Mays, T. J.

THE

NON-CONTAGIOUSNESS OF PULMONARY TUBERCULOSIS.

BY

THOMAS J. MAYS, M.D.,

PHILADELPHIA, PA.

SURGEON GEN'L'S OFFICE
294
LIBRARY

Read before the Philadelphia County Medical Society February 23, 1887.

[Reprinted from The Therapeutic Gazette, March, 1887.]

DETROIT, MICH.:
GEORGE S. DAVIS, PUBLISHER.
1887.

SURGEON GENERAL'S OFFICE
294
LIBRARY

THE NON-CONTAGIOUSNESS OF PULMONARY TUBERCULOSIS.

WE are probably safe in asserting that the majority of the members of the medical profession are impressed with the belief that pulmonary consumption is a contagious disease. If this current opinion is true, it becomes one of the gravest questions, both in domestic and public hygiene, to define the proper relation between the consumptive patient and his surroundings. Therefore, fully appreciating the difficulties which envelop this problem, and holding the highest regard for the intelligent minds with whom we are compelled to take issue, we shall offer no other apology than the importance of the subject for making it the topic of this paper; with the express avowal, however, that this is not undertaken for the mere purpose of entering the arena of controversy, but from a conviction that the belief in the contagiousness of the disease is erroneous, and with a sincere desire to add something which, perchance, may be of value in placing this much-disputed question on a more solid basis than it has heretofore occupied.

Viewed from the broad stand-point of evolution, as this question naturally must be, it will appear that all the infectious diseases are the result of a living union and interaction of unlike though not too highly specialized cells; or, to be more specific, these diseases are the products of grafting one cell on another,—a process identical with that of grafting practised in the vegetable world, and with skin-grafting frequently resorted to in the human subject,—and their intensity depends on the activity of the reproductive power with which these cells are endowed. This reproductiveness is common to every living cell in the animal body, but varies widely in different cells, being most active in those which are least differentiated, or, in other words, in those which retain the nearest approach to the original cell-type. In the lower stages of life all the cells in an organism are equally endowed with the power of reproduction, and any indifferent segment is capable of reproducing the whole animal. Thus, protozoa multiply by spontaneous fission, and the original organism resolves into a number of new individuals like the parent. But in the evolutionary changes of animal life the cells of some tissues undergo a greater modification than those of others, and those which diverge most from the original type become the least reproductive, while those which undergo no, or very little, change remain the most reproductive. In this higher stage of life the process of reproduction is carried on by a specialized tissue,—the ovary and testis,—the cells of which only retain the power of reproducing the whole animal, while in the cells of the other tissues, although they are still capable of reproducing themselves, this power is lost. The form-elements of the body consist of epithelial tissues, tissues of the connective substance, the muscular, and nervous tissues, and of all these the nervous tissue has the highest and the epithelial tissue the lowest organization. Gegenbaur says that epithelium represents both phylogenetically and ontogenetically the oldest and most primitive form of cellular tissue.

Now, reproduction itself is generally regarded as a very complicated process, and one for the performance of which highly specialized organs are considered essential; but on examination it will be found that both the sperm-cell and the germ-cell originate in the epithelial layer, which, as we have seen, is the simplest and most unspecialized tissue in the body. Hence, from a biological point of view, it is an extremely simple process. In relation to this subject Herbert Spencer ("Biology," vol. i. p. 220) says, "The organs

for preparing sperm-cells and germ-cells have none of the specialty of structure which might be looked for did sperm-cells and germ-cells need endowing with properties essentially unlike those of all other organic agents. On the contrary, these reproductive centres proceed from tissues that are characterized by their low organization. In plants, for example, it is not appendages that have acquired considerable structure which produce the fructifying particles: these arise at the extremities of the axes, where the degree of structure is the least. The embryo-cells are formed in the undifferentiated part of the cambium layer; the pollen-grains are found at the little-differentiated extremities of the stamens, and both are homologous with simple epithelium-cells. Among many inferior animals, devoid of special reproductive organs, such as the *hydra*, the ova and spermatozoa originate in the layer of indifferent tissue that lies between the endoderm and the ectoderm,—that is, they consist of portions of the least specialized substance. And in the higher animals these same generative agents appear to be merely modified epithelium-cells,—cells not remarkable for their complexity of structure, but rather for their simplicity."

But this is not all that concerns us here; for, in accordance with a well-known physiological law, organic cells manifest an elective affinity for one another during the process of fertilization, which is weakest when the sperm-cell and the germ-cell possess too much sameness, and strongest when these cells originate from the same tissue in different individuals of the same species. This is well shown in the vegetable world. Nearly all plants are hermaphrodites,—that is, they are so situated that it is possible for the ovules of each flower to be fertilized by pollen from the same flower; yet practically this does not occur, for Mr. Darwin has demonstrated that either the ovules and pollen of the same plant do not ripen simultaneously, or that other obstacles arise which prevent fertilization in this direct way, and that the most vigorous vegetation is produced when fertilization takes place between different plants. The same law of cell affinity also exists in the highest organisms.

That which is of the greatest interest to us at present in these biological phenomena is (*a*) that the cells of every tissue in the animal body possess the power of reproducing themselves; (*b*) that the power of reproducing the whole individual is shared only by the cells of the epithelial tissue; and (*c*) that the process of reproduction is most active between the slightly differentiated cells of the same tissue not in the same, but in different individuals. And we shall find that these deductions are as applicable to pathological as they are to physiological processes, for disease is propagated in the same manner as health is.

When under proper conditions a germ which has been modified by disease is grafted on a healthy germ, disease-germs will be produced, and the number of disease-germs thus produced will depend on the facility with which both germs reproduce themselves; and from what has been said it is evident that disease-germs will be most abundant when the epithelial tissues are involved, and least abundant when they originate in the nervous or muscular tissues, while those coming from the white or connective tissues occupy an intermediate position in this respect.

We have now arrived at a point where we are enabled to define the term contagion. Broadly, it may be stated that all infectious diseases are either contagious or inoculable, and that both of the latter terms represent processes which differ in degree only and not in kind. It is essential to both that their respective germs should find lodgment in the circulation before the disease is transmitted from one individual to another, and whether a germ is contagious or not depends on the facility with which it gains admission to and multiplies itself in the tissues for which it has an affinity; or, in other words, if a germ has the power of entering the circulation through the coverings of the body, it is a contagious germ; but when this is not the case, and it must be introduced by means of artificial force, then the germ is not contagious, but inoculable. Now, the facility with which a germ enters the blood is in a great measure owing to its reproductive activity outside of the blood. A germ which rapidly multiplies, and which disseminates a great number of contagious germs throughout the atmosphere, will expose the recipient body to a greater number of such germs in a given time, and hence will be more communicable than that germ which is devoid of these properties, or possesses them in a less degree. That the numerical element plays a very important part in the process of contagion and of inoculation is very evident from the examples which Darwin gives us in illustration of the analogous process of sexual genesis. He says,* "This view of the importance of

* Animals and Plants under Domestication, vol. ii. pages 435 and 436.

the quantity of formative matter seems probable from the following considerations: There is no reason to suspect that the spermatozoa or pollen-grains of the same individual animal or plant differ from each other; yet Quatrefages has shown in the case of the Teredo, as did formerly Prevost and Dumas with other animals, that more than one spermatozoon is requisite to fertilize an ovule. This has likewise been clearly proved by Newport, who adds the important fact, established by numerous experiments, that, when a very small number of spermatozoa are applied to the ova of Batrachians, they are only partially impregnated, and the embryo is never fully developed. The first step, however, towards development, namely, the partial segmentation of the yelk, does occur to a greater or less extent, but is never completed up to granulation. The rate of the segmentation is likewise determined by the number of the spermatozoa. With respect to plants, nearly the same results were obtained by Köreuter and Gartner. This last observer found that even thirty grains did not fertilize a single seed; but when forty grains were applied to the stigma, a few seeds of small size were formed. Naudin made the following interesting experiments: A flower was fertilized by three grains, and succeeded perfectly; twelve flowers were fertilized by two grains, and seventeen flowers by a single grain, and of these one flower alone in each lot perfected its seed, and it deserves especial notice that the plants produced by these two seeds never attained their proper dimensions, and bore flowers of remarkably small size."

Taking into consideration, then, what has been said concerning the fertility of the epithelial tissues and the comparative infertility of the other tissues, it will be obvious on *a priori* grounds that those diseases which are located in the former are contagious only, while those lodged in the latter are inoculable but not contagious; and we shall see with what remarkable uniformity this induction obtains among the infectious diseases when they are classified in accordance with this idea. Thus, the principal infectious diseases of the epithelial tissues are—

Smallpox,
Cow-pox,
Measles,
Scarlatina,
Diphtheria,
Typhoid fever,
Gonorrhœa,
Erysipelas.
} First group.

Those of the connective tissues are—

Sarcoma,
Carcinoma, (?)
Tubercle,
Syphilis.
} Second group.

It will be observed that the contagiousness of the first group of the infectious diseases as above given is directly related to the severity of the cutaneous eruption; and this is a practical confirmation of the above-made deduction that the degree of contagiousness is due to the number of contagium particles thrown off from the skin and diffused throughout the atmosphere. Smallpox produces the most extensive as well as the most intensive disturbance in the skin of any of the eruptive fevers, in all probability emits the greatest number of germs, and is admittedly the most contagious. Next in order of contagiousness comes measles, the cutaneous disturbance of which is no more marked than that of scarlatina; and yet it is said to be more contagious, because the eruption of measles is chiefly confined to the skin, while the most intense lesions of scarlatina are concentrated in the throat, from whence the contagium particles are less readily diffused than they are from the free external surface of the body. Then, again, it is a well-known fact that in many cases of measles the cuticle is cast off in a finer state of division than it is in scarlatina, and this of itself renders the epithelial germ of the former disease more diffusible. Owing to the violence of the process of diphtheria, this disease, although not accompanied by any well-defined skin-affection, ranks next to scarlatina in point of contagiousness.

In regard to the contagiousness of typhoid fever, in the sense in which the former term is used here, there can be but one opinion, but for the reason which has already been given, viz., that diseases of the internal surfaces are less contagious than those of the external surfaces, its contagious influence is rather limited. Occasionally, however, in cases where the dejecta are unduly exposed to a dry and warm atmosphere, or where they are confined in an improperly ventilated cesspool, the contagium particles diffuse so rapidly in the first instance, and accumulate and enter dwellings through drainage-pipes in such quantities in the second, that they become an undoubted source of contagion.

Gonorrhœa is the only one of the infectious diseases of the epithelial tissues in the above list which is not contagious; due, undoubtedly, to the fact that only a small surface area is

involved, and that the lesion is confined to a tubal cavity with a narrow opening on the outside, all of which forbid a multiplication and dissemination of germs in sufficient quantity to give rise to the danger of infection through contagion.

Erysipelas is essentially a skin-disease, and, as a rule, is non-contagious. Generally it is limited to a comparatively small area, and hence is not so liable to contaminate the surrounding atmosphere, and so become contagious; yet when the disease involves a large extent of surface, and at the same time exists in an aggravated form, or becomes epidemic, it certainly throws off a sufficient number of gemmules to become contagious, as is well attested by many clinical facts.

From what has already been said it follows that the infectious diseases of the second group cannot be contagious, because they are principally located beneath the cutaneous and mucous surfaces of the body. It is well ascertained that, with the probable exception of carcinoma, all of them originate from or inhabit the connective tissue. Thus sarcoma and syphilis invade the subcutaneous, the submucous, or subserous fibrous tissue, or the connective tissue of other organs; while tubercle infects the lymphatic system, which is but a modified form of the same tissue. There can be no doubt that the stroma of cancer is of connective-tissue origin, but whether its cells come from the same source, or are of epithelial origin, is a disputed point among our best histologists. This is immaterial so far as the question is here concerned, for these growths, like those of sarcoma, syphilis, and tubercle, are almost exclusively confined below the bodily surfaces, and hence have not sufficient communication with the atmosphere to become contagious. All these diseases are, however, infectious, for they have been communicated by means of inoculation. They all manifest a strong tendency towards auto-infection,—*i.e.*, the original cells multiply and distribute their germs throughout the body by means of the blood and lymphatic circulation. In this manner sarcoma and carcinoma disseminate themselves and become very malignant in their course, the rapidity of the dissemination depending somewhat on the softness or succulency of the original growth. In the same way syphilis and tubercle are capable of contaminating the white or connective tissue of the principal organs of the body from one infectious centre.

Thus when the infectious diseases are viewed from a biological stand-point we find that they naturally divide themselves into two classes,—viz., the contagious diseases, or those which are readily communicated; and the non-contagious or inoculable diseases, or those which are not readily communicated. If, in consonance with this idea, the same method of reasoning were carried further, it could also be shown that growths occurring in muscle and nerve, which are the most highly differentiated tissues in the body, possess no infectious or communicable property whatever; but we think that from this side of the question enough evidence has been brought forward to show that pulmonary tuberculosis both from its nature and relation is entirely devoid of contagion, and that it is no more communicable than cancer, syphilis, or any of the diseases with which it has the closest histological affinity.

After having said this much on the deductive side of the non-contagious nature of pulmonary tuberculosis, we will endeavor to ascertain the trend of the evidence on its inductive side. This evidence divides itself naturally into that which has been gleaned from experiment, and into that which has been derived from clinical experience. The first consists in inoculating and feeding animals with, and compelling them to inhale, tuberculous material; and the second consists in tracing the influence which tuberculous patients exert on their living surroundings through ordinary intercourse.

In regard to the experimental evidence, it may as a general rule be stated that artificial tuberculosis can be induced in the lower animals most readily by inoculation and least readily by feeding the poison, notwithstanding the facts that in numerous instances negative results are obtained by any method of introducing it; that many animals, like rabbits, guinea-pigs, etc., are more susceptible to its action than dogs, cats, etc.; and that it seems to be more communicable when introduced into the abdominal cavity than in the eyeball. The successful genesis of tubercle in this artificial way is, however, no more than one would be led to expect from a knowledge of its nature and of that of many kindred poisons, and is not the least evidence that they possess any contagious property; for abscess, gonorrhœa, malaria, etc., are communicated in the same manner, yet no one thinks of ascribing the power of contagion to these diseases.

While, then, there is no doubt as to the inoculability of pulmonary tubercle, it remains to be proven whether this disease is ever trans-

mitted between man and man, or between man and animals through atmospheric contagion. For obvious reasons clinical evidence is the only umpire to which we can appeal for a solution of this part of the question, and in order to bring this clearly into view we shall endeavor to compare the salient characteristics of those diseases, which are undoubtedly contagious, with those of pulmonary tuberculosis.

Exposure.—As a rule those who are most exposed to a contagious disease are most liable to it, while the opposite is true of pulmonary tuberculosis. Do the practitioners of medicine, and especially those who believe in the contagiousness of the disease, take the proper precautions against infection in this manner, or do their actions fail to confirm their professions? On this point Professor Lichtheim expressed himself in no uncertain tones before the Second Medical Congress of Germany, which met in Wiesbaden in 1883. Among other things he said that it must be admitted that there are many facts which contradict the contagious nature of pulmonary phthisis. Intercourse with consumptive people is not attended with danger. We hospital physicians spend much time among such people, and we have such confidence in the innocuousness of the disease that we do not hesitate to mix healthy persons with them in institutions devoted to its treatment, and we must confess that this procedure is practically unattended by any unfavorable results. He further stated that the mortality of the attendants in the principal hospitals for consumption was surprisingly low; and that he could, from investigation, confirm the belief that there is no relation between the increase of the number of phthisical patients at a health resort and the number of deaths from consumption occurring among the native inhabitants.

The statistics of the Brompton Hospital for Consumption in London, as collected by Drs. Williams and Humphreys, speak in the same emphatic manner against the contagiousness of pulmonary tuberculosis. This large institution shows that during a period of thirty-six years not a single clearly authenticated case of pulmonary consumption among all its attachés emanated from within its walls. During the thirty-six years there were twenty-nine physicians and assistant physicians connected with the hospital, and among these occurred a single case of phthisis, and he was tuberculous before he entered it. The rest were all well. Dr. Edwards was resident for twenty-six years, yet he showed no sign of the disease. During that period there were employed one hundred and fifty clinical assistants. Of these eight died of consumption; but all, except one, were sufferers from the disease before they became connected with it, and in this one case there is doubt as to the origin of the trouble. Among the one hundred and one nurses, of which there is a health record, one is suffering from a slow form of the disease, which may have been contracted during her service at the hospital, although she is predisposed to consumption. She is an old employé, and able to attend to her duties efficiently most of her time. No more positive proof of the non-contagiousness of pulmonary phthisis could be gathered anywhere than is furnished by this large institution. Every one of the individuals associated with this hospital were almost constantly exposed to the disease, and still there is only a single case to which the least claim of contagion could be made, and this rests largely on suspicion.

These statistics in regard to the non-contagiousness of phthisis are strikingly confirmed by those which relate to the influence of the Consumption Hospital of Görbersdorf, in Germany, on the death-rate from phthisis among the inhabitants of that town. Dr. Brehmer, who has been in charge of that institution for twenty years,* says that since the year 1854 more than ten thousand consumptives resided in the Görbersdorf hospital, who walked the streets of the town daily and commingled with its inhabitants. The latter were, therefore, constantly respiring an atmosphere more or less laden with tubercle-bacilli emanating from the dried expectorations of these consumptive visitors; yet, in spite of these favorable conditions for contagion, the mortality statistics of the town show that prior to 1854 there were 10.07 annual deaths from consumption among its inhabitants, while from 1854 to 1880 there were only 5.0 deaths per year, or a death-rate somewhat less than one-half of what it was before the introduction of the hospital. These figures are especially interesting in view of the assertions frequently made that the healthful influence of mountain resorts is impaired by the infectiousness of the exhalations and expectorations coming from consumptive people who go there for the purpose of seeking relief, showing that such suspicions are more imaginary than well founded.

* Die Aetiologie der Chronischen Lungenschwindsucht, p. 18.

Then, again, it is common to find physicians, both in this country and in Europe, who are sufferers from consumption, and therefore compelled to spend most of their lives in the mountain resorts of their native countries, to labor hard among their many fellow-sufferers who constantly crowd these places, and yet they experience no inconvenience from their contact with these people, but, on the other hand, regain exceptionally good health.

Once more, not very long ago, Dr. J. Solis-Cohen, who has since become our honored President, said before this society that if any class of medical practitioners is more exposed to the virus of tubercle than another it is certainly the class to which he belongs, viz., the laryngologists. They are constantly operating on patients with tubercular ulceration of the throat, inhaling their breath and often their cough, and are continuously exposed to the evaporation of the sputum in the cuspadores of their offices, yet he was unaware of a solitary instance of infection brought about in this way.

Contagion between Husband and Wife.—In 1883 a committee, appointed by the British Medical Association, investigated the contagiousness of pulmonary phthisis by sending a printed circular asking the members of the profession throughout England whether they had observed any cases in which the disease was believed to have been communicated. The committee received ten hundred and seventy-eight answers. Of these, seven hundred and seventy-eight were negative, thirty-nine were doubtful, and two hundred and sixty-one were affirmative. Of the affirmative answers, one hundred and fifty-eight were cases where the communication of the disease was supposed to have taken place between husband and wife, or *vice versa*, eighty-one between members of the same family, and the remainder were principally cases between whom there was no blood connection.

On account of the large number of affirmative opinions, this report has been made to subserve the interests of those who believe in the contagiousness of phthisis. Evidently this is unfair, since the aim of the investigation was not to ascertain the number of absolutely well-demonstrated cases in which contagion was present or absent, for this would obviously have been next to an impossibility, but to collect the individual opinions of a large number of physicians as to whether they believed the disease contagious or not, and this resulted in seven hundred and seventy-eight negative, and two hundred and sixty-one affirmative votes. Are we, therefore, justified in assuming that the two hundred and sixty-one opinions are of more weight than the seven hundred and seventy-eight negative ones, and thereby imply that the former only had the fortune or the misfortune to meet cases which originated through contagion, and that the latter had not? Is it not more probable that all of them witnessed cases around which hung a cloud of suspicion that they might be contagious, but that seven hundred and seventy-eight did not consider the proof strong enough to outweigh that which in their minds was in favor of other and more powerful influences in the production of the disease? Evidence of infection between married people is, we believe, much less common than it is generally believed to be. In our whole personal experience we can only recall a single instance where the wife may have contracted it in this way, although even in this case there is an incomplete family record, and the patient herself was a dressmaker and in all probability was predisposed to the disease. But were the fact of its communication established in any given case, it would still devolve upon the contagionists to prove that the virus was not introduced under very unusual conditions,—such as being inoculated through an abrasion of the skin or mucous membrane by intimate contact of one person with another.

As still further proof of the correctness of our view concerning the non-contagiousness of phthisis between husband and wife, we beg to call attention to a most admirable paper, entitled "Eine Statistische Studie als Beitrag zur Aetiologie der Lungenschwindsucht," contributed by Dr. Schnyder to Nos. 10, 11, and 12 of the *Correspondenzblatt für Schweizer Aertzte* for 1886. This contribution is based on three thousand four hundred and sixty-one cases of pulmonary phthisis, which were observed by its author while resident physician at the health resort of Weissenburg, in Germany. Of these cases, eight hundred and forty-four occurred among married people, but in four hundred and forty-five of them it was the husband only, and in three hundred and sixty-seven instances it was the wife only, while in thirty-two cases both husband and wife were affected. Now, it must be admitted by the most ardent contagionist that here existed the most favorable conditions for a propagation of the disease between husband and wife, or *vice versa*, through contagion; and the fact that eight hundred and twelve

of these cases escaped even a suspicion of contagion, shows clearly that the disease is not by any means readily communicated under extraordinary circumstances. But is it beyond doubt that the thirty-two cases originated through contagion? We think not, for, as Dr. Schnyder says, it is a notorious fact that, in spite of all entreaties and warnings, young people are often wedded while suffering from active lung-disease. He relates four such cases in his own experience in which both the bride and bridegroom came to Weissenburg, fresh from the matrimonial altar, to be treated for phthisis, from which they both suffered. But even letting those who are wedded while suffering from active phthisis out of the question, it cannot be denied that many young people of both sexes carry the hereditary taint of the disease in their constitution, which only awakes from its slumbering condition to assert its power when the many varied burdens and demands of family life begin to exhaust the vital resources.

Moreover, we have recently shown* that consumption makes its appearance in families which are perfectly free from all evidence of the disease. Proof based on two hundred cases of phthisis was there given, that the youngest members of families, provided either or both parents were the youngest members of their respective families, are especially predisposed to this disease. In view of this fact, it is of great importance to scrutinize the family record well before we jump at the conclusion that the disease must have been derived through contagion in the absence of a phthisical family history.

On the point of communicability between husband and wife, the late Dr. Flint, in his work "On Phthisis" (p. 420), says, "In my collection of cases (670), these five are all that I find in which there is room for the suspicion of the disease having been communicated from the husband to the wife, or the wife to the husband. By making inquiries of members of the medical profession, and searching periodicals, doubtless a considerable number of similar cases might be obtained. Collected in this way, however, they would not prove communicability. According to the law of chances, a disease of such frequent occurrence as phthisis would affect in succession a husband and wife, or *vice versa*, in a certain proportion of cases. Conceding that the histories of some of my cases are defective in information on this point, it is certain that the instances in which transmissibility may be suspected are not sufficient in number to be not allowed for as coincidences. It must, therefore, be concluded that the analysis of my cases does not furnish facts sufficient to render the communicability of phthisis probable."

Again, it is a well-known fact that phthisis may originate independently from a caseation centre located anywhere in the body outside of the lungs. Thus enlarged lymphatic glands of the neck, which so frequently follow dentition, or catarrhal affections of the mouth, may caseate at some inopportune time, and generate the specific virus which produces tubercle. Such glands are a standing menace to their possessor, and we have no doubt that they are the cause of at least some of the occult cases of tubercular phthisis. We have no doubt that pulmonary tuberculosis can arise from other infection centres in the body. Thus pyosalpinx, about which we have learned so much recently from Dr. Joseph Price, and from other members of this society, quite often goes on to caseation, and is said to be frequently accompanied, and probably followed, by tubercular involvement of the lung. How many such infection sources may originate spontaneously in the body as the legitimate product of ordinary catarrhal inflammation?

Infectiousness of the tubercle-bacilli, or tubercle-virus, diffused throughout the atmosphere.—In the deductive or biological part of this paper we have given sufficient reason to show that one of the essential requirements in a contagious disease is the property of contaminating the surrounding atmosphere with an abundant crop of disease-germs. We also endeavored to give proof from this standpoint of the question that this is true of smallpox, and of all the active diseases of the external surface of the body, and that it is not true of sarcoma, tubercle, syphilis, or of any of the internal diseases of the body. We shall now inquire whether this harmonizes with the inductive or experimental evidence which can be collected on this point.

Ever since it has been believed that the specific virus of tubercle resides in the bacilli, efforts have been repeatedly made to demonstrate the presence of these organisms in the atmosphere; and while it is claimed that they are always present, they have at no time been shown to exist in sufficient quantities to give rise to the danger of infection.

* "Some of the Causes of Pulmonary Consumption, viewed from a Darwinian Stand-point," *Medical News*, November 27, 1886.

Baumgarten,* to whom belongs the credit of being a co-discoverer of the bacillus tuberculosis, and who implicitly believes that this organism is the causative agent of pulmonary phthisis, says that he never knew of a single well-established case of phthisis which was acquired through respiring an atmosphere vitiated by the exhalation of consumptive people. And he further says that during the last ten years he made and had made in the Pathological Institute at Königsberg a large number of inoculation experiments on rabbits with tuberculous material, constantly keeping inoculated animals in the same cage with the non-inoculated, the latter thus being exposed to an atmosphere infected with bacilli; yet in no single instance was the tubercular poison conveyed from the inoculated to the non-inoculated animal.

Referring to the work of the two Italian experimenters, Celli and Guarnieri, who undertook to decide whether and under what circumstances a tuberculous person is liable to infect the surrounding atmosphere, Baumgarten describes the three series of experiments which these scientists made. In the first series they placed three ventilating devices, the inner surfaces of which were well covered with Koch's culture gelatin, at different elevations in the chamber of a consumptive patient. The air of the room was strained through these instruments for twelve nights in succession. Part of the gelatin at the end of this time was examined microscopically, and part was inoculated into the eye, the peritoneal cavity, and into the subcutaneous connective tissue of rabbits and of guinea-pigs.

The second series consisted in allowing a number of phthisical patients to respire for a long time into a reservoir which was well coated with Koch's culture gelatin, after which the gelatin was examined microscopically and inoculated into the eye, peritoneal cavity, and subcutaneous connective tissue of rabbits and of guinea-pigs.

In the third series they experimented with air which was aspirated through tubes containing tubercular sputum. The sputum was evaporated by heat, and the air thus exposed was forced through a tube containing sterilized blood-serum and Koch's gelatin. The experiments were continued for many hours, and in many instances were repeated. The culture media were then tested in the same manner as in the two former series,—viz., by microscopic examination and by inoculation.

Every one of these experiments was followed by negative results. In no case did the microscope reveal a bacillus, nor was tuberculosis produced in any of the animals which were inoculated. Bollinger repeated the work of these two investigators on a vast scale, and confirmed their results in every particular. Tappeiner also imprisoned two rabbits in a closed cage, and allowed a tuberculous patient to cough into the cage. At the end of two months the animals were found to be free from all taint of tubercle.

The results of these researches are all the more astonishing when the fact that in every instance the atmosphere was thoroughly exposed to the sources of tubercular contamination is taken in connection with the other fact that both rabbits and guinea-pigs are intensely susceptible to the tubercular poison. Surely the atmosphere here, if anywhere, must have contained tubercle-bacilli, and if not in number sufficient to produce infection, even when inoculated, how can infection possibly occur under ordinary atmospheric conditions?

Unequal Distribution.—The non-contagious nature of pulmonary tuberculosis is also strikingly manifested when it is compared in point of distribution with well-known contagious diseases. The invasion of a disease like smallpox, for example, implies an epidemic, and a rapid exhaustion of the soil on which it thrives, after which it quickly declines. Its death-rate, no matter how large or how small, is never constant, but rises to a maximum one year and falls to a minimum the next, and then nearly or entirely disappears for a number of years, only to reappear and to re-exhaust the soil which has matured during its absence. But pulmonary tuberculosis never becomes epidemic, and has no soil to exhaust through contagion, unless it is the soil of human life. Its death-rate is so uniform from year to year that it becomes dolefully monotonous. During the last four years of which we have a record the number of deaths in the city of Philadelphia were nearly the same for each year, being 2809 in 1882, 2798 in 1883, 2801 in 1884, and 2821 in 1885; while, on the other hand, there were 1336 deaths from smallpox in 1881, and only 3 in 1885. It is thus seen that the course of a contagious disease is erratic, and that of pulmonary tuberculosis is so constant that a knowledge of its past enables us to foretell its mortality in the near future.

* *Berliner Klinische Wochenschrift*, 1884, p. 626.

Then, again, if pulmonary tuberculosis is contagious, why are we able to predict with a great degree of certainty that the badly-nourished; those who are overworked, confined in-doors with sedentary employment; those who are overcrowded, or exposed to dampness; those who belong to a heterogeneous population; those who spend long terms in prisons; those who have weak circulatory organs; or those who are the youngest members of numerous families, are, if other things are equal, most prone to die of it? Has ever a contagious disease been more fastidious in the selection of its victims?

Or, again, can contagion account for the fact, which Dr. Schnyder has so well shown in the article already quoted, that while in proportion to the male sex there are more females in German cities than in the country, yet 7.21 per cent. more females suffer from the disease in the country than in the city? Will any one be bold enough to pervert reason and say that the purer air of the country contains more bacilli or contagium germs than the city air? or will he, with Dr. Schnyder, believe that the greater liability of the females in the country is due to the fact that they are greatly more exposed to overwork and to all kinds of weather and temperature than their city sisters?

Quarantine.—If any further evidence were needed to prove that pulmonary tuberculosis is not spread by contagion, it could be found in the fact that the most rigorous quarantining and isolation of tuberculous patients has not the slightest influence in modifying the fatality of the disease, as is attested by the following history: In the year 1782* the authorities of the city of Naples decided that pulmonary tuberculosis was contagious, and logically enforced the most stringent preventive laws imaginable. Every practitioner of medicine was compelled to report every case of pulmonary phthisis immediately after discovery. Neglect of this duty exposed him to a fine of three hundred ducats, and the second offence was followed by imprisonment. Indigent patients were placed in a hospital at once. Their clothing and all their belongings were carefully isolated, and an accurate record kept of them. The punishment for non-compliance with this law was imprisonment. All furniture exposed to infection was ordered to be burned. After the patient's death or restoration his room was thoroughly renovated,—the floor, doors, and windows were taken out and burned, and new ones substituted. A heavy fine was imposed on those who bought or sold clothing which was exposed.

This law was in full force up to the year 1848,—for a period of sixty-six years,—and yet during that time there appears no evidence to show its practical usefulness; but, on the other hand, Dr. Rienzi says "that the injury which it inflicted on the city of Naples is simply indescribable." Patients and their friends became objects of execration; houses in which a death occurred from the disease depreciated in value, and their owners became impoverished. A similar law existed in Portugal for many years, and was followed by like disastrous results.

In summing up the evidence which has been adduced in these pages, it appears from the first portion that nearly all the organic diseases of the human body are infectious, but that some, on account of the facility with which their germs multiply and diffuse through the atmosphere, are very readily communicated, while others, which possess these properties in a small degree only, are not readily communicated. The former we have called the contagious, and the latter the non-contagious diseases. Continuing this line of reasoning, we saw that pulmonary tuberculosis clearly belongs to the second or non-contagious class of diseases. In the second or clinical portion we found corroborative evidence of the first portion. Here the danger of exposure; the intimacy between husband and wife; the tubercle-bacilli, or the tubercular virus in the atmosphere; the distribution of the disease; the effects of quarantine; were all discussed in the light of contagion, and nothing was discovered to show the slightest danger of communicating this disease from one person to another under ordinary conditions.

In conclusion, we trust that altogether we have offered sufficient proof for believing that pulmonary tuberculosis is entirely due to influences other than those which are swayed by evil genii residing in the air; and hope that we have succeeded in allaying the morbid fear and the abomination with which consumptive people have recently come to be regarded by the medical profession, by their friends, and by all with whom they come in contact.

1716 Chestnut Street.

* Uffelmann, *Berlin. Klin. Wochenschrift*, 1883, No. 24; cited after Brehmer.