A dissertation on the properties of pus; which gained the prize-medal, given by the Lyceum Medicum Londinense, for the year MDCCLXXXVIII, and was ordered to be printed for the use of the Society ... / [Sir Everard Home].

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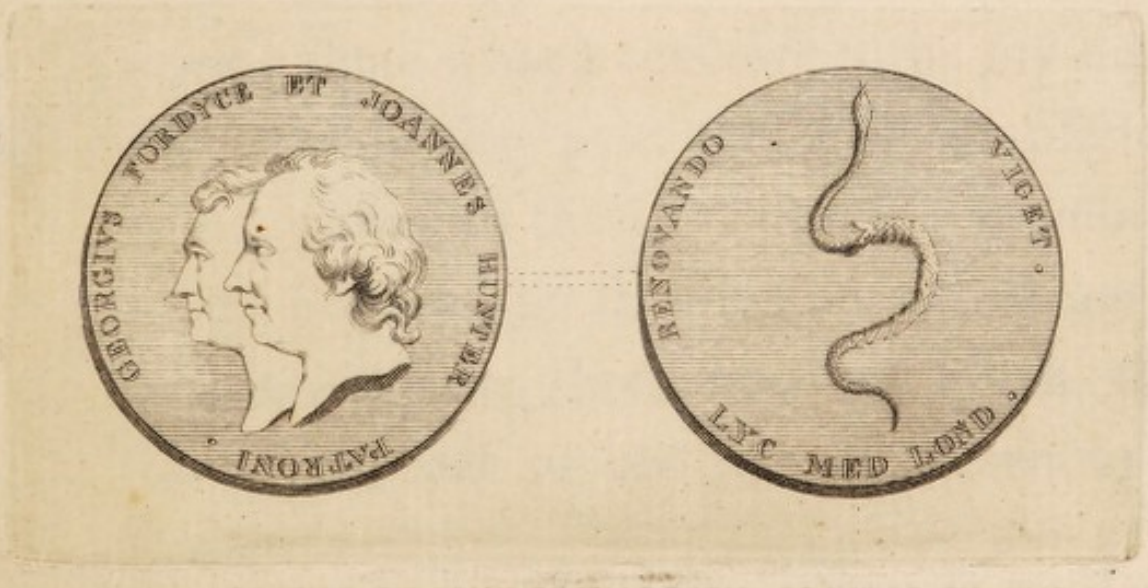
WHICH GAINED THE PRIZE-MEDAL, GIVEN BY THE LYCEUM MEDICUM LONDINENSE, FOR THE YEAR MDCCLXXXVIII, AND WAS ORDERED TO BE PRINTED FOR THE USE OF THE SOCIETY.

By EVERARD HOME, F.R.S.

AND ONE OF THE PRESIDENTS OF THE LYCEUM MEDICUM.

Felix, qui potuit Rerum cognoſere Cauſas.



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MDCCLXXXVIII.

INTRODUCTION.

I Shall make no apology for writing the following diſſertation, conſidering it as a duty incumbent on every member of the LYCEUM MEDICUM to promote, to the utmoſt of his abilities, the purpoſes of its eſtabliſhment; and although I may fail in throwing all the neceſſary light upon the ſubject, I muſt content myſelf with the ſatisfaction of having done what I conceive to be my duty, and with having paid the only compliment in my power to the PATRONS, and promoters of the Society, by ſhowing an honeſt ambition to acquire thoſe honours which they have held out as the reward of our exertions.

" THE PROPERTIES OF PUS; PARTICULARLY THOSE WHICH DISTINGUISH IT FROM OTHER SUBSTANCES. THE CASES IN WHICH IT IS FORMED. THE TIME ITS FORMATION REQUIRES; AND THE EFFECTS IT HAS UPON THE BODY."

IN treating of PUS, its properties, and its effects upon the body, as marked out in the theſis, it will not avail much to enter into the opinions of either the ancient or modern authors reſpecting it; or examine the arguments by which theſe opinions have been ſupported, ſince that would, in ſome meaſure, be deviating from the theſis before me, and would lengthen this diſſertation much beyond its proper limits, without enlarging, in any degree, our knowledge of the ſubject. I ſhall therefore avoid controverſy, and endeavour, by

experiments and obſervations, to inveſtigate the different parts of the ſubject.

It may not, however, be improper to take notice, that the moſt generally eſtabliſhed opinion of the nature of Pus, was, its being compoſed of both ſolids and fluids. It was diſtinguiſhed by the term, "True, or laudable Pus"; and was ſuppoſed to differ materially from a ſimilar diſcharge called, Mucus. Yet the diſtinctions between Pus and Mucus have been very ill defined: there was thought to be a difference, in their appearance to the eye; but the principal mark of diſtinction aroſe from a breach of ſurface being believed neceſſary to the formation of Pus, but not of Mucus; conſequently, when there was no breach in the ſolids, the diſcharge was only Mucus.

This notion of Pus muſt have taken its riſe from an idea that the ſolids of the part were broken down into Pus. The phyſiologiſts, who formed this theory, cannot, however, be ſaid to have made their diſtinctions with great accuracy, ſince the diſcharge, in conſequence of a bliſter being applied to the ſurface of

the body, was admitted to be Pus; although in ſuch caſes there is no loſs of ſubſtance, and therefore the diſcharge ſhould have been called Mucus.

To aſcertain the real difference between Pus and Mucus, has been conſidered an object meriting the attention of ſome of our moſt eminent ſurgeons, although they have not yet been fortunate enough to diſcover it. This muſt have ariſen from their adhering to the hypotheſis which I have mentioned; and which not being founded upon the principles of the animal œconomy, can never explain, ſatisfactorily, any of the operations in the living body.

The appearance of a diſcharge produced from the ſecreting ſurface of an internal canal, or excretory duct, when the reſult of common inflammation, is exactly ſimilar to a diſcharge, in conſequence of inflammation, in any other part of the body. The only reſpect in which they differ, is; that in the one caſe there is no breach of ſurface, and in the other there moſt commonly appears to be one. The one is ſuppuration alone; the other, ſuppuration attended by ulceration.

In the preſent inquiry I ſhall confine myſelf to the collecting thoſe properties and circumſtances which I conſider to have been aſcertained reſpecting Pus; and ſhall endeavour, by inveſtigating others not ſo well underſtood, to render the hiſtory of it more complete. I do not mean to take to myſelf the merit of all the obſervations contained in this diſſertation, many of them being the reſults of the labours of others, much better qualified than myſelf for phyſiological inveſtigation.

Having attended ſeveral courſes of the phyſiological and pathological lectures of one of the celebrated Patrons of this Society, and having paid particular attention to his opinions, reſpecting Pus, I ſhall avail myſelf, in the preſent inquiry, of his obſervations; and as the view which I mean to take of this ſubject may, to many, appear new, it will not be amiſs to obſerve, that I ſhall, through the whole of this inquiry, conſider Pus as a fluid, whoſe formation depends upon a proceſs in the animal œconomy, analogous to glandular ſecretions.

Although I mean to confine myſelf to the conſideration of thoſe circumſtances which are eſſential to the formation of Pus in a living animal body, yet the opinion of a preternatural degree of heat being produced in inflammation, which has been ſuppoſed neceſſary to the formation of Pus, is at preſent ſo prevalent, that it will be neceſſary, before we enter upon the inveſtigation of our ſubject, to ſhow the degree of heat which is really found to be preſent in inflamed parts in different ſituations in the body.

The heat of inflamed parts has been ſo well aſcertained by Mr. HUNTER, whoſe experiments on this ſubject are given in his lectures, that it will not be neceſſary for me to do more than to give an extract from his lectures on that ſubject.

EXPERIMENT I.

" An inciſion was made into the thorax of a dog, about the centre of the right-ſide, and a thermometer was introduced, with the ball in contact, or nearly ſo

with the diaphragm, the heat was 101°. The wound was filled with lint, dipped in ſalve, to prevent its healing, and the whole covered with ſticking-plaſter: the day following the heat was found to be exactly 101°.

EXPERIMENT II.

The heat of the rectum of a dog, three inches from the anus, was accurately aſcertained by a thermometer, and afterwards a ſolution of corroſive ſublimate was injected. The day following the heat was found to be a little increaſed, but not half a degree, although the inflammation, produced by the corroſive ſublimate, was very conſiderable.

EXPERIMENT III.

The heat of the rectum of an aſs, was found, by the thermometer, to be 99° and a half; and ſeveral different trials gave the ſame reſult. A mixture of

muſtard and ginger, in water, was thrown up. In twelve hours the heat was 99° and a half.

EXPERIMENT IV.

A ſolution of corroſive ſublimate was injected into the rectum of the ſame aſs, and in twelve hours the heat of the part was 99° and a half. In twenty hours it was the ſame. In ſixty hours it was increaſed to 100°. The injection had irritated the rectum ſo much as to bring on teneſmus, and a diſcharge of blood.

EXPERIMENT V.

The heat of the vagina of an aſs was 100°. A ſaturated ſolution of corroſive ſublimate was injected. In two hours the heat was 99°. The next day, in the morning, 99°; and in the evening 100°. The ſecond morning 99°; in the evening 100°. The third morning 99°; in the evening 100°.

This experiment was repeated ſeveral times on the ſame aſs, and the reſults were ſimilar. The inflammation was very conſiderable, and the cavity of the vagina was almoſt obliterated by adheſions, in conſequence of the coagulable lymph thrown out upon its inner ſurface.

EXPERIMENT VI.

An oblique inciſion was made into the glutæi muſcles of the thigh of the ſame aſs, about two inches in depth: the heat of the bottom of the wound was 100°, which was exactly the heat of the vagina. A plug of wood, two inches long, incloſed in a tin cannula, one inch and a half long, was introduced into the wound, ſo that the wood projected half an inch beyond the cannula, and filled up the bottom of the wound. They were kept in this ſituation by means of threads.

The next day, the wooden plug being withdrawn, and the thermometer introduced to the bottom of the wound, through the tin cannula, the heat was found

to be 100°, both in the morning and evening. The ſecond day, the heat of the bottom of the wound, in the morning, only 99°; in the evening 101° and a half. The third morning 99°; in the evening 100°.

EXPERIMENT VII.

A wound was made into the abdomen of an aſs, and a ſolution of common ſalt injected into the cavity, which produced a violent inflammation there. The next morning the heat of the vagina, examined by a thermometer, was 99° and a half; which is nearly the natural heat of that part. In the evening it was increaſed to 101° and a half. On the ſecond morning the heat of the vagina was 100° and a half, and in the evening the ſame.

EXPERIMENT VIII.

A man had the operation for the radical cure of the hydrocele, performed at St. George's Hoſpital, by Mr.

Hunter. When the tunica vaginalis was laid open, the ball of a thermometer was applied to the ſide of the teſticle, its heat was 92°; the cavity was filled with lint dipped in ſalve, that it might be occaſionally removed, and next day the heat was found to be 98° and three-fourths."

From theſe experiments it is evident, that the increaſe of heat which takes place in a part, during the preſence of inflammation, however conſiderable it may appear to our ſenſations, is no more than bringing it nearer to the ſtandard heat of the ſource of the circulation; and therefore in parts near the heart, we have no ſuch increaſe during that proceſs; but in parts at a conſiderable diſtance, and in ſmall projecting parts, we find the heat to be increaſed ſeveral degrees.

We cannot therefore admit that any preternatural degree of heat is neceſſary for the formation of Pus, although the ſtandard heat, or nearly ſo, of the body, would ſeem to be required for the full and complete action of inflammation, by which proceſs Pus is formed.

From the above experiments it appears, that the heat preſent during inflammation is greater than the ſtandard heat laid down by authors: this, however, ariſes from that ſtandard not having been taken from the heart, but from the ſuperficies of the body, which admits of conſiderable variation in its heat.

The heat of the rectum is found, from the collected reſults of a number of different experiments on living animals,* to differ from that of the heart about one or two degrees, it being one or two degrees colder; a knowledge of which fact makes the ſtandard heat of any animal very readily aſcertained with a tolerable degree of accuracy.

The rectum of a puppy is 100° of heat; of an ox 99° and a half; of a rabbit 99° and a half; of a man 98° and a half; therefore the ſtandard heat of theſe animals will be as follows: that of the puppy 101° or

* Vide Mr. Hunter's Obſervations on certain Parts of the Animal Œconomy, where a thermometer adapted for experiments of this kind is deſcribed.

102°; of the ox 100° and a half, or 101° and a half; of the rabbit 100° and a half, or 101° and a half; of man 99° and a half, or 100° and a half."

IT is difficult to give a definition of any thing, the properties of which are not well aſcertained; but as it is neceſſary that I ſhould particularize the ſubſtance which I propoſe to inveſtigate under the term Pus, I ſhall define it to be a whitiſh fluid, made up of globules, and a tranſparent aqueous liquor. Its production depends upon inflammation having previouſly taken place in ſome part of the body, either in the common reticular membrane, upon the internal ſurface of circumſcribed cavities, or the ſurfaces of internal canals, which I ſhall call excretory ducts.

Inflammation is neceſſary for the formation of Pus; and although a fluid, ſomewhat ſimilar, is produced without any preceding inflammation, ſuch fluid not having all the properties of true Pus, can be readily diſtinguiſhed from it.

Pus, whether it is formed in the cellular membrane, upon an inveſting membrane, or on the internal ſurface of an excretory duct, has exactly the ſame appearance, and general properties; I ſhall therefore make no diſtinctions between Pus produced under this or that peculiar circumſtance, believing it, when preceded by the ſame degree of inflammation in a healthy conſtitution, and when free from any extraneous ſubſtances, to be the ſame fluid; but, as a difference in Pus may ariſe, from a variety of cauſes, I ſhall endeavour firſt to mark thoſe properties which really belong to it in a healthy ſtate of body; and afterwards mention the variations to which it is liable.

Pus, taken from a healthy ſore, near the ſource of the circulation, as on the arm or breaſt, readily ſeparates from the ſurface of the ſore, the granulations underneath being ſmall, pointed, and of a florid red colour, and has the following properties: It is nearly of the conſiſtence of cream; is of a white colour; has a maukiſh taſte; and when cold, is inodorous; but when warm, has a peculiar ſmell. Examined in the microſcope, it is found to conſiſt of two parts, of

globules, and a tranſparent colourleſs fluid: the globules are, probably, white, at leaſt they appear to have ſome degree of opaſity: its ſpecific gravity is greater than that of water: it does not readily go into putrefaction: expoſed to heat, it evaporates to dryneſs; but does not coagulate: it does not unite with water in the cold of the atmoſphere, but falls to the bottom; yet, if kept in a conſiderable degree of heat, riſes, and diffuſes through the water, and remains mixed with it, even after having been allowed to cool; the globules being decompoſed.

" Pus,* poured upon the vitriolic acid, ſwims on the ſurface, and no effervеſcence takes place; but the mixture, upon ſtanding two hours, becomes ſemiopaque, and of a dark purple colour.

* As the hiſtory of Pus might be deemed imperfect, without the chemical combinations and analyſis being mentioned, I have given the following inveſtigation, as far as relates to chemiſtry, from the theſis of Dr. Brugman, who graduated at Leyden in 1787; but as there is nothing contained in many of the experiments which throws much light upon the ſubject, in the view which I have taken of it, I have only repeated thoſe which appeared to me deſerving of particular attention; reſting the others wholly upon Dr. Brugman's authority.

Upon Pus being added to the ſtrong nitrous acid, an efferveſcence takes place, and the mixture becomes green, afterwards pellucid, and then yellow.

Mixed with the phlogiſticated muriatic acid, it does not ſeem at firſt to unite with it, although ſome globules of air are let looſe; but in the courſe of two days the mixture becomes an homogeneous aſh-coloured maſs.

Pus, when mixed with the fixed vegetable alkali in the form of oleum tartari per deliquium, is neither diſſolved nor coagulated by it.

With the fixed foſſile alkali, in ſolution, a ſmall portion of the Pus unites with it, forming a milky fluid, and the reſt falls to the bottom; upon adding the weak nitrous acid to the ſolution, the Pus is ſeparated in form of a viſcid aſh-coloured fluid.

The volatile alkali, in a dry form, if mixed with equal parts of Pus, becomes exceedingly viſcid: upon the addition of water, equal to its bulk, the ſolution is

homogeneous, ſemipellucid, and white; and is ſeparated by the nitrous acid in form of a viſcid white film on the top of the liquor.

Cauſtic volatile alkali diſſolves a conſiderable portion of Pus, but not the whole of it, forming a very viſcid fluid: upon adding water the Pus is ſeparated in form of a mucilage: the ſame effect is produced by any of the acids.

Cauſtic fixed alkaline lixivium, wholly diſſolves an equal quantity of Pus, forming a very viſcid fluid; but, upon adding water, it is all depoſited in a viſcid form.

Upon adding vitriolic acid to the ſolution of Pus, in cauſtic fixed alkali, the Pus is precipitated in form of a white powder: if it is the weak nitrous acid, the Pus is ſeparated in form of flakes, ſwimming in the liquor: if the muriatic acid, it is ſeparated in form of a viſcid film upon the ſurface.

The neutral ſalts in ſolution have no action on Pus; it may, however, be obſerved, that Pus ſinks ſooner in them than in water, ſo that they appear to thicken it.

The earthy ſalts produce theſe effects more evidently; and the metallic ſalts in a ſtill greater degree.

Alcohol condenſes Pus by uniting with its aqueous parts; but neither coagulates nor diſſolves it.

Pus, when freſh, contains neither an acid, nor an alkali; but being allowed to remain expoſed to a moderate degree of heat, it takes on other properties, acquires a pungent ſmell; it changes the ſyrup of violets, red; corrodes copper, turning it green, ſhowing ſigns of an acid quality, from taking on the acetous fermentation.*

The chemical analyſis of Pus is as follows: Eight ounces and a half of thick yellowiſh white Pus, quite

* To aſcertain whether Pus turns ſour before it putrifies, I expoſed ſome Pus to a moderate heat, and every half hour tried its effects on the ſyrup of blue violets, but could not procure a red colour, although I repeated the experiment a great number of times: the only change, I could perceive, was to a green. I muſt therefore ſuſpect that, the acid properties, obſerved by Dr. Brugman, aroſe from ſome accidental circumſtance.

freſh, and without ſmell, diſtilled in a ſand-heat, never raiſed above 212°, yielded, in the firſt day, a limpid phlegm, firſt without any ſmell; but afterwards the ſmell of recent warm Pus could be evidently diſtinguiſhed. The whole quantity, ſeven ounces, two drachms, nine grains.

This phlegm contained neither an acid nor an alkali; not producing any change on the blue colour of violets; and expoſed to heat, evaporated wholly away like diſtilled water.

After this phlegm, a vapor roſe by degrees with an empyreumatic ſmell. A freſh receiver being applied to the retort, a whitiſh phlegm, with an ungrateful ſmell and taſte, was collected, in quantity three drachms.

This phlegm turned the infuſion of blue violets, green; and formed a white precipitate upon being added to corroſive ſublimate; evidently ſhowing, that it contained an alkali; and from the taſte it proved to be the volatile alkali. With this phlegm a conſiderable quantity of air was extricated.

The heat being increaſed, a little of the dry volatile ſalt attached itſelf to the neck of the receiver, which was ſoon diſſolved, and removed by the vapor; nor did the ſame appearance again occur during the whole of the experiment.

A phlegm with a ſtronger ſmell, and a yellowiſh oil, which, from its weight, fell to the bottom, weighing two ſcruples, fifteen grains, was collected in another receiver.

The oil was empyreumatic, fluid, and free from acidity; not becoming ſolid in a moderate cold. The phlegm was found to contain a conſiderable quantity of volatile alkali.

An oil now began to riſe, deeper coloured, exceedingly fetid, and empyreumatic, with a thinner yellow oil, with which it did not mix. The vapor of the volatile ſalt formed cryſtals, which attached themſelves to the ſides of the receiver.

The heat being now raiſed till the bottom of the retort was red hot, a maſs was obtained of the oil and dry ſalt, weighing two drachms, one ſcruple, and fifteen grains. Of this maſs, one-fourth part was volatile alkali.

Theſe empyreumatic oils, as far as could be obſerved, reſembled exactly a ſimilar oil obtained from blood.

The retort being cooled, and broken; the caput mortuum was black, light, and ſhining, weighed three drachms and five grains. This was put into a crucible, and expoſed to a violent reverberatory fire for eight hours; there remained eight grains of reddiſh brown aſhes, with an earthy taſte, not at all ſaline. Theſe aſhes ſhowed a polarity on the application of the magnet.

The aſhes being digeſted in warm diſtilled water; the liquor ſtrained and evaporated, no ſalt could be obtained from them. Upon adding to them vitriolic acid, a ſmall part was diſſolved, like calcareous earth;

the greateſt part, however, was neither affected by the vitriolic nor nitrous acids."

The above analyſis proves, that Pus is compoſed of the ſame materials with the blood and animal jelly; and ſo far they are ſimilar, the ſame ſubſtances being produced from both: a knowledge of the chemical properties, however, gives us little information reſpecting thoſe properties which diſtinguiſh Pus from the other parts of an animal; or from the different ſecretions.

PUS varies in its appearance, according to the different circumſtances which affect the ſore that forms it, ſuch as the degree of violence of the inflammation; alſo its nature, whether healthy or unhealthy; and theſe depend upon the ſtate of health, and ſtrength of the parts yielding the Pus. Theſe changes ariſe more from indolence, and irritability, than from any abſolute diſeaſe: many ſpecific diſeaſes, in healthy conſtitutions, producing no change in the appearance of the

matter from their ſpecific quality, but by rendering the ſore either indolent, or irritable. Thus the matter from a gonorrhœa, from the ſmallpox puſtules, the chicken-pock, and from a healthy ulcer, has the ſame appearance, and ſeems to be made up of ſimilar parts, conſiſting of globules floating in a tranſparent fluid, like common Pus, the ſpecific properties of each of theſe poiſons being ſuperadded to thoſe of Pus. Matter from a cancer may be conſidered as an exception; but a cancerous ſore is never in a healthy ſtate.

In indolent ulcers, whether the indolence ariſes from the nature of the conſtitution, weakneſs of the parts, or the nature of the inflammation, the Pus is made up of globules, and flaky particles floating in a tranſparent fluid; and theſe globules and flakes are in different proportions, according to the degree of indolence: this is particularly obſervable in ſcrophulous abſceſſes, preceded by a ſmall degree of inflammation. That this flaky appearance is no part of true Pus, is well illuſtrated by obſerving, that the proportion it bears to the globules is greateſt where there is the leaſt inflammation; and in thoſe abſceſſes that ſometimes occur which

have not been preceded by any inflammation at all, the contents are wholly made up of a curdly or flaky ſubſtance of different degrees of conſiſtence, which I do not conſider as Pus, from its not having the properties ſtated in the definition of that fluid.

The conſtitution and part muſt be in health to form good Pus; for very ſlight changes in the general health are capable of producing an alteration in it, and even of preventing its being formed at all, and ſubſtituting in its place coagulable lymph. This happens moſt readily in ulcers in the lower extremities, owing to the diſtance of the parts from the ſource of the circulation, rendering them weaker. And it is curious to obſerve the influence that diſtance alone from the heart has upon the appearance of Pus.

A man had a compound fracture of the right-leg, and an ulcer on the ankle of the left; he was in tolerable health, both the ſores looking well. An attack of fever came on ſoon after, when the ulcer on the ankle ceaſed to form good Pus, the matter not ſeparating readily from the ſurface of the ſore, while the

compound fracture continued to look very well; but in twelve hours more the ſame change had taken place in the ſore of the compound fracture, which was about ſix inches higher up the leg than the ulcer.

The following obſervation will ſhow how much the appearance of the Pus depends upon the ſtate of the patient's general health. In a large hoſpital, on the weſt coaſt of this iſland, there were, at one time, twenty men with worn-out conſtitutions in the ſame apartment, having large ulcers in different parts of the body. Theſe ulcers, when the weather was mild, dry, and temperate, put on a healing appearance, and formed good matter; but any ſudden change in the weather, either becoming rainy, or damp with fogs, produced ſo great and ſudden an effect on the diſcharge from thoſe ulcers, as to change it, in the courſe of twenty-four hours, from a healthy appearance, which had laſted for ſome time, to the very reverſe, the whole ulcer being covered with coagulable lymph, reſembling melted tallow ſpread over it, which could not be ſeparated from its ſurface.

In irritable ſores, the diſcharge is often thin, being principally made up of an aqueous fluid poſſeſſed of an irritating quality, and containing few globules; ſuch ſores are commonly attended with hæmorrhage from the ſmaller veſſels, by which means the diſcharge is very materially altered in its properties, is rendered acrid, and more ready to run into putrefaction than true Pus. We find, however, in many irritable conſtitutions, the ſame appearances that were mentioned to take place in the indolent, the coagulable lymph being thrown out, and adhering firmly to the ſurface of the ſore; therefore, the appearance of a ſore alone will not lead us to a correct judgment of its nature, but will only inform us whether it is healthy or unhealthy.

Although I have taken notice of theſe different appearances of Pus, from their being ſo connected with its hiſtory as to deſerve attention, I do not conſider them as belonging to true Pus; but as ariſing from a defect in the proceſs, whatever it is, by which Pus is formed.

As Pus has been ſuppoſed to have a corroding quality, I made the following experiments to aſcertain the truth, or fallacy of ſuch an aſſertion, and found it to be void of foundation, and to have ariſen from the inaccuracy of obſervers having prevented them from ſeeing the diſtinctions between Pus in a pure ſtate, and when mixed with other ſubſtances.

EXPERIMENT I.

I made a comparative trial upon matter contained in an abſceſs, and on Pus and animal jelly out of the body. The matter and jelly were in equal quantities, and contained in glaſs-veſſels kept nearly in the temperature of the human body. To make the comparative trials as fair as poſſible, a portion of muſcle, weighing exactly one drachm, was immerſed in the matter of a compound fracture, in the arm of a living man, and a ſimilar portion into ſome of the ſame matter out of the body; alſo a third portion into fluid calf's foot jelly, in which the animal ſubſtance was pure, having neither wine nor vegetables mixed with it. Theſe three

portions of muſcle were taken out once every twenty-four hours, waſhed in water, weighed, and returned again. The reſults were as follows:

In 24 hours—the portion of muſcle in the abſceſs weighed ſixty grains, was pulpy and ſoft, but quite free from putrefaction: that portion immerſed in the Pus, weighed forty-ſix grains, was pulpy, ſoft, and had a ſlightly putrid ſmell: the portion in the jelly weighed thirty-eight grains, was ſmaller, and firmer in its texture.

48 hours—the portion of muſcle in the abſceſs weighed thirty-eight grains, and had undergone no change: that in the matter weighed thirty-ſix grains, was ſofter, and more putrid: that in the jelly thirty-ſix grains and ſmaller.

72 hours—the portion of muſcle in the abſceſs weighed twenty-ſeven grains, was drier, and firmer: that in the matter eighteen

grains, and was rendered fibrous and thready: that in the jelly unaltered.

In 96 hours—the portion of muſcle in the abſceſs weighed twenty-five grains: that in the matter was diſſolved: that in the jelly weighed thirty-ſix grains.

120 hours—the portion of muſcle in the abſceſs weighed twenty-two grains, not at all putrid: that in the jelly thirty-four grains, not at all putrid.

144 hours—the portion of muſcle in the abſceſs weighed twenty-two grains, and was free from putrefaction: that in the jelly thirty-four grains.

The next day the jelly had evaporated to dryneſs, which put an end to the comparative experiment. The portion of muſcle in the abſceſs was kept there a few days longer, without undergoing any change or dimi-

nution of weight; and was taken out, in conſequence of the arm requiring fomentation, which interfered with the experiment.

EXPERIMENT II.

A ſimilar experiment was made upon the matter contained in an abſceſs recently opened, where the Pus was not pure, but mixed with blood from the cut edges of the external opening, which had not come to ſuppuration.

A portion of recent muſcle, weighing one drachm, was immerſed in the abſceſs; and a ſimilar portion in a ſmall veſſel of water, of nearly the temperature of the human body.

In 24 hours—the portion of muſcle in the abſceſs weighed twenty-four grains, and was very putrid: that in the water forty grains, rendered ſmaller, but free from putrefaction.

In 48 hours—the portion of muſcle in the abſceſs was wholly diſſolved: that in the water weighed thirty-eight grains.

This circumſtance alone of Pus, when in a pure ſtate, not readily taking on the putrefactive fermentation, diſtinguiſhes it from thoſe fluids which are not perfect ſubſtances, but a mixture, which Pus muſt be reckoned, in theſe inſtances, where it has extraneous parts mixed with it; and likewiſe diſtinguiſhes it from the produce of fermentation of animal or vegetable ſubſtances, as they run very readily through all the different ſtages of fermentation, that proceſs being once begun.

The property which characterizes Pus, and diſtinguiſhes it from moſt other ſubſtances, is, its being compoſed of globules. This appears to me to throw conſiderable light upon the ſubject; ſince the preſence of the globules ſeems to depend upon the Pus being in a perfect ſtate; from which we learn the circumſtances neceſſary for the production of good Pus. Mr. Hunter was, I believe, the firſt who took notice

of this property; and has thereby furniſhed us with a very accurate diſtinction between Pus and animal mucus. For the appearance of what is properly termed Mucus, that is, animal ſubſtance diſſolved from putrefaction, is flaky, and very different in its appearance from Pus. It is alſo by this property diſtinguiſhed from all the chemical combinations of animal ſubſtance that I am acquainted with; every one of which appear in the microſcope to be made up of flakes.

At the ſame time that this appearance in the microſcope diſtinguiſhes Pus from other ſubſtances, it ſhows its great affinity to the other animal ſecretions, although in many circumſtances it differs from them.

It differs from the blood in the colour of the globules; in their not being ſoluble in water, which thoſe of the blood are; and from the fluid in which they ſwim being coagulable by a ſolution of ſal ammoniac, which ſerum is not.

The obſervation of, " The fluid in which the globules of Pus are contained, being coagulated by a ſolution of ſal ammoniac," is not taken from the reſults of Dr. Brugman's experiments; but from the following, made by Mr. Hunter, prior to the publication of Dr. Brugman's Theſis.

EXPERIMENT III.

" A drop of matter, and a drop of blood, were placed upon a piece of glaſs, at a ſmall diſtance from each other, and the glaſs was fixed under the magnifying lens of a microſcope: while in this ſituation, the point of a toothpick was dipped in a ſaturated ſolution of ſal ammoniac, and applied to each of them. This was repeated two or three times. The drop of matter, inſtead of appearing more diluted, became viſcid and ropy; and upon being examined through the magnifying glaſs, the globules appeared perfectly diſtinct in the coagulum.

The drop of blood had no appearance of coagulation; on the contrary, it was more diluted.

This experiment was repeated ſeveral times, and the reſults were always ſimilar."

Pus differs from chyle, in its globules being larger; not coagulating by expoſure to the air, nor by heat, which thoſe of chyle do.

The pancreatic juice contains globules; but they are much ſmaller than thoſe of Pus.

Milk is compoſed of globules, nearly of the ſame ſize as thoſe of Pus; but much more numerous. Milk coagulates by runnet; which Pus does not; and contains oil and ſugar, which are not to be diſcovered in Pus.

THE caſes in which Pus is formed, are, properly ſpeaking, all reducible to one, which is, The ſtate of

parts conſequent to inflammation. For as far as I yet know, the fluid which I have conſidered as Pus, in this diſſertation, has, in no inſtance been met with, unleſs preceded by inflammation; and although, in ſome caſes, a fluid has been formed, independent of preceding inflammation, it differs from Pus in many of its properties, as has been already obſerved.

Inflammation appears not only to be the forerunner, but the abſolute cauſe of the formation of Pus; and there are ſome facts which furniſh ſtrong arguments in favour of the ingenious idea Mr. Hunter has ſuggeſted in his lectures; "That the veſſels of the part take on the nature of a gland and ſecrete a fluid which becomes Pus."

The facts are as follows: In inflammation, the ſmaller blood-veſſels become conſiderably enlarged; and what is curious, this takes place in the greateſt degree in the veins; the ſmall veſſels are not only enlarged, but become more numerous; which does not proceed entirely from the blood being propelled further than uſual in the old veſſels, but from new ones being

formed; and this takes place in a much ſhorter time than has been commonly imagined. It is highly probable, that theſe new veſſels are ſo conſtructed, as to make the blood undergo certain changes, by which the fluid, that afterwards conſtitutes Pus, is formed.

It has been long diſcovered, that new veſſels are generated in extravaſated coagula of blood, and exudations of coagulable lymph; and this fact is well illuſtrated by many ſpecimens, in the collection of diſeaſed parts, exhibited by Mr. Hunter at his lectures. But the following caſe aſcertains the period in which this effect can be produced to be within twenty-four hours. And we know that Pus commonly requires a much longer time for its formation under the ſame circumſtances, and in ſimilar parts.

I performed the operation for the ſtrangulated hernia, upon a man, in other reſpects in health, at ſeven o'clock in the morning. The hernial ſac was laid open, and the gut, which proved to be a portion of the ilium, about ſix inches in length, was attentively examined previous to its being returned into the cavity of the

belly: it had the natural poliſhed ſurface, peculiar to an inteſtine; and although its veſſels were turgid with blood, it did not appear that they were uncommonly numerous. After the operation, the ſymptoms did not abate ſo much as might have been expected; and, during the afternoon, he complained of pain in the lower part of his belly: he had no paſſage by ſtool; and next morning, about ſeven o'clock, his pulſe was ſcarcely perceptible to the touch; his ſkin cold and clammy; and about twelve at noon he died, having lived twenty-nine hours after the operation.

The body was opened, and the portion of gut, which had been ſtrangulated, was found conſiderably inflamed; the external ſurface having loſt its natural poliſh, and having ſeveral ſmall portions of exuded coagulable lymph adhering to it. The veſſels of the gut were minutely injected, the arteries with a red coloured injection, and the veins with a yellow one. Upon examination, afterwards, all theſe adhering portions of coagulable lymph were found to be injected, having a conſiderable artery going to each of them, and a returning vein which was larger than the artery. It is

evident, therefore, that the coagulable lymph was laid upon the external ſurface of the gut after the operation: and we cannot ſuppoſe, that any ſuch proceſs as the forming of new veſſels, could have been going on during the laſt five hours of his life, when the pulſe in the wriſt was ſcarcely to be felt, and the powers of life were ſo much weakened in every reſpect. We muſt therefore conclude, that the whole operation of throwing out coagulable lymph, and ſupplying it with blood-veſſels after it had become ſolid, was effected in leſs than twenty-four hours.

This ſhows, that inflammation forms a vaſcular ſurface previous to the formation of Pus. Is it not, therefore, highly probable, that the newly formed parts are ſo organized as to ſecrete that fluid?

IN conſidering the time required for the formation of Pus, I ſhall firſt take notice of the periods which are found, under different circumſtances, to intervene between a healthy or natural ſtate of the parts, and

the preſence of that fluid after the application of ſome irritating ſubſtance to the ſkin.

In caſes of wounds made into muſcular parts, where blood-veſſels are divided, the firſt proceſs which takes place, is the extravaſation of red blood; the ſecond, is the exudation of coagulable lymph, which afterwards becomes vaſcular; and the third, the formation of matter, which laſt does not, in common, take place in leſs than two days: the preciſe time will, however, vary exceedingly, according to the nature of the conſtitution, and the ſtate of the parts at the time.

If an irritating ſubſtance is applied to a cuticular ſurface, upon which it raiſes a bliſter, Pus will be formed in about twenty hours, as we find in the following experiment.

EXPERIMENT I.

I applied a bliſtering plaſter, the ſize of a half-crown piece, to the pit of the ſtomach of a healthy young man. In eight hours a bliſter roſe, which was

opened, and the contents removed; they were fluid, tranſparent, and coagulated by heat; had no appearance of globules when examined by the microſcope; and in every reſpect reſembled the ſerum of the blood. The cuticle was not removed; but allowed to collapſe; and the fluid, which was formed upon the ſurface of the cutis, was examined from time to time, by a microſcope, to detect, as accurately as poſſible, the changes which took place. The better to do this, as the quantity in the intervals ſtated below muſt be exceedingly ſmall, a piece of talc, very thin and tranſparent, was applied to the whole ſurface, and covered with an adheſive plaſter; and the ſurface of the talc, applied to the ſkin, was removed and examined by the microſcope, applying a freſh piece of talc after every examination, to prevent any miſtake which might have ariſen from the ſurface not being quite clean.

The fluid was examined by the microſcope, to aſcertain its appearance; but as the aqueous part in which the globules of Pus ſwim, is found, by experiment, to coagulate, by adding to it a ſaturated ſolution of ſal ammoniac, which is not the caſe with the ſerum of the

blood, nor the tranſparent part of milk, I conſidered this as a property peculiar to Pus; and conſequently that it would be a very good teſt by which to aſcertain the preſence of true Pus.

In 8 hours—from the time the bliſter was applied, the fluid diſcharged was perfectly tranſparent, and did not coagulate with the ſolution of ſal ammoniac.

9 hours—the diſcharge was leſs tranſparent; but free from the appearance of globules.

10 hours—the diſcharge contained globules, which were very ſmall, and few in number.

11 hours—the globules were numerous; but ſtill the fluid did not coagulate with the ſolution of ſal ammoniac.

12 hours—the appearance much the ſame as before.

In 14 hours—the globules a little larger; and the fluid appeared to be thickened by a ſolution of ſal ammoniac.

16 hours—the globules ſeemed to form themſelves into maſſes; but were tranſparent.

20 hours—the globules were double the ſize of thoſe firſt obſerved at ten hours, and gave the appearance of true Pus in a diluted ſtate: the fluid was coagulated by a ſolution of ſal ammoniac; the globules, at the ſame time, remaining perfectly diſtinct; ſo that I ſhould conſider this as true Pus.

22 hours—no change appeared to have taken place.

32 hours—the fluid was conſiderably thicker in conſiſtence, the number of globules being very much increaſed: but in no other reſpect, that I could obſerve, did

it differ from that formed twenty hours after the application of the bliſter.

As the reſults of microſcopical experiments have been found exceedingly fallacious, a prejudice has very naturally ariſen againſt all experiments of this kind, upon the ſecretions of the human body, from a ſuppoſition that they are not to be depended upon. But it is right that we ſhould diſcriminate, and not condemn the uſe of the microſcope altogether, becauſe, from ignorance of its principles, it has been miſapplied; ſince theſe very deceptions have been the means of our acquiring a more accurate knowledge of the uſe and application of that inſtrument.

The errors, in the uſe of the microſcope, have ariſen from increaſing the magnifying powers of the glaſſes too much, and not taking in all the circumſtances relating to the refraction of the rays of light; making no allowance for the abberration. An attention to the aberration alone will explain the different appearances under which the red globules of the blood have been repreſented. Some have found them perfect ſpheres;

which will always be the caſe when the glaſſes are perfectly adjuſted, and the object placed at the true focal diſtance. Others have found them annular, from the object being at the focal diſtance of the rays tranſmitted near the circumference of the magnifying glaſs, which are refracted in a greater degree, and conſequently ſhorter than the central rays. Others again have viewed them as flattened bodies of a circular figure, bright in the centre, and becoming darker towards the edges; which appearance ariſes from the object being at the focal diſtance of the central rays of the magnifying glaſs, which will be leſs refracted than thoſe near the circumference. Although ſuch are the errors which ariſe when microſcopical reſearches are puſhed beyond certain bounds; yet that the red part of the blood is made up of globules, is a diſcovery for which we are indebted to the microſcope; and which ſeems to be as well aſcertained as any diſcovery in anatomy or phyſiology. The appearances of Pus, mentioned in this paper, are equally diſtinct, when examined on the field of a microſcope, as the globules of the blood; are viſible with a ſmall degree of mag-

nifying power; and are the ſame to the eyes of different perſons.

The time required to form Pus, on a ſecreting ſurface, appears, from the following experiment, to be five hours.

EXPERIMENT II.

A common bougie, four inches long, was introduced into the urethra of a healthy young man. The ſurface of the bougie was not oiled, which made the irritation more violent, and prevented there being any ambiguity in the appearance of the fluid collected upon it.

In ½ an hour—the bougie was withdrawn, and the fluid on its ſurface, examined by the microſcope, was found to contain globules that were very ſmall, and few in number, reſembling thoſe found under the cuticle in the bliſter at ten hours. The bougie was again introduced.

In 1 hour—the fluid had the ſame appearance.

In 1 hour and ½—the globules larger and more numerous.

3 hours—the globules more numerous.

4 hours—the globules larger; but the fluid did not coagulate with the ſolution of ſal ammoniac.

5 hours—the globules large and numerous: the fluid coagulated with the ſolution of ſal ammoniac. I therefore conſidered it as true Pus.

To proſecute this inquiry ſtill further, I endeavoured to aſcertain the changes this fluid undergoes from the time of its leaving the extremities of the veſſels which form it, till it becomes that thick fluid we find upon ſuppurating ſurfaces, called Pus.

In this inveſtigation it is neceſſary to attend to the following circumſtances: That a ſuppurating ſurface,

upon expoſure, does not form Pus, but a watery fluid, ſimilar to what is thrown out in conſequence of the irritation of cantharides, which, from its coagulating by heat, is moſt probably ſerum; and, that preſſure, from a hard ſubſtance, acts as an irritator, and produces a ſimilar effect to expoſure. Theſe circumſtances rendered ineffectual ſeveral trials which I made, to collect the matter from a healthy ſore, on pieces of glaſs.

After ſeveral unſucceſsful trials, in different ways, to collect the fluid in the various ſtates of its formation, I uſed ſmall pieces of very fine lamellæ of talc; which, although hard ſubſtances, were, from their extreme thinneſs, very light; and, having a ſmooth poliſhed ſurface, gave leſs irritation than any other ſubſtance that I could deviſe. One circumſtance which renders them fit for theſe experiments, is, that the fluid being in very ſmall quantity, and from that circumſtance drying almoſt immediately, there is no time for removing it from the ſurface upon which it is collected, to another, for examination.

I ſhall briefly ſtate the arguments which appear to have moſt weight, in ſupport of Pus being a ſecretion from the blood.

In its chemical analyſis, it is found to contain ſimilar ſubſtances with the blood.

It is, in a recent ſtate, free from any tendency to putrefaction.

It is always in harmony with the parts which form it, having no power of irritating them, even when the ſurrounding parts are affected by it. This ſeems to be peculiar to ſecretions; and may be illuſtrated by the tears excoriating the cheek, although no ſuch effect is produced on the lacrimal gland or ducts.

Its appearances vary according to the ſtate of the conſtitution at the time; and are affected by very ſlight changes in the general habit, ſimilar to ſecretions; which could not be the caſe were it only made up of the ſolids and fluids of the part.

It is readily abſorbed or taken back into the circulation, without producing any ill effect upon the conſtitution.

The parts which form it aſſume a ſtructure ſimilar to that of a gland, by becoming exceedingly vaſcular: and what is curious, and deſerving of obſervation, is, that parts appear to require more time to be rendered fit for carrying on this proceſs, in proportion as they are different in ſtructure from a gland. In internal canals, which have naturally a ſecreting ſurface, Pus is formed in five hours. On the cutis, which is very vaſcular, in leſs than twenty hours. And in common muſcles, nearly in forty-eight hours.

It is compoſed of globules ſwimming in a tranſparent fluid; which is the caſe with many ſecretions.

It is thinner at the time of leaving the veſſels than afterwards, ſimilar to ſecretions in general.

I made ſeveral attempts to aſcertain whether thoſe ſecretions in which there are globules, really leave the

ends of the veſſels in that form, or acquire it afterwards, ſimilar to Pus. But the ſtructure of glands, in general, is ſuch, that I have been unable to deviſe any method of collecting the ſecretion immediately upon its leaving the ſecretory veſſels before it is carried along the excretory duct, which muſt be done to aſcertain its nature at the time of its formation.

It is, however, highly probable, from what we know of the ſecretions in general, that they muſt, in every inſtance, leave the terminations of the ſecreting veſſels in a very fluid ſtate; and muſt take on the conſiſtence they are found to poſſeſs, either immediately, or ſoon after they are ſecreted, ſimilar to Pus.

THE END.