S

On Suppuration, with special reference to its occurrence in the Closed Cavities

A Thesis by D. C. Burlingham

Definition of suppuration

Suppuration may be defined as the formation of pus.

Description of pus

There are several varieties of pus, but I shall describe as a typical form laudable or healthy pus, referring a little to the other varieties later.

Pus is a yellow or whitish yellow fluid, of about the consistence of cream, having a slightly sweet taste, and an oily feeling when touched. When warm it has a faint rather sickly smell. It is quite homogeneous. Its specific gravity is 1030 - 1033. When allowed to stand it deposits a sediment at the bottom of the vessel, leaving a clear liquid floating on the top, though if it be unusually thick this clear liquid may not be obtained. On a microscopical examination, it is found to consist of a number of globules floating in liquid. It is the globules to which the colour is due, for the liquid portion of the pus when free from them is clear. These globules are called pus corpuscles. They are globular in form, granular in appearance with a sharply defined outline, varying from $\frac{1}{2500}$ to $\frac{1}{3000}$ of an inch in diameter, and ressembling almost exactly if not exactly the white corpuscles of the blood.

On the addition of water pus mixes freely with it, forming a turbid fluid. A sediment is however apt to occur. The corpuscles greatly increase in size, and become less granular. They do not however burst as do the red corpuscles of the blood. The effect of acetic acid upon the corpuscles is remarkable. If it is weak, it partially dissolves the outer covering of the corpuscle,

which is called the cell wall; and as a consequence causes the sharp well defined outline to become fainter and fainter, and also brings into view in the interior of the cell a nucleus, which is occasionally single but much more often composed of two or three (sometimes even four or five) granules, close together, each with a central shaded spot. From this reaction the following definition of pus has been founded — "Pus is a creamy liquid containing abundant globules, which on the addition of acetic acid become transparent and show a two to five partite nucleus." If the acid be strong the cell wall is entirely dissolved. On the addition of caustic potash pus is converted into a ropy viscid mass; and under the microscope there are now seen only a few very minute dark molecules, what these really are being uncertain. This reaction serves to distinguish pus from mucus, and is of great practical value, in testing urinary deposits. Pus is not altered by blood, urine, mucus, or saliva.

The reaction of pus is if healthy weakly alkaline; but if at all affected by decomposition, it may become either acid, or strongly alkaline from the ammonia which is produced. The proportion of solids to the whole mass varies very much. In recent suppurations they are usually much more abundant than in chronic dis-charges. Schere found 12·8 per cent of solids in a psoas abs-cess just opened, and only 4 per cent in the discharge a few days afterwards. On an average they form 10 to 16 per cent, and when burnt leave an ash of 5 to 6 per cent, consisting principally of chloride of sodium, with

a slight intermixture of other sodium salts, potash salts, and phosphates.

The following analysis of pus is given by Dr. Wright.

	From a vomica	a psoas abscess	a mammary abscess
Water	894·4	852·2	897·4
Fatty matter	17·5	28·8	26·5
Cholesterine	5·4		
Mucus.	11·2	6·1	—
Albumen	68·5	63·7	83·6.
Lactates, carbonates, sulphates, phosphates, of soda potash and lime	9·7	13·5	8·9
Iron	A trace	—	—
Loss.	3·3	2·7	1·6.

The following analysis of three specimens is given by Von Bibra.

	I	II	III
Water	907	862	769
Albumen	63	91	180
Extractive matters.	20	29	19
Cholesterine and fat	9	12	24
Salts.	6	9	9

The fixed fatty acids are normally present in the form of their alkaline salts or soaps; but if the pus is allowed to stand they are sometimes separated, and precipitated as crystals. The volatile fatty acids are rarely present, and only appear after considerable changes in the pus have occurred. They give rise to an intensely acid reaction. Protagon may be obtained by rubbing the corpuscles with quartze, and exhausting with ether. The bile pigments and bile acids may be obtained from the pus of persons suffering with jaundice, and sugar from that of those suffering from diabetes. Occasionally the pus from the wound assumes a peculiar blue colour. Lücke has shown this to be due to the growth of a certain kind of vibrio. The substance

however which directly gives rise to this blue colour, can be obtained by dissolving it in chloroform and then allowing it to separate, when it is deposited in the form of needle shaped crystals. The serum of pus can with some difficulty be separated from the globules by the addition of salts. It greatly ressembles the serum of the blood. Like the latter it coagulates at 75°C., showing the presence of albumen; it also contains paralbumen and albuminate of potash (which is identical with casein), and according to Hoppe, myosin

Varieties of pus.

There are many unhealthy varieties of pus, which are comprised by Rockitansky under the term sanies. These are usually thinner than ordinary pus, and much more irritating. On a microscopic examination the corpuscles are found to be small, as if stunted by the irritating nature of the fluid in which they float. Besides these there is what is termed serous or glandular pus, resulting from the breaking down of lymphatic glands which have undergone caseous degeneration. This however is not pus in the true sense at all, as it contains no pus corpuscles but merely a débris of glandular tissue and fatty granules. A similar puriform fluid is produced in other cases, when exudations soften and break down without forming true pus.

Formation or genesis of pus

This means the actual process by which pus is produced, the nature of which I shall now attempt to describe. The formation of pus has been long known to be in all cases preceded by inflammation; which may be present in a greater or less degree of intensity, and remain a longer or shorter time. And it is found that the process of inflammation is so essentially bound up with that of suppuration, that

we cannot truly understand the latter without examining the former. I will give a brief account of the nature of inflammation, and will commence with a description of what was known of it in early times when its true nature was almost entirely unknown, and will endeavour to show what light has been thrown upon the subject by recent discoveries.

Hippocrates was the first philosopher so far as we know who investigated the subject. He seized at once upon four leading symptoms, which are present in ordinary cases of inflammation viz. redness, swelling, heat, and pain, which taken together serve very well to define the process roughly. Now these symptoms were evident and easily perceived, but it was a very different matter to find out what the process essentially consisted in; and of that, almost endless theories have been propagated at different times. The idea of Hippocrates was that some irritation occurred in the fluid parts or humours of the body principally the blood, which underwent a series of changes known as coction, of which the brick red deposit of urates that occurs in the urine after many acute inflammations is the result, and also the series of changes which take place in the mucous discharge from the nose in ordinary coryza. Galen describes four different kinds of humours or fluids in the body, viz. blood, phlegm (or serum), bile, and black bile. He supposes inflammation to be produced by an abnormal afflux of blood to the part, erysipelas by a like afflux of bile, œdema of serum, and scirrus (any hard swelling) of black bile. He gives as a proof that inflammation is produced by an afflux of blood, the fact that when an incision is made into an inflamed part blood flows out of it abundantly. Now this is certainly a fact in most cases, and shows that inflammation is usually accompanied with increased afflux of blood, but modern pathology regards this not

as a cause but as an effect. The doctrines of Galen were generally followed by the Arabian physicians, and by Europeans in the Middle Ages. Wiseman one of the greatest English surgeons in the 17th century, keeps as close to Galen as possible in his description of inflammation. He however describes the cause of inflammation as being "generally a plethora having some acrimonious mixture in the serum of the blood, which latter is the usual matter of phlegmon being cast out of the vessels and lodged in the pores of the skin and other parts of the body." In the 17th century a heavy blow was struck at the old doctrine of coction by the importation of Peruvian bark; and it was perceived that inflammation might subside without any apparent evacuation of morbific matter as supposed to be evidenced by a deposit of urates in the urine, which was formerly thought necessary. Most of the surgeons of the 17th and 18th centuries have assumed the existence of a conscious or semi-conscious agent or agents, which preside over the functions of the whole human body or of different parts of it; and modify them in disease, as may be required under altered circumstances for the good of the individual. Thus Sydenham says that Nature "conscious of the danger produced by the generation of humours in the blood sets up a fermentation, which ends in the thorough despumation of morbific matter." Van Helmont assumes more strongly the separate entity of this agent, which he calls the Archeeus, and says that when offended by acidity, it sends the disordered blood to the pleura to cause a pleurisy. Thomas Willis affirms the existence of a corporeal soul as distinct from the rational soul, the former he

says presides over the functions of the body and is composed of "Animal Spirits." About the middle of the 17.th century when the doctrine of the circulation of the blood and the physical nature of the latter were generally understood —; a school arose founded by Borelli, called the iatho-mathematical or mechanical school, which endeavoured to explain the phenomena of disease by the mechanical laws to which all matter is subject This sect usually attributed the cause of inflammation to the obstruction of the smallest arteries and capillaries Boerhave, one of the followers of this school, says that inflammation is caused by a stagnation of the blood produced by such a narrowing of the extreme arteries or capillaries that their diameter is less than that of the red corpuscles of the blood, which in consequence they become incapable of transmitting. Stahl in 1707 speaks of a stasis or stagnatio as the essential cause of inflammation This he believed to be caused by the direct action of the Anima or immortal soul, which he thought presided over the body. Thus these two philosophers clearly established one of the leading features of inflammation when it occurs in vascular tissues, which is still known as stasis or stagnatio of the blood, though they were mistaken as to the cause of this. Hoffman regards this stagnatio as caused by spasm of the extreme arteries and capillaries, a doctrine which Cullen taught and developed in the middle of the 18.th century. Boden in the 18.th century speaks of blood being drawn to an inflamed part by the action of the part itself, he regards each organ in the human body as having a life in itself independent of the rest, and compares the body to a swarm of bees moving as a whole yet composed of a number of independent vital units. Hunter calls inflammation

"an increase of that power which a part naturally possesses" He looks upon the buffy coat which appears in blood drawn from an inflamed part as evidence of increased vitality. In the latter part of the 18th and commencement of the 19th centuries the use of the micros-cope was brought to bear upon the phenomena of inflammation. Fahre in 1770 observing the minute network of capillaries which exists in all parts of the body, repudiates the idea of obstruction being the essential cause of inflammation, for he thinks that if any of the capillaries were blocked up the blood could easily find its way by the neighbouring channels. In the year 1800 Dr. Wilson Philip after careful microscopic investigation came to the conclusion that inflammation consisted of a debility of the capillaries with a preternatural distension of them and a retardation of the blood current. Dr. Thomson on the other hand denied that retardation of the current in the capillaries was a necessary or essential condition of inflammation. Sir Charles Hastings after careful examination with a view to solving this discrepancy, states what is now universally admitted to be true that while on the application of certain stimuli the blood current in the capillaries is not at first retarded but accelerated, and the blood vessels contracted —; yet if that stimulus be increased in intensity or if it be long continued the capillaries become dilated and the blood current retarded. He found also that during the period of acceleration the part appeared paler than ordinarily, and that none of the usual phenomena of inflammation occurred, but that when retardation took place these supervened at once; so that it was scarcely fair to call what appeared in the first period in-

flammation at all [Anticipating the chronological order, I will here state the views now generally held on this point from the evidence of later observers, especially Sir James Paget and Wharton Jones. Immediately on the application of a stimulus, contraction generally occurs, though not always. During this period the flow of blood is not accelerated, but rather retarded. This contraction is speedily succeeded by dilatation which is permanent. If the contraction does not occur, dilatation takes place immediately. This frequently happens when the stimulus is very strong. The first effect of this dilatation is to produce a considerable acceleration of the blood current. This however speedily yields to retardation, which after a time terminates in complete stasis.] We soon afterwards find Gendrin advancing another step. He distinctly saw the blood corpuscles flow to the point of irritation, and some of them even retrograded towards that point. In the year 1838 Macartney in his "Treatise on Inflammation" supposes the dilatation of the capillaries to be a tonic action, and their contraction a state of collapse. This view however was now rapidly giving way. It may be mentioned here that Macartney added to the four cardinal symptoms of inflammation a fifth, which has since been generally recognized viz. "functio laesa" or damaged function of the part affected.

There now arose what is known as the cell theory, which was destined to throw much light upon the nature of inflammation. In 1838 Schleiden showed that all vegetable tissues consisted essentially of a number of minute cells, each of which was itself living and contributed to the life of the whole organism. Soon afterwards Schwann showed that the same thing existed in animal tissues as well. As a corollary to this it appeared that as these minute cells were outside even the smallest capillaries, the blood-vessels

could no longer be regarded as active agents in the process of nutrition, but simply as carriers of the nutritive elements, which the tissues themselves utilized by an action of their own. As to the mode in which these cells were formed there was great difference of opinion. The majority of scientific men held that they were all developed from pre-existing cells, while others notably Professor Hughes Bennet held that they might be produced from a structureless substance effused into the tissues called "blastema." Bennet held that inflammation was simply an intensification of the ordinary nutritive process, that the exudation of the blastema, (which he held was really liquor sanguinis) which occurs in health becomes increased in inflammation, the quality of it is deteriorated, and the number of cells produced in it is also increased These views are laid down in Bennet's "Treatise on Inflammation" 1842-44. In the year 1841 Dr. Addison of Malvern discovered that the white corpuscles of the blood showed a tendency to adhere to the walls of the capillaries in inflammation, and in 1843 Dr. C. J. Williams made the still more important discovery that the white corpuscles of the blood actually passed through the walls of inflamed capillaries. This discovery however long remained unnoticed, until it was verified by Cohnheim in 1867. Hitherto it had been supposed that the increase and multiplication of cells in the neighbourhood of inflamed capillaries was the result of increased exudation of liquor sanguinis, but in 1850-51. Redfern showed in a paper on the "Abnormal Nutrition of Cartilage" in the Edinburgh Journal of Medical Science, that a precisely similar process which there was every reason to believe was really inflammation might occur in cartilage, in which no bloodvessels were present; and it was

thus seem to be quite possible that the changes in vascular tissues might be due not so much to the increased exudation of liquor sanguinis, as to the action of the tissues themselves. This theory was called textualism, in opposition to the former which was called interstitialism. In the year 1858 Professor Lister in his valuable paper "On the Early Stages of Inflammation" drew attention to three points. 1st He found that the tendency of blood corpuscles to adhere together, was not greater when the blood was drawn from inflamed parts than from parts which were not inflamed 2nd He confirmed Gendrin's observation, and showed that when any kind of irritation, whether mechanical or chemical was applied to any point in a bloodvessel, the corpuscles of the blood instantly moved towards that point. 3rd He confirmed so much of Dr. Williams' observation as to find that the white corpuscles stick fast to the walls of inflamed vessels, though he did not see them pass through the walls. In the same year 1858 appeared Professor Virchow's great work on "Cellular Pathology." He maintained strongly that no cell could arise except from a preexisting cell; and that the essential process of inflammation lay in the connective tissue corpuscles, and that the vascular phenomena were entirely secondary. He held that what was commonly spoken of as inflammatory exudation really arose from the multiplication of these corpuscles, not from an exudation from the vessels; and that even the fibrinous deposit of lymph which occurs in pleurisy arose from the tissues themselves, and not from the vessels. He held that the original cause of inflammation was some "irritation" in the cells, and that in consequence of their increased activity an increased amount of liquor sanguinis was supplied to them. In 1865 Dr. Lionel Beale in his "Lectures on Inflammation" expressed his belief that the cell is for

the most part formed material produced by the nucleus, which is the only living portion, and that minute particles of germinal matter (represented in cells by the nucleus) are scattered throughout the body. He also thinks that the increased vigour and rapid multiplication of cells in inflammation arises in consequence of the increased supply of liquor sanguinis. In 1869 Cohnheim (Ueber Entzundung und Eiterung, Archiv. Virchow) made a much larger breach in Virchow's doctrines. He observed that in keratitis the turbidity usually commenced at the circumference, and spread to the centre. He thought that the numerous cells (pus cells) with which it was infiltrated must originate in the bloodvessels. To ascertain the truth of this, he injected some aniline dye into the mesentery of a frog, and observed that many of the white corpuscles absorbed a portion of it, and became coloured. He then produced artificial keratitis, and on examining the cells found that some of them were coloured likewise. He therefore supposed that these were in reality the white corpuscles of the blood he had observed before, and which had migrated from the vessels. It now only remained, to see the actual passage of the white corpuscles through the walls of inflamed vessels. For this purpose, the mesentery of a frog was drawn out and made to inflame; and it was actually observed that the white corpuscles first adhered in great numbers to the walls of the vessels, and then actually passed through them, as had been observed by Williams twenty-five years before, but since lost sight of. In further experiments, performed on a frog's tongue, he did not observe that the connective tissue corpuscles underwent any change, and therefore supposed that all pus cells are in

reality emigrated white corpuscles, with which in form they are identical. In 1869 Norris and Stricker observed that in artificial keratitis the corneal corpuscles did undergo change; they increased in size, while their nuclei multiplied, and they then began to move spontaneously. Moreover these changes commenced not necessarily at the circumference, but at whatever point irritation was applied. These gentlemen then examined the tongue of a frog, but from the crowded state of the field, they could not distinctly say whether the connective tissue corpuscles divided or not, though they assumed some degree of mobility. They then took out the cornea from one eye of a frog, and divided it into two portions; one of which was killed by being washed with distilled water, while the other was not interfered with. Both these portions were then transplanted into the conjunctiva of the other eye, which had been previously made to inflame. The result was, that in 24 hours the living portion presented all the ordinary appearances of inflamed cornea, the other showed only a few white corpuscles. The conclusion arrived at therefore is, that of the cells similar to the white corpuscles of the blood found outside the vessels (and which when very numerous constitute pus cells), some are emigrated white blood corpuscles or leucocytes, but the majority are produced by the division and multiplication of the connective tissue corpuscles (or in the cornea corneal corpuscles) of the part. About the same time Dr. Rynak succeeded in throwing much light upon the state of the vessels in inflammation. He drained the blood from an animal, and injected the vessels with milk, keeping up the circulation by artificial means. On applying an irritant to the vessels, it was found, that the globules of milk moved to the point of irritation just as the the corpuscles of the blood did. He

then tried the same experiment with the defibrinated blood of pigs, and found the same result. He then washed out the vessels with a solution of common salt, and reinjected the blood. Now, on applying an irritant the corpuscles showed no disposition to move towards the irritated point, for the salt had killed the vessels. This showed clearly, that the vascular phenomena of inflammation viz. dilatation of the vessels and stasis of the blood current, were produced entirely by an alteration in the nature of the vessels, and not at all in that of the blood. (These experiments of Shicker and Ryneck were published in the "Studien aus dem Institute für experimentelle Pathologie in Wien aus dem Jahre 1869") Thus the result arrived at is, that inflammation is a process consisting of alteration in the walls of the blood vessels and of the tissues themselves, and that the so called inflammatory exudation arises partly from alterations in the tissues, and partly from the migration of the white blood corpuscles. The blood itself undergoes various changes, of which the principal are, an increase of fibrine (hyperinosis), a relative diminution of the number of corpuscles, a diminution of specific gravity, and a tendency to the formation of what is known as the buffy coat. These changes are probably secondary, and Ryneck's experiments showed conclusively that the blood has no direct agency in the formation of stasis; but still morbid alterations in the blood may have a very strong effect in predisposing to, or actually cause various inflammations.

Having thus described the nature of inflammation it is easy to consider that of suppuration. The doctrine of suppuration held in the 17th century

and previously to that was that it consisted of a dissolution or breaking down of the solid matter of inflamed parts. The hard swelling of inflammation becoming gradually transformed into a soft fluctuating collection of pus seemed distinctly to indicate this. This doctrine however caused it to be supposed that wherever there was suppuration there must also be ulceration or destruction of tissue. Hence it was supposed that whenever pus was expectorated an ulcer existed in the lungs or air passages, and that in every gonorrhœa there was an ulcer in the urethra. In 1752 however, De Baen, observing that pus might be expectorated in considerable quantity without any such ulceration being discernible on a post-mortem examination, sought for some other hypothesis; and imagined that pus was produced by the vessels, by a process analagous to secretion. This seemed to be confirmed by the fact that large quantities of pus might accumulate in the cavities of the chest and abdomen without any ulceration. Hunter strongly supported this view, and affirmed that the bloodvessels in inflamed parts assumed what he called a glandular action, and began to secrete pus. Gendrin whose researches on inflammation I have already mentioned, thought he saw the red corpuscles of the blood become converted into pus. He also saw some of the extra vascular tissue become pus. Dr. Carswell said that blood might be converted into pus by a process independent of the blood-vessels, and found that when a quantity of blood was injected into the cellular tissue it became pus. This mode of pus formation he proposed to call extra-vascular.

When in 1838 the cell theory was introduced, it immediately caused as great a change of character in the speculations concerning suppuration as in those concerning inflammation. Schwann supposed that in inflammation resulting in suppuration, a fluid was exuded from the blood as in ordinary nutrition; but that

instead of the cells peculiar to the part which would have been developed in it in the latter case, pus cells were produced. This view was strongly supported by Bennet. I have mentioned, that he considered inflammation to consist essentially in the exudation of an increased quantity and deteriorated quality of liqua sanguinis. This exudation he thought might die rapidly constituting mortification, or more slowly constituting ulceration. Or it might live and produce one of three different kinds of cells. First it might produce exudation cells, in which case inflammatory softening of the part affected occurred. Secondly it might produce plastic cells mixed with organizable lymph in the form of primitive filaments, in which case the exudation became organized tissue. Thirdly it might produce pus cells, in which case the exudation became converted into pus. Bennet thought that there were three factors which determined what the exudation should become. 1st There is the nature of the surrounding tissue, for if any exudation becomes organized it assumes the character of the surrounding tissue 2nd The vital power of the whole organism. The stronger the body is the more likely is the exudation to form healthy tissue, and the less likely to die. 3rd The rapidity with which the exudation is poured out influences the kind of cells into which it is developed. If the process is slow it tends to be converted into organized tissue, if rapid into pus. Sir James Paget divided the lymph which is thrown out in inflammation into two classes, fibrinous, and corpuscular. In the fibrinous form lymph coagulates & becomes converted into healthy tissue. In the corpuscular form there is no coagulation, but cells or corpuscles are produced and the lymph is converted into pus. Virchow in his "Cellular Pathology" maintained that pus corpuscles were invariably produced by the multiplication and division of preexisting cells. He held at first that the

processes of inflammation and suppuration resided entirely in the connective tissue. He held that the connective tissue corpuscles enlarged, that their nuclei multiplied and divided, and that finally each corpuscle separated into a number of fresh ones, which were now pus corpuscles, and together formed a collection of pus. He held at first, that when suppuration appeared on mucous membranes the pus corpuscles were formed from the sub-mucous connective tissue, and had found their way through the epithelium. Afterwards he admitted that pus might be formed by a similar process from epithelial cells. He then held that there were two kinds of suppuration In the first pus corpuscles were produced from the excessive multiplication of epithelial cells. The new cells, instead of becoming healthy epithelial cells like their parents, became pus cells. In this case there was no destruction of tissue. In the second case pus cells were produced from the multiplication of connective tissue corpuscles. The now cellular portions of this tissue were dissolved; so that in this case there was destruction of tissue. Professor Beale maintained that suppuration might not only arise from epithelium and connective tissue, but from germinal matter in whatever part it might exist. When Cohnheim rediscovered the migration of the white corpuscles, he naturally supposed that all pus corpuscles were in reality these emigrant leucocytes. We have seen that the two agree almost exactly in their physical and chemical properties; and they have also this further ressemblence, that they both when living possess amœboid movements. When Stricker made his further investigations it appeared that while some of the corpuscles were emigrated leucocytes, as Cohnheim had imagined, others were produced by the multiplication of connective tissue corpuscles or epithelial cells, as Virchow supposed. Klein after

wards saw a white corpuscle actually divide on the stage of the microscope, thus showing a third mode of production of pus corpuscles, or at all events a probable mode viz. by the division of those already formed. The conclusions arrived at with regard to the production of pus may be summed up as follows—

1st is one of the terminations of inflammation, and is intermediate between resolution, or organization of the exudation, on the one hand, and mortification, or ulceration on the other. It shows, not an absence, but rather a superabundance of vitality, but of a low kind. The corpuscles may be formed in three ways 1st From emigration of the white blood corpuscles 2nd. From proliferation of epithelial cells or connective tissue corpuscles. (Possibly also they may be derived from other parts, as the elements of the neuroglia, or glandular secreting cells) 3rd From the multiplication of existing pus cells. The liquor puris is probably derived in connective tissue from the breaking down of the non cellular elements, and ~~or~~ epithelium from an increase of the fluid normally secreted. Thus we see how it is that in suppuration occurring in connective tissue, there is always a dissolution of the solids of the body, while in that occuring on epithelial surfaces there is usually no destruction of tissue, or abrasion of surface, unless the upper layers of the epithelium are so tough as to oppose the free escape of the newly formed liquid. Thus in supposing pus to be formed by a dissolution of the solids of the body the early theorists were mainly right.

Pus considered as a living fluid, and its effects upon the organism

In my description of pus I have simply described the properties it possesses whether dead or living. No mention has been made of its vital properties, which will

now be considered. In the first place, when pus corpuscles are living the well-defined spherical outline they possess in the dead state is absent. It is observed that the outline is constantly changing, and that little protusions are continually put forth and again withdrawn. These are called amœboid movements, from their occurrence in the animalcule the amœba. These movements are best seen, by placing a small quantity of pus which has been recently secreted on a warm slide. Then on placing the covering-glass (which should be thin) over it, it is well to interpose a few hairs to prevent pressure. Besides this they possess the power (which has been mentioned under a previous heading) of multiplication. They have also the power of growth, by which the newly formed cells attain to full size. During their growth they must derive nourishment from some source. They are capable of assimilating most living tissues with which they come in contact, and this probably is to a great extent an explanation of the destruction of tissue which occurs so frequently in suppuration, but it may be supposed that their most usual food is the liquor sanguinis.

If these corpuscles are transplanted in a living state to any fresh epithelial surface, they are still capable of growth, and may set up suppuration on this surface. The action in this case is somewhat similar to transplanting a young shrub from one soil to another. The process is also probably assisted by the fact that as they require nourishment they compell the blood-vessels to enlarge to bring an increased supply of liquor sanguinis, and thus produce inflammation, and this of itself tends to suppuration. They may also communicate to the epithelial cells of the part a tendency to rapid growth and multiplication. Also pus together with other living fluids has in some cases the property of attaining, that is if transplanted from one living subject to another it may convey the disease by means of which it was produced, or any accidental qualities arising from the mode of its production. Thus pus from a chancre may set up syphilis in a fresh subject, or pus from a variolous pustule

may set up small-pox. The same thing is seen when we contrast the effects of pus transplanted from a violently inflamed surface, and from one in which the inflammation is of a milder type. In the one case the transplanted pus will set up a violent inflammation, and in the other a comparitively mild inflammation. Next comes the fact that pus though a living fluid, acts to a certain extent like a foreign body, and seems to irritate the living tissues. It is less irritating to the part where it is first produced, and more so to any fresh part that it comes into contact with. An instance of this is the sore throat of phthisical subjects produced by the constant irritation of the pus which is coughed up. Hunter supposed that it was not at all irritating to the part in which it was first produced; but even this appears to be scarcely correct, for one of the essential conditions of an ulcer's healing is the frequent washing away of the pus which it secretes, and the lotions which kill pus cells are most efficacious in promoting the healing process; while sinuses and fistulæ which harbour collections of pus, will rarely heal till they are laid open. Also pus has a power (which has been already alluded to) of dissolving living tissues. Dr. Walsh says that pus will dissolve pieces of meat placed in it. It seems doubtful whether this is not a consequence of the production of acids in the pus arising from decomposition; but whether this be so or not pus can certainly cause the dissolution of some living tissues. Perhaps the most striking instance of this is the psoas abscess, in which the pus formed in the lumbar vertebræ eats its way down the psoas muscle, causing the destruction of a large part of that muscle, and finally points below Poupart's ligament. This probably arises in great measure as has already been mentioned from the tendency of pus corpuscles when living to assimilate to themselves

or so to speak to feed upon living tissues with which they are in contact.

Now arises the important question with regard to animal economy — is suppuration eliminative? There can be little doubt that in many instances it is. Take the case of small-pox. Here we see violent fever and constitutional disturbances, followed by the appearance of a rash which is at first papular, but soon becomes vesicular and then pustular. The pus contained in these pustules is impregnated with the small-pox poison in the highest degree of concentration, and no doubt the poison is eliminated from the blood by the same means. So in scarlatina, the abscesses which often form during convalescence in the neck, are probably also eliminative. And if the eliminative properties of the pus in these instances be granted, it is not difficult to suppose that many of the abscesses which occur without apparent local irritation or evident cause are really produced by a morbid matter circulating in the blood, which like the small pox or scarlatina poison attacks some particular part gives rise to a process terminating in suppuration, and that the poison then escapes in the pus produced. Deep seated collections of pus usually give rise to constitutional disturbances, sudden and violent rigors, and temporary rises of temperature. It has been supposed that whenever these occur a portion of pus is reabsorbed into the blood. Now if we suppose collections of pus to contain morbid matter eliminated from the blood, we can readily understand the disturbing effects produced by its reabsorption. On the other hand suppuration is not always eliminative. Any local irritant may cause inflammation followed by suppuration, whether there be any morbid matter in the blood requiring to be got rid of or not, and even if there is, it does not necessarily follow that it will be eliminated by this channel. It is not very

likely to be so, unless the morbid matter is itself the irritant, which causes the subsequent inflammation and suppuration. When suppuration is eliminative, it is generally beneficial to the system, and must always do some good, though in some instances it produces evil results, which may more than counterbalance the good it does. Thus in some cases of post scarlatinal abscess, when we see the frightful ulcerations produced, and the fever or even pyæmia which results from them, we can hardly imagine that nature could have chosen a worse method of eliminating the poison. I have seen two cases of frightful ulceration in the neck originating from this cause, the sterno-mastoid muscle being quite laid bare. In one instance the child died. In the other great feverishness was produced, and a condition approaching pyæmia if not actually so; but the child eventually with great difficulty recovered. There in some cases where we cannot exactly say that suppuration is eliminative, it is beneficial, because it takes the place of other processes which are infinitely more injurious. When for instance a wound or an ulcer ceases to secrete pus, and the surface becomes dry and glazed, a feverish condition of the body at once occurs. The commencement of pyæmia is always marked by the same phenomena. When on the other hand free suppuration returns the feverish condition invariably ceases. Sometimes suppuration produces very injurious effects upon the system. Long continued suppuration however produced is very hurtful, as it is a great drain upon the system, and very exhausting. It was formerly thought that pus when absorbed produced pyæmia. It is now believed however that pyæmia is not caused by the absorption of pus, nor by pus as such at all, but is caused by the absorption of some poisonous material produced in connection with decomposition either of pus or any other fluid containing organic

matter. Some imagine this poisonous matter to be chemical; others think that it consists of minute animalcules called bacteria. However as this disease is not produced exclusively in connection with pus, it need not be further described here.

Causes and Terminations of suppuration

The great cause of of suppuration is as we have seen inflammation. Suppuration is always or almost always, preceded by some degree of inflammation, though it varies greatly in intensity. The tendency however of different kinds of inflamation to lead on to suppuration varies very much. In acute rheumatism on the one hand, suppuration of the joints is almost unknown though cases have been recorded in which it has occurred; while on the other hand in pyæmia, the joints frequently suppurate. The same thing occurs in artificial inflammation of the skin. The inflammation caused by the application of croton oil has a great tendency to terminate in suppuration, while that caused by mustard never does.

The most usual termination of suppuration is that the pus escapes externally either naturally or by an artificial opening. When pus within the system does not speedily escape rigors and constitutional disturbances may occur. Occasionally pus is absorbed. In this case the fluid portions are first absorbed, leaving the corpuscles to form a cheesy mass. These then undergo a fatty degeneration, and are absorbed by the blood-vessels. In chronic suppuration the pus may after an abscess has been opened continue to form and drain away for a long period. These discharges are peculiarly injurious to the patient. In suppuration which occurs in a healing ulcer it will cease as soon as the ulcer is healed, and should the healing process stop suppuration will probably cease.

General diagnosis of suppuration

When suppuration occurs on a raw surface it is of course visible at once. When a collection of pus, or abscess forms, it may be detected by physical signs, and its existence may be suspected from symptoms. The great physical test for suppuration is what is known as fluctuation. The best way of effecting this is as follows —; the surgeon places the finger and thumb of one hand near together but by slight distance apart at some point underneath which he supposes pus to be present and makes gentle pressure. He then with the finger or finger and thumb of his other hand smartly taps some other point over the supposed collection of pus, and if pus be present a peculiar wavy impulse is communicated to it, which is distinctly felt by the finger and thumb of the first hand. The two hands should not be too near together, or a sensation simulating fluctuation may be produced when no fluid is really present. In testing for suppuration in the thigh, one hand should be placed higher up than the other which should be placed on the same side but lower down. The two hands ought not not to be placed with regard to each other in a direction going round the thigh, otherwise mistakes are likely to be made. In testing for pus or fluid in a joint, place the finger and thumb of one hand at the upper end of the joint, and those of the other at the lower one. In testing for a psoas abscess, place the finger and thumb of one hand on the swelling in the groin, and those of the other above Poupart's ligament. This test of fluctuation only shows by itself the presence of fluid, and does not show whether it be pus or some other fluid. But in many instances as in cases of ordinary abscess, we know that pus is the only fluid which can be present. In other cases we must endeavour to judge from the na-

ture of the case, and the symptoms which are present, as to what the fluid really is. There are of course cases in which fluctuation is inapplicable, as in suppuration within the pleural cavity, or within the cranium. Then supposing the abscess to be underneath a muscle, instead of the ordinary impulse, only a boggy feeling will be felt. Supposing the abscess to be near the surface we shall presently be helped by other physical signs. The swelling which probably existed before, becomes more elevated and conical; this is termed the pointing of the abscess. The bright red ~~colour~~ which at first existed becomes a more dusky red, and finally yellow. These things show, not merely that pus exists, but that it is making its way towards the surface. We may be aided in our diagnosis by symptoms. The most important of these is the alteration in the pain. In most instances when pus is formed the pain subsides or is relieved, but in some cases as when the pus is formed under a fascia or some dense substance it is aggravated owing to the increase of tension produced.

It was formerly thought that rigors were an important sign of suppuration, but late investigations show that they have no necessary connection with it, but are apt to be produced by the absorption of the pus into the blood. In deep seated collections of pus there is an important test by which we can usually detect them when we should otherwise remain uncertain, and that is by making an exploratory incision, or by using an aspirator, a hypodermic syringe. If fluid be present, a small quantity is withdrawn, and we can readily see whether it is pus or not.

General treatment of suppuration

In suppuration occurring on a raw surface, the best remedy is some astringent lotion as sulphate of

zinc, which will destroy the pus cells as well as moderately stimulating the part and assisting the healing of the wound. In the case of an abscess, it is well as a rule, to apply in the first place warmth and moisture. This is done by means of hot fomentations, or poultices, of which the latter are generally the most convenient. There are various sorts of poultices, bread, linseed meal, oatmeal, bran, chamomile flowers, mashed mallows, etc. Of these the one most in favour with surgeons is linseed meal. Linseed contains a great deal of oil, and therefore preserves its moisture longer than most of the others. For small abscesses on the fingers, bread poultices are a useful and convenient form of application. The chief value of poultices seems to be the relief which they give to the pain of the part. Then it is probable that their warmth and moisture may facilitate the growth and multiplication of pus corpuscles; and that it may promote the proliferation of the connective tissue corpuscles between the pus and the surface of the body, and so according to the common expression draw the matter to the surface. †
There are cases in which these remedies are not of much use, as in cases of very deep-seated abscess, or in suppuration within the cranium, where the intervening skull will prevent the poultice from having any effect and also prevent the pus from escaping, or in cases of suppuration within the cavity of the pleura or peritoneum, for these membranes are not usually dissolved by pus, and even should they be so, the walls of the cavities are so thick that poultices will not much assist the process. In some cases where if pus formed it might be dangerous to let it out with the knife, it may be advisable in cases of inflammation tending to suppuration to try some remedies which have the soothing effect of poultices without their tendency to the formation of pus. In suppuration in the palm of the hand, the pus may burrow among the

† Perhaps also they increase the tendency for the white corpuscles to leave the bloodvessels

muscles without tending to the surface, and the surgeon may be unwilling to make an incision for fear of wounding the palmar arch. In such cases Dr. Lewis of Dalbeattie with whom I acted as assistant never applied poultices but always one or other of the following remedies (1) Rx. Ext. Belladon. ʒ III. Ung. Iodi ʒ V M. Sig. apply to the part affected (2) Rx. Plumbi Acetat. ʒ II Vin. Opii ʒ III Aquam ad ʒ XII Sig. apply warm to the part affected. I remember two cases of violent inflammation in the palm of the hand threatening speedy suppuration, treated the one by the ointment, and the other by the lotion, in which great relief was immediately produced, and although suppuration was not altogether averted yet the quantity of pus formed was very small in comparison with what threatened at first. Spongio-piline may here be mentioned as a useful substitute for a poultice. It gives warmth, and by preventing evaporation, moisture, but where there is much pain it is not so soothing as a good poultice.

When supposing the abscess from the use of poultices or otherwise has approached pretty near the surface, it is advisable to open it artificially. If this is not done it will presently open of its own accord; and in some cases it may be left to do so if the patient prefer, or the surgeon think fit. If the abscess enlarges in breadth, but does not point it is better to open it, as otherwise it may become much larger than necessary. Very large abscesses will probably require to be opened artificially, even if they have already opened of themselves, as the natural opening is rarely sufficient for the escape of the pus. In the following cases the surgeon should never leave abscesses to themselves, but make an opening early. These are

1st When the abscess is beneath some fascia, or strong tissue, as in the axilla or hand, which prevents the pus from getting through it to the surface.

2.nd When the abscess is caused by irritating matter, as fæces or urinary extravasation, which it is desirable to afford an opportunity of escape.

3.rd When the abscess is situated in some loose areolar tissue, which is capable of great distension, as that round the anus.

4.th When there is danger of the abscess bursting not externally, but in some other direction, as into the cavity of the pleura, or into the jugular vein, or the trachea.

5.th In parts specially sensitive as the testicle, it is desirable to allow the pus to escape as soon as possible.

6.th Where, as in the face and neck it is desirable to avoid the scar which would result if the abscess opened spontaneously. (There is some difference of opinion about this as some surgeons think that the abscess leaves a less scar if it bursts of itself, than if opened artificially.)

As regards the place of making an opening it is well to select. 1.st A part when the abscess comes near the surface, or at least not less near than at at any other point 2.nd The most dependent part in which the first condition holds true. 3.rd A part when we shall not do damage to important structures. (In a mammary abscess the incision should be in a direction radiating from the nipple, so as not to cut across the milk ducts.)

The best mode of opening abscesses is generally by an incision with a Syme's abscess knife, which the surgeon holds like a pen, and passes rapidly into the abscess, enlarging the opening as he draws it out. A lancet used for venesection may be employed. When it is desirable to make a very shallow incision as in an abscess near some large bloodvessel the lancet may be gaurded by having a piece of lint wound round it to within a short distance of

the point. Caustic has sometimes been used, but it is very painful and leaves a deep scar, and is generally both avoided. When used caustic potash is the best. Dr. Hilton has introduced a mode of opening deep seated abscesses, so as to avoid injury to the blood vessels etc. In the case of axillary abscesses he says. "Cut with a lancet through the skin and cellular tissue and fascia of the axilla, about half or three quarters of an inch behind the axillary edge of the great pectoral muscle. At this point we can meet with no large blood vessel. ---------- Then I push a grooved probe, or grooved director, upwards into the swelling of the axilla; and if you watch the groove, a little opaque serum or pus will show itself. Then take a blunt (not a sharp) instrument, such as a pair of dressing forceps, and run the closed blades along the groove in the probe or director into the swelling. Now opening the handles you at the same time open the blades situated within the abscess, and so tear open the abscess. Lastly by keeping open the blades of the forceps during the withdrawal of the instrument, you leave a lacerated trunk or canal communicating with the collection of pus, which will not readily unite, and will permit an easy escape of matter." (Hilton on the influence of Mechanical and Physiological Rest, in the Treatment of Accidents and Diseases p. 121) Dr. Hilton applied the same method to the treatment of other deep seated abscesses.

Suppuration occurring in the closed cavities

A. Empyema or Suppuration in the Pleura

By the term empyema, is commonly understood the occurrence of suppuration within the cavity of the pleura, although there is no reason etymologically why it should not refer equally to that occurring within any other closed cavity. It must be considered as one of the results of inflammation of the pleura, in which from some cause or

other pus is effused instead of serum or mixed with it It is a moot point whether in these cases pus is effused ab initio, or whether serum is first effused and subsequently becomes purulent, or whether both these conditions may occur. The pus is usually less thick than that which occurs in ordinary abscesses, and shows a greater approach to serum.

Causes

As empyema is a variety of pleurisy, it will be well to consider first the causes of pleurisy, and then the causes which render the effusion purulent instead of serous. The causes of pleurisy are 1. Traumatic, arising from wounds or injuries, as for instance when a broken rib pressing on, wounds or perforates the pleura. 2. Spreading of inflammation from neighbouring organs. 3. Idiopathic. Cold and wet are frequent causes, though it is doubtful how far they can produce pleurisy in a healthy subject. Dr. Tanner says "I do not believe, however that any amount of cold by itself, will produce the disease in a healthy individual. It may prove the exciting, but not the essential cause of the inflammation" (Tanner's Practice of Medicine 7th edition Vol I p 610) Then pleurisy is apt to occur after fevers, especially after scarlatina and measles. It is also exceedingly common in pyæmia and puerperal fevers. Bright's disease also predisposes to it. It is common in phthisis, and this may occur in two ways. 1st from extension of inflammation from the lungs 2nd from actual deposit of tubercle in the pleura. It may also occur consequently to a deposit of cancer in the female breast. This may occur from a secondary deposit of cancer beneath the pleura, which presses upon it, and probably in some some instances from the extension to the pleura of the sub-inflammatory action set up in the neighbourhood of the mamma, by the original cancer itself. Pleurisy is rarely met with in early childhood. Dr. West says

that acute plenisy is very rarely met with in childhood, and that chronic plenisy "while it is a very rare occurrence as a purely idiopathic affection in early life, it is one of the most common complications of the dropsy which often succeeds scarlatina" (West on Diseases of Infancy and Childhood.) Many persons think that when plenisy occurs in very young children, it is an indication of blood-poisoning of some kind Dr. Sansom says "Plenisis at a very early age is rare. Whenever it thus occurs blood poisoning may be suspected. I remember a post mortem examination made by my colleague Dr. Sutton, in the case of an infant who had died suddenly. The plena showed signs of intense inflammation, and Dr. Sutton remarked that probably the case was one of some "fondroyante" infection, in which the usual signs had not had time for evolution. His opinion was immediately confirmed by the discovery that the kidneys showed signs of intense inflammation, such as occurs in scarlatina, and I believe that on enquiry the probability of scarlatinal contagion was shown to be very strong." (Dr. Sansom on Localized Empyema Medical Times and Gazette September 21 1878) Such being the principal causes of plenisy, what is it that causes the effused fluid to be purulent. We do not exactly know, but we find 1st That most subjects of empyema are pale, scrofulous, or cachectic, and with the general health below par. 2nd That empyema is relatively much more common in children than in adults. During my residence as house-surgeon at the North Eastern Hospital for Children in London for a period of eight months, fluid was removed from the plenral cavity in ten or a dozen cases, and in every instance the fluid was purulent; it was never clear serum.

Symptoms and Diagnosis

In these as in the causes empyema resembles in

many respects ordinary cases of pleurisy. Pleurisy usually comes on with a stitch in the side which may be felt very acutely or be scarcely perceptible, with an inability to draw a deep breath. The patient does not like to lie on the side affected. Along with this there is usually some degree of fever the thermometer rising to 102° or 103°. F., but not so high as in pneumonia. On the application of the stethoscope a frichon sound is heard. Afterwards when fluid is effused, the frichon sound disappears, and is succeeded by a feeble and indistinct respiration, bronchial in character, with vocal resonance bronchophonic, sometimes ægophonic, absence of vocal fremitus, and dulness on percussion. Supposing the amount of fluid to be great the affected side may be markedly bulged out, and the heart may be displaced. The most usual difficulty in diagnosis is between pleurisy with effusion and pneumonia. The leading points of distinction are 1. In pleurisy the line of dulness varies with the position of the patient. (The dulness is usually more absolute in pleurisy than in pneumonia) 2. In pleurisy the rise of temperature is less than in pneumonia 3. In pleurisy the vocal fremitus is extinguished, in pneumonia it is increased. 4. There is no rusty coloured sputum in pleurisy, as there usually is in pneumonia. 5. Supposing the case to be seen early, there is a frichon sound heard in pleurisy, while fine crepitation can be detected in pneumonia. Suppose then we have satisfied our minds that fluid is present, how are we to tell whether it is pus or serum. Usually if pus be present the subject has a pale yellow unhealthy look, as it is usually in these subjects that empyæma occurs. Here we have other diseases which conduce to the same appearance, simulating empyæma.

There is malignant disease of the lungs. This may be distinguished from empyema by the same physical signs by which consolidated lung in pneumonia is distinguished from pleurisy with effusion. Upward enlargement of the liver may also be mistaken for empyema, but here we are assisted by finding that in enlargement of the liver the breathing is natural in the middle and upper parts of the chest, that the heart is displaced upwards not laterally, and that even in the lower parts of the chest the breathing is much freer than we should suppose from the dulness. Occasionally the pus presses forwards, and forms a fluctuating tumour between the ribs, and if this occur on the left side there may be a pulsation uniform with the beat of the heart, and it may simulate an aneurism. There is however no bruit nor aneurismal thrill. Still with all these helps we cannot always diagnose certainly even the presence of fluid, much less the nature of it. Especially is this the case in children, where from the difficulty we sometimes find in getting them to speak the test of vocal fremitus is not always applicable. A plan is now however coming into pretty general use, by means of which the difficulty is solved. This is simply, in any doubtful case to insert a hypodermic syringe between the ribs and draw up the piston. Thus if fluid be present we readily obtain some of it, and see at once whether it is simple serum or pus. Supposing no fluid is drawn into the syringe we know that none is present. This proceeding is very simple and unattended with danger, especially if the point of the syringe be dipped in carbolic oil, to prevent any possible introduction of putrefaction.

Prognosis

The prognosis of simple pleurisy is favourable, as the serum if any be present will probably soon be

absorbed. The two layers of the pleura may however become adherent, so causing a partial obliteration of the pleural cavity. Supposing both sides to be affected, the prognosis is more grave. If pus be present instead of serum, the prognosis is not so favourable. Pus is not absorbed with the readiness that serum is. It probably is sometimes absorbed; but on the other hand if not evacuated it may remain for an indefinite length of time, causing frequent attacks of feverishness, and rises of temperature, and probably causing the deterioration of the health, and predisposing to diseases in the lungs or elsewhere. Sometimes it is evacuated spontaneously either externally through the intercostal spaces, or through the lung substance into the bronchi, or through the diaphragm into the peritoneal cavity. If the opening takes place externally it is usually about the middle of the side and not at the lowest part of it. If the pus escapes externally the prognosis is decidedly favourable, though frequently there is great shrinking of the side, and the compressed lung does not fully recover its functions. If the pus finds its way through the lungs into the bronchi the prognosis is much worse, as the pus is not completely evacuated, and what remains coming into contact with the air is apt to decompose and set up mischief, while at any rate a portion of the lung substance must be destroyed, and is apt to cause future mis-chief. Besides this the constant irritation produced by the coughing and the passage of the pus through the bronchi and trachea must be very injurious. When the opening takes place into the peritoneum this gives no escape to the pus whatever but merely gives it passage from one closed cavity into another, and is as injurious to the system as before. If the pus be removed by artificial means, the prognosis is better than in either of the two last cases, and

about as good as in the first. This will be further discussed under the head of treatment.

Recorded Cases

Perhaps I may be allowed to defer any remarks on the subject of treatment until I have related some cases which came under my observation in the N. E. Hospital for Children, the notes of which were taken by myself under the superintendence of the Physicians of the Hospital.

I James Bingham

James Bingham aged four years and nine months was admitted to the North Eastern Hospital under care of Dr. Sansom. on 1st of February 1878. He was a weakly and ill nourished child, in a very neglected condition, body covered with vermin; he manifested a frequent cough. The history obtained was to the effect that three months ago the child began to ail, and that he would often on returning from school sit down, and complain of feeling unwell. About Christmas time he was attacked by vomiting, and a severe cough, and became seriously ill. This condition was at first attributed to Christmas festivities, but as it continued unabated the child was brought to the hospital.

The signs were—

1 Respiratory System. Suffers from a frequent cough. There is dulness on the left side in front from the second or third interspace downwards, except a small portion in the fold of the axilla. Vesicular murmur suppressed on left side. Fremitus both with inspiration and expiration felt by hand over base of left chest at back. Dulness at back not complete; extends from angle of scapula downwards, but most dense outside axilla.

2. Arthritic System. Child complains of pain in both knee and hip joints. Walks with difficulty, and saves his left leg as much as possible.

3. There is pyrexia; temperature 103. F.

The diagnosis was broncho-pneumonia with considerable consolidation. It was thought that the tactile sensation at the left base was probably a bronchial fremitus.

Treatment The patient was placed on milk diet, and had the following medicine. R. Vin Ipec m 2 Spirit Ammon. Aromat. m 5. Spirit. Vini. Rect. m 5 Mist. Pot Bicarb. (gr XX ad ℥I) ℥III. To be taken every 4 hours. Mustard and linseed poultices were applied externally.

February 2 Slept well; perspires freely; takes food well

Feb. 4. Passed a restless night; considerable pain in limbs; comparitive dulness now extends over the apex of left lung in front.

Feb 6. Sleeps better; cough not nearly so trouble some.

Feb 7 Perspiration much less; respiratory murmur in left side more distinct

Feb 8 Dr. Sansom now observed that while the diagnosis of broncho-pneumonia was pro tanto correct, there were signs of a graver import. Dulness presumably from broncho-pneumonia, had spread upwards towards the apex, but the audibility of the respiratory murmur had increased, so that it would seem that some of the blocked air-cells had begun again to function; crepitations began to be heard over the base of the left lung. The adverse signs however were (1) the temperature history. For the first six days after admission there was no rise above 103°F. the temperature recorded on entry. At first a fall occurred to below 100°F. but there was always a high evening rise, making the chart show many peaks. The fall between the evening of February 5th and the morning of February 6th amounted to 5·5 degrees. Dr. Sansom

pointed out that the chart began to ressemble a case of septicæmia. (2) The articular symptoms. There was considerable pain but no articular swelling. (3) The sweating. All these circumstances suggested blood poisoning, and enquiries were made as to the possibility of contagion before the child came into the hospital. At this time nothing material was elicited, however. Four grains of sulphate of quinine were now ordered every night.

The effects of the sulphate of quinine upon the temperature were well marked. It will be noticed on referring to the temperature chart, which is appended, that on the evening of the 8th when the quinine had just been ordered, but probably before the first dose was administered, the temperature was nearly 104°, but that for the twelve following days it did not exceed 101°, and that it manifested sudden falls—to 96° on the mornings of the 13th 14th 18th and 24th. During this period there seemed to be some general improvement, especially in appetite. The breathing was however short and jerky

Feb. 22nd. Ordered five grains of salicylate of soda; quinine continued.

During the ensuing fifteen days, the temperature chart showed great irregularities, the elevations reaching close to 104° while the depressions were to 96°. The pulse also varied extremely from 98 to 160, and respirations from 32 to 60. Cold spongings were resorted to, and on March 8th cold baths. These however failed to have any permanent effect, at any rate upon the maximum temperature. On March 12th the quinine was increased to ten grains every night, and there was a notable depression of the maximum temperature to 101·2°, 100·8°, 99·8°, 98·8° in the days following respectively. Coincidently there was general improvement; respiratory murmur heard more distinctly over left lung.

March 17 Complains of difficulty in swallowing.

March 18 This evening the child began to give a

hoarse laryngeal cough. Inhalation of steam and creasote was ordered, and the child was removed from the ward to a warm room.

March 19 This morning evidently worse; the croupy cough more pronounced, and great tracheal dyspnea. Ordered five minims of antimonial wine, with ten minims of ipecacuanha wine every two hours. At 4 p. m. he was given a hypodermic injection of apomorphia, which produced vomiting. The antimony and ipecacuanha were then omitted, and wine and brandy were ordered freely. The creasote was discontinued, but the child was kept in an atmosphere freely supplied with steam. At 10 p.m. the child seemed worse, and was evidently dying of suffocation. Mr. Jay was sent for, and performed the operation of tracheotomy. The child seemed greatly relieved, and began to be able to swallow (which he had scarcely done for the last two days) and drank a large quantity of milk.

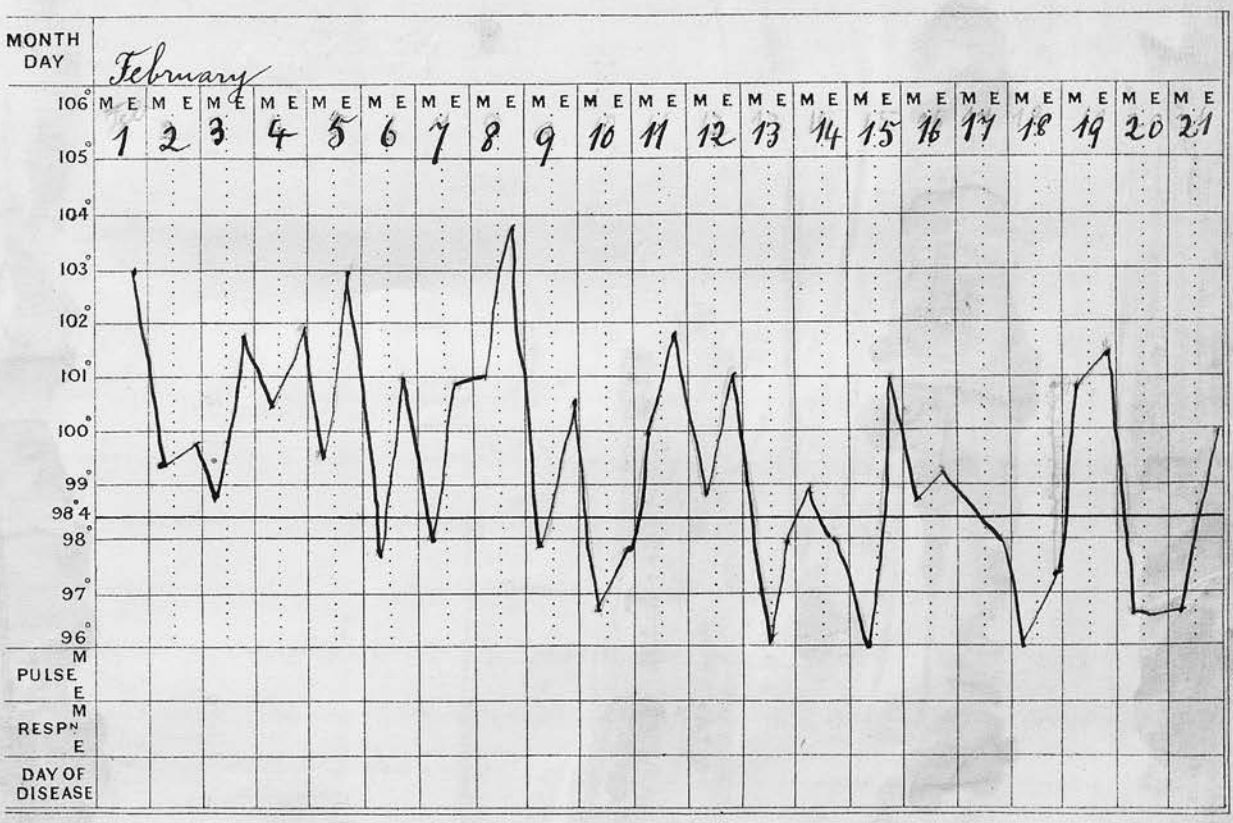
March 20 Child seemed to be doing well till about 1 p. m., when the breathing again became embarassed and the pulse rose.

March 21 Child continued to show dyspnea, and also great exhaustion all day, and died at 5 p. m.

Post-mortem Examination The pharynx, larynx, and trachea were all in a state of acute inflammation, and presented a greyish appearance. The lining membrane of the trachea was markedly granular. A considerable patch of false membrane was removed from the trachea. The trachea and larger bronchi were choked with pus. Many of the glands of the neck were enlarged, and infiltrated with caseous material. On opening the thorax and removing the left lung, the visceral layer of the pleura did not come away with it, but remained, and

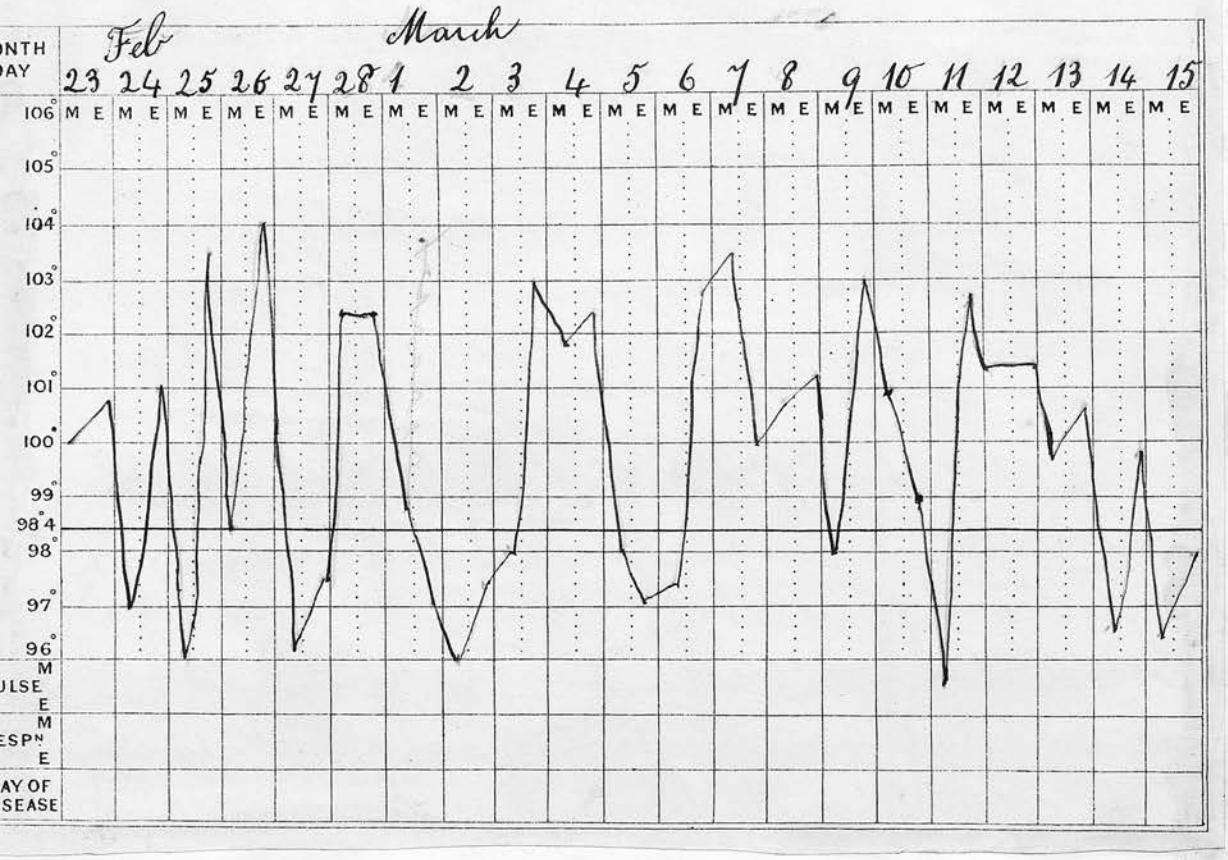
between the two layers was a locular encysted empyema extending from the base of the lung in front to about the second interspace. It did not extend to the back of the chest. On opening it the pleura was found to be greatly thickened, and about two and a half ounces of pus escaped. Though extensive in area the collection of pus was shallow. On the right side the pleura was somewhat thickened and adherent. The lungs themselves were both healthy. Other organs normal.

CASE James Bingham CHART No 1



DATE							
QUANTITY							
APPEARANCE							
SPEC: GRAV:							
REACTION							
ALBUMEN							
SUGAR							
BLOOD							
DEPOSITS &C.							

CASE James Bingham CHART No 2



The temperature charts are annexed for the whole of the illness except the last few days, of which the record has unfortunately not been preserved.

This case was reported by Dr. Sansom in the Medical Times and Gazette September 21 1878 and made the subject of a very interesting paper. Dr. Sansom was so strongly of opinion that the child suffered from a form of septicaemia, that he wished to procure a more detailed account of the history of the child previous to admission. A nurse was despatched to the patient's with instructions to report all she could elicit. The report was to this effect. — "The mother of J. B. says that her little son was taken ill about the middle of December 1877; he complained of sore throat, but got better again, and went to school. He came home at times from school very hot, but used to "get so cold" after. He went to his Christmas meal, and when he returned home was very sick. He vomited very often during the night, and afterwards for a day or two complained of pain

at the chest and between the shoulders. His appetite was bad, but he seemed to get better, and began to play about, but soon fell sick again and medical advice was sought; he was said to have bronchitis. He often complained of pain in the limbs, and was off and on poorly up to the middle of January. The child had whooping cough and measles two years ago. No fevers occurred in the house in which he lived. His mother says the drain pipe was stopped up for three weeks, and the house smelt very bad. No disease in other members of the family, except gout in the father."

Remarks. This case is one of peculiar interest. There is in the first place the gradual onset. The child began perceptibly to lose health about the middle of December, though previously he had been anything but strong. Then throughout January there was the cough and frequent sickness. Then on admission there was the dulness of the lower part of the left side of the chest in front, with suppression of the vesicular murmur; and also the high temperature and the pains in the joints. So then at this time the child was suffering from arthralgia, what afterwards proved to be localized empyæma, and probably broncho-pneumonia as well. Then throughout the period of seven weeks residence in the hospital, there was the extremely interesting temperature history, showing frequent and sometimes high rises of temperature, the temperature being usually highest in the evening. It will be seen that the quinine as far as we can judge, especially when given in ten grain doses, had a marked effect in keeping the temperature down; while the cold spongings which were resorted to before the increase of the quinine although they reduced the temperature temporarily, seemed to have little or no influence in effecting a permanent reduction. On the 12th of March the quinine was increased from four to ten grains, and it will be seen on referring to the charts that the reduction of

temperature was immediate. On the 18th of March the attack of croup came on which carried him off, but it will be noticed that on the day before he had complained of difficulty of swallowing, so that the first symptoms of the attack were not laryngeal but pharyngeal. These various symptoms would seem to be due as Dr Sansom has pointed out to some form of septicæmia or blood-poisoning. The attack of croup can hardly be supposed to be purely accidental. It might indeed be imagined to be a case of primary croup arising simply from cold, but the first symptom was difficulty of swallowing, which was noticed on March 17th the laryngeal symptoms not appearing till the following day. Also before the difficulty of swallowing came on we could remember no circumstance which could have accounted for a fresh cold. Then supposing the attack to be of a diphtheritic nature, the disease must either have been contracted in the hospital, which is extremely improbable as all sources of contagion were shut out, and the hygienic conditions were favourable, or if the disease were contracted before the entrance of the patient into the hospital, it must have been latent forty-nine days, which is most unlikely. Therefore we may suppose that the attack was one of secondary croup, arising from previous morbid conditions. Dr West has noted twenty-three cases of croup of which eleven were primary, and twelve secondary, eleven of the latter were sequelæ of measles, and one of pneumonia. (Diseases of Infancy and Childhood 6th edition p. 391.) But if it were secondary, was it due directly to the empyema, or were they both effects of some common cause? Dr. Sansom, bearing in mind the additional presence of the arthralgia, and probably of the broncho-pneumonia, and especially the his-

tory of the temperature chart, considers the latter to be the case; and thinks that the croup was "a phenomenon in the evolution of the septicæmia," as were also the other symptoms. It cannot be supposed that the presence of these two and a half ounces of pus, which were perfectly inodorous could cause this attack of septicæmia. Nevertheless the continued presence of the pus might have been a powerful auxiliary to the blood poison. For may we not look upon this suppuration as an effort of nature to throw off this morbid condition; and suppose that the pus was loaded with the poison whatever it might be; but that as unfortunately the pus had no exit, and as from the small size of the collection it was unluckily not diagnosed, that the poison remained within the system, and that part of it was reabsorbed into the blood, probably in a more concentrated form. And might not the sudden rises of temperature which were observed coincide with this reabsorption, so that the suppuration which could it have escaped would have been eliminative had really the contrary effect.

Another point worthy of remark in this case is the illustration of the good effects of quinine in keeping down the temperature; this succeeding where cold sponging and cold baths failed to have a permanent effect.

II Mary Anne Boston

Aged about four years admitted to the hospital, under care of Dr. Turner on the 22nd of July 1878. She had for sometime previously suffered from cough and ill health. Pus was withdrawn from the left side of the chest by the hypodermic syringe. On admission the child was pale, but without much loss of flesh. There was absolute dulness all over the left side of the chest, extending from the left side of the sternum. Apex of heart felt under the right nipple. There was deficient movement of the lower part of the left chest, upper part expanding more freely. At the apex of the left lung behind, there was tubular breathing and bronchophony, with crep-

itations. Breathing distinctly heard lower down nearer the spine, but very deficient in the lateral region. Breath sounds distant and tubular in front, with increased vocal resonance. A systolic murmur is heard in the aortic region. Aspiration was performed and four ounces of purulent pus removed.

July 26th. Breathing audible all over left chest after some coughing. There is crepitation at the apex. Breathing tubular in front of the chest.

August 10. Cough troublesome. Chest quite dull. Murmur very indistinct in front though loud at the back. Chest aspirated, and twelve ounces of purulent pus removed.

August 19 Since aspiration there has been no cough, and temperature normal. Left shoulder seems fallen, and ribs close together. Very little movement of left side of chest. Percussion dull throughout, except close to spine and at apex. Respiration free at apex behind elsewhere much diminished. Dulness extends up left border of the sternum.

The patient was in much the same state when I left the hospital at the beginning of September. The pus seemed to have disappeared, and the temperature with one exception about the 20th of August had remained nearly normal. The lung however was not expanding, and the side was contracting to fill up the pleural cavity. The patient was discharged on the 7th of October.

The treatment consisted of a mixture of tincture of cinchona, sulphocarbolate of soda, and ipecacuanha wine.

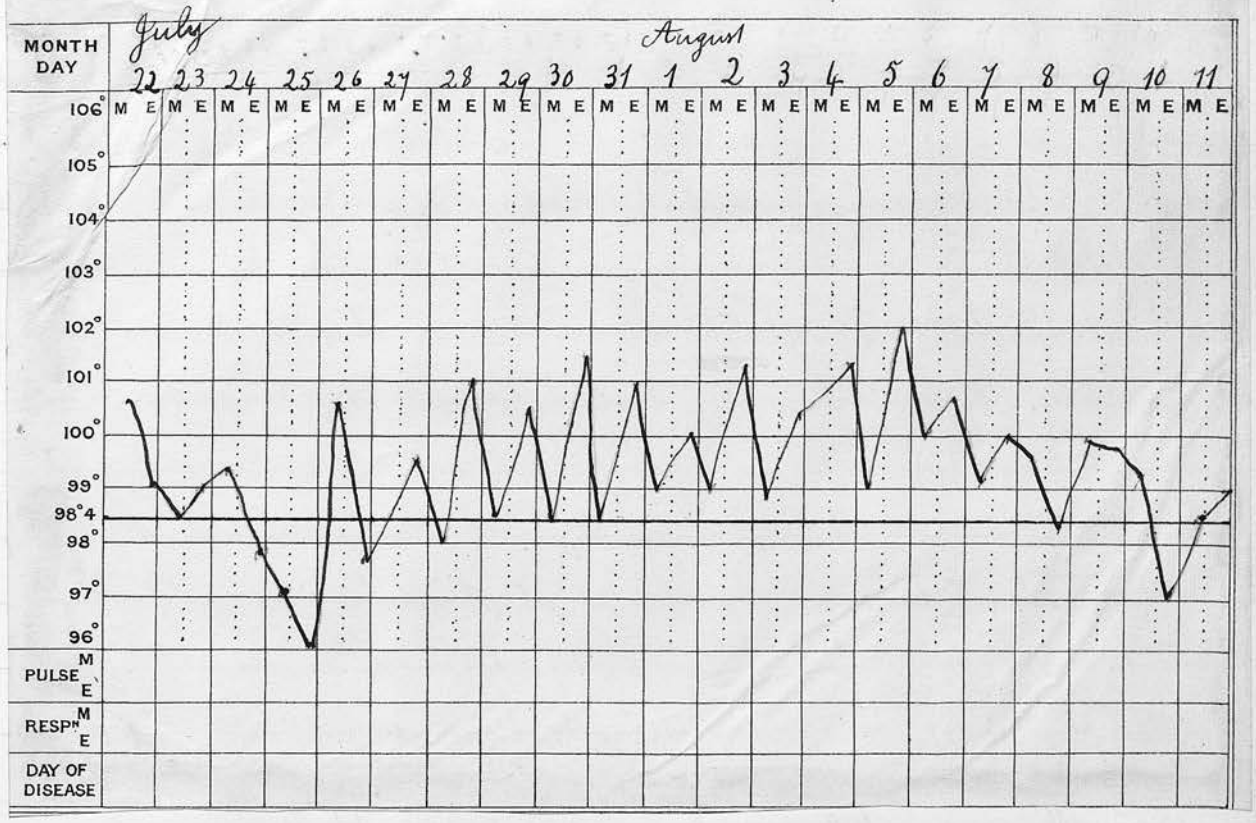
The temperature charts are annexed.

III James Wise

James Wise aged nine and half years was admitted to the hospital on the 8th of July 1878. He had suffered for five weeks with cough and spit, and was said by his medical attendant to have pleurisy. On admission he did not seem to be in any great distress from difficulty of breathing or other cause. The left side of the chest was

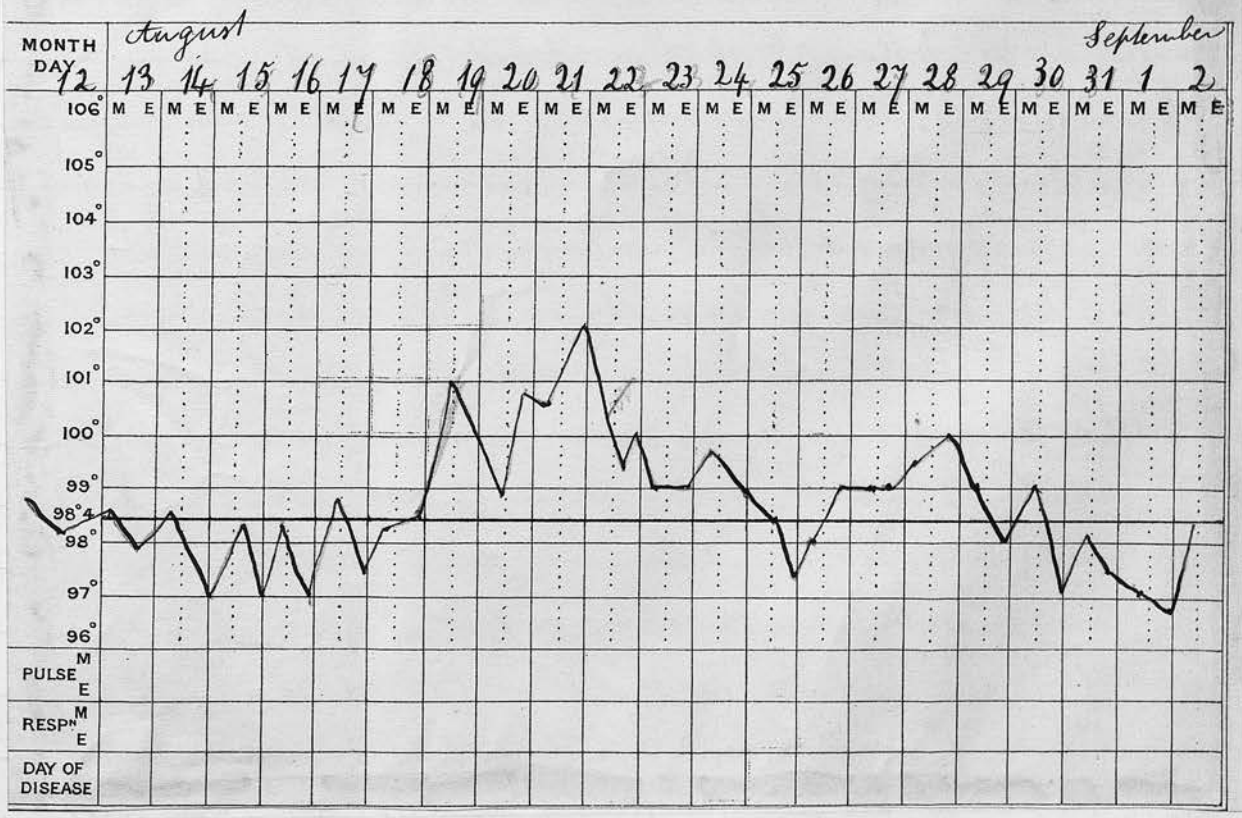
CASE Mary Anne Boston

CHART Nº 1



CASE Boston

CHART Nº 2



obviously bulged out. Measurement from centre of sternum to spine through mamilla 12 inches on the left 11 inches on the right side. The heart was displaced, apex beat felt below right mamilla. Absolute dulness over the whole of left side in front. Behind not quite so dull though the dulness was more than comparative. Left side did not expand on inspiration. Vocal fremitus absent. Breathing very indistinct, more so in front than behind, character tubular, no adventitious sounds. Vocal resonance diminished rather ægophonic. Temperature 99°5. (Pus was removed from left side by hypodermal syringe)

As there seemed to be no pyrexia, it was determined not to aspirate immediately, but to try tonic treatment and wait. The iodide of iron and cinchona were ordered, and full diet was given.

July 10 Does not sleep well, but takes food well. Whole circumference of chest just below the nipple 22½ inches left side 11¾ inches. Dulness absolute all over left side. Inferior intercostal spaces obliterated. At apex behind tubular breathing and sharp crepitations. In front absence of breathing all over. Impaired resonance extends to right nipple line in mammary region. Dulness extends to right border of sternum, impaired resonance one inch beyond. Lower dulness one inch below costal border in mammary line; edge of spleen indistinctly felt on left side.

July 16 It was now noticed that the temperature had risen the last two evenings to 102°. It was therefore determined to aspirate, and three ounces of pus were removed. The pus was thick and curdy, and did not flow easily.

July 17 As it was supposed that a considerable quantity of pus still remained in the pleura, aspiration was again performed, and ten ounces of pus were removed.

July 20 The temperature has been sinking since last aspiration. When lying on his back, there is a tympanitic resonance all over the front of the left side of the chest, extending to left border of sternum, and laterally to left border of axilla, and covering the cardiac region.

When he sits up dulness extends as high as the second rib. When he lies on his right side, tympanitic resonance extends back over the whole axillary region, though in less degree. When lying on his face, a certain degree of resonance extends to vertebral column, in upper part of chest; but below the middle of scapula dulness remains. Resonance in former region persists when he sits up. Breath sounds are here distinctly audible with much crepitation. At apex of lung breathing tubular, voice bronchophonic, crepitation moist and abundant. On the lower part of the left chest breath sounds still audible and tubular, and in character diminished in intensity. Voice increased in clearness, diminished in intensity. Little or no breath sound audible below the angle of scapula. Very little breath sound audible over tympanitic area. Impulse felt to the left of lower end of sternum, and cardiac sounds not distinct in this region. Vocal fremitus distinctly felt over upper part of left chest behind, and rather increased, but cannot be distinctly felt anywhere else.

July 26 No absolute dulness at any part of left side of chest, more or less vesicular breathing can be heard throughout, most free at apex in front. In mammary region some crepitation heard, perhaps pleuritic?

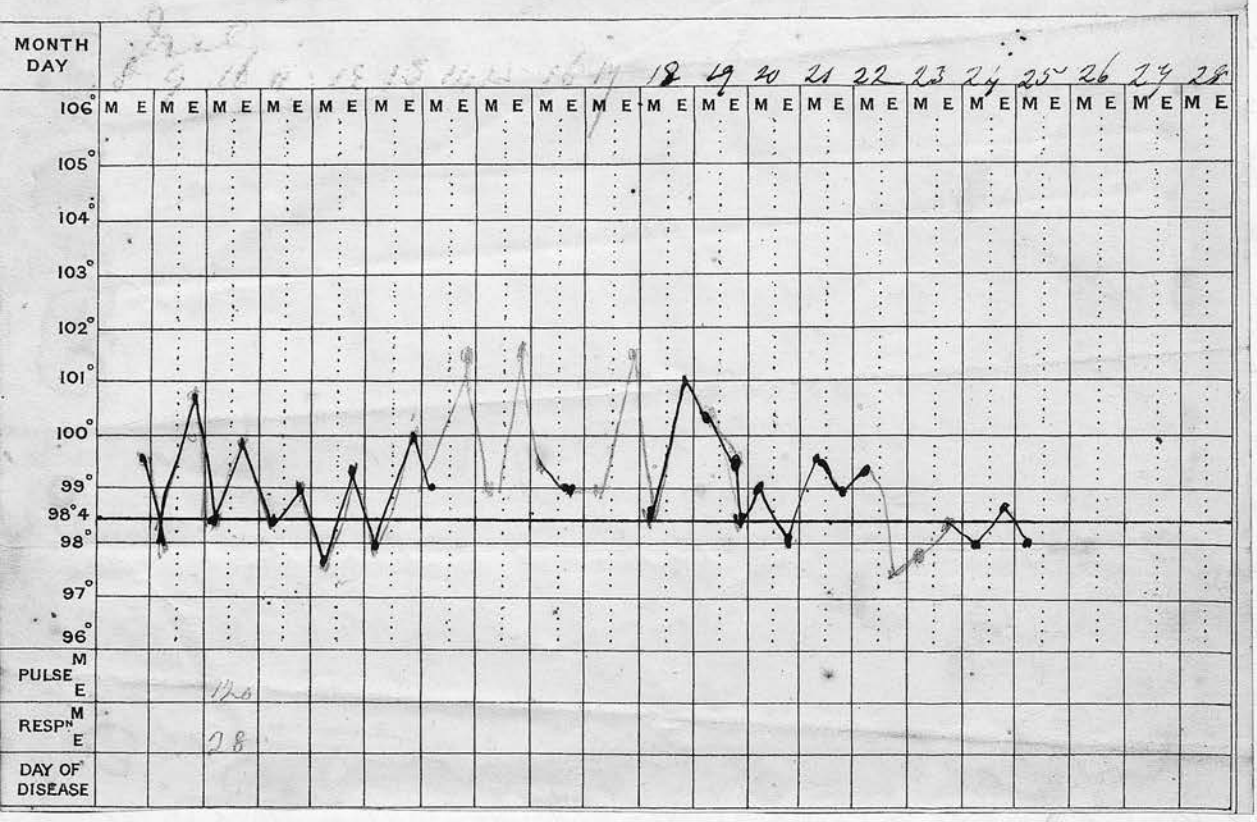
Intestinal resonance rises to within an inch of nipple. No dulness in splenic region. Circumference of chest just below nipple 22 inches left side 11 inches.

August 7 Continues to improve. Steel wine and cod-liver oil ordered. Other medicine discontinued.

From this time the boy steadily progressed, and the vesicular breathing became more and more distinct, although when I left him in the beginning of September it was not quite so distinct as that on the sound side. He was discharged cured on the 12th of September.

Remarks These cases are mainly of interest in showing the value of tapping, at any rate in children. In these cases, after two aspirations the pleural cavity was prac-

CASE James Wise CHART Nº



tically emptied, and the pus did not reaccumulate, and the children were discharged cured, except that the lungs of the affected sides had not completely regained their functions. Also in examining the temperature charts it is interesting to note the fall of temperature which took place after each aspiration. In both of these cases the patients were fairly well nourished and not emaciated or cachectic as in the other cases of empyema which are quoted.

IV Elizabeth Stanbrook

Elizabeth Stanbrook aged one year and six months was admitted to the hospital under care of Dr Turner on June 6th 1878. She had previously attended the hospital as an out-patient for three weeks, suffering from cough and emaciation. On inserting the hypodermic syringe into right plenral cavity pus was withdrawn. The whole of the right side of the chest was dull, and the breath sounds feeble. Aspiration was immediately performed, and nine ounces of inodorous pus were removed

The temperature was at this time normal.

June 8 Respiration audible over the whole of the right chest, but less free than in the left. Right side also expands, but very imperfectly. Measurement from sternum to spine through mamilla, on the right side 7 3/4 inches on the left 8 inches.

June 11 Intercostal spaces on right side of chest are flattened. Some tympanitic resonance at apex, in front and behind, and down along the spine.

June 19 There did not seem to be any reaccumulation of pus in the chest, but the general health of the child was so unsatisfactory, and she seemed so emaciated, that the prognosis was doubtful. It was resolved to have her weighed, and the series of weighings is appended.

August 7 At this time there was a little fresh cold, but it soon passed off.

August 22 Marked flattening of the right side under the nipple was now observed. Measurement (as before) right side 7 3/4 inches left 8 inches. General health improved weighing satisfactory.

On the 29th of August the patient was discharged. The resonance of the right lung was only slightly impaired at the base, and the breathing was nearly normal, though rather fainter than on the opposite side. The child attended as an out-patient for a few weeks longer, and continued to do very well.

V. Emmanuel Hicks

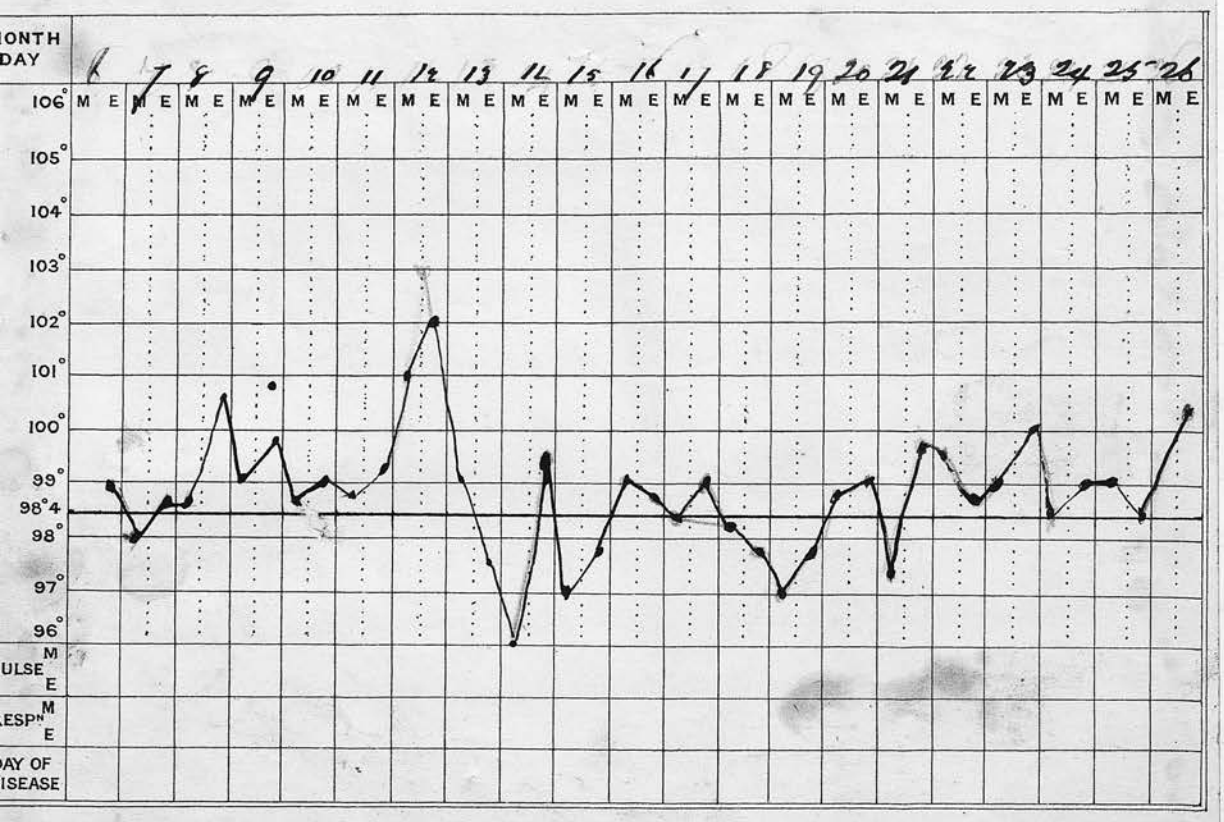
Emmanuel Hicks aged one year and four months was admitted on the 15th of July under the care of Dr. Turner. Patient suffers from a severe cough, loss of flesh, and vomiting. Temperature 101. On the right side of the chest, breathing indistinct and feeble. Percussion dull behind, but tympanitic in front.

July 16 Chest aspirated, and four and a half ounces of pus removed.

July 20 Breathing distinct all over right side, with crepitations. Temperature normal.

CASE Eliz Stanbrook

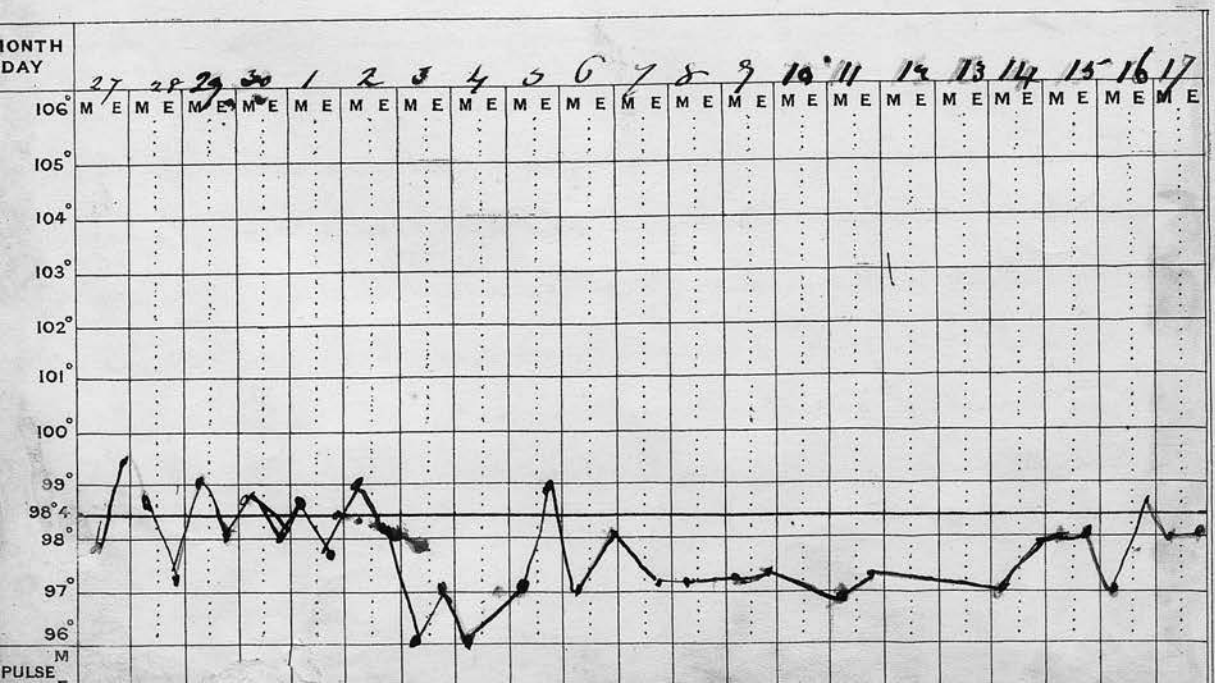
CHART Nº 1



DATE	June 19	14 ths
QUANTITY	June 27	14 lb.
APPEARANCE	July 2	15 1/2 lb.
SPEC: GRAV:	July 9	12 1/4 ths
REACTION	July 11	13 1/2 ths
ALBUMEN	July 15	12 3/4 ths
SUGAR	July 22	13 3/4 ths
BLOOD	July 29	13 3/4 ths
DEPOSITS, &c.	Aug 16th	15
	" 18	15 1/4
	26	15 3/4

CASE Elizabeth Stanbrook

CHART Nº 2



There was no return of pus, and the patient was discharged cured on the 29th of August.

Remarks These two cases are instances of empyema occurring in very young children, both being under two years old. Both of them were ill nourished delicate children. In both the pus was removed by one aspiration, and did not recur. In the first case we were for some time doubtful as to the prognosis, owing to the unhealthy condition of the child, though there was no more empyema; however she ultimately recovered, and did very well.

VI Ada Jones.

Ada Jones aged ten years admitted to the hospital May 28th 1878 under the care of Dr. Cayley. The child suffered from scarlatina two years ago, and was more or less ailing ever since. About three months ago she was attacked with a violent cough and spit, which had continued ever since. At the same time an ulcer appeared in the calf of the leg, a little below the knee. On admission patient was suffering from a most violent cough, with a profuse expectoration, which seemed to be purulent in nature, bringing up a porringer-ful in about fifteen minutes. This subsided to some extent in an hour or two. The child looked sallow and phthisical. The physical signs were – Right side of the chest greatly bulged forwards. Did not move on inspiration. Percussion note absolutely dull below mamilla, and more than comparatively above it on the front, and the lower half is more than comparatively dull behind. Vocal Fremitus absent: breath sounds very indistinct. On the Left side the percussion note was normal; breath sounds distinct, rather exaggerated The breathing was mainly diaphragmatic. The left knee joint was swollen, and a little below it in the calf of the leg there was an ulcer. A probe was passed upwards, but did not go very far; probably it did not enter the cavity of the joint. Below the ulcer was a sinus, through which the probe passed for some distance The temperature was 100°F.

The case at this time was thought to be probably phthisis
The Treatment consisted of codliver oil, and also tincture of steel drops and quinine with a cough mixture.

July 11 During this time the patient was troubled with a severe cough, and frequent expectoration of purulent sputa. This varied very much, some days being very copious, and the quantity at other times being very small. The left leg tending to become drawn up a light weight was attached. A fresh ulcer had broken out lower down in the calf of the leg, and a sinus about five inches long communicated between it and the old one. The discharge was at one time offensive, but now sweetened by means of charcoal poultices. The physical signs were now as follows — Right side of the chest is obviously bulged. It contrasts markedly with the left. Movements in right side very slight. Absolute dulness from right clavicle to liver dulness. Vocal fremitus less marked under right than left clavicle, and absent lower down on right side. Heart's impulse visible over 2nd to 5th left spaces, apex beat in 5th space half an inch interior to nipple line. Posteriorly there is absolute dulness from the angle of the right scapula downwards, impaired resonance over the scapula. Breath sounds almost inaudible over the right side. It was now suspected that the child was suffering from empyema, and an exploratory puncture with a hypodermic syringe revealed the presence of pus in the right side. An aspiration was performed, and eight ounces of creamy inodorous pus were removed.

July 12. Child appeared considerably relieved by the aspiration.

July 17 Has frequent paroxysmal attacks of coughing, lasting several minutes, almost pure pus expectorated. Absolute dulness from right clavicle downwards High pitched bronchial almost cavernous breathing

Posteriorly absolute dulness from mid-scapular region. Chloroform was administered, and paracentesis performed in the infra axillary region in the fifth interspace. Twelve ounces of creamy inodorous pus were removed. Towards the end of the operation only air seemed to enter. Right side now tympanitic on percussion. Breath sounds normal, the cavernous breathing having disappeared.

July 21 Five ounces of pus removed by aspiration

July 25 Patient better till today, when she had another bad fit of coughing, and spat much pus. Ten ounces of pus removed by aspiration under chloroform.

July 26 Considerable purulent expectoration Right side moves very little with the breathing. Heart's impulse felt most distinctly in 6th interspace, $1\frac{3}{4}$ inches below and $\frac{1}{2}$ an inch to the left of the nipple. Dulness under clavicle not quite absolute, and at right back, the resonance is fairly good almost to base. Breath sounds fairly heard over the right back. Bulging of right side is very marked from the fourth rib downwards, breathing almost suppressed below this rib.

July 30 A free incision made with antiseptic precautions in the right chest, in the fifth space, an inch and a half outside sternum. Another made in the fourth space. No pus escaped with the first incision, but a considerable quantity of air in bubbles at each inspiration. A large cavity appeared. Probe seemed to pass upwards and outwards. The counter opening in the axilla made by cutting down upon the probe, and soon blood-stained pus escaped. A drainage tube was passed between the two openings.

August 2 Cough and expectoration have been much less since the incision. Free discharge from the wounds Appetite good.

August 10 Since the free incision temperature has been much reduced, and there has been no cough.

August 13 Discharge is rather copious, and is inodorous, though the antiseptic dressings have been removed. The drainage tube is continued, but the discharge does not escape freely unless patient leans forward, arising from portion of apertures. Margins of each wound covered by granulations. Cough is much less, and expectoration very slight. There is a tympanitic resonance near the area of incision, and high pitched metallic râles nearly as high as the clavicle. There is certainly less bulging of the chest wall. Temperature since incision has only been normal. The former medicines were now discontinued, and one drachm of codliver oil mixture with half a drachm of syrup of the iodide of iron were given twice a day.

Shortly after I left the hospital (September 4th) another opening was made in the back, the position being more convenient. From that time until the present as I have found by enquiry, she has remained much in statu quo. The discharge has varied greatly sometimes almost none, at other times a good deal. The wound is now dressed once in two days. The cavity though still extending to a great depth appears to have contracted considerably laterally. The temperature chart shows little of interest, here and there an exacerbation, but in the main varying but little from the normal.

Remarks This case is interesting as an of empyæma accompanied by a more than usual degree of pallor and cachexia, phthisis possibly coexisting. In this instance the pus had no doubt formed an opening through the lung into the bronchial tubes, and a portion of it was periodically discharged through them, by a violent cough accompanied by much distress. The collection of pus however was not got rid of in this way, but still continued

fresh pus being no doubt secreted. After a time when the presence of pus was definitely ascertained by the introduction of a hypodermic syringe, aspiration was resorted to. However the cavity rapidly refilled, so that after foure successive aspirations, there still seemed to be plenty of pus in the cavity. It is interesting however to note the effect of each aspiration upon the temperature. The first, third, and fourth aspirations were each succeeded by a temporary though only transient fall of temperature. The effect however was not so marked in this case as in some others, owing probably partly to the large quantity of pus present, of which perhaps a good deal was left behind, and partly to the fresh secretion which was continually going on. But when a free incision was made, and a drainage tube introduced, the result was most striking. For a period of fifteen days, notwithstanding the irritation which such a wound would be likely to produce the temperature remained nearly normal, and never once rose to 100°, and when a rise did occur at the end of that time it was only temporary. The removal of the drainage tube on the 28th of August, as secretion of pus still unfortunately continued, effected a fresh rise of temperature, which lasted a short time. Since I left I am told the temperature has remained nearly normal. (The temperature charts are annexed to the following pages)

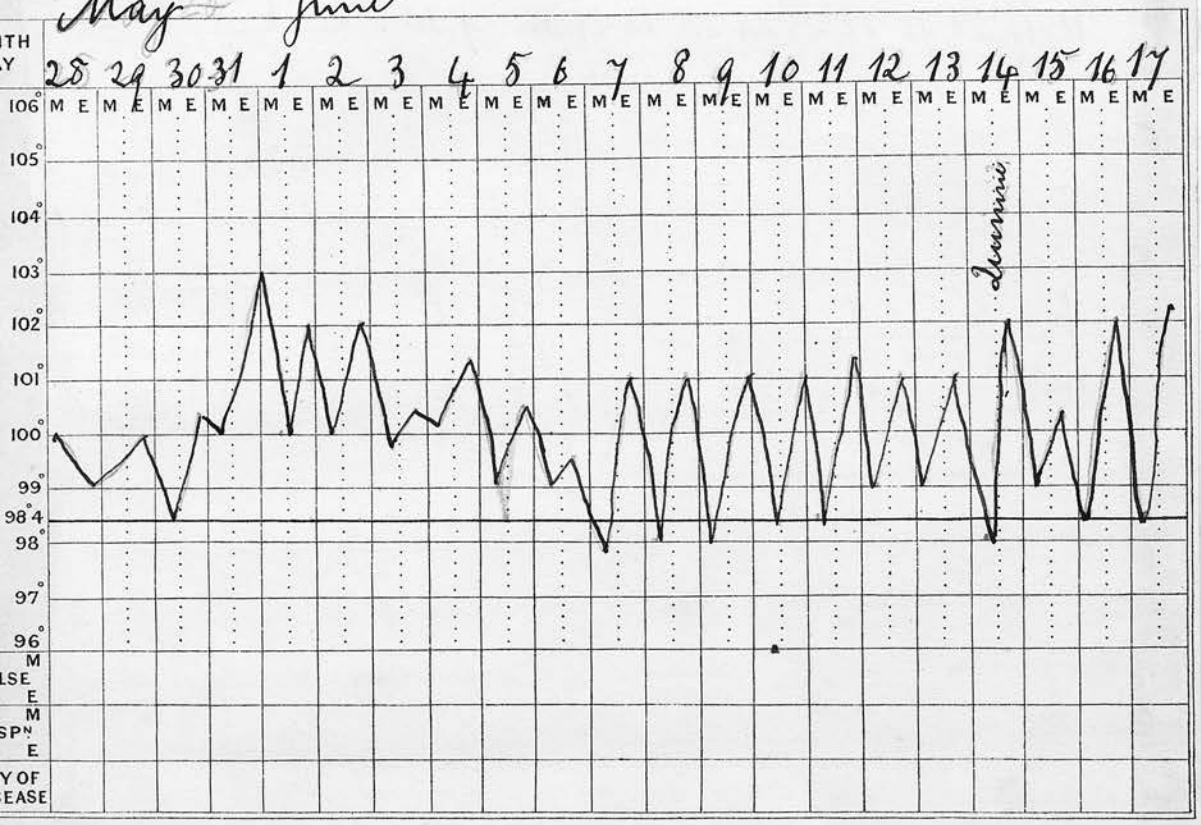
General Remarks

The first striking point to be observed in these cases is the effect which the presence of pus in the pleural cavity exerts upon the temperature. These cases all show what a disturbing effect it has, and how it continually prevents the temperature from remaining for any time normal. We also see how the removal of pus by aspiration almost invariably causes a fall of temperature, which in all the cases related except one was permanent. In one instance the case of Ada Jones, when fresh pus

CASE

Ada Jones

CHART Nº 1

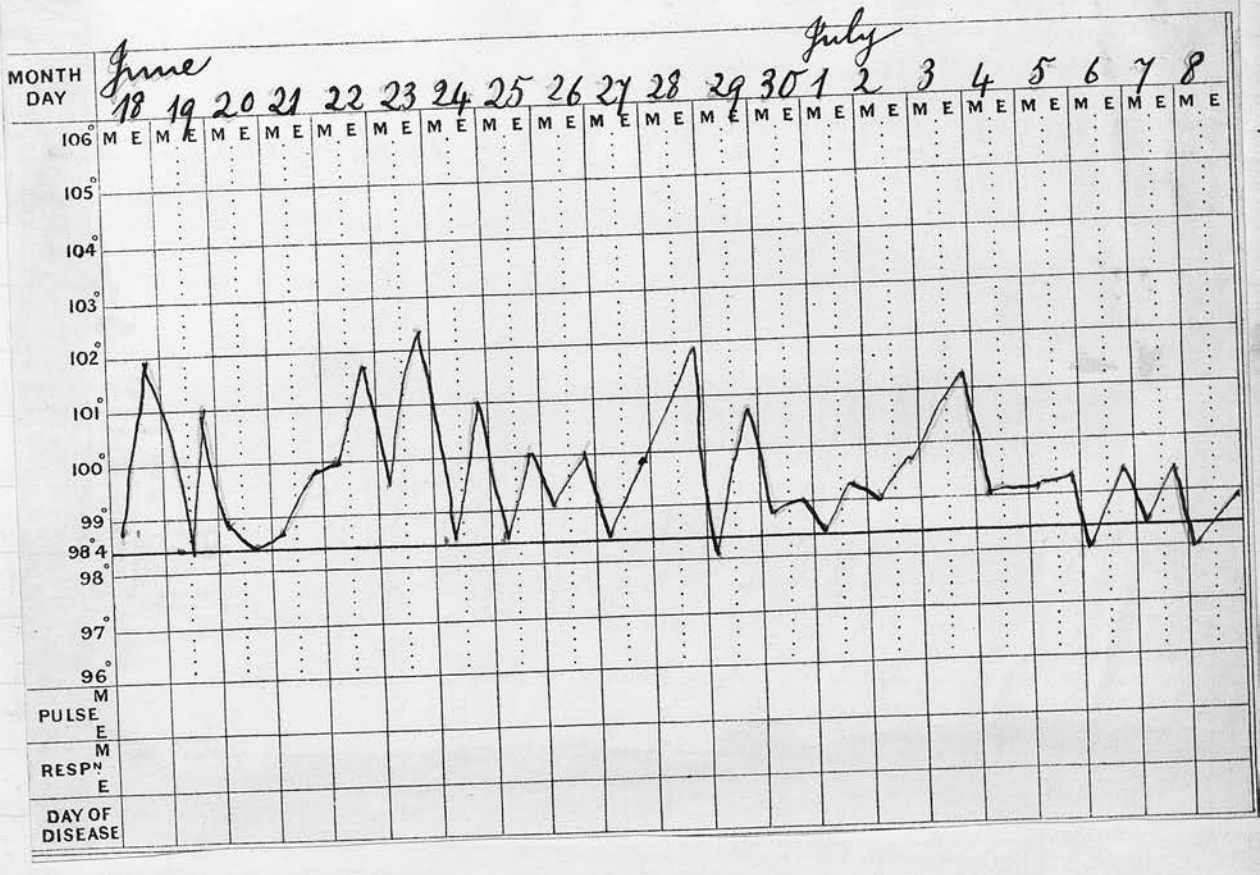


DATE		
QUANTITY	June 16	44½ lb
APPEARANCE	" 18	44¼
SPEC: GRAV:	" 25	45
REACTION	July 1	43½
ALBUMEN	" 16	44
SUGAR	" 23	43
BLOOD	" 30	43
DEPOSITS &C.	Aug 26	43

was constantly secreted, and where the effect of aspiration was only transient, when a free incision was made and a drainage tube introduced, the temperature continued nearly normal during the whole time that the drainage tube remained in, with one shot exception, and when we consider the cachectic condition of the girl, and the likelihood of some irritation occuring about the wound that cannot be wondered at. Then secondly we must observe that in all these cases except two, the general condition of

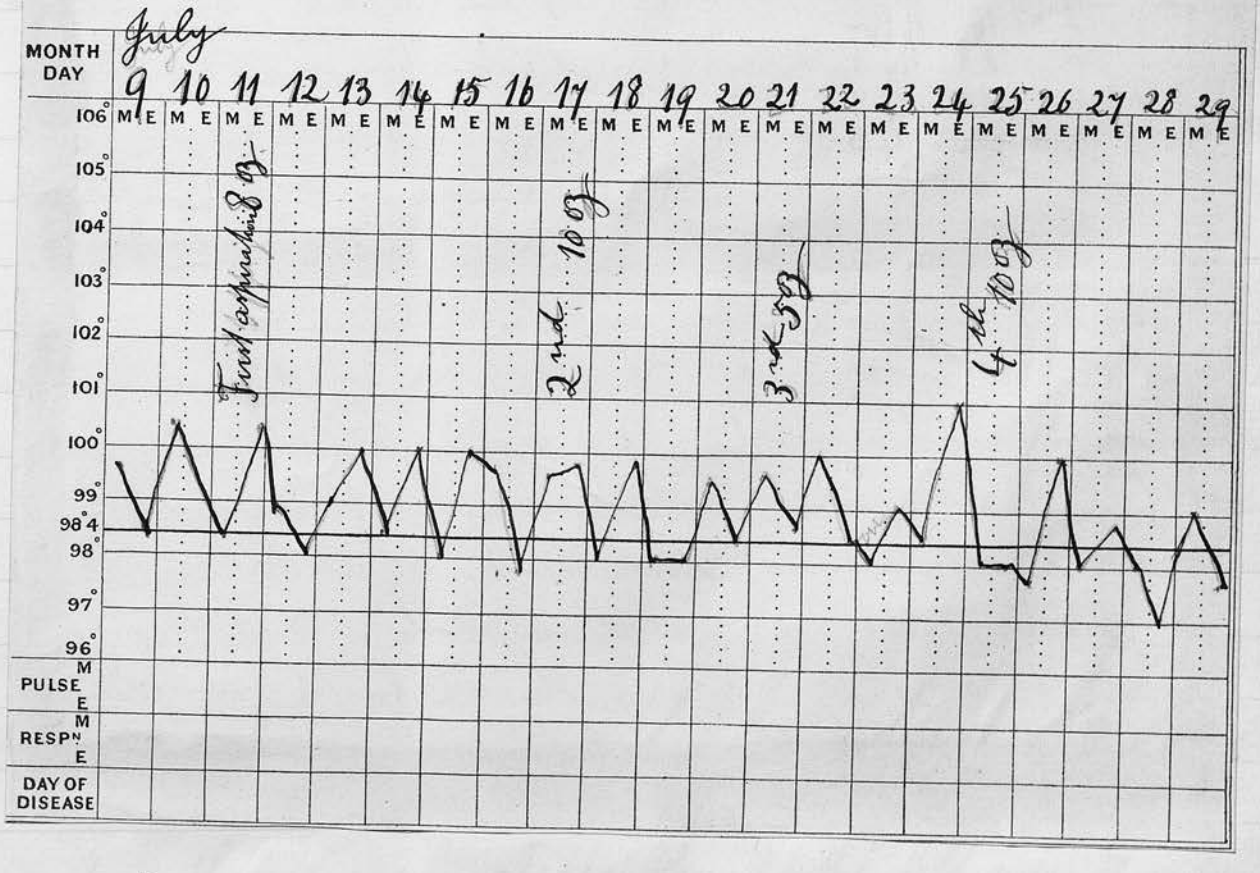
CASE Ada Jones

CHART No 2



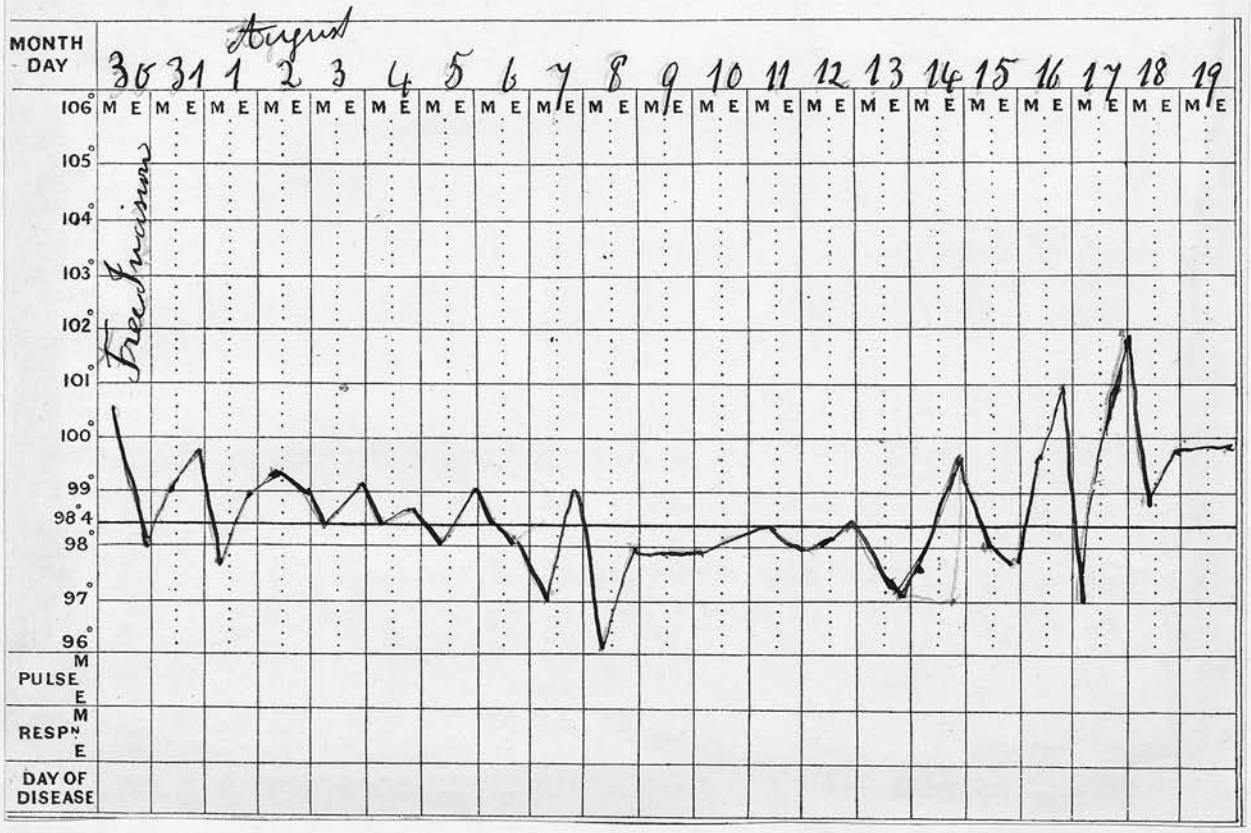
CASE Ada Jones

CHART No 3



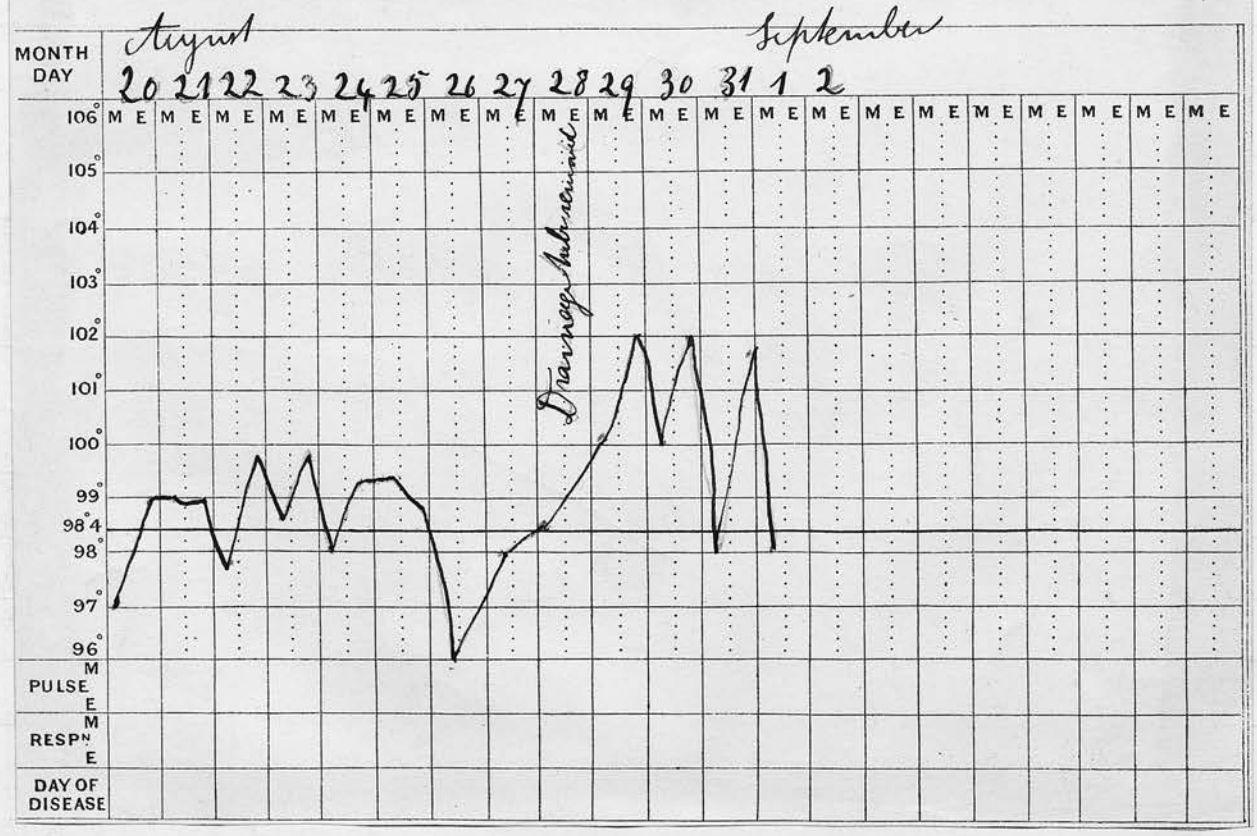
CASE Jones Ada

CHART No 4



CASE Jones

CHART No 5



the patients was markedly unhealthy. What inferences can we draw from these facts? Taking the general unhealthy condition of those suffering from empyæma, shall we not suppose that the essential though not perhaps exciting cause is in most instances some morbid condition of the system? Then when we observe the irritating effects upon the body produced by an continuance of pus in the pleural cavity, as shown by the temperature chart, I think we may imagine that the suppuration is due to some effort of nature to throw off this morbid condition, and that inflammation which would in a healthy condition result in the exudation of lymph and effusion of serum now terminates in suppuration. So that if this is so the empyæma is the local expression of a general morbid condition of the system. If this be so the pus thus formed would be highly injurious to the system, and as it does not find exit, a certain portion of it is always liable to be reabsorbed, which readily accounts for the disturbances of temperature. The presence of a blood poison or form of septicæmia was strongly pointed out in the case of James Burgham; and although we have not such positive evidence in the other cases, yet considering the circumstances which have just been alluded to, I think we may suppose that some poison or morbid condition of the blood existed in them also, though perhaps not of exactly the same species, and not so intense in degree. In the case of Ada Jones it was probably some morbid condition left by the scarlatina.

The treatment indicated by these cases is to remove the pus as quickly as we can. This should be done in the first instance by aspiration. It is well to dip the needle or trocar and canula in carbolic oil so as to avoid introducing causes of putrefaction. The trocar should be introduced at the most dependent part of the collection of pus that is easily accessible. At the left side it is best to introduce it when we can at the back, so as not to

wound the heart or pericardium. We should avoid the borders of the ribs, so as not to wound the intercostal arteries. Probably the best position is generally between the eighth and ninth true ribs. When we begin to exhaust it is doubtful whether we should completely exhaust the pleura, as if we do the vacuum will probably be filled with air. On withdrawing the canula it is well to place one's finger on the opening as it slips out, and then to place a little cotton wool on it, fastened down by strips of adhesive plaster, to prevent the entrance of air. It is thought by some that simple aspiration is of little use in empyema. However this may be with adults it is very frequently successful in children, especially if repeated once or twice. In five of the above cases it was tried, and in only one was it unsuccessful. Supposing that after three or four aspirations pus is still present, it is well to make a free incision, and introduce a drainage tube. It is best to make two incisions, one of which shall be in as dependent a position as possible, and pass a drainage tube between them. Having made one incision introduce a pretty long probe into the cavity. This will give some idea of the size of it. Then press the end of the probe between the ribs, where you wish to make the second incision, and cut down upon it. Pass a piece of waxed silk or catgut through the eye of the probe, and tie it to a drainage tube perforated at frequent intervals. Then by means of the probe you draw the drainage tube through the openings so that one end of the tube comes out at one opening, and the other at the other. Then tie the two ends together. The cavity can be frequently washed out if necessary with carbolic or other antiseptic lotion. The openings will probably have to be kept open for a considerable time, till the cavity contracts, and becomes obliterated, or at any rate till the mem-

brane ceases completely to secrete fresh pus. This method was recommended first by Dr. Goodfellow and Mrs. Campbell De Morgan. It was adopted in the case of Ada Jones. The patient should be kept on liberal diet, with perhaps a little wine. Tonic medicines should be given as steel, quinine, and codliver oil. If the cough be troublesome a mixture may be given to allay the irritation, as one consisting of tincture of hyoscyamus, spirits of chloroform, syrup of squills, and water.

B. Suppuration in the Peritoneum

Suppuration not infequently takes place in a slight degree in the course of acute peritonitis, the peritoneum being bathed with pus. Sometimes the quantity of pus is greater and it may form a localized abscess, but it is rare that extensive suppuration follows acute peritonitis. Suppuration as the result of chronic peritonitis is also not very common, but if it does occur it may be more extensive than in the former case. The diagnosis is not easy. In the first place the presence of pus so as extensively to dilate the abdominal cavity is rare, and so when we find by physical signs that a large quantity of fluid is present, we do not suspect pus. Then it would not be quite safe to introduce a syringe as in the pleural cavity, as by so doing we should run the risk of wounding the abdominal viscera. When any considerable quantity of pus is present in the peritoneal cavity, the prognosis is not very favourable, but the best thing is for the pus to escape externally, through the umbilicus or through some other part of the abdominal wall. Sometimes an opening is made into the intestines allowing the pus to escape per anum. This is much more unfavourable to the patient than an external escape. Rokitansky has pointed out that occasionally it escapes both externally and into the intestines as well, so that a fistulous opening into the bowel is thus established. As regards treatment supposing we were satisfied of the presence of pus, and that it was present in considerable amount and had not already escaped, it would

be well to resort to paracentesis abdominis, but we could not do this unless a large quantity of pus were present. Tonic treatment should be resorted to as in empyema. In acute peritonitis the presence of a small quantity of pus is a circumstance which cannot be determined during life and does not affect the treatment, which consists of opium and sedative remedies to keep down the inflammation. The causes of suppuration in the peritoneum except acute peritonitis, are generally similar to those of empyema, an unhealthy condition of the body generally is the great predisposing cause. I will now relate two cases one of slight suppuration with acute peritonitis, the other of chronic suppuration in the peritoneum, in which the pus escaped externally.

I Sarah Baggot

Sarah Baggot aged ten years was admitted under the care of Dr. Armand-Semple May 11 1878. Patient was said to have been perfectly well, till the evening before admission, when she was seized with a violent attack of vomiting and purging, the vomited matter being green, together with considerable abdominal pain. On examination patient appeared very feverish, lips dry and parched, tongue furred, and considerable tenderness on pressure over the abdomen. Temperature 103° pulse 120.

May 13 Patient restless at night, complains of great abdominal pain, constantly vomiting greenish matter, bowels open once in twenty-four hours, motions loose but of a natural colour, tongue thickly furred, patient seems in great distress. Respiration 42 per minute Temperature has fallen to 99·5.

May 14 Patient continues to vomit persistently. Suffers from retention of urine, bladder relieved by catheter, greatly distressed, appears in a moribund condition. Temperature 104°.

May 15 Patient died.

A post-mortem examination revealed the presence of acute inflammation of the peritoneum, with the presence of a slight quantity of pus in the peritoneal cavity.

The treatment in this case consisted in placing the patient upon a milk diet, and in the administration at first of small doses of rhubarb and bicarbonate of soda; for this bismuth and opium were soon substituted, but the patient being unable to retain anything given by the mouth these were also discontinued, and nutritive enemata consisting of beef tea and brandy were given from time to time.

This case was published along with some cases of gastric irritation in the Medical Examiner June 27 1878. It is given as a case of acute idiopathic peritonitis in a child, which was accompanied by a slight degree of suppuration, and which ran on to a fatal termination unrelieved by treatment.

II Martha Richardson

Martha Richardson aged four years and a half was admitted to the hospital on May 13 1878 under care of Dr. Turner. She had been ailing for six weeks, and suffered from diarrhea; but no blood in the motions. The abdomen was much swelled ten days ago, after which there was a discharge from the umbilicus, and it sank. The child was strumous and ill-nourished. Temperature 101.

May 16 Yesterday evening the child suffered from pain and diarrhea, and this morning about three ounces of pus escaped from the umbilicus. Child removed today by parents.

June 24 Child brought back. During absence two large abscesses had appeared, one on each side of the abdomen about two inches distant from the umbilicus, and had burst leaving ulcers. The discharge now comes from three places, from the umbilicus, and from the two ulcers as well. The child seems very low, and takes no notice of anything. Appears to be sinking. There is a peculiar rash over the body,

papular on the back and vesicular on the arms and legs. The fluid contained is alkaline. There are one or two pustules. Temperature 101°.

July 1. Child seems better. Diarrhea gone. Sign of abdomen diminished. Rash is fading. There seemed to be a conical swelling round the umbilicus, which was tympanitic on percussion. An attempt was made to pass a probe through the peritoneal cavity, between the two ulcers, but it was desisted from owing to the pain which it caused.

July 18 Discharge very slight.

From this time the discharge continued to diminish and by degrees the three openings healed up, and the patient was discharged cured on the 12th of September.

Remarks This is a case which from the large quantity of pus discharged was almost certainly an instance of suppuration in the cavity of the peritoneum, in which a large quantity of pus was probably present. This is confirmed by the fact that the percussion note between the umbilicus and the two ulcers was quite tympanitic. Here the child was apparently very near death, but when the pus had freely escaped the child gradually got better the openings healed up, and the child was discharged quite well, better probably than when she entered the hospital. Here the pus being eliminative had probably on the whole a beneficial effect, though while it remained it was injurious.

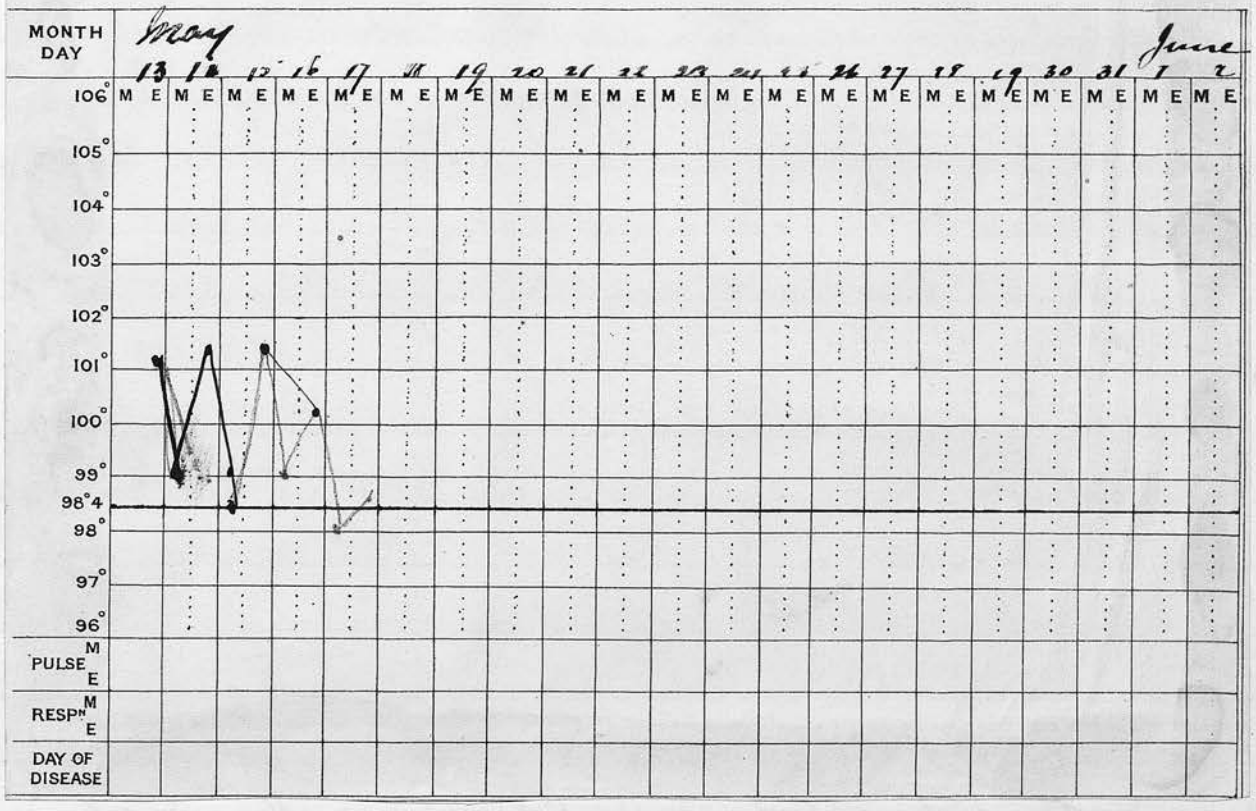
(The treatment consisted in this case of half a drachm of Parish's syrup three times a day.)

Reference to the chart shows that the temperature in this case never rose beyond 101, but when the child was first seen the discharge had commenced, and so partial relief would be produced. After the second admission when the two fresh openings had just formed and the discharge became very free the temperature was speedily reduced, and this coincided with the general improvement.

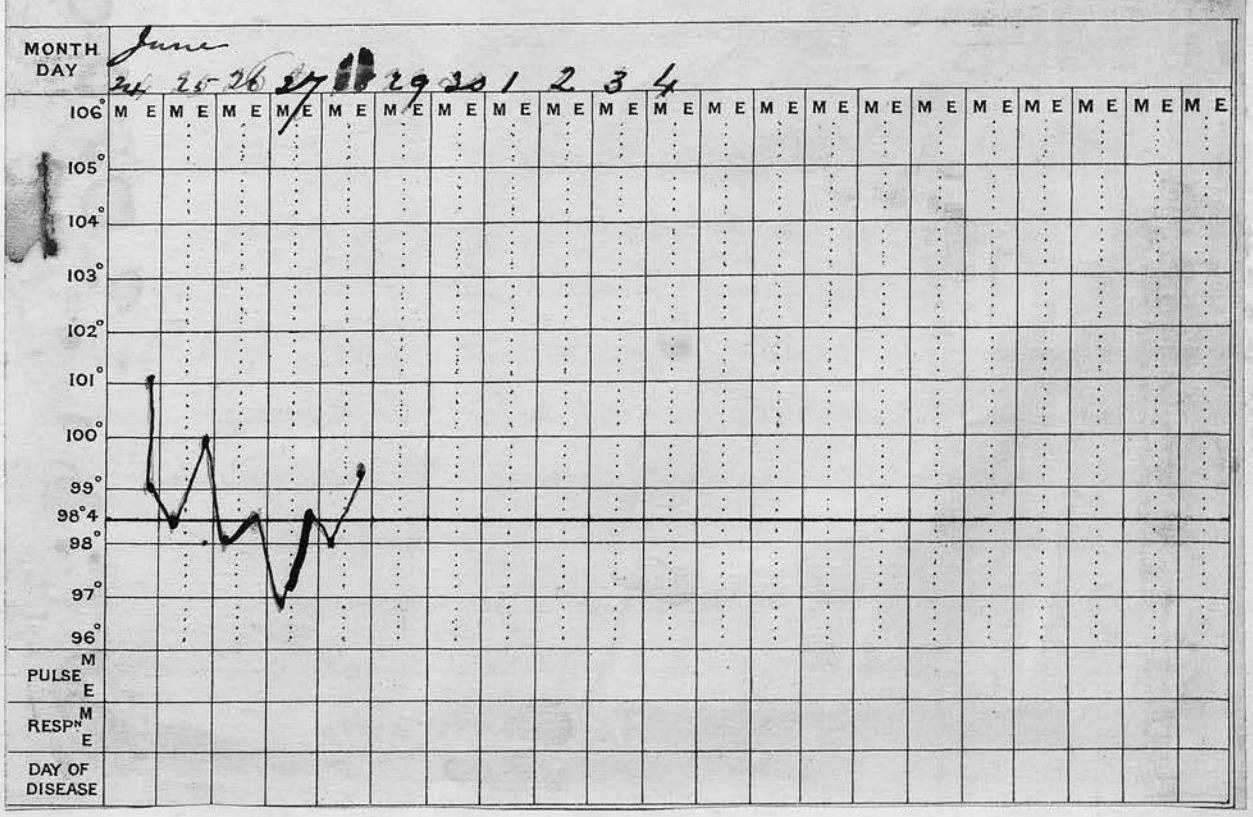
C. Suppuration in the Pericardium

Suppuration in the pericardium is rare. When

CASE Martha Richardson CHART No. 1



CASE Martha Richardson CHART No.



it occurs it is usually in old standing cases of pericarditis with effusion, where the serum has become purulent, though many people suppose that cases do occur, especially in connection with pyæmia, which are purulent from the first. The physical signs are the same as in ordinary pericarditis with effusion, and it cannot be diagnosed from this, except as far as it may be suspected from the general condition of the patient. The prognosis is very unfavourable. Little can be done by way of treatment. It would probably be well to resort to tonics as in most cases of suppuration in the pleura and peritoneum

D Suppuration in the Arachnoid Cavity

Suppuration in the arachnoid cavity in the cranium is extremely rare, but has been known to occur as a result of meningitis. A case which occurred at St. Mary's Hospital is related by Dr. Sieveking (Jones and Sieveking's Pathological Anatomy, second edition page 238). Here there had been obstinate cephalic symptoms had been noticed, otorrhœa, and [illegible] when unexpected coma came on and the patient died in thirty six hours. No connection between this and the otorrhœa was traced after death. Two yellow patches appeared on each parietal surface of the brain, which proved to be caused by accumulation of pus. The diagnosis of this condition could not be made out satisfactorily during life. The prognosis is very unfavourable. No treatment would be likely to be of much avail.

Suppuration may occur in the arachnoid cavity of the spine as a result of spinal meningitis, though not often. Here as in ordinary cases of spinal meningitis the prognosis is bad. The treatment must be directed to keep down the inflammation, and flying blisters on each side of the spine, and perhaps mercury or iodide of potassium inwardly, are probably the best.

E Suppuration in the Synovial Membranes

Suppuration in the synovial membranes may be divided into two kinds, firstly that caused by some local inflammation, and secondly that which results from some

direct and well-marked blood poison, such as pyæmia or erysipelas. In the first case there is usually severe pain in the joint and considerable distention of it, accompanied by a good deal of feverishness. Or it may occur in a more chronic form, with less pain and feverishness. The abscess will probably point at a particular part of the joint. The pus is in these cases mixed with synovial fluid, and is occasionally quite of a sea-green colour. The treatment frequently recommended is to allay the irritation for a day or two by means of poultices or hot fomentations, and then to make a puncture into the joint, and if pus escapes to lay it freely open, then afterwards to put the limb upon a splint, and aim at a cure by anchylosis. The practice of opening the joints however is rather a doubtful one. A case occurred in the N. E. Hospital under care of Mr. Tay, of a girl about nine years old, suffering from an abscess in the knee joint. Mr. Tay, saying that he had seen unfavourable results from opening such abscesses, but never from leaving them, resolved to wait The limb was accordingly placed in a M'Intyre splint, and warm fomentations and spongio-piline were applied to the joint. In this condition there was no pain or feverishness, and slowly the abscess pointed, and after several weeks it opened and discharged. Healing ointments were applied, and the limb still kept motionless in the splint. Gradually the openings began to contract, and the child was sent to Margate infirmary almost certain to make a good cure.

In the second case suppuration in the joint comes on with great rapidity as the direct result of some obvious blood poison, and is no doubt eliminative. In these cases it is best to open the joint freely, and confine the limb with a splint, and to adopt constitutional treatment suitable to the disease. In these cases the blood poison is evident, and I have tried to show that in ordinary cases of suppuration in other closed cavities, there is a morbid material in the blood, though perhaps not what we should ordinarily call a blood-poison, and not so evident as here.

Conclusion In concluding my thesis I will just

say, that as the practical effect of suppuration upon the human body is the most important part of this subject— the reasons why I have dwelt specially upon its occurrence in the closed cavities are — first because owing to the presence of the epithelium which lines them, which pus does not dissolve so readily as it does other tissues, the pus often remains there for a long time if not removed artificially, and gives us an opportunity of studying the effects of its presence, and secondly because I had met with several cases, which with their temperature charts might I thought serve to illustrate the subject, and show the disturbances which the presence of the pus was able to exert upon the system, as evidenced by the temperature, these disturbances ceasing when the pus was removed. The first result of the development of the cell theory was very naturally, to regard pus as harmless. The late Professor Hughes Bennet in his Text-Book on Physiology Vol I p 59 says "Thus pus — that fluid which surgeons formerly considered as a deposit or secretion foreign to the frame, irritating in its nature, and which ought therefore to be let out of the body as soon as possible — is like the blood, a bland living fluid, crowded with multitudes of compound animal existences, which are born, live, and die as man himself does." It was however soon seen that pus was to some extent irritating, and that its continued presence in the human body was injurious. I have tried to show that it is probably of use eliminative, it is certainly a fluid admirably adapted for elimination, but that in proportion as it is eliminative, it is injurious if retained in the system and liable to reabsorption, and that therefore supposing it is not likely to escape speedily of its own accord, the old surgeons were correct in letting it out as soon as possible.