silver bath was found to contain per liter

1st experiment.....	1.5706 grms.
2d	1.5694 "
Mean.....	1.5700 "

The presence of silver could not be qualitatively ascertained in the residual liquor.

Although sheet zinc, or zinc and iron sheets, serve so well for the precipitation of silver, they cannot be

employed for the recovery of gold. The latter separates out in such a case very incompletely and as a firmly adhering lustrous film in the zinc. On the other hand, finely divided zinc, the so-called zinc dust, is an excellent substance to employ for precipitating gold quantitatively and in the form of powder from spent cyanide liquors. When zinc dust is added to a spent gold bath and the liquid periodically stirred or shaken, all the gold is precipitated in two or three days. The amount of zinc to be added naturally depends on the quantity of gold present. Freshly prepared gold baths for gilding in the cold contain on the average 3.5 grms. gold per liter, while those used for the hot process contain 10.75 grms. To precipitate all the gold in the original bath, 1.74 grms. or 0.37-0.5 grms. zinc dust would be necessary, and, of course, a much smaller quantity would be sufficient for the spent liquors. Since the precipitation takes place more rapidly when an excess of zinc dust is present, it is generally advisable to add $\frac{1}{4}$ or at the most $\frac{1}{2}$ kilo. of zinc dust to every 100 liters of solution.

The precipitated gold, which contains zinc dust and usually silver and copper, is washed, freed from zinc by hydrochloric acid, and then from silver and copper by nitric acid and thus obtained pure.

A spent bath treated in this way gave the following amounts of gold per liter:

1st experiment.....	0.2626
2d	0.2634
Mean.....	0.2630 grms.

The presence of gold in the residual cyanide solution could not be qualitatively detected. The potassium cyanide of the solutions obtained by this process should be converted into ferrocyanide by heating with ferrous sulphate and milk of lime, since this substance is not poisonous and can therefore be got rid of without danger. It would, however, be more economical and, considering the large amount of cyanide present, more profitable to work it up into Prussian blue.

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