

**The cure of consumption : further communications on a remedy for tuberculosis / by Robert Koch.**

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# THE CURE OF CONSUMPTION

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FURTHER COMMUNICATIONS ON  
A  
REMEDY FOR  
TUBERCULOSIS

BY  
PROF. ROBERT KOCH

AUTHORISED TRANSLATION

*From the Original Paper published in the "Deutsche  
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## REMEDY FOR TUBERCULOSIS.



IN an address which I delivered a few months ago at the International Medical Congress, I mentioned a remedy which is capable of rendering animals experimented on insusceptible to inoculation with the tubercle bacillus, and which arrests the process of tuberculosis in animals already diseased. Meanwhile, experiments have been made on human patients with this remedy; and these will be treated of in the following discourse.

Originally, it was my intention, before publishing anything on the subject, to complete all my



researches thoroughly, and especially to acquire sufficient experience of the practical application of the remedy, and its preparation on a large scale. However, in spite of all precautionary measures, so many garbled and exaggerated versions have been made public, that it seems to me advisable, in order to avoid any false impressions, to give at once a sketch of the present state of the matter. It is true that, under these circumstances, the sketch can only be brief, and many important questions must be left unanswered.

The experiments have been carried out, under my direction, by Dr. A. Libbertz and Stabsarzt, Dr. E. Pfuhl, and some of them are still in progress. The necessary patients were placed at our disposal by Professor Brieger, from his Poliklinik; Dr. W. Levy, from his private surgical clinic; Geheimrath Fraentzel and Oberstabsarzt; R.

Köhler, from the Charité Hospital; and Geheimrath von Bergmann, from the surgical clinic of the University. I wish here to express my heartfelt thanks to all these gentlemen, as well as to their assistants, for the lively interest they have shown in the cause, and for the disinterested way they have received me. It would have been impossible without all this co-operation to have advanced so far in the arduous and important investigation within so short a time.

As my work is not yet completed, I cannot make any statement here as to the origin and preparation of the remedy, but must reserve this for future occasion.\*

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\* Those doctors who may already wish to make use of the remedy, can obtain it from Dr. A. Libbertz (Lüneburgstrasse, 28 II, Berlin, N.W.), who has undertaken to prepare it, with Dr. Pfuhl's and my assistance. But I wish to state that the present supply is but small, and some weeks must elapse before larger quantities will be at our disposal.



The remedy consists of a clear, brownish liquid, which keeps its strength without any special precautions being taken. For use, however, this fluid must be more or less diluted, and these dilutions, if prepared with distilled water, are liable to decomposition; bacterial growths very speedily develop in them; they become turbid, and are then quite useless. In order to avoid this, the dilutions must be sterilised by heat and preserved under a cotton-wool stopper, or, what is still more convenient, be prepared with 0·5 per cent. solution of phenol.

It appears, however, that after some time the effect is weakened, both by constant heating and by mixture with the phenol solution, especially in much diluted solutions, and I have therefore, as far as possible, made use of freshly prepared solutions.

The remedy does not take effect through the stomach ; in order to obtain a reliable effect, it must be introduced by subcutaneous injection. In our experiments we have always used for this purpose the syringe recommended by me for all bacteriological work ; it is provided with a small india-rubber ball, and is without piston. This kind of syringe can very easily be kept aseptic by rinsing it out with absolute alcohol ; and it is to this circumstance that we attribute the fact that not one single abscess has been formed in over a thousand cases of subcutaneous injection.

After several trials on other parts of the body, the place we chose for the application of the injection was the skin of the back, between the shoulder-blades and in the lumbar region, because in these places the injection produced



the least local reaction, and was almost painless.

As regards the effect of the remedy on human beings, it was evident at the very beginning of the experiments, that in one very important point the effect of the remedy on man is entirely different from that on the guinea-pig, which is the animal usually experimented upon. Here again is a fresh and conclusive proof of that most important rule for all experimentalists, that an experiment on an animal gives no certain indication of the result of the same experiment upon a human being.

Human beings showed themselves to be very much more susceptible to the effects of the remedy than the guinea-pig. As much as two cubic centimètres, and even more, of the non-diluted liquid can be injected under the skin

of a healthy guinea-pig without any noticeable injury to it. But for a healthy grown-up man 0·25 cubic centimètre suffice to produce a very intense effect. Calculating by body weight, therefore, the 1500th part of the quantity which produces no visible effect on the guinea-pig has a very powerful effect on the human being.

I have experienced in my own person the symptoms which arise after the injection of 0·25 cubic centimètre, having made an injection in the upper part of my arm. These symptoms were briefly as follows: Three or four hours after the injection I felt pains in the limbs, fatigue, inclination to cough, difficulty in breathing, all which speedily increased; in the fifth hour I was seized with an unusually violent fit of shivering, which lasted nearly an hour; at the same time there was sickness, vomiting, and the temperature of the body



rose to  $39.6^{\circ}$  C.; after about twelve hours all these symptoms gradually grew less, the temperature fell, and by the next day was again normal. The heaviness in the limbs and the feeling of languor lasted a few days longer, and the spot where the injection had been made continued red and painful for the same length of time.

For a healthy human being, the lowest limit of the effect of the remedy is about 0.01 cubic centimètre (equal to 1 cubic centimètre of the hundredth solution), as numerous experiments have proved. Most people for whom this dose was used showed reaction merely by slight pains in the limbs and passing languor. In a few of the cases there was a slight rise in the temperature, to  $38^{\circ}$  C., or a little more. Although, in regard to the dose of the remedy, there is a very considerable difference between men and animals



(calculating by the weight of the body), still in some other points there is much resemblance between them.

The most important of these points is the specific effect of the remedy on tuberculous processes, of whatever kind they may be.

I will not here describe this action with reference to the animals experimented upon, as it would lead me too far from my subject, but will at once turn to the very remarkable action it has on tuberculous human beings.

A healthy human being reacts, as we have seen, either not at all, or very slightly, at the use of 0.01 cubic centimètre. Various experiments have proved that the same holds good, too, with people suffering from any disease that is not tuberculous. But it is a very different matter when the patient is tuberculous; if the same dose of the remedy

(0·01 cubic centimètre)\* be injected there ensues a strong general, as well as a local, reaction.

This reaction usually consists in a feverish attack, beginning, as a rule, with a shivering fit; the temperature rises to  $39^{\circ}$ , sometimes to  $40^{\circ}$ , and even to  $41^{\circ}$  C.; added to this, there are pains in the limbs, a tendency to cough, great exhaustion, and often sickness and vomiting. On several occasions a slight icteric colour was noticed, and in some cases there also appeared an eruption like measles on the chest and neck. As a rule, the attack begins four or five hours after the injection, and lasts from twelve to fifteen hours. In exceptional cases it begins later and passes off with less violence. The patients are very little affected

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\* For children of three to five years of age, we have injected a tenth part (0·001) of this dose, for very delicate children only 0·0005 cubic centimètre, and have produced by this a strong but not alarming reaction.



by the attack, and as soon as it is over they feel comparatively well—as a rule, even better than they did before it.

The local reaction can best be observed in those patients whose tuberculous affections are visible ; for instance, in cases of lupus. Here changes occur which show the specific anti-tuberculous action of the remedy in a very surprising degree. A few hours after the injection has been made under the skin of the back—in a spot, that is, absolutely removed from the diseased parts of the skin of the face—the lupus spots begin to swell and grow red ; this is generally the case, too, before the shivering fit comes on. While the fever lasts, the swelling and redness continue to increase, and may finally become very considerable, so that the lupus tissue becomes necrotic and of a reddish-brown colour in places. Where the seat of the lupus was more



sharply defined, the much swollen and red-brown spot was sometimes encircled by a whitish rim nearly 1 centimètre broad, which again would be surrounded by a highly coloured, broad red band. After the fever has gone down, the swelling of the lupus spots gradually decreases, and after two or three days they have entirely disappeared. The seats of the lupus are then covered with a crust of oozing serum, which dries on exposure to the air; this changes into scabs, which fall off after the lapse of two or three weeks, and sometimes, after repeated injections of the remedy, leave behind them a smooth red scar. Generally, however, several injections are required to remove the lupus tissue completely—but more of this later on. It must be observed, as being of special importance in this proceeding, that the changes described confine themselves solely and entirely to parts of the skin

affected by lupus. Even the smallest and most trifling little nodules concealed in the lupus tissue go through the whole process, and become visible in consequence of the swelling and change of colour, whereas the actual tissue where the lupus changes have taken place remains unchanged.

The observation of a lupus patient treated with this remedy is so instructive, and at the same time must be so convincing with regard to the specific nature of the remedy, that every one who wishes to adopt the remedy should begin his experiments, if possible, on lupus patients.

Less striking, but still visible to both eye and touch, are the local reactions in tuberculosis of the glands, bones, and joints, &c.—cases which are attended by swelling, increased pain, and redness of the superficial parts. The reaction in the internal organs, especially the lungs, cannot be observed,



unless, indeed, increased cough and expectoration of the consumptive patients after the first injections may be looked upon as a local reaction. In such cases the general reaction is dominant. It must nevertheless be assumed that changes take place similar to those which come under direct observation in lupus cases.

The symptoms of reaction here described occurred without any exception in those cases where a tuberculous process was present in the organism, after a dose of 0·01 cubic centimètre; and I think, therefore, I am not going too far in assuming that in future the remedy will prove to be an indispensable *diagnostic aid*. It will be possible with this remedy to diagnose doubtful cases of incipient phthisis, even after failing to determine with certainty the nature of the disease by the discovery of bacilli or elastic fibres in the sputum, or by a



physical examination. Glandular affections, latent tuberculosis of the bone, doubtful tuberculosis of the skin, will be easily and with certainty defined as such. It will be quite possible in apparently cured cases of tuberculosis of the lungs or joints to determine whether the process of disease is really terminated, and whether there may not still be some few diseased spots which might cause the disease to break out afresh, spreading its ravages like sparks from under smouldering ashes.

The healing effects of the remedy are, however, of much greater importance than its diagnostic uses.

In describing the changes caused by a subcutaneous injection of the remedy into portions of the skin affected by lupus, it has already been mentioned that after the swelling and redness have abated, the lupus tissue does not resume its original state, but is more or less destroyed, and

so disappears. In some parts, as shown by observation, this result is caused by the instant destruction of the diseased tissue after one sufficient injection, so that, at a later stage, it falls off like a dead mass. In other parts there seems to ensue a disappearance, or sort of melting away of the tissues, which requires repeated injections of the remedy for the completion of the cure. It is not yet possible to define with certainty the development of this process, as the necessary histological researches are still wanting. So much, however, is certain, that it is not a question of the destruction of the tubercle bacilli in the tissue, but only that the tissue which contains the tubercle bacilli is affected by the remedy. In this tissue, as shown by the visible swelling and redness, considerable disturbances of the circulation take place, combined evidently with serious changes in its nutri-



tion, causing the tissue to die off more or less quickly and deeply, according to the extent with which the remedy is used.

To repeat briefly: the remedy, therefore, does not kill the tubercle bacilli, but the tuberculous tissue. This, then, gives clearly and definitely the limit of the action of the remedy. It is only capable of influencing living tuberculous tissue; it produces no effect whatever on dead tissue, such as, for instance, necrotic cheesy masses, necrotic bones, &c.; nor can it influence any tissue already rendered necrotic by the remedy itself. These dead tissue masses may still contain living tubercle bacilli, which will either be thrown off with the necrotic tissue, or may possibly, under certain circumstances, enter the neighbouring and still living tissues.

It is very necessary to give careful consideration to this peculiarity of the remedy, if its healing



properties are to be turned to profitable use. The still living tuberculous tissue must therefore be destroyed, and every effort then made, for instance, by means of surgical aid, to remove the dead tissue. In those cases, however, where this is not feasible, and the organism can only help itself by slowly throwing off the tissue, a repeated use of the remedy is enjoined, in order to protect the endangered living tissue from a possible re-installation of the parasites.

The fact that the remedy renders tuberculous tissue necrotic and acts only on living tissue, helps undoubtedly to explain another and a very peculiar characteristic—namely, that it may be administered in very rapidly increasing doses. At first this might seem to be a question of habit. But when it is recognised that in the course of about three weeks the dose may be increased to

five hundred times the original quantity, the question of habit can no longer be entertained, as nothing analogous to such a complete and rapid adaptation of a powerfully active remedy has ever been known.

This phenomenon must rather be explained by the fact that there is much tuberculous living tissue to start with, and, consequently, a small quantity of the active substance will suffice to cause a strong reaction ; after each injection, however, a certain quantity of the tissue capable of reaction disappears, and comparatively increasing doses are then necessary to obtain the same degree of reaction as before. It is possible that within certain limits habit may here assert itself. As soon as a tuberculous patient has been treated with increasing doses until the result is that the reaction is as slight as that of a non-tuberculous.



patient, it may then be assumed that the destruction of all tuberculous tissue capable of reaction has been accomplished. The treatment will then have to be continued with slowly increasing doses and at intervals, so as to protect the patient from fresh infection as long as there may be bacilli in the organism.

Whether this conception and the inferences arising from it be correct, the future will show. Meanwhile, I for my part have based and constructed thereon that method of using the remedy, which we employed as follows :

To resume with the simplest case—namely, lupus ; we injected at once into nearly all those patients the full dose of 0·01 cubic centimètre, allowing the reaction to run its course to the end ; then injecting again 0·01 cubic centimètre after one or two weeks, continuing in this manner until the



reaction became feebler, and finally ceased entirely. In two cases of facial lupus the lupus spots were in this way brought to smooth cicatrisation after three or four injections; other lupus patients have also improved in proportion to the duration of the treatment. All these patients had been sufferers for many years, and had been previously treated in various ways without success.

Tuberculous affections of the glands, bones, and joints were treated in a similar way, large doses being given at long intervals. The result was the same as in the lupus cases: rapid recovery in recent and slight cases; slow, gradual improvement where the cases were severe.

Somewhat different were the circumstances in the phthisical patients, who form the majority of our patients. Patients with decided tuberculosis of the lungs are far more susceptible to the remedy

than those suffering from surgical tuberculous affections. We were obliged to lower the dose of 0·01 cubic centimètre as being much too high for a phthisical patient to begin with, and found that they nearly all reacted strongly to 0·002, and even to 0·001 cubic centimètre. But from this small first dose it is possible to rise more or less quickly to the same quantities taken by, and agreeing with, other patients. As a rule, our plan was as follows : First, an injection of 0·001 cubic centimètre was given to the phthisical patient, and then, when the rise in the temperature ensued, the same dose was repeated once daily until no reaction occurred. Then only was the dose increased to 0·002 cubic centimètre, until this quantity too could be taken without causing reaction, and so on, increasing to 0·001 cubic centimetre, or, at the most, 0·002 cubic centimètre, up to 0·01, and higher still. This



cautious treatment seemed to me a necessity for those patients who were reduced in strength. If the above method is adhered to, the following result is easily obtainable: a patient may be brought to bear very large doses of the remedy without suffering from fever, and in a manner barely perceptible to himself. A few of the tolerably strong phthisical patients were treated from the first, partly with larger doses, and partly with rapidly increasing doses; this treatment apparently was conducive to more rapid and favourable results. The action of the remedy in cases of phthisis generally showed itself in this way: the cough and expectoration usually increased after the first injections, but then gradually became less and less until, in the most favourable cases, they totally disappeared; the expectoration also lost its purulent character and became mucous. Only



those patients whose expectoration contained bacilli were chosen for experiments, and the number of bacilli generally decreased only after the expectoration had assumed a mucous appearance. They then sometimes disappeared entirely, but were met with occasionally from time to time until the expectoration entirely stopped. Simultaneously, too, the night sweats ceased, the patients improved in appearance and increased in weight. Those patients who were treated in the early stages of phthisis were all free from the symptoms of the disease from within four to six weeks, so that they might be looked upon as cured. Patients, too, with not too highly developed cavities improved considerably, and were almost cured. Only those whose lungs contained many and large cavities did not improve objectively, although the expectoration decreased and their subjective condition was better.

From these experiences I conclude that *phthisis in the early stages can be cured with certainty by this remedy*.\*

Partially, too, this may be taken for granted in cases not too far advanced.

But phthisical patients with large cavities, who almost always suffer from other complications, arising, for instance, from the penetration of other pus-forming micro-organisms into the cavities, or from incurable pathological changes in certain organs, &c., will probably only in exceptional cases derive any lasting benefit from the

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\* This declaration is certainly liable to limitation, in so far as at present no conclusive experiences are yet to the fore, nor could possibly be brought forward yet, to prove that the cure is a lasting one. As a matter of course, relapses may still occur, but it may be assumed that they will be just as easily and quickly cured as the first attack. On the other hand, it may be possible, as with other infectious diseases, that patients once cured always retain their immunity. But this, too must remain an open question for the present.



use of this remedy. In most cases, however, even such patients as those were cured temporarily. From this it may be concluded that in their case, too, as with other patients, the original process of disease, tuberculosis, is influenced by the remedy, and that the one thing wanting is the possibility of removing the necrotic masses of tissue, together with the secondary suppuration processes. Involuntarily the question arises, whether it might not be possible to afford relief to many of these suffering people by a combination of this new therapeutic method with surgical additions (such as the operation for empyema) or with other curative methods. And here I desire earnestly to dissuade any one from using the remedy in a conventional and indiscriminate way in all cases of tuberculosis. The treatment will probably be most simple in the early stage of phthisis, as also in any simple surgical affections; but in all other forms of tubercu-



losis, free scope must be allowed to medical art, so as to assist the working of the remedy by a system of careful individualisation and the appliance of other auxiliary aids. In several cases I have had a decided impression that the nursing of the patients had a very considerable influence on the result of the treatment. For this reason I strongly advocate the use of the remedy in proper institutions, where careful observation of the patients and requisite nursing can be carried out, in preference to the treatment at home or as an out-patient. It is impossible as yet to decide how far the methods of treatment hitherto acknowledged (such as mountain climate, fresh-air treatment, special diet, &c.) may advantageously be combined with the new treatment; but I believe that these therapeutic methods, when combined with the new treatment, will prove to be highly beneficial in many cases, parti-

cularly in neglected or very severe cases, as also in the convalescent stage.\*

The most important point in the new treatment consists, as I have already said, in the earliest possible application of it. The first stage of phthisis ought really to be the subject for treatment, as in this way the working of the method can be more clearly and fully demonstrated. On this account, therefore, it cannot be too seriously pointed out that in future, more than ever before, all practitioners must make every effort to diagnose phthisis in as early a stage as possible. Hitherto the proof of tubercle bacilli in the sputum has been looked upon as an interesting feature, but of secondary importance only, which, though it determined the

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\* As regards tuberculosis of the brain, larynx and miliary tuberculosis, too little material was placed at our disposal to enable us to gain proper experience.



diagnosis, was of no further benefit to the patient, and was in consequence only too often neglected. This has latterly been repeatedly brought under my notice in numerous phthisical patients who had generally been in the hands of several doctors, and always without having had any examination of the sputum made. In future this must be changed. Any doctor who may neglect to diagnose phthisis in the earliest possible stage with all means at his command, and especially by examining the suspicious sputum on tubercle bacilli, is guilty of most serious neglect of his patient, whose life may depend, not only on this diagnosis, but also on the specific treatment to be followed immediately on the completion of the diagnosis thereof. In doubtful cases a doctor ought to make a probing injection, and thereby assure himself of the presence or absence of tuberculosis.



Then only will this new method of healing have become a true blessing to suffering humanity, when it has been carried so far that all cases of tuberculosis are treated in their earliest stage, preventing thereby the development of those neglected but serious cases which have hitherto formed inevitably an everlasting source of fresh infections.

In conclusion, I wish to remark that I have purposely abstained from giving any statistical reports or descriptions of individual cases in the above communication, because those doctors whose patients we made use of for our experiments have themselves undertaken to describe the different cases, and I wished my account to be as objective as possible, and in no way to encroach upon their own personal observations.