"The Infectiveness of Phtisis:"

A thesis presented to the University
of Edinburgh in April 1887.

By Andrew Smith M.B.

T. Whickham

Co Durham

When a candidate for the degree M.D.
The Infectiousness of Phthisis

Although this question of the infectiousness of Phthisis has often engaged the attention of Medical men it is one regarding which there has not been a general concurrence of opinion. Galen believed it to be dangerous to pass an entire day in the company of a Phthisical person. Morgagni has recorded this timidity even in regard to the Phthisical corpse. In Italy and the South of Europe the belief in this infectiousness is so strong and prevalent that when a person dies of Phthisis it is customary to burn the clothing or bedding that he has used. In England again the profession has in general been opposed to this belief whilst the outside public have held strongly by it; indeed very few will incur the risk of constant attendance on, and especially of sleeping with, a Consumptive patient if it be avoidable, and it is a very common thing to hear the device in one's patient described as infectious. This of itself is a fact of some importance, but to be altogether ignored, as ideas widely prevalent and generally believed in by intelligent men amongst the laity have usually some foundation.
It seems apparent also that of late years a more general belief in the transmissibility of Phthisis from the sick to the healthy has begun to prevail among medical men. Professor Walsh, for instance, while pointing out the insufficiency of the ordinary evidence and showing certain fallacies in it, is yet constrained to acknowledge that "his belief in the reality of such transmissibility has of late years strengthened," the cases of apparent or possible infection having become so numerous that "coincidence" has become itself an explanation difficult of acceptance. Professor Jaccoud of Paris has arrived at the same conclusion and lays down rules for the protection of the healthy in their attendance on the sick, and emphatically urges that a husband should not occupy the same room, far less the same bed, as his consumptive wife.

In the medical journals also similar opinions have lately found frequent expression, notably so in a paper on the "Infection of Phthisis" by Reginald E. Thomson, M.D., in the "Lancet" of November 6th, 1881, to which we will have subsequently to refer.

The evidence to be relied on in an investigation of this subject may be considered under two
heads. 1. Clinical. & 2nd Experimental. But before entering on this it will be better to clearly define what is meant by Phthisis.

By Phthisis, or more strictly speaking, Pulmonary Phthisis then, we mean a disease of the Chest attended by certain distinct symptoms, as persistent Cough, prevalent expectoration, loss of power, loss of flesh, profuse sweeating & diarrhoea and fever of the hectic type with evening exacerbations. Such is the clinical aspect of the disease as it has been known since last century when the term Phthisis was first definitely limited to consumptions dependant on disease of the Respiratory System, and about which there is no difference of opinion. When however we enquire as to the pathological lesions in the lung corresponding to this clinical state we find that opinions have differed and still differ widely so that it is perhaps better to retain the term Phthisis Pulmonalis as a generic term for the disease having the above clinical features independent of the anatomical lesions present - as undoubtedly there are very in different cases not always readily distinguishable from one another.

Some of the older writers spoke of inflammation
Jalloud, as above, p. 207.
1. Jacqoud, "Leçons de Clinique Médical fait à l'Hôpital Lariboisière," p. 188 + follow.

+ Jacqoud (same) p. 200 + following.
ending in suppuration and abscess in the lung as the cause of the lesions found in Phthisis, while others ascribed these to the development of tubercles in the lungs, which tubercles subsequent suppuration or as Deterre pointed out, under went a caseiform change led to an ulceration of the lung tissue. The latter failed to recognize the relationship between the semi-transparent granulations found in the lungs and tubercles and consequently described another form of Phthisis called granular Phthisis which sometimes caused death without the ordinary symptoms of Phthisis. It was not till the time of Leaueze that Phthisis in the clinical sense was held to be identical with the pathological state - tubercle - the showed that this has its original elementary condition in the grey semi-transparent granulations described as a separate product by the older writers, which by a further growth and evolution develop into the large opaque yellow tubercles. A continuation of this caseiform process results in softening and breaking down and thus leads to the formation of small cavities which increase in size through secondary inflammation of the surrounding tissue or by the running together of adjacent cavities thus producing extensive wasting of the lungs.
From the time of Laennec until comparatively recently, this doctrine of the Unity of Phthisis—which identified it universally, accepted by Laennec and his followers, evidently regarding Caseation as pathognomonic of tuberculosis, so that whenever they found the caseiform condition in the lung they inferred the pre-existence of tubercles. One of the first to clearly challenge this doctrine was Graves, who distinctly described cases of Phthisis independent of tuberculosis, pneumonia and confluent bronchitis without a trace of tubercles although both of these conditions were liable to give rise to tubercles. He was followed by Addison and Lombard with somewhat similar ideas. Then Reinhardt showed that what in many cases was described as tubercular infiltration was really the result of inflammation—of Catarrhal Pneumonia which by loading the alveoli with its products undergoing fatty metamorphosis produced an appearance exactly like tubercles. Virchow, starting from this basis, having shown that Caseation is a process by no means peculiar to tubercles but applicable to many other products including the products of inflammation which resolve bodily, and that this process of Caseation is still essentially the characteristic of post-phthisis, he finally elucidated...
the doctrine of the chronicity of phthisis—that it is sometimes connected with simple caseous alterations and sometimes with tubercles or granulations of a caseous evolution, or as he has finally expressed it “the history of phthisis has much more to do with caseous tuberculosis than with tubercles.” As this view has since been largely accepted by eminent observers and is clearly advocated by Niemerger in his text-book of Medicine we may adopt the general conclusion that “Pulmonary phthisis is sometimes connected with chronic tuberculosis or granulosis and sometimes with pneumonias of a caseous evolution;” the relative frequency of the two varieties being differently estimated by different authorities. At the same time we must remember that in those cases commencing with tubercles secondary pneumonias frequently occur and in those beginning as pneumonias tubercles generally develop more extensively as the disease advances.

We have now to enquire how this view of the pathology of phthisis affects the question of its infectiveness. If then many, if not the majority, of cases commence as a catarrhal pneumonia, the products of which, instead of resolving completely by fatty metamorphosis, subject to absorption, result in caseation or incomplete fatty metamorphosis, whatever tends to the production of catarrhal pneumonia of a low type will be a cause of phthisis.
Hence all irritants affecting the respiratory system, associated with bad hygienic arrangements will form such a cause, especially acting on persons of low vitality, such as above all those hereditarily predisposed.

Now, amongst these, there is scarcely one more powerful than the allergic germs, and as it cannot be doubted that the purulent excretoration of patients far advanced in Phthisis, especially where cavities exist in the lungs is decidedly prolific, I think we fairly arrive by a priori reasoning at the conclusion that a patient an advanced consumption with excessive purulent excretoration is likely to communicate the disease to any one who is in constant association with him under the hygienic conditions to common with consumptives with their close rooms of high temperature, and all the more so if the attendant has any hereditary tendency to the disease, and this quite apart from the probable existence of any specific germ.

I would have no hesitation in affirming that any hereditarily predisposed or weakly person being exposed would in all probability fall a victim, while a robust person might be able to resist this as well as other accidental causes of Phthisis. Now, I submit that in such cases the escape of the strong is not to be accepted as evidence against the idea of infection, as even in the worst infectious diseases a certain susceptibility...
is acknowledged to be required, in the absence of which (as in exposure to small pox after thorough vaccining) the amount of exposure will infect the person.

If then it can be fairly shown in fact that even in cases with a consumptive family history the disease within, not formerly existent, has developed after close association with a consumptive patient, and without any other known exciting cause, I think the infectious character of the disease will be fairly well established in a practical sense—at least whether it will come under the strictly scientific idea of infection or not.

Many practitioners have referred to the frequency with which wives have become consumptive after closely nursing their husbands through the fatal illness and bereavement, often even when no hereditary taint could be traced, and the converse cases where the second consort remains exempt and especially where a husband has had two wives successively destroyed by consumption himself remaining well, though they weaken certainly do not destroy this evidence. Then though a certain number of men of consumptive family history will marry wives of consumptive family history, this would scarcely account for the immediate consumptive illness of the two which is frequently occurs; the idea of the one first affected by infection awakening into active disease the latent tendency in the other, would seem the more plausible theory.
"Die Tuberkulose Vom Standpunkte Der Infektionslehre" translated by D. H. Cullimore.
Chapter II. p10.
This suggests another class of facts that seems to have been too much neglected, but which has shown me forcibly in a comparatively limited experience of case of phthisis, namely where two or more members of a family or household of different ages suffer at the same time or closely after each other. This no explanation of these cases to appeal to the hereditary character of the disease, as heredity only conveys the tendency ready to be aroused into actual disease by any of the exciting causes. The account I should give of such cases is that heredity gives the susceptibility and infection develops the disease. Of course in such cases in proportion as heredity is weak so is the evidence for infection strengthened. If however it be true as Columbian asserts that heredity implies the existence of the disease from birth up to far as the tubercular virus is in the syphure though in a latent condition, then still the Coloral inflammation excited by the specific ferment will cause the latent virus into active disease in accordance with the strongly asserted tendency of tubercle to combine with inflammation.

In support of these arguments the following cases may be cited:

1. M. M. — Aged 32, died of Chronic Phthisis with purulent expectoration in September 1876 after an illness of nearly three years.
his wife who was with him during the critical illness and who had three children to him during the five years that they were married, had always been strong. Her family history was good, both her father, mother and all three children and none of her relations were believed to have suffered from consumption. Early in 1876, during pregnancy, she began to suffer from a cough, which persisted and was soon accompanied with slight expectoration. Though the case was soon regarded as one of incipient phthisis it did not develop rapidly until her confinement when all the symptoms speedily became aggravated. Cough & expectoration became excessive and the patient was rapidly wasted and died in October 1876, only one month after her husband.

Infection from her husband seemed to be the most probable cause of the illness.

II. A somewhat similar case is reported in the "Lancet" of May 22nd, 1880 by Dr. Russell under whose care in the Royal Hospital for Diseases of the Chest the patient was. Apparently a woman without the slightest trace of consumptive family history, had developed genuine phthisis after prolonged attendance on her husband who died of chronic phthisis attended with excessive purulent expectoration; her husband
had been dead nine months when the patient was examined by Dr. Warren and reported by him as in well developed Consumption, having had cough persistently since her husband's death. Spit; there was coarse crepitation at both apices. She was losing flesh and sweating profusely at night.

III. B. T. April 17 of robust and healthy appearance. When suffering from a slight cough, had a sudden attack of hectic fever, about a month later she had another slight attack, after which all the characteristic symptoms and signs of Phthisis developed and she died in November 1878 after seven months illness, exhervine cavities having formed in both lungs. Both her parents were alive and well. Her family history in regard to consumption was otherwise good.

About three months before her death, her brother Thomas T., aged 22, a fitter, who was greatly attached to his sister, who spent most of his spare time in the evenings presence he was at home beside her, became affected with a persistent cough and spit which steadily got worse. His breathing became short, he lost power of flesh, he became feverish at night, sweated freely, and when his sister died he had well developed Phthisis. After her death he still got worse, he worked rapidly with severe hectic fever, loud crepitation of the chest, the voice became hoarse and he died ten weeks after his sister.
By this time another sister, aged 15, had begun to suffer from cough, feverishness and weakness. Immediately on her brother's death she removed for change of air to another village on the top of a hill, where the air is remarkably pure and bracing. Here she soon began to improve and in a few months she felt quite well enough, and has remained so since.

This case impressed me very much at the time, as I could form no other conclusion than that the second patient was infected from the first, there being no other way of accounting for his illness satisfactorily. The third patient again was to all appearance following the others, but she speedily rallied on being removed from all other source of infection and to a locality with a pure bracing atmosphere, eminently antiseptic.

IV. This was a case of a strong, healthy woman aged 22, of a healthy family, who married a consumptive husband whom she assiduously nursed until his death ten months after marriage. One month after his death she gave birth to a child, when I saw her for the first time. I was informed that she had been suffering for a month or two from constant, hacking cough with slight expectoration. She had had feverish flushings with sweating and had lost flesh. After her confinement she got much worse, the feverish symptoms with occasional shiverings, hectic and profuse sweating...
suggesting septicemia, but the lochial discharge was quite natural and free from smell, she had no abdominal pain or tenderness. In fact there was not a symptom of any uterine or abdominal disturbance, but on the other hand all the chest symptoms were greatly aggravated quite in proportion to the feverishness; the breathing became very short and quick, the cough severe and straining with copious expectoration occasionally tinged with blood. Physical examination showed localized patches of comparative dulness with harsh breathing or crepitant rales chiefly about the apex of both lungs, prolonged expiration and increased vocal resonance. In short, it was a case of tubercular pneumonia giving every promise of going on to acute phthisis. In a few weeks however a prodigious improvement took place and she ultimately recovered her health perfectly to the surprise of her friends who all regarded her as suffering from following consumption contracted from her husband, and I must say I felt very much inclined to take the same view of the case, and I believe that had there been any tendency to phthisis such would have been the result, as attributed her recovery chiefly to her previously strong constitution with its freedom from all tendency to tubercular disease, which is after all perhaps the chief cause of the inveterate character of phthisis.

V. In this instance we have a family consisting of
father & mother, one son and three daughters who were all considered healthy except the son who was usually regarded as delicate. The grandmothers on both sides appear to have died of consumption, otherwise the family history was good. About the beginning of 1880 the boy J. A. aged 18 caught cold and while suffering from this he was thrown out of a cart and was so stunned that he lay for an hour or two before he was able to get home. He never seemed to get over this though there was no definite injury but he shortly developed all the symptoms of pulmonary phthisis of which he died four months after. As before his death his two sisters M. A. aged 15 and L. A. aged 22 who occupied chiefly the same room (the kitchen) with him, began to fail in health, both becoming affected with cough and pains in the chest and a general feeling of languidness and debility, all which continued to get worse for a month or two after their brother's death. The younger girl M. A. became very ill, her cough and spit being accompanied with a pretty persistent fever greatly aggravated at nights, she wasted to almost a skeleton, had frequent hectic flushing, her pulse being frequently 130 per minute. She subsequently rallied; however, the feverishness gradually subsided, the other symptoms improved and she slowly regained strength. When I last saw her in January of the present year she had still moderate cough & spit with a
somewhat quicker pulse but without fever, there was
dullness over the right chest, with harsh breathing and
a slight increase of Vocal resonance.
The eldest girl E.A. also became febrile but went off
to the seaside for a month from which she returned
considerably better and has since remained so, though
she is still far from robust, the cough still troubling
her occasionally with slight expectoration. Her appetite
is fairly good, and except a little harshness in
the breathing the Chest Sounds are normal.

VI. J. Wilson. Aged 19 had suffered from cough, with a
shortness of breath from the beginning of 1878 but
continued at work, though he had got very thin weekly
until November 1878 when he got an attack of pleurisy
which became chronic and subsequently developed into
Empyema for which Paracentesis was performed
without relief, the patient dying in July 1879.
During this illness his brother D. W. stayed with
him & slept with him. Early in 1879 he began to
complain of tickling cough soon accompanied with
expectoration, he became languid & weak and suffered
from night-sweats. The left chest became
stiff on percussion, the breathing became harsh
and was accompanied with Crepitating oozing
Vocal resonance. These symptoms and signs were
deliberately when his brother died. He then went
to sea for some months and returned much improved. Four months later however his cough and all other symptoms returned, lungo being affected and he died in June 1880.

The maternal grandson ofConsumption.

VII. John Howden, aged 30, residing chiefly at Sunderland, suffered for three years from cough, shortness of breath, frequent expectoration, in short from Chronic Phthisis of which he died in September 1880. During his illness he stayed a good deal with his two sisters at Willaston and they also often stayed with him at Sunderland. One of these sisters, Barbara H., was also brought into further contact with Consumption as she was great-heart to the above J. Wilson (first case of Example page 15) with whom she spent whole afternoons during his illness. She began to decomp below the time of J. Wilson's death, becoming affected with cough, spit, shortness of breath, weakness, feverish attacks, other symptoms of Phthisis of which with intercurrent attacks of pleurisy she died in October 1880.

Mrs. T., a widow, the other sister was in constant attendance, day and night, upon the above Barbara H. and slept with her. She began in
July 1880, to complain of general malaise with cough and wasting. To try change of air she went to Sunderland, where her brother having now given up work was slowly dying of consumption, but did not improve. She returned home with pneumonia of the base of the right lung rapidly breaking down and crepitant-and sonorous râles all over the chest, indicating the rapid formation of Cavitie.

She died in November 1880.

Here were three deaths in one family within two months. There was certainly hereditary influence, the maternal grandfather having died of consumption at the age of 30, and the paternal grandmother at the age of 50, and the father probably as well, his death being ascribed to ‘Vomiting of blood’ at the age of 50.

In the case of Barbara, in addition to the constant association with consumptives and the hereditary tendency there was the grief at the death of her sweetheart to which her mother chiefly ascribed her illness, but still I think we must allow a good deal to infection as an exciting cause.

In the case of Mr. T. the infectious origin is more evident, as she had always previously enjoyed good health and was not aware of having caught cold, only having the hereditary tendency she was not able to resist the constant exposure to the
In the "Lancet" of November 6th, 1880 there is a very important paper by Dr. Reginald E. Thomson, entitled "The Infection of Phthisis". In this paper Dr. Thomson clearly demonstrates the fact of infection, but regards the infective disease as having "special features clinical and pathologic which distinguish it from ordinary forms of Phthisis"; these features "approximating closely to those of a pyogenic or infective pneumonia.

Well, if this be so, it is still a 'phthisis', indeed. Many eminent physicians consider that pyaemic or pyaerion plays a very important part in ordinary phthisis. Dr. J. Menzies Mackenzie supports this view, in commenting on Dr. Thomson's paper, in the "Lancet" of Nov 27th, 1880 and quotes Professor Chese of Paris as saying that "the thermic curves are not those of inflammatory action but of pyaemic infection". He also quotes Dr. Waters of Liverpool and Dr. Cliffe of Aldburt to the same effect. If such be the fact, the characteristic cases of Dr. Thomson are brought into much closer alliance with those of ordinary phthisis of a pneumonic character as already defined, and I think a careful study of his Articles will lead to the same conclusion; at all events the symptoms
As one reads them, do not very materially differ from those frequently enough met with in ordinary phthisis. Further, his characteristic cases are taken from those where no vestige of hereditary tendency could be traced, while he admits the most frequent occurrence of cases apparently due to infection, but where the symptoms are not so distinctive but approach more closely to those of ordinary phthisis. In face of this reflection and admission his estimate of the risk of infection as represented by fifteen well marked cases out of a total of fifteen thousand would seem too low. The symptoms in some of the cases I have described appear to be exactly similar to those in his characteristic cases. Further, as these cases exhibit such severe and acute symptoms of a phthisical as well as a septic character, and are undoubtedly the result of infection from ordinary cases of phthisis, the fact of infection and that of a circular character in phthisis is very well established.

But when we meet with such results in persons of previously robust health and who have no hereditary tendency to phthisis or tubercular disease, and in view of the fact that cases originally pulmonary in character do not develop tubercles in their course where a predisposition exists, this fact constituting according to
Niemeyer, the greatest danger for the majority of consumers, we must expect that in those persons similarly exposed and who inherit a tendency to tubercular phthisis, the disease will be more readily produced, and having arisen will more speedily lead to the formation of secondary tubercles in the lung, and hence to the characteristic clinical and pathological of ordinary tubercular phthisis. Hence also, in all probability, the explanation of the perfect recovery so frequently achieved in Dr. Thomson's cases notwithstanding the apparent severity of the symptoms. It is also worthy of remark that in the only case reported by Dr. Thomson, where a post-mortem examination was made, where the symptoms had been so characteristic of infective pneumonia, and where the general pathological conditions were also so characteristic of nephric poisoning and where the patient's family history was perfectly free from tubercular taint, even there, before death, tubercles had at last begun to form, there having been discovered, close to a cavity in the lung, two race more groups of recently formed tubercles.
Diseases of the Chest and in Mediastine Auscultation
translated by J. Forbes M.D. - Fourth edition P. 305

Laennec as above, post make Page 305. Also Dr People Fox on The Artificial Production of Tuberculosis. Page 2.
We have now to enquire into the nature of the experimental evidence.

Lamme, while examining some vertebrae containing tubercles, slightly grazed his forefinger with the saw. On the following day this scratch was slightly inflamed, and there gradually formed in it and almost without pain, a small roundish tumour, apparently confined to the skin, and which at the end of eight days was of the size of a large cherry stone. At this period the epidermis cracked and showed the tumour to be yellowish, firm, and in every respect like a crude yellow tubercle. He Slowed this with the deliquescent hydro-chlorate of Antimony and then detached it by gentle pressure. The walls of the cavity left were a pearl grey colour, slightly semitransparent and without any redness. After applying the caustic again to these the part soon healed and gave no further trouble.

With the exception of this accidental experiment, others performed, prior to M. Villenemlin, by inoculating animals with the joints of tuberculous ulcers, such as those of Weilbeard and Lepelletier in France and Karst and others in Germany, were productive either of as result or of a very doubtful result as regards the production of tubercles.

M. Villenemlin communicated his first series of experiments to the French Academy of Medicine in 1865; and his second series
Cohnheim's pamphlet 'Die Tuberkulose vom Standpunkt der Infectionslehre'. Cullimore's translation Page 5.
in 1866. The results of these experiments were very definite. By then Villemin showed conclusively that on inoculating rabbits with tubercular matter and placing them under exactly the same conditions as other rabbits not inoculated, those inoculated almost invariably became tuberculous while the others remained well. This result was not produced when matters other than tubercles were inoculated.

These experiments have been frequently repeated since by such observers as Simon, Burdon Sanderson, Klein, Wilson Fox & others with the same success, wherever rabbits or guinea-pigs (the animals chiefly experimented on) have been inoculated with tubercular matter, they have almost invariably developed first locally and afterwards generally (in other organs) a disease which the general consensus of pathological opinion has regarded as similar to tubercular disease in man. In the words of Cohnheim—"every symptom tuberculosis has is manifested in animals experimented upon, those particular symptoms and none other."

When we consider that tubercles for the most characteristic products of most cases of phthisis, many being tubercular from the beginning & most of the others developing tubercles in the lungs and other organs in their course, and that tubercular matter so certainly..."
Artificial Production of Tubercle
produces tubercular phthisis in animals when inoculated, I think the theory of the communicability of the disease from the sick to the healthy becomes in the fullest sense exceedingly probable, though to completely establish the theory it would be necessary to show that the tubercular virus can gain entrance into the system by one or other of the natural channels. However we must look more closely into the more recent inoculation experiments since it has been shown by Burdon Sanderson, William Fox and others that other substances besides tubercle, when inoculated in the same way, also produce the same tubercular disease. Dr. Fox has given the general results of a large series of experiments in a tabular form. On examining this table, the first thing that strikes us is that the products of all low and chronic pneumonias as certainly produce general tubercular disease as tubercle does itself. Cohnheim has demonstrated the same thing, as well as that all sequestrum products of purifying articularis are equally potent, and he has drawn the conclusion that all these products are essentially tubercular, thus returning to Laennec's idea that all sequestrum diseases and all ordinary forms of phthisis, including those described by so many modern authorities as cases of pneumonias, are essentially of
the same nature as tubercle. Cohnheim even proposes to adopt as the real criterion of tuberculosis its power of inoculability—whatever, says he, an inoculation produces tubercular disease in an animal is tubercular, whatever fails to do so is non-tubercular. However this may be, the fact remains that general tubercular disease is produced in animals whenever either fresh tubercle or the Caseiform product of pneumonia is inoculated in any way into their bodies.

This does not yet exhaust the subject, for, though Cohnheim denies that any non-tubercular product can produce tubercular disease, Felton Fox and others assert that it can, and we find cases in proof of this in Dr. Fox’s table above referred to. On carefully examining these however it seems evident that in all, the matter inoculated was either certainly septic or the conditions were such that the septic element was very probably present. The rarity of essentially simple irritants producing it (as the future will be mentioned in the appendix to his published lecture) points strongly to some such influence creeping in. In view of these cases, we must I think come to the conclusion that under certain conditions, the ordinary septic virus seems capable of producing general tubercular disease, though this is denied.
Wilson Fox, Table on Page 6 of Lecture on "The Artificial Production of Tubercle."
by Cohnheim, and the facts as above are attempted to be explained away by Dr. Cullimore.

The general conclusion to be formed from the inoculation experiments is well stated by Mr. Semont in his reports to the Privy Council in 1874. Referring to Dr. Klein's paper on the lymphatic system and its relation to tubercle, he says: "the broad results of modern discovery in regard to ordinary tubercular disease tend to represent it as a chronic locally originated zymotic process, which, starting under certain conditions in one first spot of the (tuberculous) animal body, advances by successive steps in definite anatomical lines to infect the entire system, a process which by means of its characteristic products is inevitable from part to part, and from subject to subject; but of which in certain other cases the locally originating cause or contagium appears to be the common septic ferment, or a ferment not yet separable from the septic."

This of importance to note further that the spectrum of phthisical patients can in the same way produce general tuberculous while that of bronchitic or pneumonic (acute) patients can not.

Such being the results of inoculation, it becomes of great importance in the next place to ascertain whether similar results are produced by the tubercular virus gaining admission into the system by any of the ordinary channels? We find that this virus is endowed
* Cohnheim's pamphlet as above. Page 4.
† 'The Lancet' for November 23, 1878 or Vol. III. p. 741

Consumption as a Contagious Disease. Page 38.
with considerable vitality enabling it to resist attacks by destructive agents as the digestive ferment.
Thus, Thomeau and others have succeeded in producing the disease by feeding rabbits with tubercularly infected food. Dr. Tappeiner of Meran has made some experiments by feeding dogs with tubercularly infected food to the extent of fifteen grammes daily. In two of the dogs, fed at Innsbruck, tubercles were found in the lungs after six weeks of feeding, but in six others fed at Meran, all the organs were normal, a difference of result of which no explanation is given by Dr. Tappeiner, the general surroundings of the animals at the two places not being indicated. In those which became affected however, it is important to notice that the intestinal tract was affected.

Dr. D. H. Calllimore published in the "British Medical Journal" of May 22nd, 1880, a very interesting case which he has republished in his monograph. One of his dogs—a parish—at Mandalay was in the habit of frequently visiting the house of a patient—fur advanced in pulmonary consumption with obvious tubercles and coughing up the expectorated matter. How long this had continued was not known but a few days after the death of the man the dog appeared out of sorts, refused his food, rapidly emaciated, had a cough which increased quickly in severity, and was attended later on with a
tenacious and glairy discharge from the mouth and eye.
The stethoscope detected moist rales with rhonchi and
rhonchi were a greater part of the chest. These symptoms
continued to grow worse for a week or ten days, when
convulsive fits, of about five minutes duration and
occurring several times in the course of the day, made
their appearance. These fits were of an epileptiform or
tetanic character." On the second day of the fits and
twelfth of the real disease the dog was poisoned and
a post-mortem examination was made of the head and
chest which disclosed the following: "Both pleurae
were adherent, the adhesions being recent, and the
lung were studded with softened patches in varying
stages of Caseous degeneration, many of them containing
تعبيرulent matter, with which the minute and
larger bronchi were also clogged. The bronchial glands
were not noticed. The brain did not show much
sign of disease; the membranes were thickened
and congested, and on cutting them, a good deal
of serum exuded; there were no tubercular or cheesy
deposits; the whole mass was uniform and appear
softer. This case shows how rapidly and severely
the lungs can become affected, even when the infection
is apparently conveyed to the stomach by the food.
Though the abdominal glands were not examined, I think
they would certainly be affected. In fact from the
Cohnheim's Pamphlet as above - Page 18.

severity of the symptoms and the rapidity of the case, it would be more properly described as a case of acute miliary tuberculosis. This would probably result from the poison gaining access to the blood in quantity sufficient to affect all the organs, probably through the thoracic duct, since Cottingham quotes Parfitt as having "observed tuberculous and caseating infiltration of the thoracic duct in cases of miliary tuberculosis."

However interesting these facts may be in showing how tubercular splattering can be produced in animals by the swallowing of actual tubercular matter or tubercular spu palate, they are of less importance in a practical case than those experiments relating to the inhalation of tubercular spu palate, because, in adults at any rate, the disease can very seldom originate in the stomach or bowel in that way, as the stomach is not at all liable to become tubercular and the digestive juices have a considerable destructive power. At the same time it seems very likely that, in that way, the Beyers patches and solitary glands of the intestines become secondarily tubercular or from these the mesenteric glands become affected.

In November 1878 Dr. Falleriner of Grenz published in Virchow's Archiv the result of his first series of inhalation experiments. In these experiments dogs alone were employed as they very rarely suffer from spontaneous tuberculosis. The dogs
were made to breathe for several hours daily in a chamber, in the air of which fine particles of phthisical spatum were suspended. The spatum was mixed with water and the mixture was then atomized by a steam atomizer. In all cases the spute was from persons with cavities in their lungs.

The result was that of eleven animals experimented on, with one doubtful exception, after a period varying from twenty-five to forty-five days, all, being killed, presented well developed miliary tubercles in both lungs; and in most of the cases tubercles were present to a smaller extent in the kidneys, and in some cases also in the liver and spleen. The tubercular nature of the products was confirmed by microscopic examination.

The quantity of spatum necessary for the effect is certainly a very small one. In these experiments only one gramme of spatum was daily atomized in the air of the chamber, and the quantity of dry spatum must have been exceedingly small. So far the result is very striking, but Dr. Max Schottelius made other experiments not only with phthisical, but also with that of persons suffering from simple bronchitis, and with pulverized cheese, brain and cinnabar. The result was that miliary tubercles were found in the lungs in all cases, and in equal quantity with both phthisical and bronchitic spatum. Cheese produced
a smaller quantity; pulverized brain still less; and
the Cinnabar least; effect of all, merely a few whitish
tubercles with pigmented centres, with an interstitial
deposit of the substance which caused an inflammatory
reaction. Tappeiner also experimented with
Calves' brain in two cases, but with purely negative
results. No changes in the lung followed such
as resulted from the inhalation of tuberculous spume.

The second series of Dr. Tappeiner's experiments pub-
lished last year in Virchow's Archiv, and summarised
in the Lancet, of November 24th, 1880 is even more
conclusive. These experiments were primarily to
ascertain whether the inhalation of material from
secreting glands can produce the same effect.

Half a gramme of pus was obtained daily from the
caseating glands of a boy, aged five years, and
was mixed with 100 grammes of water, and the
dogs were made to inhale the atomised mixture
a quarter of an hour daily for about ten days. For
purposes of comparison two dogs were similarly treated
with Phthisical spume. These two and one of the dogs
attacked with gland fever, were killed and examined
twenty-three days later. The organs of the latter were
found to be perfectly normal, although the animal
had presented a cough and loss of weight. (Could this re-
sult from septic pneumonia?) In the two dogs
treated with Phthisical Spuza, tubercular nodules were found in both lungs and spleen; their nature from the microscopical characters, was beyond doubt. The two other dogs treated with gland pus were killed and examined thirty-three days after the commencement of the inhalation, and the organs were also found free from tubercle. The same negative result was obtained in the case of two dogs killed on the twenty-ninth day after the inhalation of gland pus. In order to ascertain the period of incubation two dogs were killed on the 13th and 19th days respectively from the commencement of the inhalation, and no tubercle was found. Hence the period of incubation in dogs is between nineteen and twenty-three days.

By the suggestion of Professor Waldenburg, two other dogs were treated with Spuza from single chronic bronchitis, fifteen grammes daily for ten days, and they were killed on the twenty-eighth day after the commencement of the inhalation. The post-mortem examination showed both lungs to be perfectly normal, without a trace of tubercle.

The experiments were made at Berlin, and the pathological results ascertained by Gravitz, Graef and Friedlander, under the supervision of Dr. Cohn, so that the facts appear to be beyond question.
The conclusions drawn by Taffener, and I think fully justified, are 1. The inhalation of Phthisial Spuza by dogs, even in small quantities, produces with certainty tuberculosis of the lungs, with or without general tuberculosis, especially of the spleen. 2. The stage of incubation in dogs, longer than nineteen days but shorter than twenty-three days. 3. The inhalation of Cerebrospinal Pus from glands produces no infection—a fact which indicates an essential difference between cerebrospinal and tuberculous. 4. The inhalation of the Spuza from chronic bronchitis is equally ineffectual. These observations thus constitute experimental confirmation of the infection of Phthisis, to which many clinical facts point, and they indicate the probable mode by which the infective is produced.** By simply breathing and still more by coughing, the consumptive patient certain atoms of a considerable quantity of his Spuza and at the same time disperses the abominate matter through the air of the room in which he is.

The next question that arises is scarcely less importance is, whether the infective virus exists in any of the other secretions or excretions of the tuberculous patient. Facts directly bearing on this part of the subject are very meager, but there are some of an indirect character, very suggestive, which...
See Mr. Fleming's paper on the transmissibility of tubercle in the British and Foreign Med. Chin. Review (1876) Coll. LXXV.
merit careful consideration. In the first place it will scarcely be doubted that, in those cases of Phthisis attended with profuse diarrhea, due to tubercular ulceration of the bowels, the tubercular virus will pass with the alvine discharges and so may possibly be communicated to others so as to induce tubercular disease in the same way as the enteric poison is communicated. Then from the fact of the kidneys sometimes becoming affected and some of the experimental cases, it may be supposed that the virus is partly eliminated with the urine. But the facts of by far the most importance in this connection are those derived from feeding animals with the milk of tuberculous cows. Of animals so fed, generally develop tubercle; it will show that the tuberculous poison exists in the milk, and if in the milk of the tuberculous cow, so in all probability in the milk of a nursing tuberculous woman; and if in the milk there is no reason why it should not be in other secretions and hence there may be more reason than is generally supposed in the somewhat popular belief that the sweat of consumptive patients is a vehicle of contagion.

It appears from the statements of veterinary surgeons that tuberculosis is a very common disease among cows, especially in those that are stall-fed in towns or are of the higher breeds, in fact, probably...

Dr. Creighton's paper as above. Page 9.
five per cent of such cows are so affected. The disease as it appears in them, known as ‘Perlsucht’ has quite distinctive and specific characters, but there are by no means sufficient to separate it as a really different disease from the general tuberculosis of man; the special characters of the bovine tuberculosis indeed are more or less distinctly marked in some cases in man as first clearly pointed out by D. L'Erblanc in the Journal of Anatomy and Physiology of October 1850. He attributes such cases, with much probability, to infection from Cows.

Probably the first to direct attention to this subject was Gerlach in 1869 when he suggested that the milk of tuberculous Cows was dangerous and that it was perhaps the chief cause of tuberculosis in Children. He instituted a series of experiments to test the infectious character of the disease with decided success. He have only at present to do with those referring to the feeding of animals with the milk of Cows suffering from Perlsucht. He selected a Cow with well developed symptoms and signs of Perlsucht, and gave its milk to the following animals, allowing them at the same time other food; i. A healthy and well nourished Calf, 8 days old, was fed for
Dr. Creighton's paper in Journal of Anat. & Physio. Vol 54,
"Pulmonary Tuberculosi in Man." Page 24.

Consumption as a Contagious Disease - Cullinane P 1 2.
fifty days and was killed at the end of another fifty days.

2. An eight-month's lamb fed with the milk from the same cow was killed after three months.

3. A pig six to eight weeks old was fed for twelve days and was killed thirty days later.

All of these showed, on post-mortem examination, the characteristic appearances of tuberculosis closely allied to the form it assumes in the cow, though also resembling in other respects rather the tuberculosis as it appears in man and the apes."

In one case, amongst others not so conclusive, described before the French Academy by M. Perche, two of a litter of three rabbits were fed on decayed milk; one died and the other was killed some time after, and both showed tubercular granulation.

In 1874 M. Fleming, F.R.C.S., published a paper in the Medico-chirurgical Review in which he pointed out the infectiveness of tuberculosis, and gave further experimental proof of its communicability to animals through feeding with milk of tuberculous cows. He also showed that boiling was not always sufficient to destroy the infective power as in this case: two pigs were taken from the litter of a healthy cow, of these two were fed with
unboiled milk, two others with boiled milk, the milk being in all cases got from a cow in advanced tuberculosis, and the two others were kept as control animals. After some months, on being killed, the control animals were found with all their organs quite healthy, while all the other four were tuberculous.

Mr. Wally describes a case reported to him by Mr. W. Bronte, M.R.C.S. of Lancaster of much interest as it is not directly experimental case. He says—'A short time ago two pigs were killed on a farm in this neighbourhood which had been fed with milk from a cow afterwards found to be the subject of tuberculosis, and from which she died, and upon post-mortem examination characteristic pulmonary and pleural tubercular lesions were discovered.' The mother of the two pigs was subsequently slaughtered. She was perfectly healthy, no trace of tubercular or other deposits being discoverable in any part of her body.'

A similar communication to man may be supposed to be shown in the following case given by Mr. Fleming in his pamphlet "Tuberculosis from a Sanitary point of view" though I think the case is very far from convincing. A surgeon in Providence, United States of America, had a cow affected with
Consumption as a Contagious Disease - Cullimore
p. 62.
Tuberculosis, the milk of which was consumed by his family, a large portion being allowed to one of his young children. The warning against using this milk, by the veterinary surgeon was unheeded. The child who got the largest quantities of this milk soon died of tubercular meningitis.

Dr. Cullimore has lately been in the habit of making careful inquiries from amongst the numbers of children affected with primary intestinal tuberculosis, who seek advice at the North-West London Hospital, and has been able in many cases to connect their disease with the milk drawn from cows kept in confinement.

But perhaps the latest and most important contributions to this part of our subject are those of Dr. Creighton, contained in his two papers already referred to, in the Journal of Anatomy and Physiology of October 1880 and January 1887. In these he reports a series of twelve cases of general tuberculosis in man identical in pathological characters with the special form of the disease as it occurs in cows, and which cases he attributes unhesitatingly, and on the ground of their similarity in general characters and minute structure, to infection from cows. In his general summary he says
"I have rested the whole case upon certain minute identities of form and structure in the infected body, due to the miniery of infection. Among other points, there were the leaf-like and coat-like outgrowths of the pleura and peritoneum; these being the early stages of the cerebrite-like or pearl-like nodules and their connecting threads; the lymphatic glands, with distinct nodular formations in their substance; the lungs, with smooth-walled closed conicae or calf encapsulated nodules. In the new formations generally there was a particular pattern of microscopic structure, in which giant cells and epithelial-like cells figured largely, and there was a relatively high degree of vascularity. In all these points the disease in man is a miniery of the parent disease in the bovine animal. "That miniery is not only in single features, but it is of the whole disease. Every case is not in all particular perfectly identical with bovine tuberculosi, but they all resemble it so closely, that believing in the marvellous miniery of infection" he considers that they are only to be accounted for by infection. As similar cases must have frequently occurred before, they have without doubt been always included amongst the
other forms of tuberculosis.
It thus appears absolutely certain, from all
this evidence, that the milk of tuberculous
 cows is capable of communicating tuber-
culosis to other cows, to other animals and
to man. While this concluding with the
alleged comparative frequency of tuberculous
in cows, is of an alarming character especially
with regard to the infant population, it is
of scarcely less importance in showing that
the infective power of tubercular consumption
can exist in the natural secretions of the
tuberculous subject and that, therefore con-
sumption can be communicated in that
means. It thus strongly suggests a further
source of danger to those who are in close
and constant attendance on the consumptive

On taking a general survey of the whole
evidence adduced in this paper, the following
general conclusions may, I think, be legit-
imately drawn:—
1. Phthisis can be communicated from
the sick to the healthy through the air of the
room becoming contaminated by means of
the respiration and expectoration of the patient.
2. The form of Phthisis, as produced, varies being (a) sometimes of a local septic inflammatory character, from which recovery may readily occur in the early stages. (b) Sometimes of the true tubercular character, speedily going on to a general tuberculous. (c) Sometimes of a special septic character, causing a somewhat rapid phthisis, the rapidity being out of proportion to the local pulmonary changes, the symptoms being more allied to general septicemia. From this, under favourable conditions, recovery may take place even after the patient is very greatly reduced, as in many of Dr. Thomson's cases.

3. Tubercular Phthisis may arise by infection from lower animals suffering from the same disease, either by eating their tuberculous organs, or in the case of cows by the consumption of their milk.

4. As a general inference from the last, it is probable that the secretions of the phthisial patient may also communicate the disease, and thus may children get it through the milk of their tuberculous fathers.
And others through the perspirations.

The practical inference to be drawn in regard to the treatment of Phthisis is that this is obviously on principle antiseptic and hygienic, but the details do not belong to this paper, at the same time it may be noticed that the carrying out of this principle in practice has been attended with the most marked success.

Notwithstanding all that has been said by the careful carrying out of which to some principles in full accordance with this view of the infectiveness of Phthisis, the danger to the attendant will be reduced to a minimum. Thus though Phthisis is, in my opinion, an undoubtedly infectious disease, its infectiveness may be readily guarded against by simple precautions so that, under these, acts of attention and loving kindness which affection prompts to soothe the sufferings of our companions and which are so much relished by them may be freely indulged in, without very much danger.