No. IX.

Observations on the Filth of the Thames, contained in a Letter addressed to the Editor of "The Times" Newspaper, by Professor Faraday.

SIR,

I TRAVERSED this day by steam-boat the space between London and Hungerford Bridges between half-past one and two o'clock; it was low water, and I think the tide must have been near the turn. The appearance and the smell of the water forced themselves at once on my attention. The whole of the river was an opaque pale brown fluid. In order to test the degree of opacity, I tore up some white cards into pieces, moistened them so as to make them sink easily below the surface, and then dropped some of these pieces into the water at every pier the boat came to; before they had sunk an inch below the surface they were indistinguishable, though the sun shone brightly at the time; and when the pieces fell edgeways the lower part was hidden from sight before the upper part was under water. This happened at St. Paul's Wharf, Blackfriars Bridge, Temple Wharf, Southwark Bridge, and Hungerford; and I have no doubt would have occurred further up and down the river. Near the bridges the feculence rolled up in clouds so dense that they were visible at the surface, even in water of this kind.

The smell was very bad, and common to the whole of the water; it was the same as that which now comes up from the gully-holes in the streets; the whole river was for the time a real sewer. Having just returned from out of the country air, I was, perhaps, more affected by it than others; but I do not think I could have gone on to Lambeth or Chelsea, and I was glad to enter the streets for an atmosphere which, except near the sink-holes, I found much sweeter than that on the river.

I have thought it a duty to record these facts, that they may be brought to the attention of those who exercise power or have responsibility in relation to the condition of our river; there is nothing figurative in the words I have employed, or any approach to exaggeration; they are the simple truth. If there be sufficient authority to remove a putrescent pond from the neighbourhood of a few simple dwellings, surely the river which flows for so many miles through London ought not to be allowed to become a fermenting sewer. The condition in which I saw the Thames may perhaps be considered as exceptional, but it ought to be an impossible state, instead of which I fear it is rapidly becoming the general condition. If we neglect this subject, we cannot expect to do so with impunity; nor ought we to be surprised if, ere many years are over, a hot season give us sad proof of the folly of our carelessness.

I am, Sir,

Your obedient servant,

Royal Institution, July 7. M. FARADAY.

No. X.

Report on the Chemical Examinations of Rice-water Discharges. By R. D. Thomson.

Specific gravity of rice-water fluid.

THE following densities were derived from four cases in St. Thomas's hospital on the 16th October 1854. The specimens were examined as soon after expulsion as possible.

	Specific Gravity.
1 -	- 1008
2 -	- 1009
3 -	- 1008
4 -	- 1010
Mean	- 1008

Although I have found the specific gravity of this fluid in occasional exceptional cases to attain a higher density than the above, which I have quoted as a mean, still the present number is corroborated by a large number of trials made during the preceding and late epidemic. This low density, which corresponds with that of the urine in its most dilute conditions, is sufficient to distinguish the rice-water evacuations from the category of blood serums, which attains a very high specific gravity in cholera; for while the serum of a healthy individual at the same period I have found 1028, that of cholera patients amounted to 1058 in one case, and in another to 1042.

Diffused matter in rice-water excretion.

The amount of matter mechanically diffused through the rice-water evacuations varies very considerably in quantity in different cases, and great difficulty is experienced in estimating with any degree of accuracy the amount, from the obstruction opposed by a filter to the passage of the fluid through its pores. The most abundant matters present are the flocculent bodies which impart the characteristic aspect to the fluid, which have been in their turn viewed as coagulated albumen, epithelial scales, and corpuscles. The amount of silica present in the fluids when these contain much organic matter, is in favour of the idea of the epithelial scales entering into the constitution of the rice-water evacuations. From analogy I think it probable that when this fluid is first exuded into the intestinal canal, it contains fibrine in solution, as is found to be the case with similarly constituted fluids, deposited in the serous cavities, from which fibrine can be separated by the contact action of many solid bodies, such as washed fibrine of blood, and by intermixture with blood serum.

Whether the flocky deposit be in any measure referable to such a source is difficult of decision, since the deposit would occur by contact with the contents of the intestine before the fluid could be subjected to microscopical or chemical investigation. The substances present in smaller quantities are triple phosphate of ammonia and magnesia when the secretion is in its naturally alkaline condition; this salt likewise forms after death in apparently all the mucous fluids, when decomposition takes place and ammonia is evolved. Fat globules are likewise sometimes visible in the rice-water fluid, together with blood corpuscules, which may probably be derived from the abraded surface of the mucous membrane. I have also noticed vibriones, but these are not peculiar to this secretion, since I have observed them in the intestinal contents of other patients in St. Thomas's hospital.

Solid matters in solution in rice-water excretion.

A number of analyses of this fluid was made during the prevalence of the epidemic. The following table, however, which contains a selection, will be sufficient to exhibit the stable condition of this excretion at various periods:

	I. 3d August.	II. 29th September.	III. 9th October.	IV. 16th October.
Water	987·55	991·39	937·05	990·67
Organic Matter	5·06	·97	57·99	2·60
Salts	7·39	7·64	4·96	6·73
	1000·	1000·	1000·	1000·

The first two experiments and the last correspond closely in their results, but the third differs in having a larger amount of organic matter present. This fluid, however, was not obtained in the usual way, but was taken at a *post mortem* examination on the 9th at 1 p.m. from the duodenum and ilium of a nurse who had died the preceding evening at 6 p.m. It contained flakes, vibriones, and ammonia-phosphate of magnesia.

Chemical characters of the rice-water fluid.

On filtration the fluid, in a majority of instances, on the addition of nitric acid yielded slight flocks resembling albumen; a precipitate likewise ensued on the addition of acetic acid and ferrocyanide of potassium; and generally on the application of heat, particularly after a certain amount of evaporation, slight coagulation occurred or a scum formed on the surface. These characters correspond with those of albumen, or at least that form of it which is found in serous fluids. Nitric acid yielded with the fluid a fine pink colour, and in some cases with sulphuric acid a similar change in tint, from which it may be inferred that probably some of the acids of the bile were present in minute quantities. I have likewise detected sugar in some instances, and urea has likewise been observed. No doubt all the constituents of the blood might be sought for successfully by working on sufficiently large quantities of the excretion. The chemical composition of

the residue from the fluid is represented in the following table; the substance was derived from mixed cases by evaporation after filtration.

Composition of rice-water fluid in 20 *grains, and in* 100 *grains.*

		Per Cent.
Organic Matter	6·40	32·000
Silica	·460	2·300
Phosphate of Lime	·150	·750
Insoluble Lime	·100	·500
Insoluble Magnesia	trace	trace
Soluble Magnesia	·171	·855
Potassium	2·230	11·150
Sodium	4·370	21·850
Chlorine	3·180	15·900
Sulphuric Acid	2·441	12·205
Phosphoric Acid	·310	1·550
Carbonic Acid	·380	1·900
	Per 20 Grains.	Per Cent.
Organic Matter	6·400	32·000
Silica	·460	2·300
Phosphate of Lime	·150	·750
Carbonate of Lime	·180	·900
Sulphate of Potash	4·980	24·900
Triphosphate of Soda	·710	3·550
Carbonate of Soda	·920	4·600
Sulphate of Soda	·270	1·350
Chloride of Sodium	·040	30·200
	20·110	100·550

As far as microscopical and chemical evidence can throw light on the subject, there seems no reason to suppose that any substance or organized matter exists in the rice-water capable of communicating the disease from one individual to another or from one animal to another; but as experiments are said to have been instituted on the Continent which support the view that a similar disease can be produced by the administration of human rice-water fluids to small animals, some experiments were instituted for the purpose of elucidating this point. Before intelligence of the German experiments reached this country, the epidemic had left London, and it was necessary, therefore, to obtain the excretion from some other locality affected with the disease. The fluid had all the usual characters, and had been vomited recently; it was allowed to evaporate slowly and spontaneously without the application of heat. During the escape of the aqueous portion, the organic matter in solution began to putrefy and to evolve the odors of decomposition, in accordance with the Continental experiments. The whole of the putrefying residue, amounting to a grain or two, was administered to a healthy mouse. The animal, having been previously starved for some hours, greedily swallowed the bread, which had been soaked in the cholera matter, and continued to feed at intervals on

bread supplied to it, without apparently being in the slightest degree influenced by the putrid diet. The same mouse had been previously subjected to a similar experiment with the putrid contents of the intestines of another patient, who died from some other disease, without suffering apparently any inconvenience. The result of these experiments I do not consider sufficient to refute the statements of the German physiological chemists; but perhaps it may be admitted that they tend to show that experiments bearing in such a striking manner on the essential character of the disease, require repetition before we can with certainty conclude that the intestinal fluids in cholera are possessed of contagious powers.

ROBERT DUNDAS THOMSON, M.D., F.R.S.

St. Thomas' Hospital,
March 1855.

No. XI.

Report on the Microscopical Examination of the Blood and Excretions of Cholera Patients. By Dr. Hassall.

THE outward and physical characters of the rice-water evacuations of cholera vary considerably in different samples and in different cases; they vary in colour, consistence, and composition; ordinarily they resemble thin gruel rather than rice water, being thicker and less white and transparent, and sometimes they are of a brown tinge. After being set aside for some time they usually let fall a deposit, the amount of which is subject to great variation, but generally it is considerable, forming in some cases as much as a fourth or a sixth of the entire bulk.

When submitted to examination with the microscope there are detected in most samples molecules and aggregations of molecules, innumerable mucous corpuscles, single and aggregated, of irregular size and form, and which are frequently imbedded in a mucous base, presenting sometimes a fibrous structure, and molecules and globules of oil; it is of these elements, and especially of the granular corpuscles and mucous base, that the deposit which subsides in most samples is principally composed.

In addition to the above, myriads of vibriones were detected in every drop of every sample of rice-water discharge hitherto subjected to examination. Of these vibriones many formed threads more or less twisted, while others were aggregated into masses, which under the microscope presented a dotted appearance.

But some of the specimens possessed characters very different from the above.

In one sample examined there were no granular or mucous corpuscles, or mucous base to be discovered, but in place of them a great number of globules of oil and innumerable minute acicular crystals, some of which were free, but mostly they were aggregated in bundles in the form of rosettes and dumb-bells. The vibriones were present as usual.

The same crystals occurred in another specimen in great numbers. In this case they were mostly single and but seldom aggregated, and there were no large globules of oil, although a good deal of oil was present in the form of molecules and small droplets.

In addition, numerous fragments of muscular fibre, cells of potato, a few starch corpuscles, and fragments of the husk of wheat, were not unfrequently detected in specimens of the rice-water discharge, and in cases in which food had not been partaken of for a considerable time.

The same acicular crystals were likewise seen in small numbers in two or three other samples, and in several prismatic crystals of triple phosphate.