Report on the nature and import of certain microscopic bodies found in the intestinal discharges of cholera : presented to the Cholera Committee of the Royal College of Physicians of London ,by their sub-committee, on the 17th October, 1849.

REPORT

ON

THE NATURE AND IMPORT OF CERTAIN MICROSCOPIC BODIES FOUND IN THE INTESTINAL DISCHARGES OF CHOLERA;

PRESENTED TO THE CHOLERA COMMITTEE OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON, BY THEIR SUB-COMMITTEE,

ON THE

17TH OCTOBER, 1849.

(Published under the sanction of the Committee.)

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Royal College of Physicians,
Pall Mall East,
October 27th, 1849.

The following Report was, in substance, laid before the Cholera Committee on the 17th instant; and we were then authorized to send copies of it to the members of the College. The epidemic was already rapidly declining, and it seemed desirable to make known the results of our inquiry before the opportunity of verifying them should be lost.

Dr. Jenner's observations and, with a single exception, Mr. Marshall's, were included in the original draught read to the Committee. On the same day Mr. Busk communicated to the Microscopical Society his observations on the identity of some forms of the "Cholera bodies" with a species of uredo, the contents of brancells, and starch-grains, respectively. These have been

embodied in the Report, together with the result of Mr. Marshall's examination of bran-cells (made subsequently, but independently of Mr. Busk's), and the fact, that the smallest "Cholera bodies" are derived from chalk,—a result to which we were led by the remarks of Dr. J. W. Griffith on their physical and chemical characters.

William Baly,
William W. Gull.

REPORT

ON

THE NATURE & IMPORT OF CERTAIN MICROSCOPIC BODIES FOUND IN THE INTESTINAL DISCHARGES OF CHOLERA.

We propose, in this Report, to lay before the Committee the results of some experimental inquiries on a subject which, within the last few weeks, has engaged much of the attention of the profession. We allude to the discovery, by Mr. Brittan and Mr. Swayne, of Bristol, of peculiar bodies in the "rice-water" dejections of Cholera patients; and to the statement that similar bodies have been found by Mr. Brittan in the atmosphere, and subsequently, by Dr. W. Budd, in the drinking-water of infected localities.

These observations, on account of their important bearing, if true, on the Pathology of Cholera, seemed to us to demand a searching examination. We have, accordingly, given much time and attention to the subject. Having, in the first place, satisfied ourselves of the distinctive characters of the bodies found in the rice-water dejections, we next sought to verify the observations of Mr. Brittan and Dr. Budd with reference to their presence in the air and drinking-water of places infected with Cholera. It was necessary that this part of the inquiry should not be delayed; for the epidemic had already reached its turning point, and it would, before long, have been difficult

to obtain favourable opportunities for experiments of a satisfactory character.

Our inquiries were afterwards directed to the nature and properties of the newly-discovered corpuscules, and to the question of their occurrence in other diseases. In this investigation, we soon perceived that objects totally different had been regarded as identical; but we had arrived at no positive conclusion respecting those which seemed most characteristic of the Cholera evacuations, when we received two important communications on the subject from Mr. Marshall and Dr. Jenner. The letters of these gentlemen are appended to this Report ; but the results obtained by them are embodied in it.

Our observations on the air and drinking-water of infected localities, twenty-four in number, gave uniformly negative results. With regard to the value of our experiments, taken separately, it will, we think, appear that many are liable to no objection. Some of those which relate to the drinking-water of infected places, are certainly wanting in the conditions which would make them convincing. But when it is considered that Dr. Budd believes he has detected the objects sought for "in great numbers", in such large bodies of water as the Float, at Bristol, and the Surrey canal, and that he represents them as being deposited in the sediment of the water, we shall not be thought unreasonable in having expected that they *might* be discovered in the cisterns of houses and public institutions in which Cholera had prevailed severely, although it had ceased there for some days or weeks.

Nevertheless, a much larger amount of evidence would have been required to disprove the statements

to which our observations refer, had those statements been unassailable from other points. But the facts to be detailed in the subsequent part of this Report, will shew that the bodies found in the rice-water dejections have no peculiar relation to Cholera; and, that if they should occasionally be present in the atmosphere, or impure water, this will not happen exclusively, or even especially, in districts infected with the epidemic.

We shall now submit the particulars of all the observations to the Committee, describing first those on the air.

Microscopic Observations on water condensed from the Atmosphere of Infected Localities.

Two methods were employed for condensing the aqueous vapour. One was, to suspend in the air to be examined a glass funnel, nearly filled with a freezing mixture, its lower opening having previously been closed by a cork and covered with sealing-wax. The moisture condensed on the outside of the funnel, trickled into a small phial placed beneath. The second method was, to force air slowly, by means of bellows, through a bent glass tube immersed in ice and salt; when the moisture was deposited on the interior of the tube, and collected in a bulb at its lower part. In either way from half a drachm to a drachm of water was readily obtained.

Obs. 1.—In Millbank prison, from the 6th June to the 16th September, there occurred eighty-four cases of cholera. The last patient began to suffer from diarrhœa on the 16th September, and died on the 25th. On the 19th, when he lay in a state of collapse, about a drachm of water was condensed from the air of a lobby which separated his small apartment from a water-closet, in which

his evacuations were emptied. The water thus obtained was submitted to microscopic examination the same evening.

Obs. 2 *and* 3.—On the same day (the 19th September), we accompanied Mr. Bayfield, one of the surgeons of the Union of St. Olave's, Southwark, to two localities in his district, in which cholera had been most prevalent, namely, English Ground, Bull Court, Tooley-street, and Gimber's Rents, Snow's Fields. In a ground-floor room of a house in the former court, a woman and child had died of cholera within a few days; and the husband, at the time of our visit, was in bed, ill with the disease. Nearly a drachm of water was obtained from the noisome atmosphere of this room.

In Gimber's Rents the drainage and the ventilation were as bad as possible. In several places we saw the openings of drains covered with matting, to prevent the escape of effluvia. We collected about a drachm of water from a house where a woman lay ill of cholera; her husband having only recently died of the epidemic. The water procured in these two experiments, was examined the same evening, and the examination of it repeated on several subsequent days.

From Gimber's Rents we brought away a piece of bread which had been long in the house, and which had not been cut for a week; a piece of butter, the surface of which was covered with dust; and a jug, which we found filled with drinking water. The examination of this water will be referred to in our second series of experiments. On the bread and the butter, no bodies like those observed in the rice-water evacuations could be found.

Obs. 4 *and* 5.—On the 22nd September, water was condensed from the atmosphere in two houses situated in St. Erman's Hill, near the Broadway, Westminster. Mr. Painter, Surgeon of St. Margaret's parish, to whom we had explained our object, conducted us to this locality, as, at that time, the chief focus of the disease. In one house (No. 21) a child lay dead, having been attacked with cholera the preceding evening. Two other cases had recently occurred in the same house At No. 12 a child was ill of cholera; and a second had been removed, in the morning of the same day, to the Cholera Hospital, where it died. Mr. Brittan and Mr. Newport took part in the microscopic examination of the water condensed from the air in these houses, about an hour after it was collected; but, like ourselves, were unable to discover any "annu-

lar bodies". On the following day, the same water, as well as that procured in the second and third observations, was again examined by Mr. Brittan, and with the same result.

Obs. 6.—On the 6th October cholera appeared amongst the patients in the Insane ward of the Birmingham workhouse ; many were attacked. On the 9th October, at our request, Dr. Fletcher, of Birmingham, kindly obtained for us some water condensed from the atmosphere of this ward, and likewise from that of one above it, when diarrhœa was prevalent. These specimens of water reached us, and were examined by us, on the 11th October.

Obs. 7.—From the beginning of the month of October cases of cholera had been numerous and fatal in the workhouse of the Walsall Union ; partly imported, but partly occurring in inmates of the workhouse. When the epidemic was at its height, we obtained, through the kindness of Dr. F. Burton, of Walsall, about a drachm of water from the air of the room in which the greater number of the cases occurred. This specimen of water was condensed from the air on the 7th, and was examined by us on the 8th October.

The water condensed from the air in the several localities and under the circumstances we have described, was, in each case, examined by us more than once. But the search for "annular" bodies, such as those found in the Cholera dejections, failed, as we have already intimated. Neither cells, nor rings, nor anything bearing a resemblance to them could, in most cases, be discovered. We saw merely portions of gelatiniform matter containing bright points—sometimes finely granular, brownish masses, perhaps derived from smoke,—and occasionally colourless, transparent particles, of a crystalline appearance, which may have been portions of silicious dust. After the water had been kept some time, chains of delicate oval vesicles, like those of the torula of yeast, but much smaller, appeared in it. These were absent at first, and could not be mistaken for the Cholera discs. Equally unlike

those discs, were the three or four separate oval cells, which, in two instances, were seen in the water when first examined. They had a clear, single outline, and were not flattened.

Microscopic Observations on the Drinking-Water of Infected Places.

Obs. 8.—On the 26th September, Dr. Snow kindly furnished us with a specimen of water from Albion terrace, Wandsworth, a locality in which cholera had been very fatal between the 28th July and the 13th August. This water, which was very foul, had been taken from a tank at Albion terrace on the 16th or 17th of August; but, as it had been kept so long before it was submitted to microscopic examination, it may be objected that, had "cholera fungi" originally been present, they might have become decomposed or otherwise destroyed.

Obs. 9.—A second specimen of water, sent to us at the same time by Dr. Snow, was obtained from a house in Gresse street, Rathbone place, in which five persons had recently died of cholera. The last case of the disease here occurred two days before the water was obtained from the cistern, and twenty-four days before it was examined by us with the microscope.

Obs. 10.—From the 31st August to the 7th September four fatal cases of cholera occurred amongst the female prisoners in two wards of the Millbank prison. The part of the building where these wards were situated was forthwith vacated. On the 19th September a portion of water with sediment was taken from the cistern which supplied those wards, the contents of this cistern having remained undisturbed since the removal of the prisoners to another part of the building. At the same time specimens of water were taken from the cistern of the female infirmary, where two fatal cases of cholera had occurred simultaneously with those above referred to, and also from the tank which supplies the whole prison. These three specimens of water were submitted to the microscope the next day.

Obs. 11.—The drinking-water taken on the 19th September from the house in Gimber's rents, Borough, (see *Obs.* 3,) deposited a sediment which was carefully examined. The description of the locality has been already given.

Obs. 12.—On the 27th September we visited Crosby court, Bermondsey, an open space containing seven houses. Four cases of cholera (two fatal) had recently occurred in one of these houses, the others having escaped. The house in which cholera had been fatal was closed. But we found that the water used by the inhabitants of the court came from two pumps ; one supplied from the Thames water, the other raising well-water, which was hard and ferruginous. On a strict inquiry it appeared that the Thames water was used for drinking in every house except the one in which cholera had appeared ; in that house only the well-water was used. We brought away water from both pumps, and examined the deposits, which were abundant, on the following day.

Obs. 13. We next went to Jacob's Island, Bermondsey, a most crowded and wretched part of the district, in which Cholera had been very severe. It is a portion of low ground bordering the river, and surrounded by a shallow tidal ditch, which receives the contents of the privies on either bank. The water for drinking and other purposes, is taken for the most part from this ditch. We procured some water from the ditch itself, and also from two pumps supplied from it, situated in Gutteridge's Court, where deaths had occurred.

Obs. 14. On the same day we also went to Hanover Street, Rotherhithe, a low and crowded cul-de-sac. A woman lay dead of Cholera in one of the houses; and other deaths had occurred. The water used, of which we procured a specimen, was derived from the Thames, through a pump which became dry at every ebb. Behind the houses on the east side was an open ditch, receiving the refuse from them and conveying it into the Thames, at a point close to the opening of the pipe which supplied the pump in the street.

Obs. 15.—In a house in Swan Lane, Rotherhithe, close to the Millpond, a man lay dead of cholera. The disease had been fatal in two adjacent houses. The woman, whose husband had just died, told us that she and most of the inhabitants took their water for drinking from the Millpond, which is a tidal ditch serving as a sewer to the houses on its banks. We filled a bottle with water from this source.

Obs. 16.—Dr. Burton of Walsall forwarded to us, on the 7th October, three specimens of water from the workhouse, cholera prevailing at the time amongst the inmates. (See *Obs.* 7.) The first was from an open cistern fed by land drains, the second from a moat, the third from cisterns in the workhouse. The last water,

which is that chiefly drunk by the paupers in the workhouse, is derived from the moat, but is filtered through charcoal and gravel. The deposits of all were carefully and repeatedly examined.

Obs. 17.—To Dr. Fletcher, of Birmingham, we are indebted for five specimens of the water which supplies the workhouse, forwarded to us at the time cholera prevailed in the insane ward of the establishment. (See *Obs.* 6.) The specimens included:—1. Clear water from the reservoir which is supplied from the river; 2. Sediment from the reservoir; 3. Clear water from the cistern of the workhouse; 4. Sediment from the bottom of the cistern; 5. Sediment from the side of the cistern. These specimens were examined on the 11th instant, and the examination of them has been most carefully repeated.

Obs. 18, 19, 20, 21, and 22,—were all made on water obtained for us by Mr. Hunt, one of the assistant-surgeons at the Westminster Cholera Hospital, from several parts of the district called Palmer's Village, which we have ourselves inspected. The names of the places are Goodman's Green, where the water used for all purposes is contained in a filthy open trough; Perrin's Place; a house (No. 3) in Perrin's Court, in which five cases of cholera (two fatal) had occurred; a house (No. 2) in Providence Row, where also there had been five cases (three fatal); and the Dispensary, Palmer's Village, at which two surgeons successively had been attacked with cholera, one fatally. Cholera had prevailed in all these localities, but not within a fortnight of the time when the water was taken for examination.

Obs. 23.—In a small house (No. 9) in Dorset Place, Vauxhall Road, three cases of cholera had occurred in succession; the first on the 5th instant, the second (fatal) on the 8th, and the third (also fatal) on the 12th. These cases were attended by Mr. Clark, of St. James's-terrace. On the 8th instant, just after the second case occurred, two specimens of water were, at our request, taken from the butt supplying the house,—one from the surface of the water, the other from the tap after the sediment had been stirred up; and both have been several times examined with the aid of the microscope.

Obs. 24.—On the 5th October a man labouring under cholera was admitted into University College Hospital. He had resided for some months at No. 4, Howland Street. A week previous to his attack he had changed his room to another in the same house,

where a woman had died of cholera seven weeks before. Water was taken from the kettle, and from a stone water jug in his room, as well as from a cistern which supplied the house. As he had dined in another house on the day previous to his attack, water was procured thence also. The deposits of these several specimens were likewise submitted to careful microscopic examination.

The uniform result of these experiments, as of the former series, was negative. No bodies were found which could be regarded as identical with the more characteristic of those discovered, by Messrs. Brittan and Swayne, in the rice-water dejections of Cholera. The objects met with were far more numerous than those seen in the moisture condensed from atmosphere. The sediment, when viewed with the 1-8th-inch object glass of Ross, or 1-16th-inch object glass of Powell and Lealand, presented, besides amorphous matter, an almost endless variety of organic forms, both animal and vegetable. Amongst these were many round or oval cells, of various dimensions, and some separate rings of minute size, colourless, and pellucid. The cells had generally very delicate walls and a clear cavity, were never flattened, and often contained a multitude of distinct granules, which, in some instances, presented the molecular motion. Like the rings, these cells were obviously different in their nature from the thick-edged disks, which the descriptions and drawings of Messrs. Brittan and Swayne and Dr. Budd had led us to regard as the characteristic corpuscles of the Cholera evacuations.

The negative results of our search in the atmosphere of infected places, for objects identical with those just referred to, are confirmed by some observations communicated to us by Mr. Marshall. While Cholera

was prevalent in St. Giles's, he examined the dirt washed from the broken glass of windows, and from cobwebs taken from houses in that district, in which deaths had occurred from four to ten days previously. With 1-12th inch or 1-8th inch object glass, he found a vast number of objects, such as particles of silex and soot, hairs, wings, and legs of insects, round and oblong cells of a brownish colour, very dark spherical granular masses, probably of a confervoid nature, and fragments of vegetable tissue, amongst which were pieces of spiral tubes, and entire rings, apparently of woody tissue, of an oval, polygonal, or circular form. But he detected no disks with double outline. A microscopic examination of the objects collected on a moist surface from the atmosphere of sewers, gave Mr. Marshall a similar negative result with regard to those discoid bodies; although he found (besides fine particles of silex and other dust) brown, oval, and round cells, single and in couplets, minute colourless vesicles, either single, double, or in triplets, a single large oval cell, and numerous opaque granular confervoid bodies, of a brownish or blackish green colour.

Microscopic Observations on the Bodies found in the Cholera Dejections.

We next proceed to show how various are the bodies which have been confounded together under the terms annular bodies (Mr. Brittan), Cholera cells (Mr. Swayne), and Cholera fungi (Dr. Budd).

On examining the drawings given by the three gentlemen who have called attention to the subject, four principal forms, which can hardly belong to the same objects, may readily be distinguished.

1.—*Rings*, which enclose a free area, and which

Fig. 1.

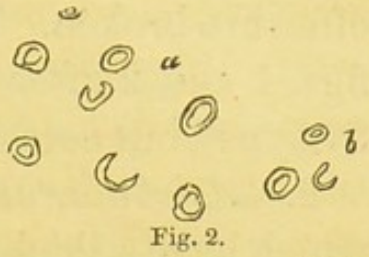

Fig. 2.

Fig. 3.

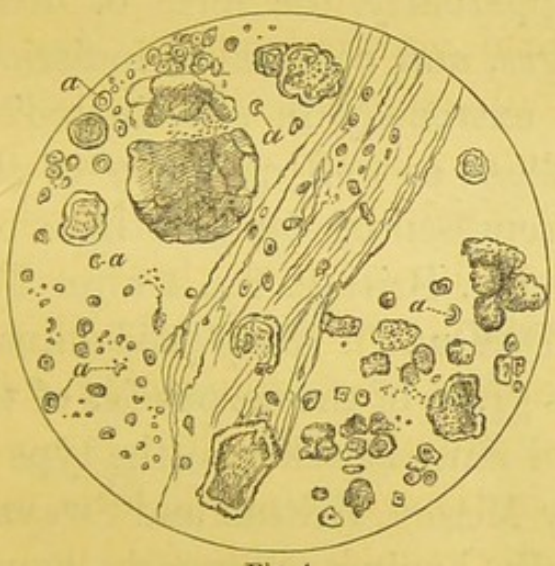

Fig. 4.

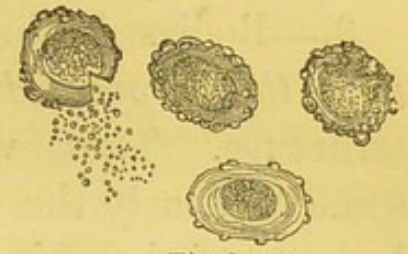

Fig. 5.

Fig. 6.

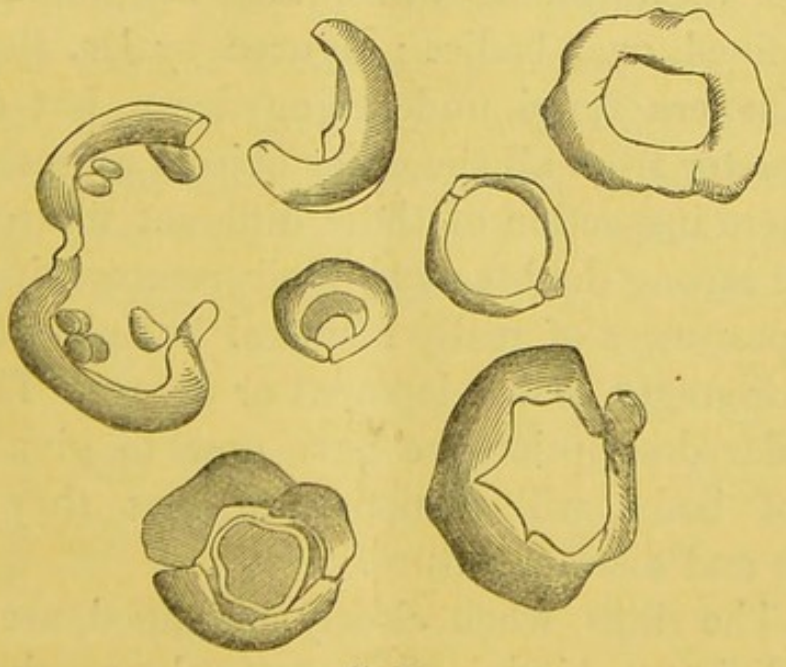

Fig. 7.

often are broken. These are usually of minute size (see figs. 1 and 2 after Mr. Brittan, and fig. 4*a* after Mr. Swayne), but occasionally large (fig. 7, after Dr. Budd).

2.—*Globular or oval cells*, chiefly of the middle size, which have a thick wall with numerous small eminences on its surface, and contain a granular mass, in some instances separated by a clear space from the wall of the cells. These are distinctly figured only by Mr. Swayne (see fig. 5), but are regarded by him as perfectly developed Cholera cells.

3.—Bodies having, apparently, the form of *discs, with thick rounded edges*, and centres of indistinct structure. These vary extremely in size, including some of nearly the smallest, as well as many of the largest, of the objects represented by the three observers (see fig. 3 after Mr. Brittan, fig. 4 after Mr. Swayne, and fig. 6 after Dr. Budd). They predominate in all the representations given of the corpuscles of the rice-water dejections, and must be taken as the type of the bodies discovered by Messrs. Brittan and Swayne.

4.—Large *broken cells*, having apparently homogeneous membranous walls, and containing small, well-defined, oval bodies ; figured by Dr. Budd (fig. 7) as Cholera fungi undergoing decay, but differing in character from all the other objects represented.

A mere inspection of these different figures would suggest strong doubts as to their representing different appearances of really identical bodies in different states or stages of development or decay. The more particular description we have now to give of each kind of body, will demonstrate that they are of various and distinct nature.

1.—The rings, when closely examined, are seen to be of different kinds, some perfectly continuous in

their entire circle, others formed by a curled fibre; some round, some oval, others lozenge-shaped. (See fig. 8.)* Some of these have been traced to their true source by Mr. Marshall, who has found that exactly similar objects may be prepared by the artificial digestion of the vegetables used as food: such as cabbages, potatoes and onions, the withered style of wheat grain, and portions of cane in sugar; the spiral and annular tissues of which, break down into rings of different sizes, or coils resembling rings. (Fig. 9.)

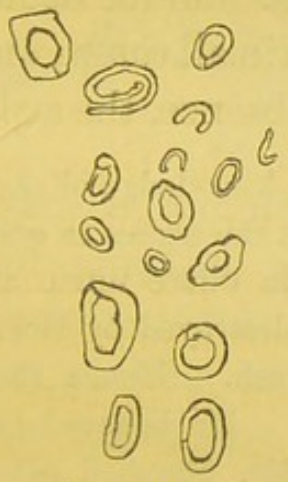

Fig. 8.—From Cholera.

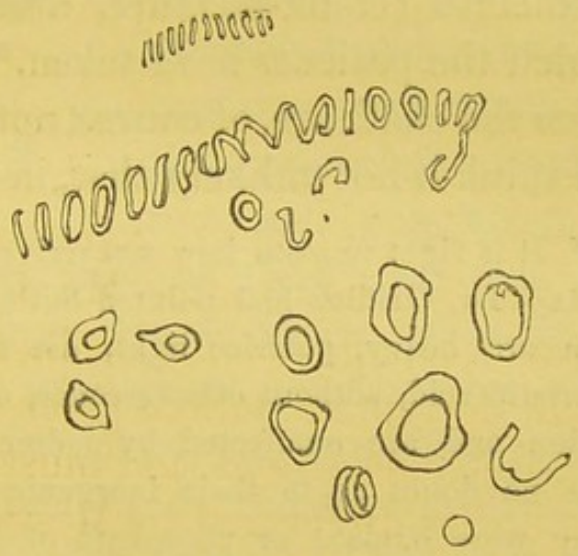

Fig. 9.—Artificial.

Many minute oval, or round, colourless corpuscles, which have an annular appearance, are, on close inspection, seen to have their area filled up with a transparent substance, presenting, sometimes, perforations. (See figs. 10 and 11.) In some specimens of the rice-water fluid, oval bodies, in part having

Fig 10.

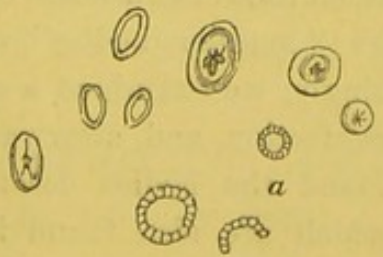

Fig. 11.

* All the figures are magnified from 360 to 400 diameters.

their middle filled up as here described, and, in part, mere rings, exist in extraordinary abundance. The rings of these bodies have been observed, by Mr. Busk and Dr. Griffith, to be divided, by cross-lines, into segments, which Mr. Busk thinks are bead-shaped: an appearance which had occasionally been noticed by ourselves, as well as by Mr. Marshall. (See fig. 11.) They are calcareous structures, originally derived from chalk, in which they abound; and they have been introduced into the contents of the intestines with the medicines (chalk-mixture, aromatic confection, &c.) which the patients have taken.* These minute bodies from the chalk are, of course, not found in all cases; and we think it not unlikely that, in their absence, the sepa-

* It is right to state how we arrived at the knowledge of these facts. Dr. Griffith had pointed out to us that the bodies in question are heavy, polarize light, are soluble in dilute nitric and muriatic acid, without effervescence, are not destroyed by incineration and are unaffected by iodine or potash. Hence there was no doubt as to their inorganic nature. He believed that they were oxalate or phosphate of lime. Mr. Marshall subsequently shewed us that acetic acid also dissolves them readily, and that sulphuric acid acts on them, producing needles of sulphate of lime. Having ourselves found the same bodies in the evacuations of two patients suffering from typhoid fever, we were examining them in company with Dr. Griffith and Mr. Marshall, when the demonstration of their calcareous nature reminded us of the fact, that these patients had been taking medicine containing chalk, and, at the same time, brought to our recollection the remark made to one of us by Mr. Topping, that Mr. Brittan's "annular bodies" were to be found in chalk-mixture. Accordingly, we examined a portion of medicine containing aromatic confection, and, afterwards, a piece of common chalk, and, in both, found the bodies described above, though not the larger disks which are also found in the rice-water fluid. Ehrenberg figures these calcareous bodies, and describes them as being "crystalloids". Abh. d Akad. d. Wiss. z. Berl. 1838. p. 68.

rated nuclei of animal and vegetable structures, as well as the vegetable rings above described, may sometimes have been mistaken for fungi. Fig. 12 represents a portion of mucus from the stomach of a Cholera patient, where the nuclei of epithelium are seen becoming freed from their surrounding cells, and assuming more and more of an annular appearance. Fig. 13 shews the green nucleated globules of a conferva, with some of the colourless nuclei free, and presenting a distinctly annular appearance, as they were seen in some drinking water from Dorset-Place (*Obs.* 23). The microscopic bodies from chalk are, however, the most striking in their characters, and, we believe, are those which have been chiefly regarded as representing the first stage of the Cholera fungi. They may be distinguished from those consisting of vegetable rings by the action of dilute nitric acid, which dissolves them, but has no action on the latter bodies.

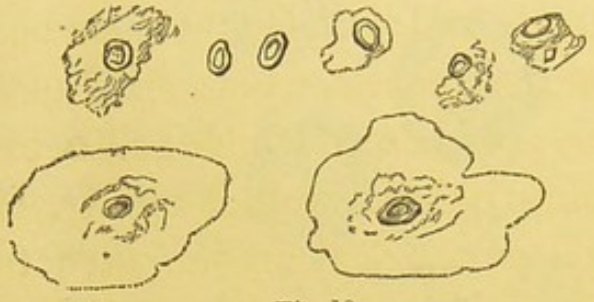

Fig. 12.

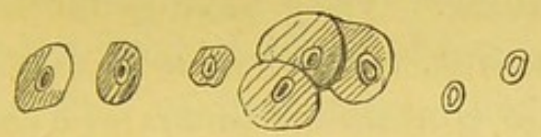

Fig. 13.

2.—The globular bodies have been clearly identified by Mr. Marshall with the spores of different kinds of Uredo, the rust, smut, and bunt of grain; some species of which may be found, not only about the withered style on grains of wheat, but also in almost every specimen of corn and bread.

Mr. Busk has made the same observation; and identifies them with the uredo segetum, or bunt. The fact is illustrated by the following figures, which may

be compared with the one copied from Mr. Swayne's paper. (See fig. 14, and fig. 15.)

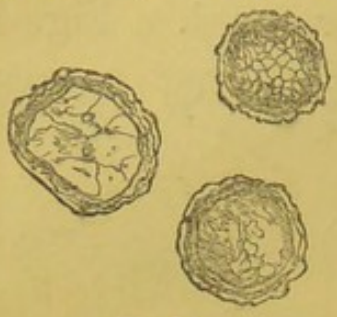

Fig. 14.
From Cholera.

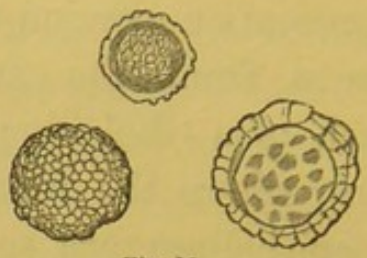

Fig. 15.
From Bread.

3.—Disks, with thick, elevated, and somewhat irregularly-curved margins; the central area flattened, and obscurely granular. They have generally a yellowish, or pale brown tint, which varies in depth with the colour of the fluid containing them. (Figs. 3, 4, and 6.) These are the most peculiar of the bodies found in Cholera, and differ from the rest in being more or less soluble in ether. Mr. Marshall, who first informed us of this fact, found that the smaller disks undergo nearly complete solution, leaving a cavity in the dried mucus (see fig. 16*a*), whilst the larger ones leave a fine granular film. They are apt to break across, and the thick margin to curl inwards. (Fig. 16*b*.)

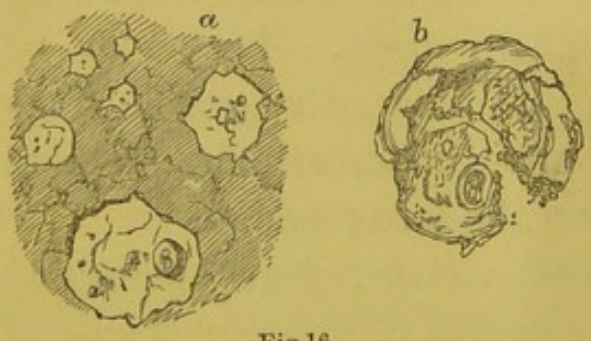

Fig.16.

They are evidently not cells, nor have they any organized structure which could give them any claim to be regarded as living organisms. On the other hand, their solubility in ether, shews that they consist, in great part, of some substance of the class to which the fats, resins, and saponaceous matters belong. This observation led Mr. Marshall to examine

different fatty substances, and at length to find that curled concretions, not unlike the disks found in cholera, could be obtained by compressing a piece of rich cheese (with or without the addition of ether) between two plates of glass. (See fig. 17.) We are not yet able to account for the origin of these peculiar discs. Mr. Busk regards the smaller ones as altered starch grains. It is, at all events, certain that they are not fungi; and, as we shall afterwards see, that they are not peculiar to cholera.

Fig. 17.

Mr. Busk thinks that the larger disks are the altered contents of bran-cells. Mr. Marshall, too, has, independently, made the observation, that certain yellowish bodies, sometimes seen, which have a thinner and narrower border than the fatty disks, and are merely rendered pellucid by ether, may, perhaps, be derived from bran. The granular masses contained in bran-cells have, however, when undigested, no distinct border. Fig. 18 represents their appearance when acted on merely by potash.

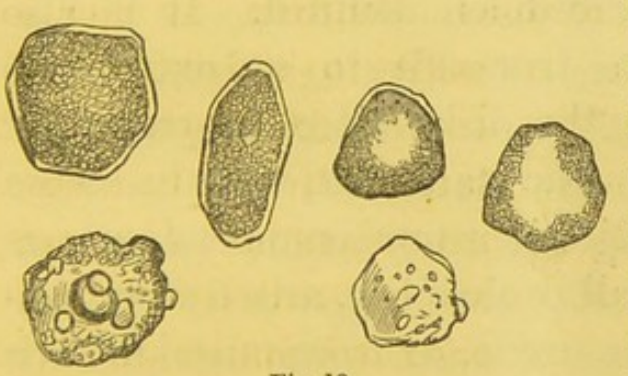

Fig. 18.

4. Under the fourth class of bodies, we refer to those represented by Dr. Budd (see fig. 7) as the cholera fungi undergoing decay and disintegration. They are evidently of a different nature from those figured by him as characteristic of the fresh cholera dejections. The mode of disintegration of the two classes of bodies is quite distinct: the so-called cholera bodies, after resisting the action of water for some

time, break up into irregular granular masses ; whilst the decomposing bodies depicted by Dr. Budd, seem to be, in part, homogeneous, membranous cells dehiscing ; and are, perhaps, starch cells. The rings are, most probably, parts of disintegrated vegetable tissue.

It is shown by Mr. Marshall, and had before been noticed by Boehm and others, that cells like fungi, or their spores, are occasionally found in the excretions in Cholera. These, however, have a more delicate structure than any of the bodies described as characteristic of Cholera, and are totally different from them. It is well known that various vegetable forms are apt to become developed in organic fluids generally.

From a review of the foregoing facts, it is obvious that various bodies found in cholera dejections have been confounded, and described as identical. It is also shewn, that many are traceable to an extraneous source, and that even the disks placed in our third division, are not fungi. The statement, that the bodies found in the cholera dejections present an endogenous multiplication, has, in all probability, arisen from confounding them with the uredo, or from mistaking the appearances produced by the small bodies seen through, or upon, the larger ones, or entangled in their substance.

We are unable to identify the rings obtained from the air and figured by Mr. Brittan with any of the bodies included by him under the term 'annular bodies'. Our own experiments have satisfied us that these bodies do not commonly exist in the atmosphere of

infected places, but the observations of Mr. Marshall, on the dirt collected from windows and cobwebs, shew the great variety of matters which must be wafted about in the air, in the form of dust, and which might, in different instances, be caught with the condensed moisture.

The bodies represented by Dr. Budd, as being found in impure drinking water, have the form of disks with thick edges. We have ourselves never seen such bodies in water. But, if it should be established that the contents of bran-cells sometimes assume that form, the occasional presence, in water, of bodies capable of being confounded with the disks derived from the discharges of Cholera, will not appear remarkable.

Had the bodies described by Messrs. Brittan and Swayne been proved by the foregoing investigations to be of fungoid nature, yet the facts we have now to add would have shewn that they have no necessary connection with Cholera. In the first place, they seem not to be constantly present in the discharges. It is, indeed, remarkable that, in those dejections which, from the absence of colour, have usually been regarded as the most characteristic of the disease, they are frequently absent. We have failed to find them in several instances. In one, a portion of every evacuation was set apart, and examined several times by each of us, and yet in no portion could we detect them.

A still more important fact, which, from the explanations already given might be anticipated, is, that all the more remarkable of the bodies which have been thought peculiar to Cholera, exist in the intes-

tinal evacuations of persons affected with other diseases. Dr. Jenner first demonstrated to us their presence, in great abundance, in the dejections of a patient affected with typhoid fever. We have since verified his observation in five other cases of this disease (see fig. 19). We have also satisfied ourselves of the existence of some of the forms in dejections apparently healthy, from two patients in Guy's Hospital, one suffering from bronchitis, the other from early cirrhosis of the liver; and Mr. Marshall has detected small annular bodies "in the mucus covering the healthy excrement" of several herbivorous animals. It is obvious that bodies derived from such various sources will not commonly be found all present together. This, indeed, is not the case in Cholera. The minute bodies, especially, which belong to chalk will, of course, very rarely be met with, except that substance has been taken as medicine.

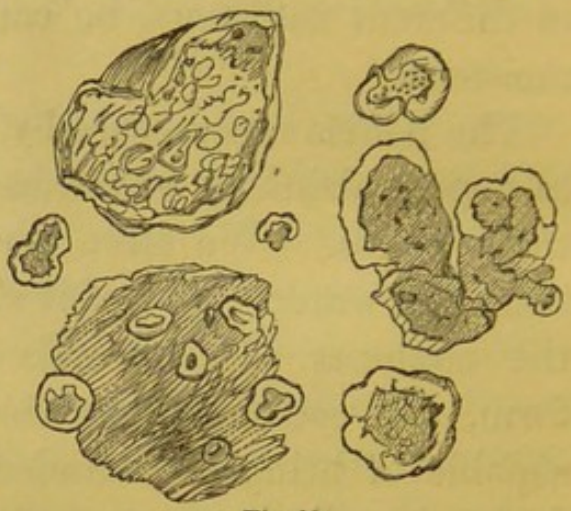

Fig. 19.

We shall now briefly restate the principal results we have arrived at, and submit the conclusion which seems to us justified by them.

1. Bodies presenting the characteristic forms of the so-called Cholera fungi are not to be detected in the air, and, as far as our experiments have gone, not in the drinking water of infected places.

2. It is established that, under the term, "annular bodies," "Cholera cells," or "Cholera fungi," there

have been confounded many objects of various, and totally distinct, natures.

3. A large number of these have been traced to substances taken as food or medicine.

4. The origin of others is still doubtful, but these are clearly not fungi.

5. All the more remarkable forms are to be detected in the intestinal evacuations of persons labouring under diseases totally different in their nature from Cholera.

Lastly, we draw from these premises the general conclusion, that the bodies found and described by Messrs. Brittan and Swayne are not the cause of Cholera, and have no exclusive connexion with that disease;—in other words, that the whole theory of the disease which has recently been propounded, is erroneous as far as it is based on the existence of the bodies in question.

(Signed) William Baly, M.D. } *Cholera*
William W. Gull, M.D. } *Sub-Committee.*

Letter from Dr. W. Jenner, Professor of Pathological Anatomy in University College.

Albany Street,
17*th October*, 1849.

My dear Sir,—On reading Messrs. Brittan and Swayne's papers, it appeared to me that the bodies they described as cholera fungi, bore a very close resemblance to objects I had long since observed in examining microscopically dejections passed by patients labouring under typhoid fever. That they were identical, whether of vegetable origin or otherwise, seemed to me the more probable because of a certain resemblance in the chemical constitution of the evacuations in the two diseases.

My colleague, Dr. Parkes, found, when analyzing, at the early part of the year, several dejections passed by patients suffering respectively from typhoid and typhus fevers, that while the latter were acid and contained no albumen, the former were alkaline and albuminous. Understanding that the microscopic vegetations which flourished in alkaline fluids are not to be found in acids, it struck me that such peculiarity in the nidus, suited for different vegetable growths, might account for Drs. Brittan and Swayne having failed to detect the "cholera fungi" (if these bodies are vegetable) in the stools passed by patients affected with typhus fever or bilious diarrhœa. Dr. O'Shaughnessy stated, in 1832, that he had tested the stools in 100 cases of bilious diarrhœa, and found them all acid, and without a single chemical character of cholera stools. Simon also says that in bilious diarrhœa they are acid. On examining microscopically four alkaline stools, passed at different stages of typhoid fever, I found in them bodies which appeared to me identical with those described and figured by the members of the Bristol committee.

The bodies I have observed consist of the ring with double outline, and others corresponding to the more developed forms of "cholera fungi", figured by Mr. Swayne. I have seen none of the most highly developed forms. Floating through the liquid part of one

dejection were numerous minute jointed threads. I may mention that the former bodies were found to exist most abundantly in the *pale* yellowish particles floating through the typhoid stools, some of which appeared almost entirely composed of them.

I am, my dear sir,

Yours faithfully,

Dr. Baly. W. Jenner.

Letter from John Marshall, Esq., Assistant-Surgeon to University College Hospital.

Mornington Crescent Place,
23*rd October*, 1849.

Gentlemen,—I beg to submit to your consideration the following results of an examination of the minute bodies which have been recently pointed out as existing in the evacuations of cholera patients.

1. In the *dejections* or in the contents of the intestines of cholera patients after death, I have, in the majority of instances, recognized all the forms of microscopic bodies described as being found therein, and represented by Messrs. Brittan and Swayne, and by Dr. W. Budd. These I have examined under high magnifying powers (using a one-eighth or a one-twelfth of an inch object glass), and have submitted them to various reagents. In order to obtain objects for comparison with these bodies, I have digested, with pepsin prepared from the sheep's stomach, the common articles of vegetable diet. Not one of the reagents which I have employed appears to have acted uniformly upon all the cholera bodies. Neither alcohol nor ether, when applied to the moist mucus in which they lie, produce much effect upon any of them; but when the mucus is spread out upon glass, and allowed to dry spontaneously, either of these agents, especially when pure, almost entirely dissolves the *substance* of a certain number of them.

a. The bodies thus acted on by ether, vary in size from the smallest up to those which are rather *under* the medium dimensions, and are plainly distinguishable from the particles of solid, and globules of liquid fat present with them. They have a bright, transparent, yellowish hue, resemble flattened discs in form, are cupped, or irregularly depressed in the centre, and have a more or

less distinct double outline. The smaller ones appear homogeneous in substance, and in them the faintly-marked inner line corresponds pretty accurately with the outer margin; but in the larger kinds, which are granular in the centre, the thickened border between the two lines is irregular in width, or seems as if it were formed by the union of two or more *curled* portions. These bodies are not acted on by iodine or chromic acid: they preserve well in thickish mucus, or in strong saline solutions; but in more watery dejections, in dilute aqueous solutions, or more readily on the addition of water, they slowly disintegrate and break up after the manner of fat. (See fig. 16 b.) When dissolved by ether, the smaller ones leave behind merely a space or mould in the dried mucus (See fig. 16 a.); but in the place of the larger ones, there is certainly an appearance of a thin film, within or upon which, besides some irregular granules, one or two of the smaller annular bodies which resist the action of ether may, though not constantly, be found.

The origin and meaning of these fatty (?) bodies is a subject for further inquiry. They may originate in the secretions of the digestive organs, or be produced from fat taken as food, or they may have some relation to the dextrine into which the starch grains are converted in the alimentary canal; for fat is known to appear under certain circumstances during the decomposition of saccharine solutions. That fatty substances may crystallize in somewhat similar forms to the bodies just described, may be shown by digesting sour cream or cheese in alkaline solutions or in ether,—or, as I afterwards found, much more simply, by compressing a small piece of rich cheese, moistened with ether, between two plates of glass,—when a multitude of minute *curled* concretions of fat (fig. 17) are seen under a high magnifying power, similar to, though of course not identical with, the class of Cholera bodies now under consideration.

Some of the bodies shown by Dr. Jenner to exist in typhoid dejections are of the same nature.

A large proportion of the Cholera bodies, however, of all sizes, but especially of the smallest kind, resist more or less the action of ether; and these, as well as the empty places or husks of such as are more or less dissolved by that menstruum, may be conveniently displayed and preserved, after the evaporation of the ether, in mastic varnish, covered with thin glass. The larger and smaller bodies not dissolved by the ether, may, I think, be referred to the following heads.

b. Numerous *yellowish* bodies *above* the medium size, having a round or oblong form, a hard outline, an irregular rim or border,

and a granular centre, which is either scarcely cupped, flat, or even slightly embossed. Iodine does not colour them; they decay in water; but after longer time than those previously described: in ether they become colourless and transparent, especially in the centre, crack in angular lines, and, in some cases, under slight blows, the rim appears to fall away in pieces and leave a central well-defined mass. One or more of the small annular bodies are frequently found lying upon them, and, occasionally, appear to be in them or beneath them ; but I have never seen a *group* of smaller bodies within a larger one.

Having found cells of this kind abundant in the case of a patient who had eaten daily of walnuts previous to his attack, I digested artifically and examined portions of that fruit and its skin. Beneath the epidermic layer, are found polygonal cells containing a *coloured* granular matter, differing from those composing the oily substance of the nut. In the cabbage and onion, greenish and yellowish cells are found, also differing in their contents from those amongst which they lie ; and, lastly, beneath the outer skin of the potatoe, and that of the grains of wheat and barley, *coloured* cells exist, perfectly distinct in character from those containing the starch granules. In the walnut, wheat, and barley, they are somewhat flattened, and have a fusiform, or polygonal, or even a roundish outline. (Fig. 18.) They resolutely resist artificial digestion. By maceration in liquor potassæ, and the subsequent addition of water (under the microscope), they swell, sometimes separate from each other, and become more or less rounded in outline. Those obtained in this way, from the softened cotyledon of wheat, are coloured *yellow* by the alkali, and display a pale central spot, which by prolonged maceration becomes larger, and pushes towards the margin of the cells, their granular contents: on bursting them, a thick, limpid, oily fluid escapes. Ether causes them to shrink. In size, colour, and form, they very much correspond with the larger cholera bodies just now described. A close imitation of the changes incident to digestion might establish their identity. Certainly, flat, yellowish, polygonal or fusiform bodies, resembling these cells unaltered, do exist in cholera and typhoid evacuations.

c. Another set of bodies, not nearly so numerous as the last, but also above the medium size, and having a rounded form, are cha-

racterized by their deep yellowish or brownish-red colour, their decidedly spherical shape, and their hard and finely indented outline, within which one or two other concentric and similarly indented lines may be traced. The surface of some is faintly marked with a polygonal tesselation; in others, which are usually larger, this is no longer recognizable. Water distends them; iodine gives them colour; and ether or alcohol greater definition. These are the spore cases of different species of uredo.

In artificially digested white and brown bread of the best quality I first found similar bodies; and subsequently in different samples of fine flour. (Fig. 15.) Four to six occur in as much flour as will lightly cover a sixpence; and in a cubic inch of bread consumed at my own table, as many as 150 must exist. Finally, in two separate specimens of wheat of this year's growth, I have found them entangled amongst the fine hairs surrounding the withered style and pistils,—in numbers, from one to eight upon a single grain,—though occasionally none could be detected. Usually, I have met with the orange-yellow spore cases of Uredo rubigo, or rust; more rarely, and only in bread, with the larger and darker sporidia of Uredo fœtida or smut balls, or of Uredo segetum or bunt.

Those found in cholera dejections (fig. 14.) appear to be often partly digested, being soft, pale, flattened out, and even emptied of their contents. In one typhoid evacuation they existed in great numbers and were only very slightly altered in appearance.

By far the most numerous of the so-called cholera bodies, are the small annular bodies, both oval and circular. Their great abundance, and variety of size, are well seen in specimens treated with ether, and put up in mastic varnish.

d. Some of these, whether oval or circular, which are not rings, but have an annular appearance, owing to their double outline (fig. 10), have, as was pointed out to me by Dr. Baly, all the characters of epithelium-nuclei from the alimentary canal, altered, or simply set free, by the digestion of their containing cells.

By artificial digestion I have succeeded in imitating the appearances of many, but not all, of these bodies, with their bright surrounding border, and their central substance and nucleoli.

e. Another set of the small annular bodies, *not so numerous* as those last described, consists of *true rings*, as may be determined by the fact of the inner bounding line being as dark as the outer

one. (Fig. 8.) In prepared specimens they are recognized by their oval and compressed form, homogeneous glassy character, and their dark outline. Sometimes the ring appears thicker, and at others, as if broken at some point. Frequently mere fragments are met with.

Exactly similar objects may be prepared by the artificial digestion of the vegetables used as food. The spiral tubes and annular tissue of plants, break down sometimes into simple entire rings, sometimes into portions of fibre, which coil up and show their overlapping ends only to a practised eye. From the cabbage and onion, from the cooked potato, where these tubes form part of every bud or eye, even from the withered style of the wheat grain, and from fragments of the cane in coarse sugars, spiral tissue, of various diameters, is met with, some of the tubes being not more than 1-4000th of an inch in diameter. (See fig. 9.) The inner rims of the stomata of plants, and the margins of flattened cells, may also furnish rings of various size and form.

Furthermore, in the mucus covering the healthy excrement of the goat, rabbit, and guinea pig, I have found similar rings of vegetable tissue.

f. There still remains a series of minute bodies, some oval and others circular, which have an annular appearance, but which, owing to their extreme precision of form and smoothness of outline, are not referrible to either of the kinds yet described. Some, which are oval, appear like minute clear cells, or like the remains of such cells ruptured. Very small circular bodies have the same characters. Probably these are really the spores of fungi, or are cellular fungi introduced with the food or drink, and only imperfectly digested. The cells of the yeast plant are to be found in moistened bread. As we have already seen, smut balls are actually introduced into the digestive organs with bread; and, in examining the hairy tufts on grains of wheat, I found the spores of *two* other fungi,—one, rare, the other in larger numbers. On the skin of the walnut I found no less than *four* different fungi, with their sporules ; and others in digested cabbage. Minute vegetable cells also exist in water. Where the digestive process is nearly arrested, as in Cholera, the remnants of these fine cellular bodies might appear in the dejections.

g. Certain circular rings, with a bead-like appearance, also seem to me to be peculiar. (Fig. 11.)

h. Lastly, I have occasionally seen in the rice-water fluid and its sediment, colourless, transparent vesicles, varying from 1-3000th to 1-1000th of an inch in diameter, and presenting, when focused at their middle, a brilliant, but very fine, double outline. They are destroyed by desiccation, and, after a few days, disappear from the fluid which at first contains them. They are distinct from any of the bodies previously noticed, but resemble some which I have seen in the fresh urine passed after the stage of collapse.

In conclusion, I may state that, whatever be the nature and meaning of the bodies described in section *f*, which are probably introduced from without; and of those in section *h*, which perhaps are formed as the accompaniments of a particular state of the fluid in which they are contained, I can trace no specific relations between these and any other series of the Cholera bodies; nor does there at present appear to me to be satisfactory evidence of the existence of any living organism, animal or fungoid, actively developing itself, and multiplying in the interior of the alimentary canal, in cases of malignant Cholera.

The foregoing observations apply entirely to the objects seen in the intestinal discharges. My examination of the matters vomited, in four instances, has led to merely negative results.

In five cases, in which both serum and clot of the blood were examined, no annular bodies of any kind were found.

I have the honour to be
Your obedient servant,
JOHN MARSHALL.

To the Cholera Committee
of the College of Physicians.

Postscript.—In a case of typhoid fever and Pneumonia, I find in the bile contained in the gall bladder, three days after death, small, roundish, fatty masses, having a bright rim and double outline; the largest having, moreover, a curled margin. The observation affords additional evidence of the proneness of fat to assume such form, and suggests the possibility of the bile being concerned in the formation of the "bodies" described in Section *a* of this letter.

I. M —October 29th.

London: Richards, Printer, 100, St. Martin's Lane.


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