Mr. Netten Radcliffe's memorandum on the reformatory school-ship "Cornwall".

LOCAL GOVERNMENT BOARD.

Mr. Netten Radcliffe's Memorandum on the Reformatory School-Ship "Cornwall."

EDWARD C. SEATON, M.D.,
Medical Department,
June 4, 1878.

This memorandum relates to the inquiry which I was directed by the Local Government Board, at the request of the Home Office, in March of last year (1877), to make (1) into the sanitary condition of the reformatory school-ship "Cornwall," lying in the Thames, off Purfleet, especially with reference to recent prevalence of enteric fever among the boys; and (2) into a suggestion that the health of the boys probably suffered from the outflow of metropolitan sewage into the river, higher up the stream, at Crossness and Barking.

It has only been practicable for me, having regard to the current work of the Medical Department, to give attention to the inquiry at long intervals, and I now propose in this memorandum to state provisionally the results as they at present stand, and ask for additional instructions before proceeding further with it.

I. Speaking generally, the inquiry has proved abortive with regard to the particular objects it had in view. This has arisen from a cause not anticipated by me when I began the inquiry, namely, that no proper record exists of sickness among the boys. The medical officer is required to keep a register in the form annexed (see Note I.) but this duty has been performed so perfunctorily, and the omissions are so numerous, that the register is valueless for the purpose of the inquiry. Even the amount and kind of fatal sickness among the boys cannot be obtained from it.

Obviously, then, it has been impossible for me, under these circumstances, to form an independent opinion on the sanitary condition of the ship as gauged by the health of the boys. Further, such help as I might have had from the medical officer of the ship was not available, as this gentleman shortly before the inquiry had resigned his appointment, and at the time of the inquiry was not in England. The sort of inquiry which it was incumbent upon me to conduct as to the health of the boys—an inquiry founded on defined technical data—became thus impracticable.

But it is proper that I should offer some observations on the opinion entertained by the Captain Superintendent and others on the general state of health of the boys. The Captain Superintendent lives, with his family, on board the ship, and has the boys constantly under observation. He states that, except when infectious disease is introduced among the boys from the shore by new comers, there is great freedom from serious sickness, and that even minor ailments are rarely troublesome. The Committee of the "Schoolship Society"—to which Society the ship belongs—entertains a similar opinion; and this opinion has been accepted by the Inspectors of Reformatory Schools. It seems to me that this opinion should not be received without some qualification. First, because it refers to a matter in which error is easy, if not unavoidable, unless definite facts as to sickness among the boys are forthcoming to support it. Next, because it is not altogether supported by certain entries which do appear in the medical register. Thus from the 22nd August 1876 to the month of May 1877 there appear a succession of entries of "sore throat" and "tonsillitis," in all 62 in number. In December 1876 scarlet fever appeared among the boys. Fourteen cases of this disease, also five cases of enteric fever, were sent from the ship to the Seaman's Hospital, Greenwich, during this month. There would seem to have been a suspicion that some of the cases registered as "tonsillitis" and "sore throat" may have been unrecognised cases of scarlet fever. This is not improbable, but after communication with the medical gentleman who, perhaps, saw the greater number of these cases, I accept his opinion that, as a rule, the cases entered as "tonsillitis" or "sore throat," and certainly the cases under his immediate observation, were instances of the ordinary catarrhal disease so named. They were attributed at the time of their occurrence, as a rule, to inclemency of weather. But the long continued occurrence of the ailments, from the early autumn of the one year to the early summer of the next, suggests the question whether the feeding and clothing of the boys at the time were all that was desirable. The occurrence of scarlet fever and enteric fever among the boys in December 1876 will be referred to again in a separate section relating to infectious diseases among them.

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Finally, the death-rate of the boys is so high that very precise information as to its causes is required before an opinion on their good health, founded on general observation, should be received without question. I subjoin the following data, furnished to me by Mr. Henry Rogers, Her Majesty's Assistant-Inspector of Reformatories and Industrial Schools, as to the total mortality on board the "Cornwall"; and I add, for the purpose of comparison, like data, furnished also by the same gentleman, as to the sister reformatory school-ships the "Clarence" and "Akbar," lying in the Mersey, off Birkenhead. (*See also* Note II.) The ages of the boys admitted into these ships range from 12 years to 16 years.*

Period.	——	Mean yearly number detained.	Mean yearly number of Deaths.	Annual proportion of Deaths per 1,000 Boys.
1859–76 (18 years)	School ship "Cornwall" -	238·6	3·2	13·4†
1864–76 (13 years)	„ "Clarence" -	196·0	3·3	16·8
1859–76 (18 years)	„ "Akbar" - -	171·3	2·9	16·9
1850–75 (26 years)	ENGLAND AND WALES: Males at ages 10–20 years -			5·6

According to these figures the death-rate on the "Cornwall," although comparing favourably with that on the "Clarence" and on the "Akbar," is more than double the rate which obtains among boys of the same age in the general population. It does not necessarily follow that this large death-rate is dependent upon the conditions under which the boys live on ship-board, but clearly it is not to be assumed without evidence that the rate is wholly independent of such conditions. As yet I have not obtained such evidence. Of the 44 deaths recorded as having taken place among the boys of the "Cornwall" during the 18 years 1859–76, the names of 26 only of the deceased have been found in the ship's records. It would be necessary to verify the reputed causes of these deaths by a reference to the public death registers before they could be made use of for the present inquiry. This will be a troublesome task (if, indeed, it can now be carried out successfully), for several of the deceased were removed to the "Dreadnought Hospital," or elsewhere; and their deaths were registered in other districts than that in which the ship lies. I have endeavoured, however, to verify the causes of death from disease during the five years 1872–76, and with the following result:—Twelve deaths are reported to have occurred (one inaccurately, 11 deaths only having happened) among the boys during the five years. Of these deaths nine only are accounted for, and of the nine *three* are ascribed to drowning, *one* is registered as from "phthisis," *one* from "suppuration in the mastoid cells, pyæmia," *one* from "spinal paralysis," *one* from "peritonitis," and *two* from enteric fever; ("enterica," one only of these two cases was verified by reference to the local registrar's returns, the other occurred under circumstances which justified me in accepting the stated cause of death without verification).

The above data alone, and without reference to the deaths of boys sent home invalided, suggest the importance of an attempt being made to obtain an accurate account of the registered causes of death among the boys from the first establishment of the ship to the present time. Until this be done it is premature to speak of the general good health of the boys, and it will be impossible to determine satisfactorily the question of the sanitary condition of the ship, as indicated by the occurrence of fatal sickness.

II. With reference to the prevalence of enteric fever among the boys in the "Cornwall," the inquiry had particularly in view an examination of the circumstances under which a considerable outbreak had occurred, beginning in September 1875 and ending in January 1876. The state of the medical register, and the absence of the medical officer who had charge of the ship at the time, presented an insuperable

* Mr. Rogers has noted for my information that—"the boys in the 'Cornwall' are all *criminal boys*, taken "from a very low class of the population. Most of them inherit disease, or the seeds of disease. A good "many of them are, therefore, exceptionally indifferent lives, and are constitutionally infirm or predisposed to "yield readily to the attacks of acute disease."
The data given in the text as to mortality include *accidental* deaths.

† The deaths on board the "Cornwall" in 1877 were 2 (See Note II.), and the mean annual mortality on board for the last seven years (1871–77) was 8·8 per 1,000.

obstacle to my obtaining the details of the outbreak. An investigation of it had, however, been made by the medical officer of health for the port of London, Dr. Harry Leach, during its progress. The results of that investigation, as given in his report for the half-year ending the 31st December 1875, contain the only account of the circumstances of the outbreak now likely to be obtained. I have had several conferences with Dr. Leach on the subject, and I concur with him in his conclusions and recommendations. The latter have been substantially carried into effect by the School-ship Committee, and need not be further referred to here.

As to the origin of this outbreak of enteric fever, I am of opinion, as the result of my own inquiries, that the disease was introduced into the ship from the shore. It may be accepted also, I think, that a like origin is to be assigned to the several prevalences of infectious diseases, including enteric fever, which have occurred among the boys from time to time. Under the present arrangements of the ship boys are sent directly on board from the original places of detention, without a precautionary delay of sufficient duration to enable it to be ascertained whether they may be in the incubative stage of certain of the infectious diseases.* Hence the ship is at all times liable to have introduced into it children sickening or about to sicken from enteric fever, small-pox, &c. Again, the ship has no proper provision for the immediate isolation of cases of infectious sickness, or of doubtful cases, as they occur. Such separation as can be effected on board is futile for the purpose of isolation. To diminish the liability to occurrence, and limit the prevalence of infectious diseases among the boys, buildings on shore, convenient of access from the ship, are necessary for the quarantine of new-comers and for hospital purposes. The question of providing a building for hospital purposes has been already under the consideration of the Ship Committee† (see Mr. Cave's letter to Major Inglis, 20 January 1877).

III. The suggestion that the health of the boys on board the "Cornwall" may suffer from the outflow of metropolitan sewage into the Thames at Crossness and Barking appears to have arisen from a conjecture that the recent prevalence of enteric fever among them possibly had some connexion with the pollution of the stream from this source. I have already expressed the opinion that in the outbreak of 1875–76 the disease was introduced among the boys from the shore, and that the malady, in the first instance, has at other times been imported into the ship.

Unable, from the condition of the medical register, to approach the question, as will be necessary before it can be completely solved, from a clear knowledge of the kinds of sickness most apt to affect the boys, I have endeavoured to ascertain whether the condition of the river at the point where the "Cornwall" lies, with reference to the flow of metropolitan sewage, was such as to lead to the inference that the ship was moored in an unwholesome position.

I have already stated that the "Cornwall" lies off Purfleet. She is the second ship of the name which has been used for school purposes. The first ship was a frigate; the present, substituted in 1868, is a roomy line-of-battle ship (two-decker). The river where she lies has a breadth of somewhat more than three quarters of a mile, and a depth in mid-channel at low water of from 36 to 40 feet.

The "Cornwall" is moored, close to the shore, *seven* miles below the metropolitan sewage outfall at Barking, and *five and a half* miles below the sewage outfall at Crossness. On the 18th August 1877, in company with Dr. Harry Leach, I witnessed, from the river, the flow of sewage into the stream. The day was peculiarly favourable for observation. The surface of the water was hardly disturbed, and then only at intervals, by a gentle current of air from west-south-west, so that it was practicable to follow the movement of the sewage at the surface with the greatest precision. It was about two hours of ebb-tide when we reached the Barking outfall. Sewage was flowing thence in a broad, black, offensive stream, carrying much floating nastiness on the surface. The sewage hugged the near bank of the river until it reached the mouth of Barking Creek, when it was deflected towards the centre of the stream, spreading out fan like at the same time. The sewage then flowed along mid-stream, the current rapidly breaking up and becoming dispersed, and a mile below the outfall, opposite the powder magazine just above Crossness point, it was entirely lost to sight, not even a trace of the floating matter being discoverable, although several casts backwards and forwards

* The boys, Mr. Rogers informs me, are subjected to an imprisonment of at least *ten days* before being sent to the ship. Assuming that the confinement has taken place under conditions which would prevent exposure to infection, this period of detention would still be insufficient to show certainly whether a boy was incubating small-pox, or enteric fever, or measles, or, in exceptional cases, even scarlet-fever.

† The boathouse of the "Cornwall" had been converted into a temporary hospital at the time when this inquiry was directed.

across the river at this part of its course were made in search of it. On approaching the Crossness outfall, three quarters of a mile below the point where all trace of the sewage from the northern outfall was lost to the sight, the odour of sewage met the nostrils in advance and the southern sewage stream, carried upwards in part by an eddy, was entered a little above the outfall. The sewage had the same aspect as that from the northern outfall. It hugged the southern bank in a broad well-defined current for three quarters of a mile, then, opposite the Belvidere Guano Works, it broke up into several branches and spread out towards mid-river, and a quarter of a mile below, opposite the powder magazine there, all traces of sewage were lost to sight.

On a subsequent occasion (13th Oct. 1877), with the object of ascertaining, if this were practicable, whether the bed of the river where the "Cornwall" is moored was affected by the metropolitan sewage outflow, I collected specimens of mud from the bed of the river in-shore, off the Barking and Crossness outfalls, from beneath the "Cornwall," and from the mud exposed at low water on the contiguous bank, and from the bed of the river at Greenhithe, at a point between the "Arethusa" and "Chichester" school-ships lying there and the bank, seven miles and a half below the Crossness outfall. For the purpose of collecting these specimens, the Secretary of the Thames Conservancy Board, Captain Burstall, R.N., courteously put at my service the Conservancy steam-yacht, and Captain James, the harbour-master, gave me his valuable assistance. The specimens of mud collected off the Barking and Crossness outfalls (that from Crossness being taken from several points on an exploration rod which had been sunk over ten feet into the mud-bank from which mud was collected), and from beneath the "Cornwall" had the appearance and odour of ordinary sewage mud. The specimen at Greenhithe had the appearance and odour of common river mud as observed anywhere within the tidal stream. These specimens were submitted to Dr. Dupré for chemical analysis, and he added to them for additional comparison specimens of mud taken at low water from the bank of the Thames at Vauxhall Bridge and adjoining the Houses of Parliament. I append Dr. Dupré's report of the result of his analysis. (Note III.)

It will be observed in this report that, with one exception, chemical analysis failed to show any material difference between the several examples. "They all consisted," to use Dr. Dupré's words, "chiefly of sand, clay, and chalk, and contained only a small "proportion of organic matter. This organic matter, moreover, seemed to be very "much of the same character in all, as shown by the slight variations in the relative "proportion of carbon and nitrogen present in it. In fact, only one sample [No. IV. "the sample taken from beneath the 'Cornwall'] shows any material departure from "the mean in this respect. In this the proportion of carbon to nitrogen is very "much greater than in the rest, showing the organic matter in it to be of vegetable "origin chiefly. This is due, no doubt, to the admixture with it of an exceptionally "large proportion of disintegrated wood. In samples I., II., and VII. [the first taken "from the bed of the river opposite the northern outfall, the second taken from the "mud-bank opposite the Crossness outfall, and the third from the mud-bank 50 yards "below Vauxhall Bridge on the Surrey side] the proportion of carbon is slightly "below the average, which may be taken as indicating a somewhat higher proportion "of animal contamination, due, perhaps, to the presence in these samples of a larger "proportion of sewage deposit. As before stated, however, neither the chemical nor "the microscopic examination lends much countenance to the supposition that one "sample consists more than another of sewage deposit."

Assuming that the small proportion of organic matter found in the several samples of mud is more or less of sewage origin—an assumption, it must be remarked, which rests rather upon the physical character of several of the samples, and generally from our knowledge of the river, than upon the chemical analysis,—it is to be inferred either that the suspended matters of the sewage which finds its way into the Thames both above the metropolitan area towards the source of the river, and below the metropolitan area at Barking and Crossness, are equally distributed within the section of the river selected for examination, or that each successive outflow of sewage at the Barking and Crossness outfalls undergoes so great a dilution and dispersion as practically to become unrecognisable on the cessation of the flow from any deposit of suspended matter it contained. In either case sewage matter in solution may be regarded as an almost inappreciable quantity and ignored accordingly.* It is not

* Messrs. Hofman and Witt in their Chemical Investigations of the influence of Sewage on the Composition of the Water in the Thames, made in 1857, observe that "numerous analyses by many different observers, and "extending over a considerable period, have undoubtedly proved that the amount of this dissolved [organic] "matter is *exceedingly small*. It has been shown, moreover, that its amount is not very perceptibly greater at

necessary for the purpose of this inquiry to determine which of these alternatives is the most probable. If the former, there is no evidence to show that the position of the "Cornwall" off Purfleet is more unhealthy than the position of any of the other school-ships on the Thames, and it is not known that the health of the boys of any of the ships has suffered from the position in which the different ships are moored; if the latter, there is no evidence that the boys on the "Cornwall" are likely to be exposed to any injurious influence from the outflow of the metropolitan sewage at Barking and Crossness.

In the course of the inquiry it was stated to me that at times much disengagement of fetid gas from the water about the "Cornwall" had been observed, particularly when at very low tides the keel had happened to touch the mud beneath her. I failed to get any precise evidence as to this statement, but the phenomenon has not been noticed during the time the present Captain Superintendent has had charge of the ship. Indeed, at the present time very little mud indeed lies beneath the ship, the greater part of the area of the river bed underneath being free from deposit. Moreover, the mud exposed on the contiguous bank at low water is comparatively small in amount to that observed adjacent to the other school-ships in the river. There would appear to have been a considerable clearance of mud at this part of the river in recent years from an increased scour of the stream there.

To this point the inquiry has served mainly to clear the way for a more complete investigation, and to show the direction which that investigation should have. Obviously, no complete investigation can be made of the sanitary condition of the "Cornwall" until a proper registration of sickness and deaths has been established and carried on for some little time. To meet the requirements of such registration the present medical register and the mode of registration needs to be modified in several respects, namely,—(*a*) as to the *Register* after the "Name," columns should be added for "Age," and for "Date of Admission to the ship," and (a smaller column being given to "Result") for "Remarks"; and as to *mode of registration*, new cases should be distinguished in some way when first entered in the register. Weekly, monthly, quarterly, and annual summaries of sickness should be prepared, showing at a glance the amount and progress of sickness in the several periods; the "Remarks" should give the facts as to "leave," and the data necessary for a clue to the probable origin of cases of infectious disease. Of course, any such negligence in keeping the register as that which has hitherto been tolerated should not be permitted. Deaths should be carefully entered in the column of "results," but a separate death-register should also be kept in which the cause of death, as certified to the registrar of deaths, should also be entered. Moreover, cases sent for treatment from the ship to any public or other hospital should be as systematically entered in the medical register as if treated on the ship, the nature of the disease being stated, the date of removal, and the result.

Meanwhile, pending the establishment of a proper system of registration of sickness, it is very requisite that an accurate account of the deaths and certified causes of deaths which have occurred on board since the establishment should be recovered from the books of the ship and from the public registrar of deaths. This work will involve considerable trouble and patience, but it is a work which ought nevertheless to be performed.

It would be particularly instructive if a comparative examination could be made of the causes of death on the three reformatory school-ships the "Cornwall," the "Akbar," and the "Clarence," and probably also of some of the reformatory land-schools. The very high rate of mortality on board the "Clarence" and "Akbar" appears to require special medical investigation as well as the high death-rate of the "Cornwall." It is probable that no thoroughly satisfactory investigation can be made into the sanitary condition of either of these ships without comparative data from the others, and from reformatory as well as other schools on shore. At any rate, if

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"London or Westminster Bridge, where the water looks so dirty, than at Kingston, Kew, or Richmond, where "it presents a beautifully clear and inviting an appearance." They then proceed to show that the most important element of offensiveness in the river is not the organic matter in solution, although they attributed to this a part in the production of offensiveness which subsequent observations do not appear to have confirmed, but the deposit of sewage mud in the bed of the stream. (*Report to the First Commissioners of Her Majesty's Works on Metropolitan Drainage*, 1857, p. 7.) I am not aware that these results have been modified by subsequent inquiries. The investigations of Messrs. Hoffman and Witt were made when the whole of the metropolitan sewage was poured into the Thames, within the metropolitan area. Now, in 1877, the question of organic matter in solution in the Thames, so far as this may be of sewage origin, has to be considered with reference to the enormous additional dilution which the metropolitan sewage undergoes by being poured into the Thames at Barking and Crossness.

the inquiry as to the "Cornwall" is to be pursued further, it will be difficult to do this satisfactorily in the desultory manner which to the present has alone been possible for me, and it will require an amount of time which in the present state of the work of the office must complicate that work exceedingly, and in several important respects bring it to a standstill. I, therefore, stop the inquiry at this point until I receive further instructions.

J. NETTEN RADCLIFFE.

May 1878.

NOTE I.—FORM OF MEDICAL REGISTER, SCHOOL-SHIP "CORNWALL."

Boys under treatment 187 .

No.	Name.	Disease.	Date of Month. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	Result.

NOTE II.

RETURN showing the NUMBER of BOYS who have Died or been Discharged on account of DISEASE in the Years noted, and the Average Number of BOYS under detention in each Year, in the Reformatory School-Ships "CORNWALL," * "AKBAR," † and "CLARENCE." †

Year.	Number under Detention.			Died.			Discharged on account of Disease.		
	"Cornwall."	"Akbar."	"Clarence."	"Cornwall."	"Akbar."	"Clarence."	"Cornwall."	"Akbar."	"Clarence."
1859	9	152	—	—	4	—	—	1	—
1860	86	150	—	1	3	—	—	—	—
1861	168	160	—	2	2	—	—	—	—
1862	197	155	—	—	1	—	—	—	—
1863	180	189	—	1	1	—	1	—	—
1864	158	175	91	2	3	—	2	—	—
1865	138	173	180	1	—	—	—	2	—
1866	185	188	192	5	2	3	5	3	1
1867	218	171	198	—	3	3	—	—	2
1868	226	180	209	4	2	3	1	2	1
1869	254	171	189	4	4	6	—	2	4
1870	285	189	185	8	1	9	5	—	2
1871	290	164	220	1	4	—	—	—	—
1872	261	170	207	1	5	1	—	—	—
1873	234	170	220	1	6	2	1	—	—
1874	238	172	232	3	1	5	1	—	1
1875	238	179	215	3	3	7	1	—	4
1876	221	176	211	4	8	5	—	—	2
1877	218	—	—	2	—	—	—	—	—

* "Cornwall," moored in the *Thames*, off Purfleet.
† "Akbar" and "Clarence," anchored in the *Mersey*, off Birkenhead.

NOTE III.

REPORT on SEVEN SAMPLES of THAMES MUD, five taken by Mr. Radcliffe near the outfalls of the Main Sewers and two by myself near Westminster.

Appearances.—All the samples were of brownish colour on the surface where exposed to the action of the air, and dark, or even black, in the interior. All of them consisted, in greater part, of silicious particles or sand, more or less fine, mixed with calcareous matter, clay, oxide or sulphide of iron, particles of wood, straw, and other vegetable fibre, cinders, coals, &c., &c.

Microscopic Appearance.—Under the microscope all the samples showed, in addition to the above, a variety of fungoid growths, broken down organic tissue, hairs, vegetable fibres, diatomaceæ, &c., &c.

The general character of all was thus exactly alike, although slight differences could be perceived between them. Thus, No. I. contained a relatively large proportion of coarse sand, No. III. was

particularly rich in fragments of wood, and No. VI. contained many of the minute red worms often found in Thames mud.

Smell.—No. VI. had a very offensive odour of sewage, all the rest had merely the odour of ordinary mud.

Chemical Character.—Chemical examination also failed to show any material differences between the samples. They all consisted chiefly of sand, clay, and chalk, and contained only a small proportion of organic matters. This organic matter, moreover, seemed to be very much of the same character in all, as shown by the slight variations in the relative proportions of carbon and nitrogen present in it. In fact only one sample (No. IV.) shows any material departure from the mean in this respect. In this the proportion of carbon to nitrogen is very much greater than in the rest, showing the organic matter in it to be of vegetable origin chiefly. This is due, no doubt, to the admixture with it of an exceptionally large proportion of disintegrated wood. In samples I., II. and VII., the proportion of carbon is slightly below the average, which may taken as indicating a somewhat higher proportion of animal contamination, due, perhaps, to the presence in these samples of a larger proportion of sewage deposit. As before stated, however, neither the chemical nor the miscroscopic examination lends much countenance to the supposition that one sample consists more than another of sewage deposit.

No. I. labelled, "No. 1. Mud from bed of Thames, opposite northern outfall metropolitan sewage, "about 100 feet from beach, collected at several castings of mud collector. Time, ½ hour before "low water. 13 Oct. 1877.—J. N. R."

No. II. labelled, "No. 2A. Mud taken from bed of Thames, off the southern outfall metropolitan "sewage, close in. Low water. Collected at several castings of mud collector. 13 Oct. 1877.—"J. N. R."

No. III. labelled, "No. 2B. Mud taken from exploration pole, sunk about 12 feet in bed of "river, off the southern outfall. Mud taken from pole at various points. 13 Oct. 1877.—"J. N. R."

No. IV. labelled, "No. 3. Mud from beneath 'Cornwall,' wholly from outer side as she lies at "her moorings. Of six casts there, two failed to bring up mud, four (of which the specimen given "shows the character) a small amount. No mud inner side of ship. Mud on beach close by of "similar appearance, and specimen put in with that beneath vessel. 'Part flood.' 13 Oct. 1877.—"J. N. R."

No. V. labelled, "No. 4. Mud collected in three castings of mud collector off Greenhithe, between "the shore and the 'Arethusa' and 'Chichester,' running from the causeway of the two school-ships "to Johnson & Co.'s Cement Works. Flood begun. 13 Oct. 1877.—J. N. R."

No. VI., "Mud taken from surface of mud bank in front of terrace of Houses of Parliament. "3 p.m., Oct. 30, 1877, near low water."

No. VII., "Mud taken from surface of mud bank on Surrey side of Thames, about 50 yards below "Vauxhall Bridge. 3.30 p.m., Oct. 30, 1877."

100 parts of Dry Mud contains:—

Number.	Volatile Matters.[1]	Matters soluble in Hydrochloric Acid.[2]	Sand and Clay.	Organic Carbon.	Organic Nitrogen.	Per-centage of Nitrogen in Organic Matter.	Parts of Carbon to one part of Nitrogen.
I. -	6·42	18·88	74·70	2·32	0·245	3·81	9·46
II. -	9·93	26·03	64·04	4·84	0·462	4·65	10·47
III. -	8·10	21·84	70·06	3·79	0·315	3·88	12·03
IV. -	14·12	24·99	60·89	6·92	0·410	2·90	16·87
V. -	4·61	20·20	75·09	2·27	0·189	4·11	12·01
VI. -	13·27	26·96	59·77	7·97	0·630	4·74	12·65
VII. -	8·72	25·44	65·84	4·88	0·511	5·86	9·55

[1] The volatile matter represents all the loss suffered by the dry mud on ignition, the carbonic acid from the carbonate of lime, which in these cases was restored before weighing, excepted. This loss is, no doubt, chiefly organic matter, but is also due to loss of water of hydration, driven off from any clay and hydrated oxide of iron present. It will thus depend partly on the proportion of these substances present, and partly on the temperature at which the specimen had been dried. These samples were dried at 125° C. For these reasons, as also because part, at least, of the carbonic acid from the carbonate of lime is, by some, included in the loss as organic matter, this loss, as estimated by various observers, is not directly comparable, and in no case can fairly be taken as representing organic impurity.

The proportion between the organic carbon and organic nitrogen is uninfluenced by any of these points, and is therefore a much surer guide in judging the nature of the organic matter present.

[2] Chiefly carbonate of lime and a little oxide of iron.

Westminster Hospital, Nov. 7, 1877. A. DUPRÉ

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