piricism—observation; and that empiricism, when in its work-day dress, and when it means anything, carries with it a fair store of inference, so that the two principles need in no way be thrown in direct antagonism to each other.

In conclusion: I have endeavoured, in writing these observations, to look the subjects before me fairly in the face, and to state without bias or prejudice what has occurred to my mind. And, as I am anxious that the Fellows of this Society should have the different topics of this paper laid open freely for their discussion, I may perhaps be excused for summing up in the following brief sentences:—

I. That the rational and the empirical forms of thought are inherent in man's nature, and will always manifest themselves in medical science, as in every other department of human knowledge.

II. That the term *empiricism*, in its simple sense, implies a system based on the mere observation of facts without deduction, and on experiments made at hazard without any precise or preconceived object: that *rationalism*, in its strictest sense, implies that mode of inquiry in which truth is obtained by the influence of reason on observation, and where experiments are performed as the means to an end, and as a test of the truth of what has been conceived beforehand.

III. That instances may be found, in which the most distinguished individuals in the records of medicine have been the pure representatives of each of these special systems.

IV. That many important points in practice have emanated from the rational and the empirical modes of thought: the rational applications being most obvious in surgery and midwifery; the empirical in medicine.

V. That empiricism and rationalism, though in direct opposition as principles, are often blended in medical science: an empirical fact being frequently the basis of a pseudo-rational deduction; and *vice versa*.

VI. That from this last statement the inference is clear, that empiricism and rationalism are both necessary to the progress of medicine; and that the more closely they are connected, turned mutually to useful account, and kept within their legitimate bounds, the more rapid and safe will that progress be.

VII. That although the rational mode of inquiry may have called into play higher faculties of the mind than the empirical, it has, by its extravagances, failed as yet in doing more for medical science:—a fact which should always be kept in mind by its enthusiastic and exclusive advocates.

VIII. I cannot lose this opportunity of observing, that whoever would properly understand the precise value of empiricism and rationalism, must submit himself to the task of going through a comprehensive course of study on the history of medicine—a subject which, to our dishonour as scholars, and to our loss as practitioners, does not receive from us that regard which its importance deserves.

11, Alfred Street, Bedford Square, 28th March, 1854.

CLINICAL NOTES ON CHOLERA.

By W. LAUDER LINDSAY, M.D., late Resident Physician of the Surgeon Square Cholera Hospital, Edinburgh.

[Continued from page 222.]

II. HISTOLOGY AND CHEMISTRY OF THE EVACUATIONS.

I. *The Stools.* Whether the cholera seizure is sudden, or preceded by a premonitory diarrhoea of greater or less duration, the first alvine discharges usually present similar characters to the evacuations in simple diarrhoea, both in external appearance and in microscopical and chemical characters. They are more or less fluid, have a brownish-red or yellow colour, and are semifluid and foetid. They gradually, however, become paler in colour, more fluid in consistence, and of lower specific gravity, and lose their fœtor; till, as the disease becomes more marked and col-

lapse sets in, the so-called "serous" or "rice water" stools appear. Neither of these terms appears to me to give a good idea of the physical characters of the collapse stools of cholera; but, as it is convenient to use one or other of these words, I shall prefer the latter, simply, however, as a designation in common use. If the "rice water" evacuations be collected in a urineglass and allowed to stand at rest a few minutes, they speedily resolve themselves into a supernatant fluid and flocculent sediment.

The fluid portion somewhat resembles whey in colour and consistence, is turbid and opalescent, has frequently a very faint greenish-yellow tinge, and a mawkish, disagreeable smell, but possesses none of the fœtor usually characteristic of fœces, and indicative of putrefaction, incipient or advanced. This absence of fecal odour has been, by some, attributed to the deficiency of bile, the decomposition of which has been regarded as the source of the peculiar smell of human and other fœces; for it has been found that there is little or no fœtid odour in abillious stools, e.g. the clay coloured fœces of jaundice. It has been stated by chemists that the silver and lead test papers show the absence, in the fresh collapse stools, of sulphuretted hydrogen and hydrosulphuret of ammonia. Though almost devoid of odour when first evacuated, these stools soon become fœtid from decomposition of their albuminous constituents. When filtered, even after the application of heat, the physical characters of the fluid portion are little altered. The specific gravity has ranged in the cases seen by me from 1005 to 1015, the average being 1010; the fluid is, therefore, not much heavier than water, and greatly less dense than the alvine discharges of most diseases with which we are acquainted. It has uniformly exhibited more or less of an alkaline reaction to test paper, and usually gives evidence, on the application of heat, of the presence of *albumen*. It is important, in testing the presence of albumen by means of heat, to bear in mind that the alkalinity of the fluid requires its previous acidification by acetic or some other acid, in order to insure the precipitation of the albumen. Many authors deny the existence of albumen in the "rice water" stools: in certain cases, the proof of its presence is somewhat difficult, from the degree of opalescence or alkalinity of the fluid, etc.; but, that in almost every case it is present to some extent, I think easily admits of demonstration. M. Mialhe states that, instead of albumen or fibrin, the existence of which he has never been able to detect, he has invariably found a substance differing somewhat from both, which he designates "*albuminose*", and which he says is "the final product of the digestion of albuminous articles of food." The chief ground of the differential diagnosis between this substance and ordinary albumen is, that the former is not coagulated by heat and nitric acid. In my own experience, I have seldom or never failed in producing either an increased opalescence and turbidity, or a distinct flocculent precipitate by these reagents; and this result, I believe, agrees with the great mass of evidence on this point. I am therefore compelled, on M. Mialhe's own grounds, to come to an adverse conclusion. Though albumen may be said to be invariably present, its presence is by no means a distinguishing feature of cholera evacuations, i.e. it does not furnish a means of separating the alvine discharges of cholera from those of other diseases. A series of experiments made with the liquid defections of other diseases led me to believe that albumen is very commonly found in the fluid portion of fœces, both in health and disease; for, on filtering the discharges in diarrhoea, etc., and applying heat and nitric acid in the ordinary way, I very frequently indeed found an albuminous reaction. I found it present *inter alia* in the stools of the following cases, which occurred in the Royal Infirmary of Edinburgh.

CASE I. *Chronic Diarrhoea of Phthisis.* Dr. Andrews' ward. The discharge was very fœtid, semifluid, of a stone colour, and alkaline. It contained a few prismatic phosphates, potato cells, and other vegetable *débris*, but no "annular bodies".

CASE II. *Chronic Diarrhoea of Phthisis.* Dr. Keiller's

ward. The last stool before death, passed unconsciously in bed, resembled closely in appearance the later collapse or earlier reaction stools of cholera. It had a fine branny sediment, of a light brown colour, intermixed with mucous flocculi. It was very fluid, of low specific gravity, and alkaline; it separated readily into a supernatant fluid, and a flocculo-granular sediment, the latter amounting to about half of the whole mass. In the sediment, the microscope revealed a number of large—almost unaltered—potato cells, prismatic phosphates, fragments of muscular fibre, large compound cellular and granular bodies of a greenish-yellow colour, and a few of the larger “annular bodies” met with in cholera discharges.

CASE III. *Simple acute Diarrhœa*. Dr. Andrews' ward. The discharge also resembled the earlier reaction stools of cholera. It separated into a supernatant fluid of a pea-soup colour, very foetid, alkaline, of specific gravity 1010; and a flocculo-granular sediment of a dark brown colour, like linseed-meal or bran, and amounting to about one-third of the whole mass.

CASE IV. *Chronic Diarrhœa, simple*. Dr. Keiller's ward. The discharge was semifluid, of pea-soup colour and consistence. It had a slight oatmeal sediment, alkaline, somewhat foetid, and contained a considerable admixture of mucus. Under the microscope, there appeared several large prismatic crystals of the triple phosphate, fragments of muscular fibre and vegetable tissues, and a large quantity of compound granular bodies of a greenish-yellow colour.

CASE V. *Chronic Diarrhœa, complicated with Utero-Vaginal Disease*. Dr. Keiller's ward. The discharge was semifluid, of a light brownish-yellow colour, very slightly alkaline. It had a disagreeable mawkish smell, but no distinct foetor. It resolved itself, on standing, into a turbid fluid portion and an oatmeal or branny looking sediment. Under the microscope, were found blood and pus-corpuscles, and compound granular bodies of very large size. The appearance of this discharge exactly resembled that of the reaction stools of cholera.

CASE VI. *Chronic Dysentery in a Child*. Dispensary patient of Dr. James Sidey. The discharge was mucopurulent, slightly tinged with blood. Under the microscope, was seen a quantity of delicately striated hyaline mucus, entangling innumerable well formed pus-corpuscles. Were the latter smaller and less distinctly nucleated, the microscopic appearances would have closely resembled those of the flocculent sediment of the “rice water” stools in cholera.

CASE VII. *Hypochondriasis*. Dr. Keiller's ward. The discharge was a jelly-like mass of a dull olive-green colour. It had no foetor, though a mawkish odour; it was alkaline. It appeared to consist of almost pure mucus. Under the microscope, no corpuscles of any kind could be observed.

In the fæces of the dog and cat, also, I have generally found similar indications of the presence of albumen; and I have no doubt, though I have not had an opportunity of extending my investigations sufficiently far in this direction, that aluminosity of the fluid part of the fæces, whether healthy or diseased, will be found the rule, and not the exception.

If the fluid part of the “rice water” stools be heated, and a few drops of nitric acid added cautiously, a light red or pink colour is most frequently the result. Its intensity usually depends on the freshness of the specimen submitted to examination [*i. e.*, the length of the period that has elapsed since it was evacuated by the patient], the early period of collapse at which it was discharged, the degree of heat and the amount of acid applied or added, and on the alkalinity and certain other chemical conditions of the fluid, with the precise nature of which we are yet, in a great measure, unacquainted. Instead of a red or pink, a brownish or greenish yellow colour may be produced. I have already endeavoured to show, in my former paper, that these various reactions are all indicative of the presence of the same substance, *viz.*, *bile*, either in a healthy or slightly modified condition.

The addition of nitric acid will further indicate, in the

majority of cases, the presence of one or other or both ammonia and carbonic acid, in variable quantity; the former from its odour, the latter from the effervescence produced. These substances will be the more readily detected in proportion to the length of time that elapses between the evacuation of the fluid and the application of the test. The presence of carbonate of ammonia in large quantity in cholera stools was long ago pointed out by Herapath of Bristol.

From the characters of the fluid portion of the “rice water” stools, its origin is generally supposed to be the serum of the blood, which has been, as it were, suddenly drained or pumped off by the intestines. The greater part of the albumen of the blood, it is said, passes thus from the system in the form of mucus, which is analogous in chemical composition. This, however, is entering on the unsatisfactory realms of theory.

On allowing the fluid to stand a few days, its surface will usually be found covered with a thin scum of an oily matter, entangling a few perfect and broken prisms of triple phosphate.

The sediment, or curdy flocculent part of the “rice water” stools, varies greatly in proportion to the fluid portion: it ranges from about one-tenth to two-thirds of the whole mass, the average being from one-third to one-half. It consists almost wholly of flocculi of pure mucus, the presence of which, in quantity, is indicated by the formation of a whitish opaque precipitate on the addition of a solution of prussiate of potash, after a portion of these flocculi has been boiled in water, and nitric or acetic acid added. Its microscopic character is finely striated, almost transparent ribbon shaped masses, having intermixed, or being covered by, a greater or less number of granular corpuscles, nearly equal in size to and resembling pus. The latter vary much in size and appearance, and in the effects of reagents upon them: some are merely hazy, others darkly granular; some seem to possess distinct single, double, or compound nuclei; in others, a very delicate cell-wall can be seen attached to one side of a dark well defined nucleus. In some of these, acetic acid, cold or hot, produces no effect; in others, again, it renders the surface more distinctly granular, or it brings into view the nucleus or nuclei and the cell-wall. Indeed, in any single specimen of the mucous flocculi of these evacuations, bodies may frequently be seen physically resembling pus-corpuscles, white blood-corpuscles, mucus and lymph-corpuscles, and epithelial nuclei; and between these I confess my inability at all times to distinguish (nor do I believe it can be accurately done) by the microscope alone. Though, therefore, I do not think it admits of absolute proof, it is yet probable that the greater number of these bodies are mucus-corpuscles. If the ordinary distinctive characters laid down in our text books on physiology and pathology be correct, I am led to believe that pus-corpuscles and free epithelial nuclei also make up a considerable proportion of the whole. This mucus greatly resembles that thrown off from many mucous membranes in a state of irritation or inflammation. Hence has arisen the opinion that cholera is essentially a catarrh of the gastrointestinal mucous membrane. It appears to differ, however, from the mucus discharged in other catarrhs in its lesser tendency to develop albumen and pus.

Among these mucous bands, the microscope will seldom fail to reveal a few of the so called “annular bodies” or “cholera corpuscles”, “fungi”, or “bodies”, the discovery of the presence of which in the cholera evacuations caused such a sensation in the scientific world during the cholera epidemic of 1848-9. On their existence was founded the very ingenious “fungus-theory of cholera”, which, for a long period, was held most satisfactorily to explain the etiology and symptomatology of the disease. These insignificant little cells played a grand part on the stage of cholera literature. Immediately that their presence in the “rice water” stools was hinted at, hosts of the more speculative members of our profession rushed before the public, through the medium of the press, to show how beautifully they could, upon the most slender and insecure foundation,

uprear a grand superstructure of theory. Comparatively few, however, of these candidates for newspaper fame took the trouble of corroborating the facts first enunciated by Dr. Brittan and Swayne.

The interest connected with this subject induces me to enter a little in detail on the forms of these bodies which it has occurred to myself and others to see, and to mention the deductions therewith connected. I must first, however, state my conviction that their presence in the cholera evacuations is accidental; that they are not confined to cholera discharges; that most, if not all, of them may be traced for their origin to articles of food; and that, therefore, they have no causal relation to the disease. I consider them interesting merely in a histological point of view, and as the groundwork of a now exploded theory. The greater number of the forms are evidently vegetable cells of some kind, more or less broken up or disintegrated. Their appearance, however, is so various, that their description is very difficult and unsatisfactory. On comparing the bodies noticed by myself with the veritable "annular bodies" originally figured by Dr. Brittan in the *Medical Gazette*, I find that I have seen most of the forms mentioned by him, besides several others. From detecting some of them in various healthy and diseased fæces, I suspected—and my suspicion has since been confirmed—that they might be referred to ordinary articles of food; but to what articles, and to what particular parts of these articles, I cannot pretend to refer them individually. This subject will require and repay a separate and careful inquiry. Several of them, however, I have found in the *débris* of bread, oatmeal, and the elements of broth, by subjecting these substances to maceration in tepid fluids, so as, to a certain extent, to imitate the natural digestion of foods. For the merits of the original discovery of the supposed fungus agents of cholera, there was of course a host of anxious claimants, some of whom went to a ludicrous extent in their eager straining to make fact subservient to theory.

The forms observed by Dr. Brittan, he divided into three classes, viz.:

- I. Mere rings, having a free central area.
 - II. Globular or oval cells, having thick walls, which are tuberculated and granular.
 - III. Discoid bodies, with thick margins.
- The chief forms noticed by myself were, *inter alia*:
- I. Globular cells, having a free central area.
 - II. Globular cells, having immediately within the cell wall an inner dotted ring or circle.
 - III. Oblong cells, with rounded angles, having a central free area.
 - IV. Large globular cells, with a distinct central nucleus, round which is aggregated a number of large granules of a greenish yellow tint, resembling the chlorophyll grains of the cells of plants. The general appearance of the cell is like that of the "gonidia" of the thallus of lichens.
 - V. The isolated nucleus and circum-aggregate granules of the above, without the cell wall.
 - VI. Disks of large size and irregular shape, the wall having a double contour, with irregularly crenate margin; the surface marked by concentric striæ or granules, or merely hazy and granular: colour usually dark brown.
 - VII. Portions of double rings, most irregular in size: in shape and colour resembling the shrivelled sporangia of ferns.
 - VIII. Very minute oval or globular rings, formed of a double circle, narrow and hazy, or granular.
 - IX. Bodies similarly formed, but much larger in size, and very irregular in shape.
 - X. Bodies resembling collapsed starch-cells.
 - XI. Bodies resembling ruptured colourless vesicles.
 - XII. Convolute bodies of various sizes, with a granular or rugose surface, or the reverse, resembling some species of helix.
 - XIII. Very large globular cells, consisting of a delicate cell wall enclosing a number of annular bodies resembling ruptured vesicles, besides a quantity of molecular and granular matter. In appearance, they are similar to the

large mother cells of cancer; frequently are found ruptured, and the secondary cells in process of escape.

Illustrations of these various forms are given in the annexed figure.

Fig. 1. represents various forms of vegetable cells, etc., occurring in the evacuations of cholera. The figures correspond to the numbers in the list of forms given above.

Many of these substances are undoubtedly different forms of the same cellular bodies, variously acted on by the fluids secreted by the stomach and intestines.

Some such bodies as have been above referred to are stated by the original describers to be "constantly present" in choleraic dejections, and to be of very frequent occurrence also in the discharges of choleraic diarrhoea. Dr. Brittan, moreover, says he did not find his "annular bodies" in healthy solid fæces, nor in the fluid stools of typhus: hence he draws the general conclusion that "a certain relation does exist between the size and number of these bodies and the time elapsed after the seizure, taken in connexion with the severity of the symptoms. That is to say, they are small and clearly defined in the matter vomited: they become larger and more compound in the dejections; and, as the disease progresses favourably, where I have had the opportunity of examining, they vanish as the symptoms disappear, and the motions regain their natural appearance." That some of these forms are "constantly present" in cholera stools, I admit, is highly probable; but I am also bound to admit that they appear equally to occur, to some extent (in my experience), in healthy and diseased fæces of different kinds. Dr. Brittan goes still further, however: he asserts that he found the same bodies in the atmosphere surrounding cholera patients, and in the water drunk by them. Nothing is more likely, I conceive, than that minute vegetable organisms should be found floating in both these media; in fact, where can we avoid finding them? But I can see no necessary connexion their presence can have with cholera. Immediately after the existence of these bodies was pointed out by Dr. Brittan, it was made the subject of special and elaborate investigation by many of our most eminent microscopists, who corroborated their presence in the stools of cholera, but most of whom denied it in the air or water.

Mr. Quekett of London pronounced them to be fungi; and with him most investigators coincided, though they differed as to the precise genus or species to which to refer them. By other authors, they were considered the sporules of a species of *uredo*, fragments of the inner coat of the bran of wheat, or of the husks of other grains, altered starch granules, altered blood-disks, *débris* of food, animal and other organisms contained in chalk mixture and other medicines. The tracing these bodies back to their original source is immaterial and unnecessary, so long as we can show that they can have no share in the causation of the disease. We must obviously look elsewhere for a true solution

of the great problem, What is cholera? The fungus view, however, had the weight of evidence and probability in its favour. Different species and genera of fungi are very commonly developed in decomposing animal fluids. This we should, *a priori*, expect when we consider what are the conditions favourable to the transmission and development of these minute structures. By Remak, they have been observed in evacuations, "no matter how produced, whether by typhus, dysentery, errors in diet, or purgatives". Fungi also—but having a different appearance from those figured by Dr. Brittan—were noticed in cholera evacuations so long ago as 1838. We well know that, in many diseases, certain states of the skin and mucous membrane predispose, or render them suited, to the growth and propagation of microscopic fungi. During the last few years—since the introduction of histology as a branch of the study of rational medicine—the subject of vegetable parasites (ento- and epiphytes), both in man and the lower animals, has been investigated with considerable care, and the result has been, that almost no part of the human body can be considered exempt from the attacks of these plants. I need only mention, as examples of fungi being the origin or concomitants of disease in man, favus, mentagra, plica Polonica, some forms of pityriasis and aphthæ, chronic vomiting connected with sarcina, tubercular cavities and sputa, carious teeth, urine, and milk; and in the lower animals, the muscardine of the silk-worm, the fungous growths on the gills and scales of gold and other fishes, on the bodies of frogs and newts, in the trachea, lungs, and stomach of certain birds, in the yolk of the hen's egg, on the face of the mouse, and in the contents of the stomach of rabbits, oxen, sheep, and pigs. Is it not, then—instead of regarding fungi as the cause of cholera—much more reasonable to suppose that the condition of the gastro-intestinal mucous membrane, whether as a direct result of the disease, or of the same atmospheric or other state which induces cholera, is favourable for the development and growth of such bodies?

Such was the importance attributed to the presence of these insignificant organisms in the cholera stools, that the investigation of the subject was, during and after the epidemic of 1848-9, taken up by several public scientific bodies, and, among others, by the London College of Physicians, whose elaborate report contains the following conclusions:—

I. These bodies are not "constantly present", and therefore cannot stand in any causal relation to the disease.

II. Most of the forms are traceable to various articles of food; *e. g.*, the rings or simple annular bodies might easily be produced by the spiral and annular vessels of various plants used as food.

III. Others are apparently fatty in their nature: similar bodies can be produced by squeezing a fragment of cheese between two plates of glass.

IV. Others, again, appear to have been introduced in the state in which they are found in the evacuations, in various medicines.

The subject was also investigated in Edinburgh by Dr. W. Robertson and Professor Bennett, the result of whose joint inquiry* was that—

I. These bodies frequently occur in the "rice water" stools.

II. In the majority of cases, they *do not*.

III. They failed in detecting them in moisture condensed from the atmosphere surrounding cholera patients, and in the Edinburgh water.

IV. They are not amylaceous in their nature, for they resist the action of iodine.

V. In the cholera discharges, other and less equivocal vegetable bodies occur; *e. g.*, sarcina, torulæ, and ramose fungi.

Another set of theorists have attributed the causation of the disease to the presence of millions of animalculæ in the intestines, founding their belief on the fact that the cholera evacuations are frequently found teeming with mi-

nute *vibrios*. True, I have seen them myself in thousands; but they occur equally in all decomposing animal fluids, so can have no special connexion, whether as cause or effect, with cholera discharges. We must remember that the "rice water" stools, though not foetid when discharged, begin to undergo decomposition immediately; and that in no essential feature do they differ from other animal excretions.

In the sediment of the "rice water" stools, I never observed under the microscope any of the cylindrical epithelium of the intestines; and this it is of importance to keep in view, as Boehm and others have considered the pathological essence of the disease to be a desquamation of the intestinal epithelium. This idea has probably been suggested by a too exclusive examination of the intestines and their contents *after death*; for then the intestinal villi are quite nude, and the yellow opaque curdy matter found in the canal abounds in cylindrical epithelium, both in the shape of isolated cells, and in patches of cells adhering by means of a membrane connecting their apices. The deduction naturally follows, that what has been described as a *vital* act, and one essentially characteristic of cholera, is merely *mechanical*, *i. e.*, the result of *post mortem* maceration. Leaving, however, the consideration of this subject at present, the facts above narrated are, I think, sufficient to indicate the great importance of applying the microscope to the examination of fæces, not only in cholera, but in other diseases, as well as in health.

In rare cases, the microscope detects, among the mucous flocculi of the serous stools, the presence of a small amount of *débris* of the food, in the shape of potato-cells and other vegetable tissues or elements; but, in general, these are entirely absent.

For the detection of the saline constituents of the collapse stools, I filtered and evaporated down, and found two salts present in large quantity, *viz.*, chloride of sodium (common salt) and the triple phosphate. The crystalline forms in which these occurred were very various, and depended on the degree of freshness of the discharge, the early period of collapse at which it was voided, the degree of concentration and heat, and other circumstances. The former was chiefly met with in broken cubes, and the latter in perfect or broken prisms, which are sometimes arranged in stellate or crucial groups. The phosphates also occurred in delicate needle-shaped crystals, frequently exhibiting a stellate arrangement, and in large irregular pyramids. By incinerating the evaporated residue, and applying the ordinary qualitative chemical tests, the chief saline constituents will usually be found to be—

I. Carbonates of potash, soda, lime, and magnesia;

II. Phosphates of soda, lime, magnesia, and perhaps iron;

III. Chloride of sodium;

IV. Sulphate of soda; and

V. Silica.

Of these, the carbonates, sulphate, and chloride occur in the aqueous solution of the ash, and the silica and phosphates in the insoluble residue. It is seldom that the practitioner has either the requisite time or opportunity for making even this amount of rough qualitative analysis; nor is it necessary, in ordinary cases, that he should do so. The microscope will detect some salts; the presence of a large quantity of chlorine and phosphoric acid may be indicated by nitrate of silver; sulphuric acid by chloride of barium; carbonic acid and ammonia by nitric acid. *Urates* are stated by some to occur frequently. I have occasionally seen them, but I generally attributed their presence—with what justice, I cannot say—to carelessness on the part of some of the hospital nurses in allowing the accidental admixture of a small quantity of urine. Dr. Herapath states that *oxalate of lime* is constantly present. I have not once met with it in the cholera stools, so far at least as the microscope can detect its crystalline form; but it would be well that its presence were in future looked for. He also mentions the presence of phosphates *in excess* as a characteristic of cholera stools. I am not prepared to go so far, seeing that I have found them in equal or nearly equal

* Edin. Month. Med. Journ. for 1848-9, p. 1233.

abundance in healthy fæces, and in the diarrhoeal discharges of phthisis and other diseases, on allowing them to stand exposed to the air a day or two, or filtering and evaporating down. It is now generally admitted that the collapse stools contain a considerable excess of insoluble inorganic salts; and this is considered dependent on a compensatory for the deficiency of the same salts, which is equally well known to occur in the blood. Whether this theory be true,—what relation, if any, exists between the proportion of water and salts in the blood, and in the stools, etc.,—are questions which I cannot here enter upon.

In collapse, or in the consecutive fever, while the urinary secretion is greatly diminished in quantity, or entirely suspended, it is reasonable to expect to find *urea* in the stools, and it ought, therefore, in such cases, to be looked for: but its detection here requires a slightly more complex process than is necessary for detecting it in the urine, namely, the making a watery and then an alcoholic extract, dissolving the latter in hot water, and adding nitric acid. I tested for it in this way in several cases, but found its presence distinctly indicated only in one.

It must be kept in view, also, that *blood* may be discharged along with the serous stools, or that these may have less or more of a bloody tinge. I have never met with this in any cases seen by me; but it has undoubtedly occurred in the practice of others. Whether it is the result of co-existing or sequential ulceration, or of the congestion and ecchymosis of the intestine, and especially the rectum, which is a comparatively common pathological feature of severe cases, remains *sub judice*.

As collapse graduates into reaction, and the consecutive fever subsequently becomes developed, the stools gradually again assume the characters of ordinary diarrhoeal discharges. The colour gradually passes from whey colour, or the faintest greenish-yellow, into stone colour, buff, a pea-soup tint, various shades of brownish-red, brown, and black. The sediment decreases in amount, becomes less flocculent and more granular, first resembling the finest oatmeal, and afterwards bran or linseed-meal and water; at last, there is no separation into fluid portion and sediment, the whole mass becoming thicker, so as to resemble gruel or thin porridge; the specific gravity increases in a corresponding ratio, and the usual fæcal fœtor is ultimately added. In the fever and convalescent stages, the stools frequently become tarry in colour and consistence, such is the amount of bile they contain: this phenomenon has usually been attributed to a compensatory or retributive action on the part of the liver, which is now, as it were, atoning for its former deficient action. How far this appearance is due to altered biliary or blood pigments, or to the vitiated secretions of the canal, does not appear yet to have been determined. The stools are now much fewer in number, there is a greatly less amount of fluid thrown off from the gastro-intestinal mucous membrane, and the bile is consequently less diluted: they therefore soon regain their natural tint.

If the reaction and fever stools are examined with the test tube and microscope, the chief differences discoverable between them and the "rice water" or collapse stools will be, in the case of the former:—

- I. The high specific gravity and change of consistence.
- II. The complete change of colour.
- III. The substitution of a greenish-yellow or brownish-red reaction, with nitric acid, for the pink.
- IV. The decrease of albumen and mucus.
- V. The gradual appearance, under the microscope, of *débris* of the food, in the shape of fragments of vegetable and animal tissues, intermingled with innumerable molecules and granules, all having more or less of a bright greenish-yellow tinge.
- VI. The acquirement of fœtor.

On allowing the fluid portion of these stools to stand a few days, there will generally appear on the surface an oily scum, consisting of a mass of minute globules entangling a greater or less amount of phosphates. Sometimes this oily matter is in large quantity, forming a stratum of almost

pure liquid oil, or occurring in irregular masses or pellets of white or yellowish concrete fat. The latter I have frequently seen as large as a field bean; they resemble pieces of suet, are of firm consistence, and, under the microscope, present the appearance of numerous rounded cells or globular masses, each having in its centre a radiating group of needle shaped crystals of margaric acid. Whether this oily matter is the fat of the food, which has passed through the system unaltered, or whether it exists sufficiently frequent in the reaction stools to warrant the suspicion that the pancreatic functions are deranged, I am not prepared at present to say. In the fever stools, the microscope frequently detects the large cells of the potato; fragments of the epidermis of barley, oats, potato, carrot, and turnips; portions of spiral vessels from the fibrous part of the two latter vegetables; starch-cells from bread and the potato; pitted vessels, isolated spirals and cells; aggregated masses of chlorophyll grains, and hairs of plants; bodies closely resembling, if not really, cryptogamic spores; portions of muscular fibre; scales of fish; compound granular and cellular bodies, having a greenish yellow tinge; large, dark, irregular, fatty bodies; minute oil globules, and a few hyalines. By an examination of the fæces, we are enabled not only to determine the presence of foreign organisms, but to ascertain, often with considerable exactitude, what has been the nature of a patient's food. It appears to me that this department of histology has been greatly neglected, chiefly, I suppose, from the forbidding nature of such an investigation; but the advantages that might and will accrue from it are too obvious to require comment. In cases where the patient is unable to furnish replies to our queries, and where there are no friends to fall back upon for information, such an examination might be especially useful.

Pavement epithelium I have sometimes met with in the collapse, as well as in the subsequent stools; but the patients were females, and the source was probably some leucorrhœal matter accidentally intermixed with the alvine discharge, for I always found pus-corpuscles abundant at the same time.

Fig. 2. The part of this figure to the left of its middle line represents the microscopic characters of the mucous flocculi of the rice-water stools. 1. Hyaline bands of mucus. 2. Mucus-corpuscles, free granules, etc.

The right side of the figure represents the microscopic characters of the fever stools, and of healthy fæces. 1. Potato-cell. 2. Starch-granules. 3. Covering of barley-grain. 4. Muscular fibre. 5. Prismatic phosphates. 6. Hairs. 7. Compound granular bodies. 8. Patched vegetable cells. 9. Fragments of vegetable spirals.

From what I have stated in the foregoing remarks, it will be seen that there are no marked features of the cholera collapse stools serving to distinguish them from the alvine evacuations of other diseases, except the freedom from fœcal odour, and the circumstances which combine to give them the physical character denominated "rice watery"; for excess of water, albumen, and salts, as well as "annular" and other vegetable bodies, etc., may be present in

other stools, as I have attempted to demonstrate. I believe that a series of investigations on the subject, would result in finding that the stools of the collapse and reaction period are similar to the discharges in many affections of the intestines, not only in external appearance, but in chemical and microscopical character, or at least that they differ in no essential points. I have already stated, that it is impossible to distinguish between the stools of the premonitory and terminal stages of cholera, and those of simple diarrhoea. The conclusion to which these facts tend is, that the stools cannot, even in the collapse stage, be considered invariably pathognomonic of cholera, and that the disease is, to this extent, less specific in its nature, and less distinguishable from other affections, than is, perhaps, usually held to be the case.

The following cases will serve to illustrate the character of the stools in the various stages of the disease :

CASE I. M. R. *Recovery*. Seizure sudden, while walking from L— to Edinburgh. First discharge came away in gushes ; described as resembling potato-water ; afterwards white like whey, with curdy flakes floating in it.

First day. *Deep collapse*. First stool immediately after admission : "rice-water" ; quantity $\frac{3}{4}$ vi ; sp. gr. 1010 ; alkaline, devoid of odour. Sediment occupied one-sixth of bulk. Non-coagulable on the mere application of heat. Under the microscope, flocculi consisted of hyaline, striated bands of mucus, covered with molecules and granules. Nitric acid caused great effervescence. Contained a considerable amount of urea. Second stool had same character ; quantity $\frac{3}{4}$ iss.

Second day. *Collapse passing into reaction*. First stool, quantity $\frac{3}{4}$ iss ; fluid part light brownish yellow. There was a sediment like thin porridge or gruel. The odour was slightly fæculent. Second stool, $\frac{3}{4}$ ij ; third stool, $\frac{3}{4}$ iv. These resembled very thin gruel, being of a clayey colour, similar to that of jaundice stools ; they were of a fæculent odour and alkaline. On standing, a copious scum of phosphates, in very large and perfect crystals, appeared on the surface.

Third day. *Reaction passing into fever*. First stool, $\frac{3}{4}$ v. It was of the consistence of thin porridge, of a light loam colour, and fætid. Second stool, $\frac{3}{4}$ xvi. It was of specific gravity 1015, also of a light brown colour. Under the microscope, was seen a considerable amount of phosphates, in the form of prisms, and acicular and capillary crystals, often exhibiting a radiating stellate arrangement. There were also a few narrow hyaline mucous bands, compound cellular bodies, resembling the mother-cells of cancer, compound granular bodies, and molecular *débris* of a greenish-yellow tinge.

Fourth day. *Fever established*. The stools were fluid, of pea-soup colour and consistence. The fluid portion, when filtered, resembled urine loaded with urates ; its surface acquired a deep brownish-red colour on exposure. Under the microscope, appeared "annular bodies" of different kinds, collapsed and altered starch grains, fragments of the epidermis of barley and sugar cane, parenchyma of the cabbage, hairs and isolated cells of various vegetables introduced as food, irregular cellular bodies having double nuclei, and a very granular surface, and a mass of molecular *débris*.

Fifth day. Two stools amounting to $\frac{3}{4}$ xviii, of pea-soup character. Fluid part (filtered) had specific gravity 1015.

Eleventh day. *Convalescence*. The stools were of a dark loam colour, of the consistence of gruel, having intermixed a quantity of scybala. The fluid portion, when filtered, had a fine claret colour.

Thirteenth day. The stool was well formed, and apparently quite healthy.

CASE II. *Recovery*. A. W. On the day previous to admission, her mother stated she had had simple diarrhoea. For several hours before admission, the alvine discharges were described as resembling "white of egg", and afterwards "sage water".

First day. *Deep collapse*. First stool about $\frac{3}{4}$ x, passed in the warm bath. It was semifæculent, of a dark brownish-yellow colour. The microscope revealed the presence of

large quantities of "annular bodies", especially the forms which I have already referred to as Nos. 1, 2, 3, 4, and 5. Iodine had no further effect on these than colouring them. Second stool $\frac{3}{4}$ iss, "rice water", alkaline, albuminous, devoid of odour. The sediment had the ordinary microscopical characters of the flocculi of the collapse stools ; a few phosphates, and a quantity of molecular and granular *débris* of a light greenish-yellow colour also occurred. Third stool $\frac{3}{4}$ ii. It separated into a fluid portion of a dark brown colour, and a sediment resembling oat or linseedmeal. It was alkaline and fætid. The microscope showed the presence of some fragments of vegetable tissues, and a few perfect prisms of triple phosphate.

Second day. *Reaction established*. The stool was of a loam colour, quantity $\frac{3}{4}$ j ; it was alkaline and fætid ; there was no separation of a sediment.

Fifth day. *Fever well marked*. The first stool passed for nearly three days, under action of a purgative. The quantity was $\frac{3}{4}$ viii ; it was alkaline, of specific gravity 1015, and had a bright greenish-yellow colour. Under the microscope, were seen starch-granules and a large quantity of oil-globules, and the compound cells, mentioned under form 13, of the "annular bodies". The patient required purgatives for several days subsequently.

Ninth day. *Convalescence*. Stool passed under the influence of castor oil. It was half formed, very dark in colour, and fætid. On the surface, a considerable quantity of fatty flocculi or masses was found floating. They resembled pieces of suet, and had a bright greenish-yellow colour, which was removed by immersion in water.

Thirteenth day. The stool was of the consistence of thick porridge, and fætid ; the colour was a bright greenish-yellow.

Fifteenth day. The stool was half formed, of a light brownish-yellow colour, and fætid.

CASE III. M. F. *Fatal*. Previous to admission, the stools were described as very fluid, fætid, and of a greenish-yellow tint.

First day. *Collapse slowly merging into reaction*. First stool "rice water", quantity $\frac{3}{4}$ iss. It was alkaline, albuminous. The microscope showed a few phosphates, and bodies resembling (if not) cryptogamic spores. Second, third, and fourth stools, about $\frac{3}{4}$ ix in all, "rice water". They were alkaline, albuminous, of specific gravity 1010-12. Under the microscope, the flocculi consisted of striated bands of mucus, covered with the granular corpuscles formerly described, having intermixed a number of "annular bodies", especially of form 5 ; and a few phosphates. On standing, urates, in the form of radiating globular masses, were found in the surface scum.

Second day. *Reaction passing into fever*. First stool "rice water". Eight or nine stools were subsequently passed during the day, consisting of a few ounces at a time, all having the ordinary "rice water" characters. The sediment gradually became less white and flocculent, but heavier, more granular, and of a light buff colour, resembling oatmeal and water ; its bulk varied from one-seventh to one-third of the mass. The last stool was dark brown, fluid, fætid, and $\frac{3}{4}$ ii in quantity.

Third day. *Fever well marked*. There were seven stools during the night, in all amounting to $\frac{3}{4}$ xiii. They all were dark brown, and fætid ; the sediment was like bran or linseed-meal. The last stool, passed (in bed) immediately before death, was of a chocolate or *café au lait* colour, and $\frac{3}{4}$ xii in quantity. The microscope showed fragments of vegetable tissues, oil-globules, and dark compound granular bodies. The sediment preponderated in the earlier stools ; in the later, it amounted to one-fifth of their bulk. They were all alkaline, of specific gravity 1010-12, albuminous, and very fætid. On one, a copious scum of phosphates soon formed ; on another, on standing, there were found floating on the surface large masses of concrete fat, showing under the microscope delicate radiating crystals of margaric acid.

Crichton Royal Institution, Dumfries, March 1854.

[To be continued.]