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

A Thesis by D. E. 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 a yellow or whitish yellow fluid of about the consistency 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 homogenous. Its specific gravity is 1.030 - 1.035. 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 microscopic examination, it is found to consist of a number of globules floating in a 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 2.500 to 3.000 of an inch in diameter, and resembling 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 corpuscles.
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 particle nucleus." If the acid dissolves the cell wall is completely dissolved. On the addition of caustic potash pus is converted into aropy 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 urine deposits. Pus is not altered by blood, urine, mucus or saliva.

The reaction of pus is of 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 discharges. Slight found 12.8 per cent of solids in a Jaundice albumin just opened, and only 4 per cent in the discharge a few days afterwards. On an average they form 10 to 15 per cent, and when burnt leave an ash of 5 to 6 per cent, consisting principally of chloride of sodium, with
as slight intermixture of other sodium salts, potash salts, and phosphates.

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

<table>
<thead>
<tr>
<th></th>
<th>Water</th>
<th>Total albumen</th>
<th>Ammonium</th>
<th>Ammonia</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>84.4</td>
<td>852.2</td>
<td>897.4</td>
<td></td>
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<tr>
<td>Fatty matter</td>
<td>17.5</td>
<td>28.8</td>
<td>26.5</td>
<td></td>
</tr>
<tr>
<td>Cholesterol</td>
<td>5.4</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mucus</td>
<td>11.2</td>
<td>6.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albumen</td>
<td>68.5</td>
<td>63.7</td>
<td>83.6</td>
<td></td>
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<tr>
<td>Lactate, carbonate</td>
<td></td>
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<tr>
<td>Sulphate, phosphate</td>
<td>9.7</td>
<td>13.5</td>
<td>8.9</td>
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<tr>
<td>of soda, potash, lime</td>
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<tr>
<td>Iron</td>
<td></td>
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<tr>
<td>Loss</td>
<td>3.3</td>
<td>2.7</td>
<td>1.6</td>
<td></td>
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</tbody>
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The following analysis of the specimens is given by von Bibra.

<table>
<thead>
<tr>
<th></th>
<th>Water</th>
<th>Albumen</th>
<th>Extract matter</th>
<th>Cholesterol and fat</th>
<th>Salts</th>
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<tr>
<td>I</td>
<td>90.7</td>
<td>812.7</td>
<td>76.7</td>
<td>24.9</td>
<td>9</td>
</tr>
<tr>
<td>II</td>
<td>63</td>
<td>91</td>
<td>180</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>20</td>
<td>29</td>
<td>19</td>
<td>12</td>
<td>9</td>
</tr>
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</table>

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. Protopon may be obtained by rubbing the corpuscles with quinine 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 microbe. The substance
however which directly gives rise to this blue colour, can be obtained by digesting 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 resembles the serum of the blood. Like the latter it coagulates at 75°, showing the presence of albumen; it also contains paralbumen and albuminate of potash which is identical with casein), and according to Hops, myom.

Varieties of pus.

There are many unhealthy varieties of pus, which are comprised by Hochstadius under the term sanies. These are usually thinner than ordinary pus, and much more irritating.

In a microscopic examination the corpuscles are found to be small, as if shrunken 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 casious degeneration. This however is not pus in the true sense at all, as it contains no pus corpuscles but merely a debris of glandular tissue and fatty granules. A similar puriform fluid is produced in other cases, when cavitations soften and break down without forming true pus.

Formation 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 de-
scription 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, swel-
lings, 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 coagulation, which the brisk red deposit of mucus that
occurs in the urine after many acute inflammations was
the result, and also the series of changes which take place
in the mucus 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 supposed inflamma-
tion to be produced by an abnormal influx of blood to the
part, erysipelas by a like influx of bile, oedema of serum,
and stasis (any hard swelling) of black bile. He gives
as a proof that inflammation is produced by an influx
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
influx of blood, but modern pathology regards this not
as a cause but as an effect. The doctrices 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 accinous matter in the serum of the blood, which latter is the usual matter of phlegm 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 coition by the importation of Peruvian bark, and it was perceived that inflammation might subside without any apparent evacuation of morbid 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 "consious of the danger produced by the generation of humours in the blood sets up a fermentation, which ends in the thorough desquamation of morbid matter." Van Helmont assumes more strongly the separate entity of this agent, which he calls the Archetius, 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 Spirit." It was the middle of the 17th century when the doctrine of the circulation of the blood and the physical nature of the latter was generally understood; a school arose founded by Boerhaave, called the inchoo-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. Boerhaave, 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 animus or immortal soul, which he thought presided over the body. Thus these two philosophes 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 Bullow taught and developed in the middle of the 18th century. Boden in the 18th century speaks of blood being drawn into 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 microscope was brought to bear upon the phenomena of inflammation. Fäbri 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 partial natural 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 some 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 Macarthy 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 Macarthy added to the few cardinal symptoms of inflammation a fifth, which has since been generally recognized viz. "functio lenta" 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 Schleider 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. It is 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 modern view, 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 "blasta". Bennet held that inflammation was simply an intensification of the ordinary nutritive process, that the exudation of the blasta (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 neighborhood 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 blood vessels were present; and it was
Thus seen to be quite possible that the changes in vascular tissues might be due not so much to the inward exudation of liquor sanguineus, as to the action of the tissues themselves. This theory was called Interstitial. In opposition to the former which was called Intermural.

In the year 1853, Professor Liston in his valuable paper "On the Early Stages of Inflammation" drew attention to three points. 1. 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. 2. 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. 3. He confirmed so much of Dr. Williams' observation as to find that the white corpuscles stuck fast to the walls of inflamed vessels, though he did not see them pass through the walls. In the same year 1853 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 concretion of tissue corpuscles, and that the vascular phenomena were entirely secondary. He held that what was commonly spoken of as inflammation exudation really arose from the multiplication of these corpuscles, not from an exudation from the vessels, and that even the fibrous 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 this increased activity an unusual amount of liquor sanguineus was supplied to them.

In 1865 Dr. Learle 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 Jahnkein (Über Entzündung und Eiterung, Archiv für Chirurgie) made a much larger breach in Virchow's doctrines. He observed that in keratosis the habitus 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 blood vessels. 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 keratosis, 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 last 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
realized emigrated white corpuscles, with which in form they are identical. In 1869 Voniss and Sticker 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 motility. 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 past. About the same time Dr. Ryndak 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 a 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 re-injected 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 Shickel and Ryneck were published in the "Thudier 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 fibrin (hyperthrombus), 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 minor 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 whenever 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 gonorrhoea there was an ulcer in the urethra. In 1752 however, De Baer, 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 envisaged that pus was produced by the vessels, by a process analogous 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 blood vessels 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 extravascular 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 an ordinary nutritive, 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 Bernet. 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 take place 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 exudative cells, in which case inflammation softening of the part affected occurred. Secondly, it might produce plastic cells mixed with organized 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. Bernet thought that these were three factors which determined what the exudation should become. 1st There is the nature of the surrounding tissue, for if any exudation became organized it assumes the character of the surrounding tissue. 2nd The vitality 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 formed and 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 it into pus. Sir James Paget divided the lymph which is thrown off in inflammation into two classes, fibrinous and corpuscular. In the fibrinous form lymph conglutinates 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. Tinchow in his "Cellular Pathology" maintained that pus corpuscles were invariably produced by the multiplication and division of pre-existing cells. He held at first that the
Processes of inflammation and suppuration resided entirely in the connective tissue. He held that the connective tissue capsules enlarged, that their nuclei multiplied and divided, and that finally each capsule separated into a number of fresh ones, which were new pus capsules and together formed a collection of pus. He held at first, that when suppuration appeared on mucous membranes the pus capsules 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 capsules 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 capsules. The new 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 germinial 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 resemblance, that they both when living possess ameboid movements. When Shicer 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 capsules or epithelial cells, as Virchow supposed. Hence after
ando saw a white corpuscle actually divide on the stage of the microscope, thus showing a third mode of production of pus corpuscles, or at least 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—It is one of the terminations of inflammation, and is intermediate between resolution, or organization of the exudate, on the one hand, and suppuration, 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 neuromyelium, a glandular secreting cell) 3rd From the multiplication of existing pus cells.

The liquid pus is probably derived in connective tissue from the breaking down of the non cellular elements, and in 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 occurring on epithelial surfaces there is usually no destruction of tissue, or abrasion of surface, unless the upper layers of the epithelium are so retracted as to opes the free escape of the newly formed liquid. Thus in suppurating pus to be formed by a dissolution of the solids of the body, the early theorist 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 actual 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 protuberances are continually put forth and again withdrawn. These are called amoeboid movements from their occurrence in the ameba of the amoebce. 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 bone which occurs so frequently in suppuration, but always be supposed that their most usual food is the liqu投资者.s. 

If these corpuscles are transplanted on a living state to any fresh 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 shoot from one soil to another. The process is also probably assisted by the fact that as they require nourishment they cause the bloodvessels to enlarge by bring on increased supply of liqu investors. 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 from some case the property of alkaline, that is if transplanted from one living subject to another it may convey the disease by means of which it was produced, a 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 various putrid
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 comparatively mild inflammation. Next comes the fact that pus, through 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 when 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. Hereby 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 serous and fibrilid which harbor collections of pus, will rarely heal till they are laid open. Also pus has a protease (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 mucous abscess, in which the pus formed in the lumbar vertebrae eats its way down the psoas muscle, causing the destruction of a large part of that muscle, and finally points below Poplart’s ligament. This probably arises in great measure as has already been mentioned from the tendency of pus impurities when living to assimilate to themselves.
Now arises the important question with regard to animal economy — is suppuration eliminative? This 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 popular 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. 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 a scarlatina poison attacks some particular part, gives rise to a process terminating in suppuration and that the poison therein 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 modist melta is itself the instant, 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 result, which may more than counterbalance the good it does. Thus in some cases of post scarletinal abscess, when we see the frightful ulcerations produced, and the fever or even pyrexia 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 pyrexia if not actually so, but the child eventually with great difficulty recovered. There are some cases when 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 pyrexia is always marked by the same phenomena. When in 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 pyrexia. It is now believed however that pyrexia is not caused by the absorption of pus, or by pus as such at all, but is caused by the absorption of some poisonous material produced in conneetion 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 ani-
malules called bacteria. However as this disease is not
produced exclusively in connection with pus, it need not
be further discussed here.

Causes and Terminations of suppuration

The great cause 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 inflammation to lead to
suppuration varies very much. In acute inflammation
on the one hand, suppuration is almost unknown though
cases have been recorded in which it has occurred; while
on the other hand in pyaemia, the joints frequently
suppurate. The same thing occurs in artificial in-
flammation of the skin. The inflammation caused
by the application of caustic oil has a great tendency to
suppurate; 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 disturbance
may occur. Occasionally pus is absorbed. In this
case the fluid proteins are first absorbed, leaving the
surroundings to form a cheesy mass. Then this undergoes
fatty degeneration, and are absorbed by the blood-
vessels. The 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 in a 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 together 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 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 end. In testing for a postraumatic abscess, place the finger and thumb of one hand on the swelling in the groin, and those of the other on 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 endeavor to judge from the man-
The best moments in our education occur in moments of generalized communication and the exchange of ideas. In these moments, our minds and our experiences are transformed, our perspectives are broadened, and our potential for growth is realized. Communication is not just a tool for information, but a means for understanding and connecting with others.
give, 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, liced meat, oatmeal, bran, chamomile flowers, mixed molasses, etc. Of these the one most in favour with surgeons is liced meat. Liced contains a great deal of oil, and therefore preserves its moisture longer than most of the others. To 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. There 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 pericardium, for these membranes are not usually dissolved by pus, and even should they be so, the walls of the cavities are so thin that pus 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 loosen 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 I advise of T. album, with which I acted as assistant, never applied poultices (1) R. Tyr. Belladona 3 III. Urg. Todi 3 V. A. Fig. apply to the part affected. (2) R. Plumbi Acet. 3 II. Din. Api 3 III. Agarwad 3 XII. Fig. apply warm to the part affected. I remember two cases of a sudden inflammation in the palm of the hand, threatening speedy suppuration, treated the one by the outward, and the other by the inward, in which great relief was immediately produced, and although suppurative was not altogether avoided yet the quantity of pus formed was very small in comparison with what threatened at first. Spongio-pilice may here be mentioned as a useful substitute for a poultice. It gives warmth, and by preventing evaporating moisture, but where there is much pain it is not so soothing as a good poultice.

Then suppurating 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. Then an

1. When the abscess is beneath some fascia, or strong tissue, as in the axilla or hand, which prevents the pus from getting through to the surface.
2. When the abscess is caused by infecting matter, as fistula or urinary extravasation, which it is desirable to afford an opportunity of escape.

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

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

6. 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.® A point where the abscess comes near the surface, or at least not less near than at any other point. 2.® The most dependent part in which the fist condition holds true. 3.® A point where 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 presses rapidly into the abscess, enlarging the opening as he draws it out. A lancelet used by a Vescechior may be employed. When it is desirable to make a very shallow incision as in an abscess near some large bloodvessel, the lancelet may be guarded by having a piece of lint wound round it so 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 little
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 bloodvessels etc. In
the case of axillary abscesses he says, "Put with a lancet
through the skin and cellular tissue and fascia of
the scutum, about half or three quarters of an inch be-
hind the axillary edge of the great pectoral muscle.
At this point we can meet with no large bloodvessel.
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Then I push a grooved probe or ground
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 open the abscess. Lastly by
keeping open the blades of the forceps during the
withdrawal of the instrument, you leave a lacerted
trunk or canal communicating with the collection
of pus, which will not readily unite, and will per-
mit an easy escape of matter." (Hilton in the in-
fluence 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 theoretically why it should
not affect equally to that occurring within any other closed
cavity. It must be considered as one of the results of inflam-
mation 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, 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 good 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. Diaphoretic. 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 1st edition Vol I p. 610). Then pleurisy is apt to occur after fever, especially after scarlatina and measles. It is also exceedingly common in pyemia and purulent 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 a direct deposit of tubercle in the pleura. Pleurisy also occurs consequently to a deposit of cancer in the female breast. This may occur from a secondary deposit of cancer beneath the pleura, which paralyzes it, and probably in some instances from the extension of the pleura of the sub-inflammationatory action set up in the neighborhood of the mamma, by the original cancer itself. Pleurisy is rarely met with in early childhood. Dr. West says
that acute pleurisy is very rare, and with us childhood, and
that chronic pleurisy "while it is a very rare occurrence
as a purely idiopathic affection in early life, is one
of the most common complications of the diphtheria which
often succeeds scarlatina." ("West on Disease of Infancy
and Childhood.") Many persons think that when pleurisy
occurs in young children, it is an indication of
blood-poisoning of some kind. Dr. Sarsam says, "Pleur-
rubs at a very early age is rare. Whenever it thus oc-
curs 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 sud-
ddenly. The pleura showed signs of intense inflam-
mination, and Dr. Sutton remarked that probably the
case was one of some "foudroyante" infection, in
which the usual signs had not had time for ev-
olution. This 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 enquiring the probability of scar-
astral infection was shown to be very strong." (Dr. Sarsam
on Localized Emphysema: Medical Times and Gazette
September 21, 1878.) Such being the principal causes
of pleurisy, what is it that causes the effused fluid to
be purulent? We do not exactly know, but we find 1st.
That most subjects of emphysema are pale, scrofulous, a
cachectic, and with the general health below par. 2nd.
That emphysema is relatively much more common in
children than in adults. During my residence as
house-surgeon at the North Eastern Hospital for Chil-
dren in London for a period of eight months, fluid
was removed from the pleural cavity in three or a
dozen cases, and in every instance the fluid was pur-
ulent; it was never clear serum.

Symptoms and Diagnosis

In these as in the causes emphysema resembles in
many respects ordinary cases of pleurisy. Pleurisy usually comes on with a shiver in the side which may be felt very acutely or be scarcely perceptible, without inability to draw a deep breath. The patient doesn’t 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 friction sound is heard. Afterwards when fluid is effused, the friction sound disappears and is succeeded by a feeble and indistinct respiration bronchial in character, with vocal resonance bronchophonic, sometimes auscultated, 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 spuital in pleurisy, as there usually is in pneumonia. 5. Supposing the case to be seen early, there is a friction sound heard in pleurisy, while pus inflammation 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 serous. Usually, if pus be present the subject has a pale yellow unhealthy look, as it is usually in those subjects that emphysema occurs. Here we have other diseases which can give to the same appearance, simulating emphysema.
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 normal 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 build no 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 it very difficult to speak the rest 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 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 serum is present. This proceeding is very simple and without 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 mischief. 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.

James Brigham

James Brigham aged four years and one month
was admitted to the N.E. Hospital under care of
Dr. Sanborn, 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 attri-
buted to Christmas festivities, but as it remained
unabated the child was brought to the hospital.

The signs were

1. Respiratory System. Suffers from a frequent
cough. Turbines in the left side in front from the
second or third intercostal space downwards, except a small
protrusion in the fold of the axilla. Vesicular respiration
suppressed on left side. Fremitus both with inspiration
and expiration felt by hand over base of left chest at
back. Turbines at back not complete; extends from an-
gle 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 103.5°F.

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

Treatment: The patient was placed on milk diet and had the following medicine: R. Vini Th. sep. m. 2. Spirit. Ammon. Annum. m. 3. Spirit. Vini, Rec. m 5. Mist. Pot. Bicarb. (q. x x ad. 3 I) FIII. To be taken every 4 hours. Mustard and bisected poultices were applied externally.

February 2: Slept well; perspired freely; takes food well.

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

Feb. 6. Sleeps better; cough not nearly so troublesome.

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

Feb. 8. Dr. Sarsom now observed that while the diagnosis of broncho-pneumonia was pronounced, there were signs of a quavering cough. Painness presumably from broncho-pneumonia had spread upwards towards the apex, but the audibility of the respiratory rassum had increased, so that it would seem that some of the blocked air- cells had begun again to function; rales thus began to be heard over the base of the left lung. The adverse signs however were 6 of the temperature history. To 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 5.3 degrees. Dr. Sarsom
pointed out that the chart began to resemble a case of sepsisemia. (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. 22.** 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 sponging were resorted to, and on March 8th cold baths. These however failed to have any permanent effect, at dry 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 102.2°, 100.8°, 99.8°, 98.8° in the days following respectively. Concurrently there was general improvement; respiratory sounds heard more distinctly over left lung.

March 17th Complaints of difficulty in swallowing.

March 18th This evening the child began to give a
hoarse laryngeal cough. Inhalation of steam and creasote was ordered, and the child was removed to a warm room.

March 14. This morning evidently worse; the cough caught more pronounced, and great hachecal dyspnea. Ordered five muriens of antimonial wine, with half muriens of specacuancha wine every two hours. At 4 p.m. he was given a hypodermic injection of apostomphia, which produced vomiting. The antimony and specacuancha 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. Tay 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 embarrassed 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 hachea were all in a state of acute inflammation, and presented a greenish appearance. The lining membrane of the hachea was markedly granular. A considerable patch of false membrane was removed from the hachea. The hachea 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 loculated effusion extending from the base of the lung in front to about the second intercostal space. 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.
The temperature charts are annotted 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. Sarsam in the Medi-
cal Times and Gazette, September 21, 1878, and made
the subject of a very interesting paper. Dr. Sarsam
was so strongly of opinion that the child suffered from
a form of septicemia that he wished to procure a more
detailed account of the history of the child previous to
admission. An article was despatched 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 feast, and when he returned home was
very sick. He sounded 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 fever occurred in
the house in which he lived. His mother says the down
pipe was stopped up for three weeks, and the house
smell very bad. No disease in other member of the fam-
ily, except girl in the father.

Remarks. This case is one of peculiar interest. There
is in the first place the gradual onset. The child be-
gan perceptibly to lose health about the middle of De-


December, though previously he had been anything but
strong. Throughout January there was the cough
and frequent sickness. Then on admission there was the


dullness of the lower part of the left side of the chest in
front, with suppression of the respiratory sounds, and also the
high temperature and the pains in the joints. So then
at this time the child was suffering from asthma, what afterwards proved to be localised pneumonia 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
infusions which were resorted to before the use of
the quinine, although they reduced the temperature
temporarily, seemed to have little or no influence in
producing 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 chart that the reduction of
Temperature was immediate. On the 28th of March the attack of cough 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. Sassoon has pointed out to some form of septicemia or blood-poisoning. The attack of cough can hardly be supposed to be purely accidental. Rather indeed it may be imagined to have been a case of primary cough arising simply from cold, but the first symptom was difficulty of swallowing, which was noticed on March 27th. The laryngeal symptoms not appearing till the following day. Also before the difficulty of swallowing came we could remember no circumstance which could have accounted for a fresh cold. The supposing the attack to be of a different 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 favorable, or if the disease were contracted before the entrance of the patient into the hospital, it must have been between forty-nine days, which is most unlikely. Therefore we may suppose that the attack was one of secondary cough, arising from previous milder conditions. Dr. West has listed twenty-three cases of cough of which eleven were primary, and twelve secondary; eleven of the latter were sequelae 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 pneumonia, or were they both effects of some common cause? Dr. Sassoon, bearing in mind the additional presence of the arterioplaicus, and probably of the broncho-pneumonia, and especially the his...
Any of these temperature charts considers the latter to be the case; and thinks that the cough was a phenomenon in the evolution of the septicemia, 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 eutrophic, could cause this attack of septicemia. Nevertheless the continued presence of the pus might have been a powerful auxiliary to the blood poison. To 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 unlikely 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 not 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 genuine in keeping down the temperature; this succeeding where cold sponge and cold baths failed to have a permanent effect.

II. Mary Anne Boston

April about four years I was 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 she was pale, but without much loss of flesh. There was absolute dullness 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 bilateral breathing and bronchophony with cough.
Inhales. Breathing distinctly heard lower down near the spine, but very deficient in the lateral region. Breath sounds distant and husky in front, with increased vocal resonance. A systolic murmur is heard in the aortic region. Aphonation was performed and few ounces of mustard poultice. July 21st. Breathing audible all over left chest after some coughing. There is cresputation at the apex. Breathing still audible in front of the chest.


August 19. Since aspiration there has been no cough, and temperature normal. Left shoulder seems falling and ribs close together. Very little movement of left side of chest. Percussion dull throughout, except close to spine and at apex. Respirations free at apex behind elsewhere much diminished. Faltering 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 lungs however were 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 mixture of creosote, sulphocarbolute of soda, and specernanbarrine. 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 spitting, 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
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 fell below right mamilla. Absolute dulness over the whole of left side in front. Breath not quite so dull though the dulness was more than comparative. Left side did not expand on Inspiration. Vocal resonance absent. Breathing very indistinct move so in front than behind, character tubular no adventitious sounds. Vocal resonance diminished rather eugaphonic. Temperature 99.5°. (Puss was removed from indigestible hypoglycemia.)

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

July 10. Does not sleep well, but takes food well. While circumference of chest just below the nipple 22½ inches left side, 21½ inches. Dulness absolute all over left side. Infra cardinal spaces obliterated. A space behind tubular breathing and sharp respiration. In front absence of breathing all over. Impaired resonance extends to right nipple line in maximum region. Dulness extends to right border of sternum, impaired resonance one inch beyond. Lower dulness one inch below costal border in maximum line; edge of spleen indistinctly felt on left side.

July 16. It was now noticed that the temperature had risen the last few 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 two ounces of pus were removed.

July 18. The temperature has been rising since last aspiration. When lying on his back, there is a tympanic resonance all over the front of the left side of the chest, extending to left border of sternum and laterally to left border of scapula, and covering the cardiac region.
When the sib-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 sib up. Breath sounds are here distinctly audible with much respiration. At apex of lung breathing tubilar, voice bronchophonic, crepitation moist and abundant. On the lower part of the left chest breath sounds still audible and tubilar, 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 sympathetic 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 along part of left side of chest, more or less vesicular breathing can be heard throughout, most free at apex in field. In mammary region some crepitation heard, perhaps pleuritic. Intestinal resonance rises to within an inch of nipple. No dulness in splenic region. An inunction of chest pellitory, nipple 22 inches left side 11 inches.

August 1st. continues to improve. Skel tone and costovertebral nodules evident. Other medicine discontinued.

From this time the sib clearly progressed, and the vesicular breathing became more and more distinct, although still absent in the beginning of September it was not quite so distinct as that on the sound side. He was discharged most on the 12th of September.

Remarks. These cases are mainly of interest in showing the value of stopping at any rate in children. In these cases, after two operations the pleural cavity was par-
Locally erupted, 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 function. After 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 convulsions. On using the hypnotic syrup into which pleural 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 moderate pus was 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 mamma, as the right side 7 inches, on the left 8 inches.

June 11. Intercostal spaces on right side of chest are flattened. Some sympathetic 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 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 1. At this time there was a little fresh cold, but iron passed off.

August 22. Marked flatterness of the right side under the nipple was now observed. Measurement (as before) right side 7½ 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 unequal 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 faint. Percussion dull behind, but tympanitic in front.

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

July 20. Breathing distinct all over right side, with coughing. Temperature normal.
CASE 112  Handbrook  

CHART NO. 1

MONTH  DAY
1  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26
100°  101°  102°  103°  104°  105°

DATE  QUANTITY  APPEARANCE  SPEC-GRAY  REACTION  ALBUMEN  SUGAR  BLOOD  DEPOSITS, etc.
June  14  12 lb-  
July  15  12  6  
July  22  13  6  
July  29  13  6  
Aug.  14  13  6  
Aug.  18  15  6  

CASE  Elizabeth Handbrook  

CHART NO. 2

MONTH  DAY
17  28  29  30  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17
100°  101°  102°  103°  104°  105°
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 debilitated children. In both the pus was removed by one aspiration, and did not recur. In the first case we were for some time told full 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.

Ada Jones

Ada Jones aged ten years admitted to the hospital May 28th 1878 under the care of Dr. Cayley. The child suffered from scrofula and was more or less stooping over since. About three months ago she was attacked with a violent cough and spilt, which had continued ever since. At the same time an ulcer appeared on 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 punctuated with bringing up a purer liquid in about fifteen minutes. This extended to some extent on arm a too. The child looked yellow and phthisial. The physical signs were: Right side of the chest greatly bulged forwards. Did not move on inspiration. Percussion note absolutely dull below mammary and more than inspiratorily above it on the first, and the lower half is more than inspiratorily dull behind. Vagal sounds absent; breath sounds very indistinct. On the left side the percussion note was normal; breath sounds distinct, though exaggerated. The breathing was mainly diaphragmatic. The left knee joint was swollen, and a little below 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 cod liver oil, and also mixture of

steel drops and quinine with a cough mixture.

July 11. During this time the patient was troubled with

a hoarse cough, and frequent expectoration of purulent spuma.

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 as a light weight was

attached. It first 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 soon sweetened

by means of charcoal poultices. The physical signs

were now as follows — Right side of the chest is obviou.

ly bulged. It contrasts markedly with the left. Move

ments 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 inferior 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 per

formed, and eight ounces of creamy purulent pus

were removed.

July 12. Child appeared considerably relieved by

the aspiration.

July 17. Has frequent paroxysmal attacks of cough

spasm, lasting several minutes, almost pure pure expere

ciated. Absolute dulness from right clavicle downwards.

High pitched bronchial, almost cavernous breathing.
Posteriorly absolute dulness from midsternal region. Chloroform was administered, and paracentesis performed in the infra-aural region in the fifth interspace. Twelve ounces of nearly inodorous pus was removed. Towards the end of the operation, only air seemed to enter. Right side now symmetrical on percussion. Breath sounds sound, the cavernous breathing having disappeared.


July 25. Patient lies ill 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 very little with the breathing. Heart is palpably felt in the interspace, 1½ inches below and 2 inches to the left of the nipple. Pulse under carotid not quite absolute, and by right back, the interval 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 motion 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 gas escaped with the first motion, but a considerable quantity of air in bubbles, deep inspiration. A large cavity appeared. Curet seemed to pass upwards and downwards. The curet opening in the axilla made by cutting down upon the pock, and some blood-stained pus escaped. A drain age tube was passed between the two openings.

August 1. Cough and expectoration have been much less since the division. Free discharge from the wounds. Appetite good.

August 10. Since the free motion temperature has been much reduced, and there has been no cough.
August 13. Discharge is rather copious, and is odorous, 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. Margin of each wound covered by granulations. Cough is much less, and expectoration very slight. There is a sympathetic resonance near the area of incision, and high pitched metallic notes 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 suspen on-meth with half a drachm of syrup of the iodide of iron were given twice a day.

Shortly after I left the hospital (September 15) another opening was made in the back, the position being more convenient. From that time until the present as I have found by inquiry, she has remained much in hospital. 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 one of empyema, accompanied by a more than usual degree of pallor and cachexia. Pneumonia possibly existing. In this instance the pus had no doubt found an opening through the lung into the bronchial tube, 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 four 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 gradual fall of temperature. The effect however was not so marked in this case as in some others, owing 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, ascertained of pus still unfortunately continued, effected a further rise of temperature, which lasted a short time. Since I left Jamestown, the temperature has remained nearly normal. (The temperature charts are appended to the following page.)

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...
was constantly secreted, and where the effect of aspirin was only transient, when a free emission was made, and a drainage tube introduced, the temperature continued nearly normal during the whole time that the drainage tube remained in, with one short exception, and when we consider the cachectic condition of the girl, and the likelihood of some irritation occurring about the wound that cannot be wondered at. Then secondly we must observe that in all these cases except his, the general condition of
The patient was markedly unhealthy. What inference can we draw from these facts? Taking the general unhealthy condition of those suffering from empyema, 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 again see that the suppuration is due to some efforts of nature to throw off the morbid condition, and that inflammation which would in a health condition result in the condensation of lymph and effusion of serous now terminates in suppuration. So that if this is so the empyema 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 the does not fluid and 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 from of septicemia was simply pointed out in the case of James Bingham, 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 such poison in a 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 found I was probably some morbid condition left by the scarification.

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 in a lucerne and camphor in carbolic oil so as to avoid introducing causes of suppuration. The horeac 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
bones of the ribs, as to wound the mediastinal 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
so if we do the vacuum will probably be filled with
air. In withdrawing the cannula it is well to place
one's finger on the opening and slip out, and then to
place a little cotton wool or it fastened down by shots
of adhesive plaster, to prevent the entrance of air. The
thought by some that simple aspiration is of little use
in empyema. However this may be in 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 as dependent a
position as possible, and pass a drainage tube be-
tween 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, when 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 to-
gether. 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 be-
comes obliterated, or at any rate till the men.
brane ceases completely to secrete fresh pus. This method was recommended first by Dr. Goodfellow and Sir Campbell Te Morgan. It was adopted in the case of Toda Jones. The patient should be kept on liberal diet with perhaps a little wine. Tonic medicines should be given as steel, quinine, and curdina oil. If the cough be troublesome a mustard may be given to allay the irritation, as one consisting of mixture of hypocras, spirits of chloroform, syrup of squills, and water.

B. Suppuration in the Peritonitis

Suppuration not infrequently takes place in a slight degree in the course of acute peritonitis, the peritonitis 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 so as to pleural cavity, as by so doing we should run the risk of surrounding 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 unfavorable to the patient than an external escape. Kokitsky has pointed out that occasionally both externally and into the intestines, as well, so that a fistula opening into the bowel is thus established. As regards treatment depending upon the presence of pus, and that it was present in considerable amount and had not already escaped, it would
be well to resort to peritoneal aspirations, but we could not do this unless a large quantity of pus were present. Tonic treatment should be resorted to as in entrapment. 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 suppurative 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 of slight suppurative with acute peritonitis, the other of chronic suppurative in the peritoneum, in which the pus escaped externally.

I Sarah Bagot

Sarah Bagot aged ten years was admitted under the care of Dr. Armund-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 all 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. Suffer from retention of urine, bladder relieved by catheter, greatly distressed, appears in a malnourished 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 of a small dose 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 there were also diarrhoea, and nutritive matters consisting of beef tea and bread 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 even 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 diarrhoea, but no blood in the motions. The abdomen was much swollen ten days ago, after which there was a discharge from the umbilicus and it sank. The child was shrunken and ill-nourished. Temperature 101.

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

June 24 Child brought back. Tuning abscesses two large abscesses had appeared, one on each side of the abdomen about two inches distant from the umbilicus, and had burst leaking 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.
popular on the back and vesicular on the arms and legs. The fluid contained is alkaline. There are one or two pus
bubbles. Temperature 101°.

July 4. Child seems better. Diarrhea gone. Saji of abdomen diminished. Rash is fading. There seems to be a
conical swelling round the umbilicus which was symmetrical on percussion. An attempt was made to pass a probe
through the cavity between the two aides but it was decided 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 10th of September.

Remarks. This is a case which from the large quant-
ty of pus discharged was almost certainly an instance of
suppuration in the cavity of the pericardium, 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 utters was quite symmetrical. Had the child
been 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
absorbed had probably on the whole a beneficial
effect, although it remained it was injurious.

(The treatment consisted in this case of half a draught
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 no partial re-

duction would be produced. After the second admission
when the two first openings had just formed and the
discharge became very free the temperature was speedily
reduced, and this coincided with the general improvement

6. Suppuration in the Pericardium

Suppuration in the pericardium is rare. When
**CASE: Martha Richardson**

**CHART No. 1**

<table>
<thead>
<tr>
<th>Month</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
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**CASE: Martha Richardson**

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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 connec-
tion with pyemia, 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 send to France as
in most cases of suppuration in the pleura and peritoneum.

D. Suppuration in the Thoracic Cavity

Suppuration in the aneurismal cavity in the pericardium
is extremely rare, but has been known to occur. The case
which occurred at St. Mary's Hospital is related by
Dr. Sturteving (Jones and Sturteving's Pathological Ana-
tomy, second edition, page 238). Here there had been
aortic aneurysm, and an unexpected convulsion on
and the patient died in thirty-six hours. No connection
between this and the aneurysm was heard of 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 un-
favourable. No treatment would be likely to be of much a-
vail.

Suppuration may occur in the aneurismal cavity of the
spine as a result of spinal meningitis, though not often.
Here as in ordinary cases of spinal meningitis the prog-
nosis 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 iodoide of potassium
inwardly, 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
dried and well-marked blood poisons, such as pyogenic or syphilitic. In this first case there is usually seven pain and
foot, and considerable distortion of it, accompanied by a good deal of feverishness. 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 this case
mixed with synovial fluid, and is occasionally quite of a sea-green colour. The treatment frequently recommended is to
allow 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 puncture of opening the joints however
is rather a doubtful one. A case occurred in the N. E. Hos-
pital 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 Mr. Judge splint
and warm fomentations and spongo-pulvis 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 sufferers were applied, and the
limb still kept anchylosis in the splint. Gradually the
openings began to contract, and the child was sent to atten-
gate 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 infectious. In these cases it is best to open the joint
freely, and confine the limb with a splint, and to adopt con-
stitutional treatment made suitable to the disease. In these cases the
blood poison is evident, and I have said to show that in cases
of suppuration in other closed cavities, there is a marked curtail
in the blood, though perhaps not what we should ordinarily
call a blood-poisoning, and not so evident as here.

Conclusion I'm 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 reason why I have dwelt specially upon its occurrence in the closed cavities are—first because owing to the pres-

ence of the epithelium which lines them, which pus does not dissolve so readily as it does other tissues, the pus often

carries there for a long time if not removed artificially, and gives us an opportunity of studying the ef-

fects of its presence, and secondly because I had met with several cases, which with their temperature chart might

I thought serve to illustrate the subject, and show the distur-

bances 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 Bowen in his Text-Book on Physio-

logy Vol. I p. 59 says: "Thus pus—that fluid which

surgesformerly considered as a deposit or secer-

tion foreign to the frame, irritative in its nature, and which

ought therefore to be let out of the body as soon as pos-

sible—is like the blood, a fluid living fluid; crowded with multitudes of compound animal existence

which are born, live, and die as man himself dies." It was however soon seen that pus was not some ex-

tent irritative, and that it's contained presence in

the human body was injurious. I have tried to show

that it is probably eliminative, it is certainly a fluid

admirably adapted for elimination, but that in propor-

tion 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.