Thesis for M.D. Passed July 1883

Recent researches on Tubercle; their relation to certain points in connection with pulmonary disease - with illustrative cases &c.

by
Charles W. Stewart M.A. M.B. Cm.
June 20 1883

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 – 1346

To discover the true nature of Tubercle is a task which has long exercised the minds of pathologists. The relation also of this substance to various kinds of pulmonary disease has been a subject of much debate and the battle-ground of many conflicting opinions. Such subjects are doubtless of high scientific interest, but of general importance and interest also are any discoveries tending to elucidate this obscure connection, especially to persons exposed to a climate such as ours, which seems to favour in such a high degree the development & progress of tubercular diseases.

It would be premature to say that this subject has yet emerged from the region of cloud & shadow, but few could be inclined to deny that a very distinct advance has been made within

the past year. Renewed interest & fresh vigour have been given to ~~this~~ enquiries in this subject by Koch's great discovery announced to the Scientific World in March of last year. In those conversant with the subject generally, and acquainted with modern views, the discovery of a bacillus in tubercle must have excited a feeling of pleasure rather than of surprise, since the idea of a virus in tubercle was by no means new, but firmly maintained for some years back by the most advanced thinkers. The actual discovery was, in fact, just the confirmation of the results of years of experiment & logical deductions therefrom. This is not unthat its counterpart in many departments of science, and I may illustrate it by one example of rather remarkable similarity which occurs to me in thinking

over the subject. Leverrier by his study of the laws of gravitation & of the definite distances of the planets came to the conclusion that in the far distance, outside the orbit of the most remote known planet, there must exist another member of the solar system influencing & disturbing the others. Basing his calculations on the amount of disturbing force he defined the locality of the unknown body, and Galle of Berlin turning his telescope in that direction discovered the planet Neptune. So Koch, seeing the logical conclusion of the modern theories of tubercle, after elaborate & patient experiments with tubercular matter saw through his microscope the expected but hitherto unseen germ. This is the consummation of the views of many; and now both they, & doubters whose maxim is "Seeing is believing" will be enabled

to proceed on a basis not of mere theory but of fact. Many debatable points will be finally set at rest, & new questions will arise. Further it cannot fail to modify the current views upon many theories in connection with phthisis, and regarding several of these I propose to offer a few remarks in the further progress of this essay. It may be well at this stage, for the sake of greater clearness to indicate in more detail the intended scope of this paper.

First then that we may have a firm basis upon which to work, we must first consider in the light of Koch's discovery, what tubercle really is. Second by what means of experimentation & research the existence of a virus has been made out. Further to discuss the influence of this belief on such questions as the Contagiousness

and Hereditary character of Phthisis.
Lastly to shew in how far such views
afford a scientific basis for certain
lines of treatment giving illustrative
cases, & a corresponding series of microscopic
slides made during the progress of the
treatment. I may perhaps state
that at the beginning of this year, when
attempting to sketch out a line of
inquiry my object was, by frequent
examination of the sputum of patients
while under treatment, to discover
what relation as to appearance & number
the micro-organisms bore to the stage
of the disease & the temperature of
the patient. When speaking of my examination
of the sputum I shall give grounds for my
belief that anything like a definite
ratio cannot be made out
in this way.

What then are we to consider tubercle? Many diverse views have been held as to this, and erroneous conclusions have been arrived at by various experimenters in not clearly distinguishing between ordinary caseous matter, & caseous matter as a specific product. Etymologically either might be a tubercle, but in reality there is a great difference. The early view seems to have been that a tubercle was a direct deposit from the blood When physiologists were not so clear as they are now upon the processes of assimilation it was a convenient theory that in certain degenerate states of the system there were present in the circulation, matters unfit to take part in the nutrition of the tissues: these were therefore cast out of the blood & formed little lumps or tubercula But after a time

it became obvious that these apparently effete products had some inherent power of growth enabling them to spread in whatever organ they were retained. Hence arose the theory that tubercle equally with cancer & sarcoma was a living substance capable of propagating itself. Now this view was a distinct advance, & was gradually leading on to the clearer light which we believe we now possess. There was however, all this time, too great a tendency to speak of two kinds of tubercle - the grey & the yellow - as substances essentially distinct from one another. Still some writers did hint that the yellow was not derived from the grey miliary tubercle. The germ of truth then lay in the belief that tubercle was a living & spreading substance, & it only remained for subsequent observers to determine

wherein this infective property lay, to make matters clear. And this I believe has been done in the recent demonstration of a particulate virus uniformly present in all true tubercles, and which, by itself, or separated from all other material is capable of producing experimentally an undoubted tuberculosis.

Having got so far in the consideration of the nature of tubercle in general, we must denote carefully what is to be regarded as a tubercle, because among writers on this subject there is some diversity of opinion as to what is to be regarded as the criterion of a tubercle. The answers which have been given to this may be divided into two classes, according as they go upon an histological or an experimental basis. Thus Cohnheim

placing little confidence in the anatomical answers, states that the only true test for tubercular matter is its power, when inoculated of producing its like &c. Now I believe that this really is true, but certainly not to the necessary exclusion of the anatomical test, & indeed the one cannot be considered complete without the other. There, indifferent particles when inoculated have a power of producing, by their mechanical properties, caseous masses very like crude tubercle, & which have admittedly often been mistaken for them; how then in a given case are we to decide whether the primary material was specific or indifferent? To this, it seems to me we are thrown back on the microscope as a means of diagnosis, and I do not

see why in this instance it should be considered a more fallable guide than in the case of a sarcoma or epithelioma. If this method prove reliable, it is certainly a more speedy & convenient one, resolving itself just into the question of the essential histology of a tubercle.

Till quite recently this would have been described somewhat as follows – a small translucent body which in section exhibits at its periphery a zone of inflammatory tissue, inside this numerous small round cells, next larger epithelioid cells & lastly in the centre a large multinuclear corpuscle the so called giant cell. Let us however criticise this definition & see if it be quite satisfactory. First of all we have the peripheral layer consisting of round cell formation with the epithelioid cells

now none of these are diagnostic of any special structure, hence most reliance was placed on the presence of the giant cells. But these are universally allowed to be bodies about which little definite is known either as to their origin or destiny. We could quote perhaps a score of opinions all more or less plausible regarding their nature, are we then to commit such an important distinction to such a hazy existence as this. And furthermore it is said that such multi-nuclear cells are found in many products of excessive inflammations which have no affinity to a tubercle. Placing the matter in this light - a body with ordinary round cell formation at one part, & at another a corpuscle about which little is known & which sometimes occurs in inflammatory

tissue, it would seem that the microscope was indeed a very unreliable guide & that Cohnheim's view was the only true one. But there are many cases of evidence in wh isolated facts go for very little, but when grouped together weigh considerably. And this I think is a case in point. While not asserting that any or all of the above constitutes the essential of a tubercle, I venture to think that when seen in a definite and regular relation according to the description previously given, few errors would be made by competent observers in diagnosing a tubercle. I remember while reading the books upon this subject to have come across rather an amusing illustration of this. Mercury having been given to an animal, an eruption took place of supposed miliary tubercles. Upon microscopic examination however,

it turned out that each was merely a minute globule of mercury with an inflammatory zone round it.

Quite recently however we have been favoured with the most advanced views on the nature of a tubercle. Mr Watson Cheyne a most accomplished experimenter & microscopist disregards the giant cell as being per se of any diagnostic value; any importance it has is derived from its connection with the epithelioid cells to which it has been traced by him. According to him the only criterion is the presence of the Bacillus tuberculosis, and this as we may afterwards see is intimately associated with the Epithelioid cells, & hence also with their derivatives the giant cells. He gives the following as his definition of the structure & essential of a tubercle "a nodule, composed of

Practitioner. p312 April 1883

a central mass consisting in the main of epithelioid cells or in its place a cheesy mass, surrounded by more or less inflammatory tissue, with or without the presence of giant cells. The absolute diagnostic mark however is the presence of the tubercle bacillus.

We have now attempted to explain what the true nature of tubercle is and how a tubercle can with certainty be recognized. Our next duty must be to shew how the idea of a specific virus in tubercle gradually gained ground, & then the nature of the experiments which now amount to a complete demonstration of the fact. It was at first from the analogy between tubercular & various other diseases that the idea of a distinct particulate virus in the former arose. It was in Phlegmonic & Relapsing Fevers that such a discovery

was first made & from time to time, further investigation led to similar results in the case of other diseases such as Enteric & the malaria. Hence by considering especially the distribution & mode of extension of tubercle the idea became prevalent that it too was due to a similar organism. This view had many strenuous opponents who stated that neither did they see any ground for the belief, but rather the reverse. As has frequently been pointed out elsewhere, strong arguments in its favour are the universal & uniform distribution of the little nodules in acute general tuberculosis, and in the case of local tuberculosis the manner which the masses have of extending at their edges while breaking down in their interior.

Fresh crops arise around the original focus, this constituting the infective power as we have been accustomed to hear the word used by Dr J. Coats & some others.
How then was experiment brought to bear on this? Tubercular matter was introduced into the bodies of animals either by the eye, abdominal cavity or intestinal canal, & in all these ways a tuberculosis was produced. And it is specially to be noted that this was not a local affection confined to that system - be it pulmonary or abdominal - by which the material was introduced, but a general eruption pervading the different organs of the body.
These experiments date from the time of Villemin, nearly 20 years

years ago & have frequently been repeated since; but then the question arose does this infection demand the use of caseating tubercular matter or will undifferent irritants or the degenerated products of simple inflammation do equally well. This latter view was strenuously upheld by many observers both in Germany & England, & subsequently not only by theory but by experiment; doubts were also cast on the tubercular nature of Villemin's productions. Now I believe there is little doubt but that an eruption of true tubercle, was excited by these observers, at least in classes of animals such as guinea pigs predisposed to tubercle; while there are various ways

~~of getting~~ out of the difficulty.
Thus Cohnheim, while at Berlin,
was successful in thus producing it
but elsewhere failed; this he said
was due to there being a natural
epidemic among the guinea pigs at
that time. Another answer is that
the various sets of animals not being
isolated might infect each other in
the same manner as human beings
living in the closest intimacy probably
do: thirdly the accidental admixture
of a specific organism with the
presumably sterile material by
means of the apparatus used.
Watson Cheyne inclines to the latter
idea, & I believe that while all
the three may have been factors
the latter is a strong point
in arguing from the analogy of

~~Some~~ The professedly antiseptic methods of some surgeons who stand between the spray & their patient, lay their knives among the blankets, and permit non-disinfected hands to touch the wound. Such may have been the practice of these experimenters, and it certainly requires a great amount of scientific interest to carry out in its entirety an elaborate system directed against organisms, of which whose existence you may be very sceptical. This I think may account for the results of these observers. But we have a strong argument against the production of tubercle by ordinary materials in the experiments of those who have carried out their investigations with every care & due precautions as to fallacies. The most careful &

recent of these in England are embodied in the Chemical Report to the Association for the Advancement of Research. He set about the investigation in a most unbiased spirit, and gave each side a fair chance. The first part of the investigation was to inoculate a series of animals with true tubercular matter containing bacilli. This was uniformly followed by a general tuberculosis of the true nature of which he persuaded himself both by microscopic investigation, and by successful re-inoculations by these products. The second part was to inoculate another set of animals with the various indifferent materials which have been mentioned as capable of producing tubercle. These consist both of

animal products such as lymph, pus, brain, bits of tumours, and of inorganic as cantharides, lycopodium cork &c: in none of 25 animals thus treated did true tubercles arise, when proper precautions were taken against contamination. From my recent personal experience of these matters I may explain what these precautions are, & how the experiments are performed, considering this preferable to an abstract from any work on the subject, altho' of course it was my object to follow as closely as I could in their essentials the instructions of those who have had long experience in such matters. On account of the existing laws on experiments, and not being personally licensed I feel it my ~~difficult~~

duty here to express my thanks and indebtedness to Dr David Newman for the interest he took & the personal assistance he gave me during these attempts in the Royal Infirmary Pathological Laboratory (licensed)
The first thing to be done is to choose the kind of animal; in this case I confined myself to guinea pigs as they are more easily kept than rabbits, & it is also known that they readily become tubercular. They have some disadvantages however, even small ones are much more expensive than good sized rabbits, & further while I could procure plenty rabbits I found very great difficulty some months ago in getting any guinea pigs in Glasgow. January & February

however are the worst months, as at that time the young ones have not been produced, & dealers are unwilling to part with the full grown ones. The next point is to secure that those you buy are in a good state of health: before inoculation each animal should be carefully weighed & this is specially useful for after comparison in the case of full-grown animals. I found that they were rather susceptible of cold having one which apparently died from this; hence they should be kept in a room at a comfortable & uniform temperature in wooden boxes closed all round except the open grating in front, & having a few holes bored in the bottom. Having made these preparations what tubercular matter is to be

taken, & how is it to be injected, also for comparative experiment what non-tubercular matter is to be chosen I may take for illustration the pigs marked C & D in my note book. C was inoculated with some pus from a free surface by a valve-like flap of skin in the abdomen. For seeing the effect of a tubercular irritant matter part is better than the eye for in this transparent organ we can at least see the progress of the local lesion. Phthisical sputum mixed with a little water is well adapted for injection into the anterior chamber of the eye. For this case I have chosen a distinctly purulent bit of sputum from an advanced case of consumption & also ascertained in it the presence of the bacilli. The state of

this patient was as follows
J.C. aged 18 an iron dresser. He had complained of cough expectoration & progressive emaciation for about 6 months. On several occasions he had spat blood. As to the condition of his lungs, there was consolidation of a great portion of the right side as indicated by increased Vocal Resonance, and Fremitus. Sibilating râles & cavernous breathing indicated that the lung had to some extent broken down. In the left lung there were also signs of commencing excavation. Hence the case was a very suitable one for the purpose.
A fresh syringe should be used, & in any case it must be thoroughly disinfected, not by simple washing even with 1:20 carbolic but by the aid of heat. Many of the earlier experiments with indifferent matter were

fallacious I believe from this, for at that time the great resisting power of these organisms was unknown. It is now found that exposure even for a considerable time, to the action of such Germicides as Carbolic Acid does not destroy their Vitality, so that this can be effected only by a high temperature. The Guinea pig C inoculated with pus in the abdomen was examined every second day for several weeks with this result that nothing was found but such a local inflammation as one would expect from a wound and septic pus, and before death even this passed away. In the other case the sequence of Events is different just that described by other experimenters:— at first

the products of local inflammation which soon disappear to be followed after a certain incubation period by a sudden eruption of miliary tubercles. The notes regarding this case are as follows

Guinea pig D

8th = Inoculated this morning with tubercular sputum in anterior chamb of right eye. Took chloroform well & recovered well

10th = Eye distended with yellow pus, Animal takes food well & seems no way disturbed

13th = Eye still appears like a pustule but not so distended now

14th = Has some appearance of clearing up & the pus is disappearing

15th = Considerable difference since yesterday; eye now nearly clear

18th No trace of pus but the eye looks somewhat shrunken, as if not yet recovered from the previous distension

20th Some opacity about the eye now

23rd What I take to be tubercles are today becoming apparent.

The period between a scarlatina is about 14 days but varies somewhat with the amount injected. In the case of rabbits I understand that it is somewhat longer, varying from 3–4 weeks. Thus the period varies with the constitution of the animal. And it lie in the proper course of this paper interesting & important comparisons might be drawn between this & the various eruptive fevers, the incubation

period of which, is set down as from 10 to 14 days. There however is any considerable & I may be allowed to mention one case which impressed itself on my mind while acting as Resident in the Fever Hospital at Leith. During a typhus epidemic a girl was sent in as having Relapsing fever & so put into the typhus ward. In 2 days however her temperature became normal & the feverish appearance left her. She was removed from the ward but in about 8 days she was struck down with an undoubted attack of typhus; this unusually short incubation period I accounted for by the very considerable dose of the poison she must have imbibed while constantly in the ward for 2 days & 2 nights & in a susceptible condition. While mentioning these attempts I consider

them as matters of personal interest rather than of any value; the subject having been so thoroughly & carefully gone over by others. We may now take it as a demonstrated fact that tuberculous matter & it only is capable of reproducing true tubercle. But at this stage another & very important point arises. Is there a particulate virus contained in tubercle, & if so what is its nature. This is answered by cultivation experiments but I have not been able successfully to carry these out. The process however is somewhat after this manner. A pure organic liquid such as serum or infusion of rabbit is put into purified test tubes; a piece of tuberculous matter is lifted with disinfected forceps & gently floated on the surface & then the tube placed in an oblique direction in an atmosphere kept at a uniform temperature about the heat of the human body. Soon the little mass begins to spread & throw out processes a little bit of that is picked up & the same process gone through again with sterilized serum

After a number of successive cultivations it is found that all the caseous matter is eliminated & bacilli only left; these being inoculated produce tuberculosis even more speedily & surely than when mixed with caseous matter, pointing to the fact that the essential virus of the disease is contained in them in a concentrated form. It has been objected by some observers that the source of the infection lies in small round bodies (micro cocci) which have been seen by them in tubercular matter & also cultivated on serum. I have not seen them myself & as to the truth of the theory can only repeat what Cheyne says viz that he utterly failed to produce tubercle with them, even tho' he got the cultivations direct from Toussaint their great advocate. A foolish American idea was that the bacilli were fat crystals; this does not seem to have much weight since such a body could not propagate itself & increase in quantity as the bacilli do; & besides it has been shown that other such solvents of fat do not make any with the

(New York Med. Rec

bacilli. We know also that a very good way for liquifying the sputum previous to staining is by acting on it by KHO Now this I think would also destroy fat crystals. Taking these all these things into consideration I think we may take it as demonstrated that it is only tubercular matter which can produce tuberculosis, & that the real virus lies in the bacilli discovered by Koch.

I must now speak of these methods of detecting the bacillus, wh I have used in examining sputum of phthisical patients, referring also in a sort of slight historical sketch to the steps of progress that have been made during the past year in simplifying & improving the original methods. All the older ways were tedious & intricate the time required from the placing of the sputum on the cover glass to the mounting of the specimen being about 40 minutes. Thus in one of my early slides, the time marked down was as follows: Magenta 30 minutes
Acid 5 minutes
Chrysoidin 7 minutes
with about 10 minutes for drying sputum & mounting the slide.

The essential feature of all the methods is that of counter-staining i.e. we must first subject the specimen to a dye wh will uniformly colour everything & then immerse it in a fluid to abstract the colour from all but the bacilli, & finally stain the tissue in some colour which will contrast with the dye of the bacilli & so make them stand out visably when examined under high powers. At first it is the uniform practice to stain the bacilli red, but in Koch's original method, wh is rarely now used they were stained blue by immersion for a long period in an alkaline solution of methylene blue; the contrast stain being got by a subsequent dyeing in Bismarck brown. These colours are too dark & not sufficiently contrasted to afford a good demonstration. The method most employed in this country is Gibbes modification of Ehrlich's method. It is founded upon the great affinity of the bacilli for certain aniline dyes, & the power wh they have of retaining the colour even

When exposed to the action of strong acids. The composition of this fluid is as follows I Red Fluid 2 grms of Magenta crystals are rubbed down to a fine powder & then dissolved in a combination of pure Aniline oil & water II Counterstain is a Watery solution of Chrysoidin. I have found that the best specimen for finding the bacilli is that expectorated in the morning. Out of the spittoon pick a small piece of cheesy looking, or distinctly purulent matter, place it on a thin cover glass, & press out into a fine layer by squeezing another on the top & sliding it gently off. Then to fix it to the glass & coagulate the albumen pass it once or twice thro' a spirit flame, place in a watch glass & filter on it a small quantity of the magenta solution. In this it is left about ½ an hour. Next to remove the red stain from all but the bacilli immerse the slide in Nitric Acid (1:3) until all the colour seems to disappear, Then remove the acid by washing with water; this will have the effect of producing

a pale pinkish took all over the glass. Further immerse the specimen in the chrysoidin solution for several minutes; wash with water & dry with alcohol, & finally mount in pure Canada Balsam. The first 3 slides in the box marked I a Ib Ic are prepared in this way, & it will be noticed that the stain is very faint whether examined with the naked eye, or with the microscope. The disadvantages of this are that it gives a hazy indistinct appearance wh is very fatiguing to the eye when using high powers even for 2 hours at a time, & besides the yellowish colour of the chrysoidin is not a very good contrast to the red bacilli. I therefore procured some samples of dark basic dyes from the agent in Glasgow of Leopold Cassella of Frankfort. The chief of these colours were Methyl green, Induline B.B., Aniline Yellow Brown & Nigrosin. It will be remembered that in Kochs original method his staining solution was an alkaline one hence it is

necessary to find out how the different colours behave when acted on by acids & alkalis. To be a suitable colour, the powder must easily dissolve, & form a tolerably clear solution. To test this in relation to these various colours I prepared 3 solvents 1st An alkaline one containing 3j to 3viij of KHO: 2nd a week acid one containing 3j: 3viij of Acetic acid & 3ss pure water.

I Methyl green B_2. This is a dark green powder with a slight metallic lustre; when dissolved in pure water it presents a dark blue colour when viewed in a test tube; however it stains the skin a dark green. The colour is unaffected by acid. The Alkaline solution turns the blue colour to a light pink & after a few hours destroys it altogether.

II Induline BB a dark purple powder It seems a richer colour than the green an Equal quantity of the powder forming

a stronger solution. A weak solution viewed in a test tube gives a darker blue than No I. The tint is lightened by acid. Alkalis convert it from blue to a rich purple colour.

III Aniline Yellow does not dissolve so well as the others but forms a brown golden colour unaffected by acids. It is destroyed by alkalis & forms a flocculent precipitate

IV Aniline Brown, a rich coppery looking hard powder. To water & acid it imparts a light magenta colour. This is turned to brown by alkalis.

V Nigrosin is a fine black powder which forms with any of the solvents a black solution. This when much diluted shews a tinge of blue. When exposed to the action of alkalis long, however, it becomes purple. I need not describe more of these colours as their reactions are similar, i.e they were generally soluble in water & acids, but destroyed

or charged by alkalis. I tried the staining of the tissue with several but on the whole the Methyl green answered best, & the majority of the specimens are stained with it. It is a matter of experience whether a short time in a strong solution, or a longer period in a weak one is best: I marked down in my note book the number of minutes, & each specimen was left in the fluid, & I think it gives a better result to use a medium strength of the basis stain, & leave it to act from 5 to 8 minutes. As to the red stain I always used the solution according to Gibbes formula, but I may say that there is a great deal of doubt as to the identity of these dyes. Thus various writers recommend respectively fuchsin, magenta rosaniline, rosein &c, but when you go to buy them the dealers tell you they are identically the same; this has been my experience in Glasgow, but Dr Gibbes states in the Lancet of Dec 30/82 that fuchsin is

a by-product in the manufacture of rose aniline, & that the name magenta or rosein includes such varieties as the acetate, sulphate & of rosaniline. To outward appearance they certainly look alike & give similar solutions, but we can't expect them to have identical properties anymore than Sulphate & acetate of copper have. Dr G.A. Heron who also understood that fuchsin & magenta were the same, states that some of his staining lost colour, & I find that many of the specimens in my box, which showed plenty bacilli when made & examined at first some months ago, have faded so much as to make them difficult of detection. We are very much at the mercy of the colour merchants, for tho' we ask for one special salt, we have no guarantee that we get it when the merchant believes them to be the same thing under different names. I described, a few pages back, the method at first employed

for examining Sputum, and it will be apparent that its length hinders in great measure its utility as a means of clinical diagnosis. The process however was carried on with cold fluids, & about 2 months ago it was suggested to gently heat the watch glass containing the magenta over a spirit lamp. I have found that this heating is a great improvement, as it gives a better stain in 3 minutes, than the old method did in ½ an hour. Instead however of holding the watch glass over a Spirit lamp I have been in the habit of using a copper incubator heated by jets of gas. This having an aperture for the introduction of a thermometer can be kept at a uniform temperature, & so there is no risk of over heating & drying up the fluid. besides, the staining of several separate specimens can be carried on at the same time. I find also that when mounting in Canada balsam, it is useful to heat the slide

as if the Canada Balsam is put on to the coverglass in its usual tenacious state it is difficult to spread it in a thin layer, & set it free of air bubbles. The hot slide however liquefyes it, & so a very thin & clear layer is formed, wh is a great advantage when we intend to use high powers. All the sputum slides in the box have been prepared in these ways; but the heat method is even of greater value when examining sections of lung or tubercle. These had previously to be left in the fuchsin solution for 24 hours, but now can be done in a few minutes. The dipping in Nitric Acid is a disadvantage as complicating the process, & often spoiling the specimen, & a valuable suggestion has lately been made by which we can dispense with this. After staining with fuchsin the coverglass is immersed in a solution consisting of methyl blue, formic acid & water. * This does the double duty of removing the red from the tissues & staining

it blue, leaving the bacilli red. Having spoken shortly of these methods which I have used for examining sputum, we must next consider what is to be gained by such examination. Well after spending between 3 & 4 months on almost daily examination in this way I am forced to say that very little definite knowledge of any clinical value is thus to be got, but what there is I will try to explain according to my own experience.

First we may now & then aid, correct or confirm the diagnosis of a doubtful case of catarrh. Patients often come, who soon after careful bedside examination present difficulties to the young physician — whether is the case one of simple inflammation & so likely soon to recover, or is there something more which adds gravity to the prognosis. This cannot at first be made out by auscultation & percussion & I believe that when there is

expectoration we may at an early stage (before physical signs are definite) find a few bacilli in it, & so be forced to consider the inflammation tubercular, & modify our treatment & prognosis accordingly. Some months a case came before me which illustrates this. The patient then was past the earliest stage & from the physical signs there may not have been such an excuse; indeed personally I from the first took the view that it was tubercular, but doubts having been cast on this, I made a series of examinations of the sputum, with the result of finding the bacilli, certainly not numerous but still undoubted. As the case progressed the men got weaker & thinner; more numerous moist rales were heard in the upper part of the chest & there were evidences of breaking up of the left lung. The man died on March 19 Having obtained a p.m. there could not

See chart.

DISEASE.

Mthiris

Notes of Case.

Name Rd. Corless

Age

Diet

Case ~~Book~~ No. 6

Date of admission.

Result Died

Time.	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E	M E
Bowels.																											
Urine.																											
Temperature (Fahrenheit) 107°																											
106°																											
105°																											
104°																											
103°																											
102°																											
101°																											
100°																											
99°																											
Normal Temperat. of body. 98°																											
97°																											
Days of Dis.	27	28	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19						
Pulse.																											
Resp.																											
Date.																											

42° 41° 40° Died. 39° 38° 37° 36° March 35°

Temperature (Centigrade)

Entered at Stationers Hall. *Printed and Published by Wodderspoon & Shave, 7, Serle St., Lincoln's Inn.* *Gould's Clinical Chart.*

be no doubt as to the tubercular nature of the disease & indeed there was a small irregular cavity, some little distance from the apex of the left lung; & the right apex was rapidly going on the same. To illustrate this series of sputum slides of this case I have put into the box those marked Case vj . I also scraped off some of the matter from the interior of the cavity making the 2 following slides. In these however there was not much to be seen in the way of bacilli, since to get a good demonstration of them in lung disease the person must not be more than 12 hours dead at most, & we can seldom get a P.M. before then. Before passing on to the next point I should remark that of the cases there are many cases of lung disease, frequently enough set down as phthisis clinically which would not respond to this test, while there would others could be embraced by Dr Gairdner's definition

as stated in Stacy. Med. Journal. April 1851
"a wasting of the whole body accompanied by predominating pulmonary symptoms or" I cannot however enter at present into this wide question tho' previously making some preparation with the intention of so doing. Second. To come to a second point What does the examination teach us regarding the progress or severity of a case. In some sets of specimens I at first thought I saw indications that the numbers of bacilli present corresponded to fluctuations of temperature being more numerous when that was high & declining again when it fell. To take one of these cases for illustration W.S. aged 22 was admitted at the end of January this year & persistently showed high temperature both morning & evening. He had no family history of phthisis, but his right lung showed signs of consolidation, & an occasional crepitation could be heard. I examined

his sputum first about the middle of February when his temperatures were running as high as 103° in the morning & 104° at night, & also at subsequent periods. Some of the slides marked IV a, b &c can be seen. The ones marked a & b correspond to period of high pyrexia & my note book remarks upon the examination of a, are as follows "A good specimen; there are few fields in wh numerous bacilli are not found, now & then we see one isolated, but generally about 12 are seen lying within a small area. Similarly in b. done on the same day. But some time afterwards, having several times made 2 slides on the same day I found that the number of bacilli varied very considerably (see c & d stained with chrysoidin wh I see have now faded so much as to be almost useless) even on the same day. From this & several other cases I have come to the conclusion that the number of bacilli

scen is very little guide to the acuteness of the case as measured by the amount of hyperia. I do not say that the actual number of bacilli does not vary considerably, but that the examination of the Sputum is not a sure guide. Indeed I think it very likely that if after a period of moderate temperature we find several days of high hyperia, there is an increased number of them spread throughout the lung just as in a typhus epidemic we find the numerical chart suddenly rising & falling. Some of my reasons for not considering the number of bacilli seen in the Sputum as a safe guide are as follows. The expectoration varies somewhat in its composition from day to day, & even if we take one Spitoon some parts are more likely to contain the bacilli than others. We must certainly always be careful in our choice of the pieces taken for examination, but nevertheless an exact comparison cannot be made. Thus in a case where the lung is breaking & cavities forming, some bits of the Sputum are more caseous than others & it is known that the contents of a cavity contain more bacilli than the wall, tho' in the Spitoon we could not recognize

a difference by the naked eye. Further, the number contained will depend somewhat upon the length of time the sputum has lain in the tubes, thus there will be more in the morning after a nights rest than in the evening after the patient has been coughing all day. Portions of thick mucus from the nasal passages or pharynx may be examined by mistake for true pulmonary sputum. Again it is well known that a destructive process may go on in the lung, but in such a situation that for a considerable time the broken down material may not have a sufficient communication with the bronchial tubes to be expectorated. Therefore I believe that there are many sources of fallacy & that even from a large number of observations it is not possible to make a true generalization as to the progress of cases. However I am prepared to admit that given a case in which day by day we get a large number of bacilli, that that case is one far advanced & with a large deposit of caseous material rapidly breaking down; but this is just a condition which can with as much certainty, & with greater ease & speed be made out by the various methods of physical

examination. Since the scroll of the above was written I see by a note in the May Med. Journal p 395 that Palmer & Frankel, to some extent attach more importance to the sputum-examination. They say "fever is always with numerous bacilli, when denumerated they are few; the progression parallel in direct proportion to the number & development of the bacilli present; they increase in number as the destructive process advances." This so far accords with what I have stated, & as to those points in which it differs I only expressed my opinion, after investigating to the best of my ability what I had myself seen. I still question the fact of whether the above can be made out from simple examination of the sputum. But something I think can be made out of an examination of the breath, & whether it yields anything very practical or not, it affords scope for an interesting investigation in relation to the infectiousness of tubercular disease. Some of the earliest information in regard to this was given some months ago by one of the physicians in the Brompton Consumption Hospital. There, the vitiated air is driven away by fanners through a funnel, and

by interposing glass slides moistened with Glycerine the bacilli were caught & demonstrated. In the January number of the Lancet Dr Charnley Smith suggested a clinical method; his plan was to cause the patient to breath through a double layer of gun cotton. After a time he converted the inner layer of gun cotton into collodion by means of spirit of ether, & within layer of this upon a slide he succeeded in staining the organisms. In the wards where I am acting at present most of the phthisis cases are treated by means of respirators, & it occurred to me that we might combine therapeutics with experiment. Into a respirator like the accompanying one (which can be worn without discomfort for several hours at a time on account of the free entrance of the air) I fitted an ordinary glass slide cut in to two. To keep it from touching the patients nose & for facility in manipulating it, I got a couple of elastic bands stretched across as seen in the specimen, & so I could get the slide in & out quite easily. At first I rendered the glass

sticky by means of glycerine; this however I did not find to be a suitable agent to take on the dyes, & indeed it & the adherent particles sometimes got washed off altogether. I then tried smearing the slide with a thin layer of mucus & found that this answered much better as by drying it over the spirit lamp, a firm adherent layer was got on the glass. A microscopic slide however is not a nice thing to which to ably the staining fluids, & so my last improvement was to apply a thin layer of mucus to both sides of a coverglass; by one of these it adhered to the slide, which might remain in situ; & the other side being exposed to the breath caught the bacilli. After being long enough in its place, it was slipped off the slide with a pair of forceps & then stained according to Gibbes method like a sputum slide. To filter the air from dust, it is a good plan to have a double layer of fine carbolic gauze sewed round the sides of the inhaler. By these plans some very nice specimens were got, & I am inclined to think that more accurate comparative results can be got in this way, than by examination of sputum. Enough has now been said in regard to

those methods of which I have any personal experience; nothing has been said regarding the examination of sections of lung tissue as I have not done anything practically at that portion of the subject. Up to this point then we have considered first the nature of tubercle, & shown how the fact of a particulate virus was demonstrated; after that the detection of the bacillus in the sputum & breath was dwelt upon. This latter throws considerable light on various interesting & important questions in connection with phthisis, & to one or two of these we shall now refer. 1st As to the Contagiousness of phthisis. This is no new idea; it has been prevalent for a long time, but more perhaps in the public mind than even in the professional in this country at least. Sir Thomas Watson for instance in his Lectures expressed himself very strongly against the theory. There are few persons of those who keep their eyes about them but can recall some case or cases pointing pretty clearly in this direction. To show what is meant, I may relate one case which came under my own observation, of such a kind as to attract the attention of friends. About 10 years I met in one of the highland steamers a young Irish lady who had

recently been married to an Inland Revenue Officer stationed at the place I resided. She was to all appearance strong & healthy, while her husband tho' not robust was quite active and fit for his duties. They had not been married more than a year before she began to decline, & after her first confinement unmistakable signs of rapid consumption became visable. She went home to the mild air of Ireland, but it was not many months before we heard of her death, wh within 1/2 a year was followed by that of her husband. It is such cases as these which first gave rise to the idea of the infectiousness of phthisis. In some Southern Countries this Theory has been much more universally believed, & this pointing so clearly to the advisability of isolation has led in some places to phthisical patients being kept apart, much in the same way as we are in the habit of keeping small pox & typhus patients by themselves. Tho' we have not yet got this length with regard to phthisis, there is no doubt but that the propriety of not mingling phthisis patients with others in the general wards of a hospital is daily gaining ground. Should it not be as uncommon

to have a phthisis case, as one of typhoid in our wards? What do we learn about all this from the researches on the Sputum & breath of patients? It has been shewn that both of these contain the tubercular virus in a concentrated & subtle form. Each patient is continually contaminating the air by exhaling these micro-organisms; his Sputum is loaded with it & is capable of carrying infection in various ways. It has been proved by experiment that in these ways tuberculosis may arise; to whatever system of the body these are applied, it first or chiefly catches the infection. Thus, animals who have been fed on tubercular matter tend to have primary intestinal lesions. Dr Cullimore relates the case of a favourite dog who became affected with acute phthisis from lapping up the expectorated matter from a case of advanced consumption. Dogs have also become affected with phthisis pulmonalis by being forced to breath Sputum which was sprayed into their cages several hours a day. Out of 11 cases, in 7 the disease was purely pulmonary; in other 3 there were a few nodules in other organs

p 334 of his book on phthisis

and in only two one was there general tuberculosis. This

Chegue Practitioner p 317

is just the way, tho' in an aggravated form in which people may inhale the tubercular virus. Gibbes showed the noxious properties of phthisical breath by collecting it, and

Dr Yeo's book, note. p 40

passing it into the cages of healthy rabbits at the end of 3 months the animals exposed to this treatment "began to lose appetite, to be very thirsty, to suffer from diarrhoea & emaciation; at the autopsy tubercles were found in the principal viscera, the pulmonary lesions being far more advanced than the rest" These experiments & various others of a similar nature which could be enumerated, fully prove that discharges from the lungs are capable of exciting tuberculosis in the lower animals either when breathed or swallowed. Further it is a matter of probability that patients are auto-inoculable, & that swallowed sputum is capable of setting up intestinal ulceration. The material thus taken into the body affects primarily & chiefly either the respiratory or alimentary system according to the mode of

of infection; it is thus, for a time at least, separated from the circulatory system by a layer of epithelium; but in the case of infection from a caseous ~~nodal~~ tubercular gland, the infective particles are carried universally over the system, & scattered symmetrically in the various organs just as in the case of pyaemic absorption. How far can we argue from these experiments in the lower animals? We are certainly taught a lesson of caution since the possibility of infection is clearly shown. In the human species, as I said before, instances of communication from husband to wife are by no means rare & Dr Yeo quotes some remarkable cases. (Page 10) such as a phthisical seaman marrying one after another 4 healthy wives, who each in turn fell victims to the disease, & last of all the man died also. In the majority of the cases given the infection was from husband to wife, and I am not aware of any special cases in which direct infection occurred between persons less intimately connected, but the rapid spread of phthisis in barracks & in similar

places is generally recognized. Brothers sleeping together may infect one another, but then we cannot argue from this since they have the same hereditary predisposition. In the case of a married couple the excretions from the lungs are not the only ways by which infection may be conveyed. The subtle poison may pass from one to the other in the same obscure way as it does in the case of syphilis, where mothers become directly inoculated, & where babies are born bearing on their bodies the marks of the inherited poison. Thus it is my belief that married people may infect each other, not only by the breath but in other ways; Children are born with active tubercular disease just as much as with syphilis. Phthisis, tho' somewhat rare is not unknown in quite young children. Chesne mentions a case where the foetus of an inoculated guinea pig was found to be affected with tubercle. Even admitting however that in the case of the married, there are other ways by wh the disease may be communicated, I still think

(Finlayson)

that the experience of those who have to do with barracks, or with that low grade of society, where many persons live & sleep huddled up in one room, by pointing clearly to contagion through vitiated air, indicates the propriety of some radical change both for the sake of the patient, & for those about him. Till the millennium comes, we cannot expect to get rid of poverty & its consequences, but in the case of general hospitals, I venture to think that some change for the better might be made in this respect. Thus greater attention should be paid to the disinfection of the sputum & specially of the breath; this latter is an easy matter as by the use of antiseptic respirators, we at once benefit the patient & lessen the risk of spreading the disease. By recognizing the importance of isolation & the therapeutic value of an abundant supply of fresh air, might we not in a large hospital, have a portion set apart specially for the treatment of consumption. Considering

the valuable material which such cases afford for instruction in physical diagnosis I would not be inclined to advocate a separate institution least like the Fever Hospital at Belvidere it should be a terra incognita to 80 or 90 per cent. of the students who qualify each year. Again the question of the marriage of phthisical people should be set at rest. It is not so well proved that a consumptive wife can infect her husband, but the reverse is very plain, statistics of a number of cases being given by Dr Yeo. (see page 9 sgg). He also says "that he very seldom found a wife infecting her husband" Thus I think the impropriety of a phthisical man marrying is very clear, for not only does he put his partners life in great danger, but he further tends to spread the disease, in the event of there being children. It has frequently been noticed that wives previously healthy begin to exhibit the signs of rapid

phthisics after a confinement. I do not think that the usual explanation of their being infected through the foetus is quite satisfactory since we have the case of a guineapig, infected by injection having a tuberculer foetus in its uterus. May it not be that they follow the natural law, by which many animals and plants to, when they have produced their like seem to have fulfilled their function on the earth, & so tend to decline. Or it is possible that the well known vulnerability of females when in that state, has laid them open to infection, & that the constitutional strain of child-bearing has so weakened the bodily powers, that they rapidly fade after giving birth to their offspring. What about the converse of this? Is there any harm in a phthisical woman entering the married state? There is a common idea that marriage may cure or ~~relieve~~

alleviate phthisis in a woman. If such be the case at all, it is very temporary; there may be a stoppage of the decline during pregnancy, but this is only at the expence of a more decline after confinement; and besides this there is great probability of her giving rise to tubercular offspring. Hence while no benefit can come of such unions, there are possibilities of considerable evil. Another point in connection with the communicability of tubercle is the question of the contamination of food. It is known that the excretion & secretion of tubercular organs contain the virus; thus some observers have demonstrated the presence of bacilli in the motions of patients suffering from tubercular ulceration of the bowel; they have been seen also in the urine in cases of renal phthisis & other tubercular states of the urinary apparatus & lastly in the milk of cattle affected with perlenchat

Rabbits fed with the milk from distinctly tubercular cows have become tubercular (Cullimore p 42) & so it is quite possible that infants reared on the bottle may thus contract disease. This may be one of the causes of the preponderance of abdominal tubercular disease in children. Some writers have said that there is an immense amount of this disease among cows, & especially among those which are kept closely confined month after month, in badly ventilated houses; these are certainly the conditions which would lead to the spread of the disease, but for all this we can hardly credit the statement of D. Heath of America when he says that 50 per cent. of the cows so confined are tubercular. Owing to the careful supervision of food in large cities, such a state of matters could hardly exist without being more widely known, & the proper remedial measures taken. Milk from such cows has a

deliterious influence in 2 ways. 1st being of poor quality it does not nourish the child 2nd this very fact lays the child open to the attacks of the virus contained in the milk. All this however is no argument for rearing children on the milk of weak & sickly mothers; for while giving suck is a drain on the mother's strength, the quality is in this case as unsuited for the nourishment of the infant as that of the unhealthy cows. Those therefore who rear children on the bottle should be very careful as to the source of the supply; if the climate of Switzerland is as favourable to cattle as it is to human beings affected with tubercle, this may account for the amount of patronage the Swiss Condensed Milk has received & the success which has attended its use as a food for children. Still statistics shew that over a large number of cases of hand-fed children, the percentage of well-developed children is less than 1/3 of those reared on the breast, while

that of badly developed ones is about 4 times as much.
The contagiousness of tubercular disease is a question
closely connected with that of Heredity, but this
latter is even more obscure. We previously
mentioned that during the period of utero-gestation
a foetus may become infected, & give evidence
of tuberculosis. But how is it that a child may
be apparently healthy when born, & continue
so for perhaps 20 years & then begin to exhibit
the signs of phthisis? Some maintain that
these 2 classes are quite different; thus the
latter condition is just a case of inherited
predisposition not an actual transmission
of the tubercle. Niemeyer is quite opposed to
the theory that tuberculosis is inheritable, but admits
Niem. p. 20 the frequent disposition towards it. It seems to me
that predisposition is as knotty a point to the
physician, as predestination is to the theologian;
we are still a considerable distance from being
at the root of the matter. Some say that there is

no fact better established by clinical history than this; & it certainly appears to me to take its stand along side of such family peculiarities as prematurity, grayness of the hair, gout & the like. Dr Hamilton's view was that an undue delicacy or tendency to catarrh & of the alveolar epithelium was the inheritance, but then his opinions as to the aetiology & pathology of phthisis were peculiar, & in many respects quite different from what we were taught here. I am not aware what his views are now, but probably they have been somewhat modified by the discoveries of the last year, if not by his visit to Glasgow in the spring of 1881. It is proved now that we may have phthisis without any caseous focus, & also that certain caseous matter may exist without the production of tuberculosis. The vitality & consequent resisting power of some lungs is lower than that of others; in some cases this vulnerability may be acquired by the action of various external circumstances. E.g. improper feeding, bad hygiene & mechanical irritants. Thus weakened, the lungs become an easy prey to the virus just as syphilis after being subdued in its secondary

Edin. Med Journal April 1881

stage lies in wait ready to pounce upon any tissue of the body whose vitality is lowered by a local cause. To pass from this, taking on one side stone masons' knife grinders' & such varieties of lung disease which tho' clinically classed as phthisis are pathologically, in their earlier stages at least, pure cases of interstitial pneumonia; & on the other true tubercular phthisis, let us enquire briefly what differences there are in causation, and what in the results. Both are primarily states of inflammation, but their issue is very different. In the first case the irritant is simply mechanical; it is slowly deposited & so excites a low chronic inflammation of the connective tissue. We can see the distribution very well in the dark pigmentation of coal-miners' lungs; the particles being inhaled, are taken up by the lymphatics & so carried to the chief seat of connective tissue in the lung namely peribronchial, interlobular & subpleural; the products are fibrous tissue such as we might find anywhere else, & its tendencies are to contraction & organization rather than to degeneration,

On the other hand tubercular disease is set up, as we believe, by a specific constant, & its consequences are very different; it gives rise to products wh, unlike those of ordinary inflammation are destitute of a blood supply, & so their great tendency is to undergo necrosis; they soften first at the centre and then break down while spreading at the circumference. While this is by far the most common mode of procedure it is believed by some that this virus sometimes produces fibrous tissue also, but it is not easy to understand how the one agent could produce such opposite results. In basal meningitis the ordinary inflammatory products are the most striking feature, and it is possible that these may originate from the mechanical irritation of the tubercles, and these too at the surface of the lung may cause pleuritis; if this be so, may not the same condition obtain in the pulmonary tissue. It is hard at first to believe that these minute organisms can produce such dire effects, but our minds have been prepared for this, by the now well known rapidity & power with which the bacteria of putrefaction act

Modes of growth have been observed in these latter, although we cannot say the same regarding the bacillus tuberculosis, yet we must remember that observation of it is in its infancy, & that much still remains to be found out. The bacillus is of slow growth, and in ordinary circumstances the less disturbed it is, the more powerfully it acts. In an active portion of the lung, with a full circulation of blood its effects may in many cases be negatived, hence it has been suggested with I think a great deal of truth that this may explain the great tendency which true phthisis has for the apices. Then portions of the lung, especially above the clavicles, are least of all acted on by the respiratory muscles & the course of the blood is not so free, hence their functional vitality is less, & the bacillus may be supposed to find them a fitting nidus where it is left in undisturbed possession. I am well aware that there are various other theories to account for the apical distribution, but this one seems to accord best with what Koch tells us regarding the nature & action of the bacillus. We may account in the same

way for the greater prevalence of phthisis in the left lung. It used to be said that in as many as 8 or 9 cases out of every 10 it began in the left lung, but this has of late been much modified. To test this I have kept a record of 50 cases. When only one lung was affected it was marked down; when the disease was more advanced I marked down the lung in which the disease had made most progress. In the case of 23 men I found that the proportion was 9 right : 14 left. In females it was 9 right to 18 left, or combining males & females we get 18 right : 32 left. Of course 50 cases do not go far to prove a theory, but as far as they do go they bear out the truth of the statement, the proportion being in this case about 1:2. I think the same argument can be applied to the left lung as a whole, as to the apex of each. There are anatomical differences between the right & left modifying the blood & air supply of the latter, & so lowering its functional vitality. As there is more action in the right ½ of the body, so too the right lung may come in for a greater share of

the activity of its side. In these various ways then, we may suppose that the apex and left lung are rendered liable to disease. By these causes & by previous inflammatory conditions the lungs are rendered more susceptible to tubercular diseases; I believe they are not necessary for the bacilli to take effect; We are taught this by the inoculation experiments which caused tuberculosis in presumably healthy animals. Niemeyer's statement that "the greatest danger to most phthisical patients is the development of tubercles" Lecture p 11. is only true as referring to interstitial pneumonias since patients are not truely phthisical until they are tubercular. The bacilli themselves are capable of setting up a catarrhal pneumonia. As we are informed by Cheyne the inhaled bacilli affect primarily the alveolar epithelium, causing it to proliferate in an unhealthy manner, to fill up the alveoli, & as we before explained the great tendency of the products is to necrosis & to the implication of the alveolar walls & other portions of the lung. This spreading to other

parts may take place in various ways. Thus suppose disease is progressing at the apex, sputum charged with bacilli may be coughed up a certain distance, & then find lodgement in a lower part of the chest, & sow the seeds of infection there. Similarly the breath charged with the virus may be inspired into many healthy alveoli, & set up catarrhal inflammation in them. The evil of opiates in phthisis is partly due to this; their sedative action is no doubt very agreable to the patient and tho' sometimes necessary in order to procure sleep, they are injurious by soothing the nerves, & so arresting the cough which is nature's means of getting rid of the sputum, which is capable of infecting both the lungs & the intestines. Phthisical laryngitis when secondary to phthisis pulmonalis is probably due to the bacilli from the lungs adhering to the mucous membrane. In this latter part of the essay there, after speaking of the contagiousness of tubercle we have attempted to explain how even healthy lungs may become in various ways a favourable medium for the reception of the virus. At the same time expressing the opinion that all tho' catarrhs when previously existing, pave the way for the action of the bacillus,

this latter is capable itself of originating & carrying on tubercular destruction of the lung.

Without delaying longer, I must now pass on to that part of the subject with which I propose to close this paper, & that is the treatment of phthisis pulmonalis. It must be understood that I the intention is neither to inflict on the reader an account of the minutiae of treatment, nor bring together a long list of drugs that have been found useful, but to speak in a general way pointing out the main lines in the therapeutics of this disease, and viewing them in the light of recent pathological research. I cannot say that since Koch's discovery much new has been suggested as to treatment; the main difference is that many methods that were previously empirical in the main can now be placed upon a more scientific basis. The old maxim "prevention is better than cure" applies to lung disease: but here the difficulty of prevention is the awkward thing. Of course if we include those chronic forms excited in needle-grinders & the like, prevention is quite attainable by means of sufficient respirators to filter the air,

since the person is only exposed to the irritant for a certain number of hours each day. But it is quite different when at every breath we may inhale the virus; we cannot always be going about wearing respirators even supposing them capable of preventing the disease. Hence admitting that we inhale the poison, & get it into the system, what is to be done? In this we may get a lesson from modern surgical practice, & draw an instructive comparison between the two. The Listerian system aims at destroying the germs of putrefaction before they reach a recent wound, but this we have shown to be impracticable in the case of the tubercular virus. Next if the surgeon has to deal with a wound already infected with germs, he endeavours by germicides to kill them in the wound, and afterwards to keep others out. Now this comes nearer our problem; the tubercular germs are already in the lungs; have we any means of affecting them there? Upon this is founded the entire the treatment of phthisis by means of respirators, to which we shall presently refer. But there is another method of surgery

& that is the system of dry dressing, the object of which is to preserve as much as possible the vitality of the tissues because the germs will not flourish if the tissues are dry & have vital force to resist them. Moisture and germicides like carbolic acid, lessen the vitality. It is with a similar object that we prescribe tonics and cod liver oil, & so strengthen the body generally & the lungs & the same time. Now altho' we cannot combine these two methods in surgical practice, we can to some extent in the treatment of lung disease; we can at once strengthen the lungs, & act upon these organisms. In what various ways can we improve the condition of the body generally, & also of the lungs? Obviously by the exhibition of tonics to brace up the system & improve digestion, & of cod liver oil when the patient is in a state to bear it. Another important thing is change from such a climate as ours, to a clear bracing atmosphere; nothing is more prejudicial than life in a large city in a damp cold climate. A bright blue sky soon

work wonders, for it acts both mentally & physically. We have now lost confidence to a considerable degree in a warm close place as a health resort for many cases, for one who can bear it, a bracing climate or a sea voyage is the best thing. Of late years a great deal has been written about the benefit to be got from living at high altitudes. The most famous place of this kind in Europe is Davos Platz. It is situated 5108 feet above the sea (Culloden 91) and the peculiarities of its climate are (1) stillness of the air, due to its sheltered position (2) intensity of solar radiation (3) dryness & (4) rarity of the atmosphere. Remember to render Davos & other places with a similar climate most valuable to persons whose state makes them capable of being benefited by cold & bracing air. As pointed out by Dr McCall Anderson in his lecture on this place, we should not send any who are acutely ill, who suffer from heart or nervous affections or those who have lost much lung substance. The reason of this last is apparent, on put

keeps the great benefit to be derived from such resorts
from the rarity of the atmosphere, more work is thrown
upon the lungs to supply the adequate amount of
Oxygen, This thoroughly clears out the lungs & prevents
the vitiated air from lodging. As we pointed out previously
it is this stagnation which predisposes the apices to
disease, but now under the altered conditions they are
forced to work, & so brought into a more healthy
condition, but it is clear that if a patients lungs are
very far gone he has not got sufficient pulmonary tissue
sufficient to compensate for the lessened density of
the atmosphere. In ordinary circumstances a
persons lungs are capable of doing a great deal
more work, than they are usually called upon for;
thus in ordinary respiration only 30 cubic inches
pass in & out, while by a forced inspiration
we can get 100 more in addition to the residual air
always present in the lungs. This shews us the great
possibilities which the lungs possess, & we can judge
by the extent of the disease whether a given patient is fit

to undergo the labour of respiring at Davos. Many other similar places have been suggested, and lately Iceland has been mentioned, at which people shudder at the bare idea of it, but I may say from personal experience last summer, that a trip there & back is not only pleasant but beneficial. It has indeed many things to recommend it, the sea voyage is not too long, & the climate there in summer & early autumn is wonderfully clear & the climate salubrious, especially along the north coast, where tho' colder it is much drier than in the south. The life on land is novel, and the invariable custom of going about on horseback is exhilerating, & not fatiguing if taken in moderation. The sunshine is bright & warm, and from the length of daylight at that time of year people are in the habit of being a great deal in the open air. For this reason & also on account of the nature of the food, phthisis, unless when imported, is very rare. Sulphurous exhalations from the lava may also be beneficial;

visitors who might remain for about 4 months would get the benefit of all this, & there is very good accomodation in the chief towns, one of the hotels at Reykjavik having in addition, a steam & billiard table to boast of. Enough has now been said regarding this mode of treatment, but an important question still remains, what are we to do with those whose physical or social condition debars them from going abroad. It is not every case of phthisis that will benefit by hospital treatment, & indeed many are far better outside than when confined in the wards among other patients. Chronic cases need very little in the way of special nursing, & any medicines suitable for them can be taken at home. But if they have not a place that can be dignified by that name, or are unable to procure proper nourishment, we may with advantage extend to them the benefit of a charitable institution. But it is quite different in those rapid cases which approach in their features more nearly to an acute fever; such require constant medical attention & skilful nursing. As

regards chronic cases our treatment must be mainly analeptic; nourishing food & tonics are indicated, while we must be on the watch for any gastric or intestinal complications that may arise in the course of the disease. We are in the habit here of using respirators in the majority of cases; this is not a new treatment & was long used empirically, we can now however see scientific ground for it when a distinct organism has been found as the cause of tubercle. The patient soon gets accustomed to the inhalation, & so breathes the medicated vapour into the ultimate air cells where the bacilli are carrying on their work of destruction. In addition to this the vapours tend to disinfect the sputum & render it innocuous, thus benefiting both the patient & those about him; the unpleasant odour of the breath & sputum is quickly corrected, & with this object in view antiseptic inhalations may also be used with great advantage in cases of bronchiectasis & gangrene. Many volatile substances chiefly of a resinous nature have been used in this way such as turpentine, creasote, Eucalyptol &c, & I am quite convinced from an extended trial, by these that the sputum becomes

means less profuse & purulent; the patients express themselves benefited by the respirators & ask for it if it be not given them. But along with these substances we may with advantage combine gentle sedatives which soothe the patient, & promote sleep at night; the best of these is Spt of Chloroform, & this has the effect of dissolving the creasote; if in any case the cough be very irritable a little extra Chloroform may be added. After a good deal of trial by observing the changes in the sputum, & also consulting the feelings of the patient, the conclusion come to here is that the following prescription answers best. Rx. Creasoti et Spt Chloroformi aa ℥ss. M. We begin with 10 minims of this dropped on the sponge several times a day, & generally increase it as the patient becomes accustomed to the vapour. At first they cannot inhale for more than ½ an hour at a time, but in a few days are able to do so for several hours at once. I may now say a few words regarding the qualities of respirators, & give my reasons for thinking ones, such as I now send, to be the best. The more elaborate ones, such as McKenzie's, have this great disadvantage that the air has not a free circulation;

it is admitted by valves in the side of the apparatus, & I have heard patients say that they could not wear it long on account of the hard work respiration entails; indeed some seemed quite exhausted after using it. Again its price is too high to make it suitable for hospitals. The accompanying kind has been gradually altered & improved from one suggested some time ago by Dr Yeo I think. It has the advantages of being light & comfortable; from the porous nature of the walls, the air passes freely in & out, without any exertion to the patient; they can easily be washed without injury, the margin being generally bound with a piece of india rubber drainage tube; lastly you can obtain a dozen for the price of one of McKenzie's. It is an important matter that all respirators should cover both nose & mouth. Some months ago, a writer in the Lancet, described some experiments to shew that during several hours almost none of the creasote volatilized & was breathed, & that hence respirators were no use; as to this I can only re-state that patients do shew decided signs of improvement, & that 10 drops of creasote or eucalyptol give rise to a vapour as strong as they can inhale. I have before spoken of the advantages of a free

supply

of fresh air & the isolation of phthisical patients, for these reasons a method even better than the respirators would be to keep the patients in well ventilated wards, the air of which was continually impregnated with some of these evaporours, to whatever extent was found most convenient. We have not the army huts here, but have tried this method on several cases in a side room & found it to answer very well. Such a method approaches most nearly to the natural atmosphere of many localities which have long been recommended as beneficial in lung disease ~~as~~ ie where sulphurous fumes, or the odour of pine trees were present in the air. In addition to the physical signs we know that a patient is improving if the sputum becomes less purulent & abundant, & if the person gains strength & increases in weight. The temperature is in all cases a valuable guide, & for this purpose I subjoin a few charts regarding some of the cases spoken of. The first is a chronic case which shewed considerable improvement. Alex Mc Farva act 27 Admitted Feb 1783 was previously a patient here in April 82. At that time as noted in the Journal both apices were dull to percussion, & the respiration was hard. Now there is great dulness of the left lung extending from the clavicle

DISEASE.
Phthisis

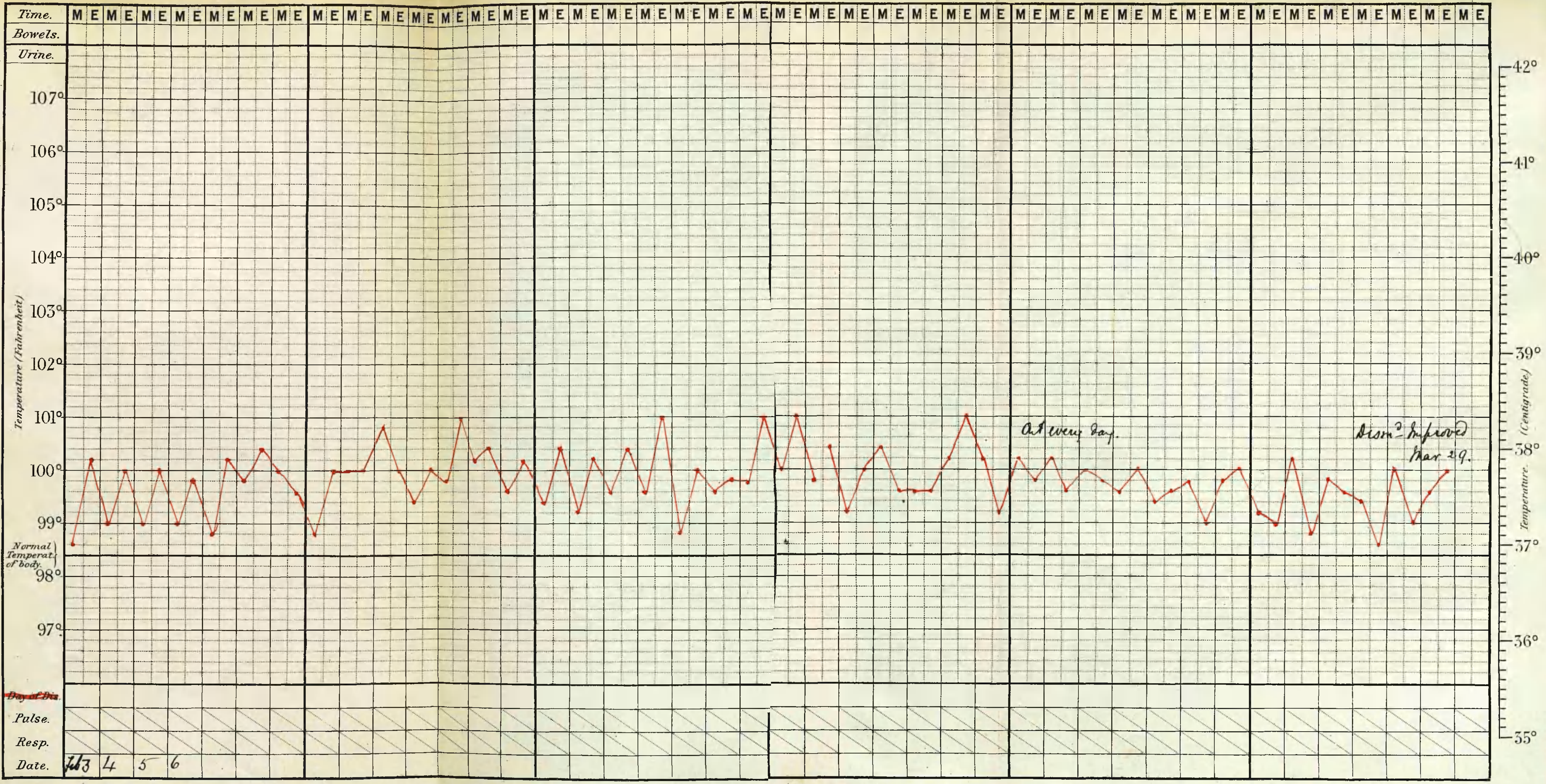
Notes of Case.

Name: Alex McGarva

Age: 27

Diet

Case Book No. III



Date of admission: Feb 2

Result: Improved

Entered at Stationers Hall. *Printed and Published by Wodderspoon & Co., 7, Serle Street, Lincoln's Inn.* *Gould's Clinical Chart.*

Stationers Hall. *Printed and Published by Wodderspoon & Co., 7, Serle Street, Lincoln's Inn.* *Gould's Clinical Chart.*

down to the precordial area, VF and VR being also much increased. Moist crepitations were heard over the whole left front & over a portion of the back as well. On the right side expiration was prolonged, but no crepitations were heard. The treatment was as follows, the respirator, Cod Liver Oil Emulsion, & Begbie's mixture containing Nitric Acid, Hydrocyanic Acid Glycerine & Quassia. His temperature never got quite normal, but in other respects he improved considerably. He got stouter, & increased 6 lbs in weight. His expectoration decreased, & tho' the crepitations did not leave his chest, they were considerably less when dismissed on March 29. To illustrate his case, the sputum was examined, & I have put in several slides marked Case III a. b. c. &c. From my note book I see that the first two gave a negative result, while some of those later on showed a moderate number of bacilli. Another case which improved a good deal was that of

Patrick Robertson aet 25 Admd March 2. His case was more acute than the above having been only 10 weeks ill before admission. He had a distinct family history of phthisis, his father & one brother having died of it. In his case the disease was mainly on the right side, dulness extending from the apex downwards for about 4 inches

and on auscultation numerous moist & crackling Rales were audible; bronchophony also existed. His temperature was at first high but gradually came down until he was in a fit state to go to the drying ground. A considerable number of slides were made from his sputum, some of them are given marked Case VIII a b c. d &c. I must say that in none of them did I get any great abundance of bacilli. Another case may be mentioned as being remarkable for the steady increase in weight even tho' the lungs were not in a very satisfactory condition. Thomas Robertson aet 25, was a patient at the end of last year, & so before I began to examine the sputum. The case was chronic as he had cough & haemoptysis a year before admission. One brother died of phthisis. The greater part of the left chest was dull in front with signs of commencing excavation, & the upper part of the right side shewed deficient R M & some crackling. His temp^{re} seldom rose above 100.2. He was in the Hospital from Oct 4 till Dec 13, & in that time gained 1 1/2 stones. He was weighed every fortnight with due precautions as to clothing & the figures are as follows. Oct 5th 9 stones. Oct 18, 9 1/2. Nov 2. 9 st 13 lbs. Nov 15, 10 st 2 lb, Nov 30 10 st 4. Dec 13, 10 st 6 lbs. In this case Eucalyptus Oil was used in the Respirator along with the internal administration of Beglis Mixture & Oil Emulsion.

DISEASE.[2]

Phthisis Pulmonalis

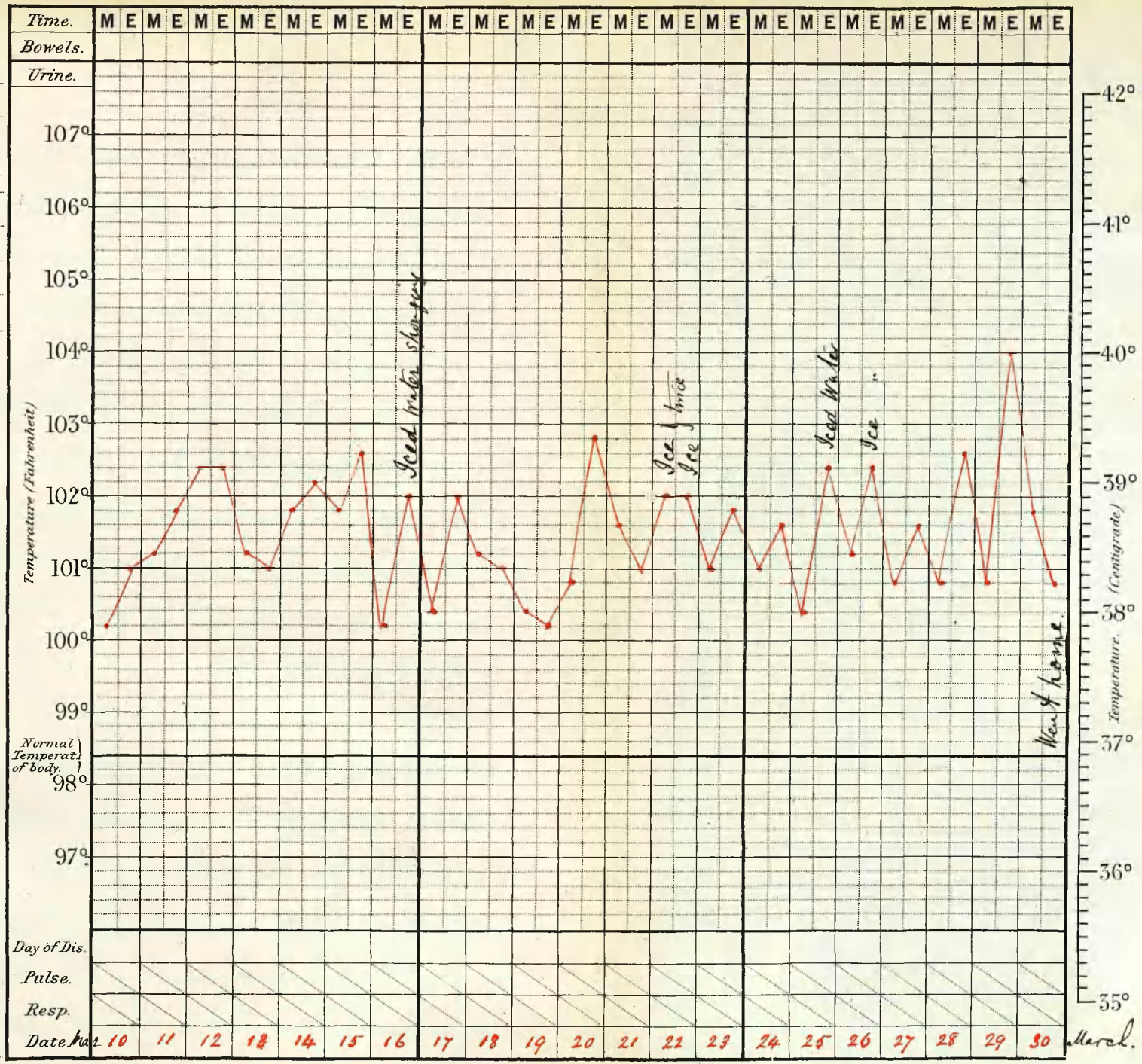
Notes of Case.

Name Mr Cowan

Age 23

Diet

Case ~~Books~~ No. IX



Date of admission.

March 9/ 83

Result

Entered at Stationers Hall. Printed and Published by Wodderspoon & Co, 7 Serle Street, Lincoln's Inn Gould's Clinical Chart

Wm Daniels, another chronic case at the same time, received the same treatment; I have only 2 notes of his weight — Oct 31. 9st. Nov 15. 9st 2lbs. In both cases the sputum improved in quality, & the lungs cleared up considerably. Many such chronic cases shewing considerable improvement could be recalled, but that this treatment is not always followed by such good results, I may notice the case of Mrs Conan act 23 Admitted Mar 9/83. She had a cough of nearly a year's standing, but no phthisis some months afterwards. There had been some haemoptysis upon various occasions, & when admitted there was slight laryngeal mischief in addition to the pulmonary. Over the chest there were flatteness & dulness on the left side anteriorly with moist crepitations. On the right side the breathing was harsh & tubular. The Notes marked Case IX refer to this case. She went home on March 21, & my journal note of that date states "This woman's disease has progressed & she feels weaker. Both lungs are manifestly affected, signs of cavity have developed on the left side, while on the right side, crepitations are now distinctly heard". It will be noticed that in these cases which improved the temperature was moderate, while in this woman as seen on the chart, it always kept pretty high, notwithstanding frequent sponging with iced water.

DISEASE.

7

Notes of Case.

Name William Lamb

Age 19

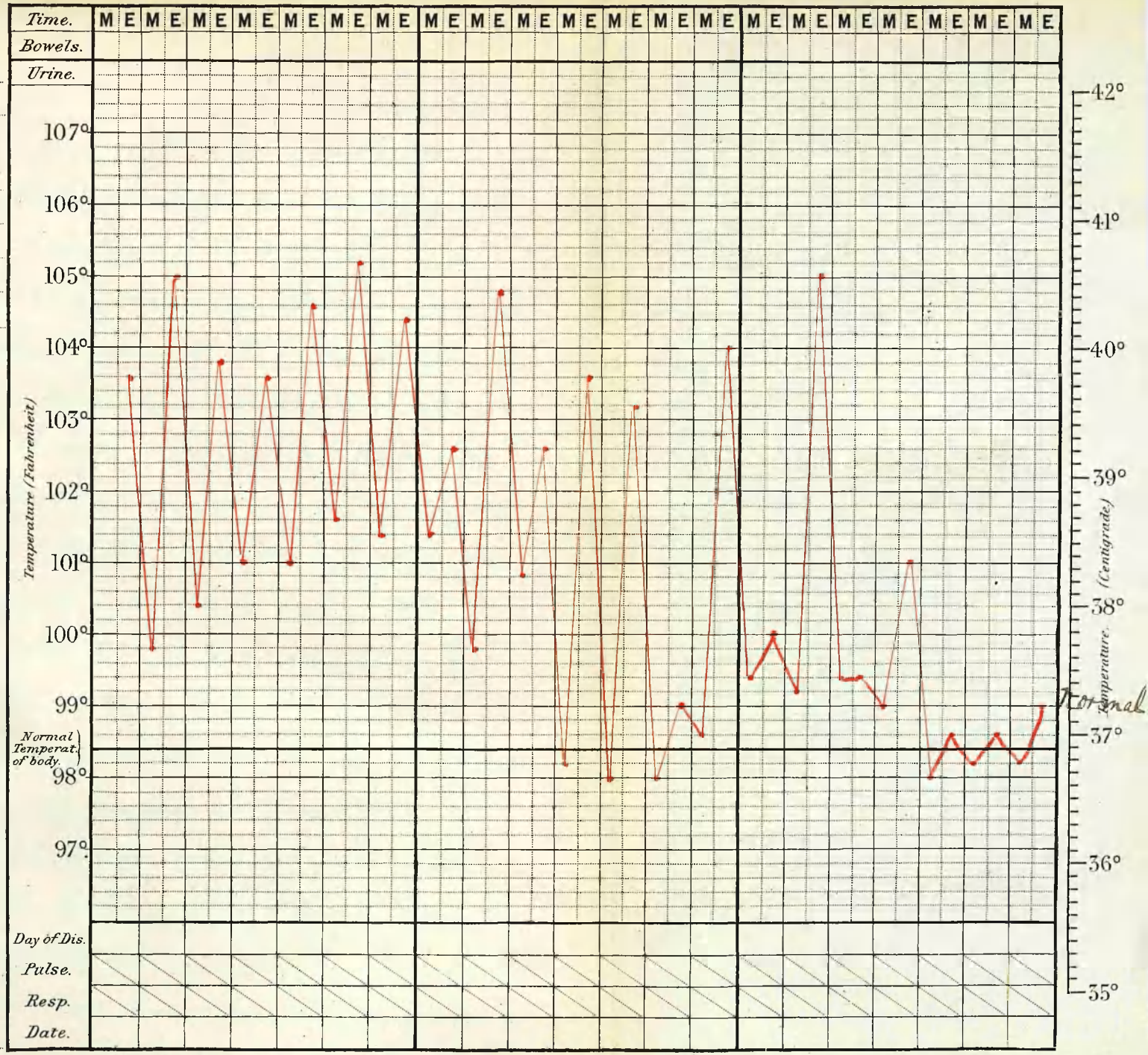
Diet

Case Book N° X

Date of admission.

March 29.

Result Well



Entered at Stationers Hall. *Printed and Published by Wodderspoon & Co, 7 Serle Street, Lincoln's Inn* *Gould's Clinical Chart.*

Such a course of temperature is disadvantageous, as the chief nourishment must consist of milk & such like diet. Any attempt at stronger food would only make matters worse by keeping up the temperature, & producing gastric & intestinal derangements.

Finally how are we to proceed in cases of continued hyper-pyrexia? Such a condition indicates rapid progress of the disease, & is also most favourable for the growth of the bacilli; hence we must employ some anti-pyretic system, such as large doses of Quinine, Hydrocyanic acid or Salicin or Cold applications. These often succeed but sometimes fail; & I shall relate a case of both.

Wm Lund, labourer aet 19, was admitted on March 29. He complained of some pain in the chest, & said he was able for work until 12 Days ago, but there is some history of cough of longer duration. We were surprised to find his temperature about 104° on the night of admission, while the nurse stated that it had been 105 some hours before. A careful examination of the chest did not reveal any extensive mischief; there was slight

dulness above the right clavicle; on both sides the respiration was somewhat harsh, and expiration prolonged on the right side but no crepitations were heard even on deep inspiration at that time, & only to a slight degree subsequently. Indeed all through the pulmonary symptoms were very slight and hardly such as to give rise to such a chart as this. The sputum tho' frequently examined, did not yield any certain information, either when examined by the naked eye or microscopically (Case X a, b, c, d). The possibility of enteric fever was not overlooked, tho' neither eruption nor diarrhoea were present, & the chart is not like it either. The temperature fell to about normal as seen in the chart, & after keeping about 99° for a considerable time it rose again on Feb 22 after a rigor, soon however to be reduced & remain normal. Now, tho' not clear about the exact diagnosis of the case, we see at least how the temperature was reduced, & I may say that the lad went out to all appearance strong & well, having gained 7 lbs in weight during his residence from March 29 to May 8.

The last 2 charts are from cases in which anti-pyretic

DISEASE.

Phthisis

Notes of Case.

Name: Felix Hughes

Age 17

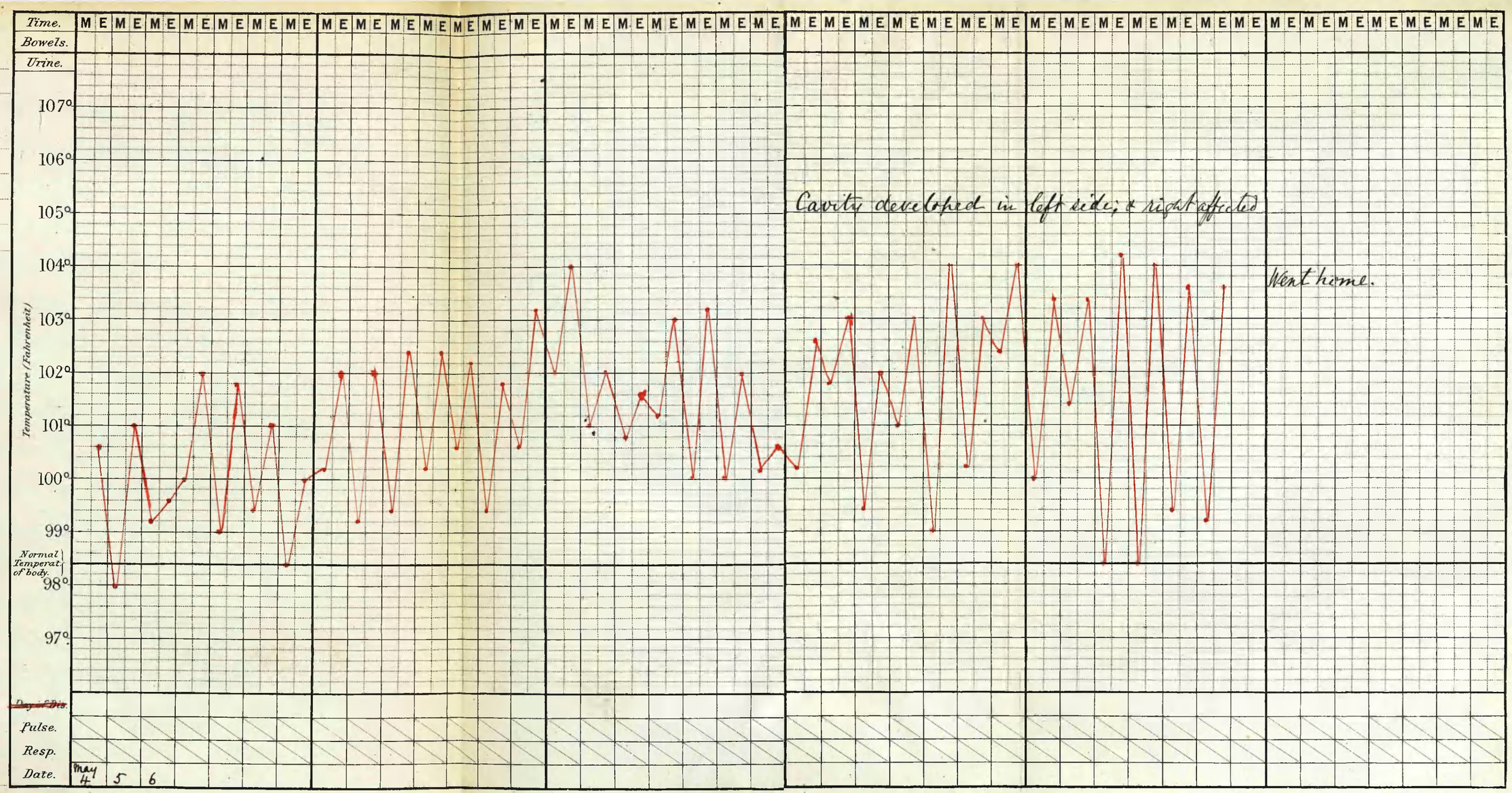
Diet

Case ~~Book~~ No. XIII

Date of admission.

May 3/83

Result Worse



Entered at Stationer's Hall. Printed and Published by Wodderspoon & Co., 7 Serle Street, Lincoln's Inn Gould's Clinical Chart Stationer's Hall. Printed and Published by Wodderspoon & Co., 7 Serle Street, Lincoln's Inn Gould's Clinical Chart.

measures failed. The first, Felix Hughes, was admitted on May 3rd with dulness, & subcrepitant rales in the left infraclavicular region, & harsh breathing on the right. As seen in the chart his temperature always kept high, while a cavity developed in his left lung, & crepitations became audible in the right. During the month of May he decreased in weight from 7st 12 lbs to 7st 7 lbs. He was the only one whom I have found unable to wear the respirator as he said it seemed to choke him. Having in the next & last case employed all the usual anti-pyretics with very partial success as the chart shews, I will bring this paper quickly to a close by a short description of it. William Shields aet 21, a miner was admitted on June 20. At first the right side of his chest was slightly duller than the left with a few crepitant rales, but as the case progressed, the left side became worse than the right. Sweating was generally profuse, & for this both hills & hypodermics of Atropia were used. The first anti-pyretics used were Quinine and Nicmeyer's pill, & after that Salicylate of Soda, which more than anything else lowered the temperature. Iced cloths were

DISEASE.

Acute Phthisis

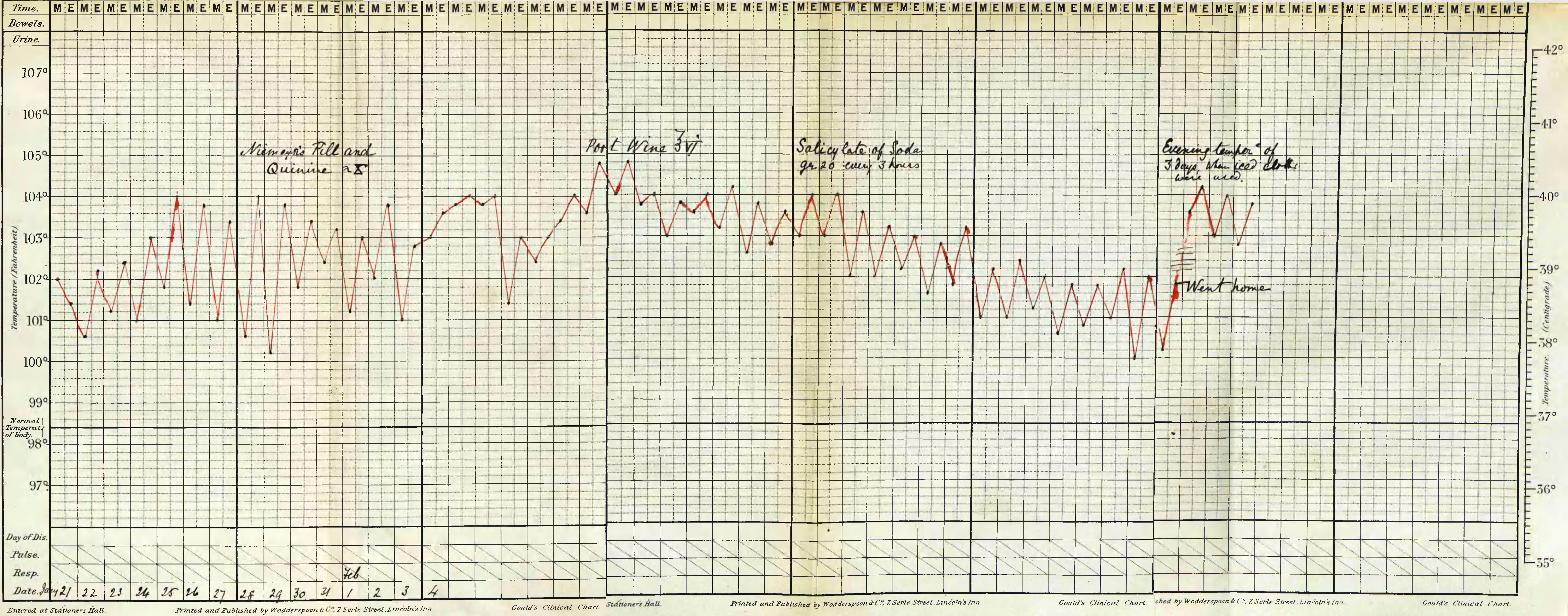
Notes of Case.

Name: William Shields

Age: 21

Diet

Case Book No.



Date of admission. Jany 20/83

Result

also used according to the method recommended by Dr Mc Call Anderson. By the latter the temperature was temporarily reduced to normal, but rose as high as ever at night (See end of chart) Notwithstanding all this the case progressed unfavourably, & the patient gradually got weaker & lost flesh: thus between Feb 2 & Feb 19 he lost 6 lbs. Lastly his larynx became affected. I was anxious that he should remain till the conclusion of the case, but so strong in him was the "Spes phthisica" & desire for home that he left on March 16 tho' so weak that he could hardly walk, & had to be assisted down stairs to a cab.

Thus I have pointed out my ideas as to the treatment of chronic phthisis, the indications being fresh air to clear & brace up the lungs; tonics & analeptics for the constitution generally, & antiseptic inhalations to act directly on the lungs. In acute forms the primary thing is to lower the fever, while supporting the strength by liquid food & wine when necessary. I had hoped to spend more time on this latter part, & to describe in more detail the sputum-slides over which I spend so much time.

As to these latter I have not found leisure to examine them lately, so that the descriptions as given are from my notes of their examination when newly prepared, and I believe that now they may have deteriorated.

Finally I am very conscious of many defects all through the essay, & cannot claim to have made much advance even after spending a good deal of time & care; in many cases too I may have failed to give a correct statement of the opinions of others. Considering the difficulty of the subject, & the frequent interruptions of hospital life I trust that some allowance may be made for my short-comings, & that a favourable verdict may be given on the outcome of my endeavours.