THE UREA AND CHLORIDES IN THE URINE OF JAUNDICE.

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I VENTURE to bring before the Society the results of my observations on the urine of patients suffering from jaundice, because I am not acquainted with any like series of observations on the urea and chlorides. A few solitary observations have indeed been published, but it is hard to draw any definite conclusion by comparing them together. Becquerel found the urea in one case to be 17·923 grm. and the quantity 1419 c.c. ; in another the urea was 4·057 grm. and the amount 634 c.c. In a pregnant woman, suffering from jaundice, the urea was 7·933 grm. and the amount 640 c.c. in the twenty-four hours.¹ A. Vogel likewise found great decrease of the urea in the urine of a man jaundiced from cancer of the liver : the urea varied from 6·75 to 9·5 grm., the chlorides from 1·6 to 3 grm., while the amount of urine was from 1350 to 2000 c.c.² Kölliker and Müller found both in jaundiced dogs and a young

¹ Becquerel, 'Séméiotique des Urines,' Paris, 1841, pp. 393, 412.

² A. Vogel, 'Zeitschrift f. rat. Med.,' 1854, Bd. iv, neue Folge, p. 391.

woman suffering from simple jaundice that the amount of urea was somewhat but not greatly decreased.¹ J. C. Lehmann found, in three cases of jaundice with clay-coloured stools, that the amount of urea was decreased during obstruction to the gall-ducts, but became greater as soon as the obstruction was removed. In a fourth case the same observer found that the amount of urea was increased.² Lehmann explains this diminution of the urea by supposing an imperfect digestion of the albuminous parts of food, probably because the parapeptones are not thrown down. This does not, however, explain the case in which the urea was increased. Leyden records also one of his cases in which the urea daily excreted amounted to 34·8 grm. and even 50 grm.³ Dr. George Harley, in a case of complete obstruction to the ducts, found the amount of urea to be 27·28, 23·994, and 15·345 grammes on three different occasions, a few days only passing between each analysis. The patient died a fortnight after the last analysis, the jaundice having lasted eighteen months.⁴

Although great attention has been paid of late years to the urine in jaundice, it is somewhat surprising that so few estimations of the urea should have been made. The amount of urea excreted in jaundice is not without interest in discussing Meissner's theory of the formation of urea. For if the formation of urea be one of the many functions of the liver, it might well be looked for that in jaundice, where so many functions are abolished, the urea-forming function would be abolished too. It has been shown that

¹ Kölliker and Müller, 'Verhandlungen der phys-med. Gesellschaft in Würzburg,' 1856, Bd. vi, p. 484.

² J. C. Lehmann, 'Ugeskr. for Læger,' 3 R. VI, No. 24—26, abstracted in 'Virchow's Jahresbericht, f., 1868,' Bd. ii, p. 143. Since this paper was read Dr. A. W. Foot has recorded a case of jaundice complicated with xanthelasma, in which the urea excreted in the twenty-four hours was 439·687 grains; quantity of urine 67 oz. ('Dublin Journal of Medical Science,' 1876, May, p. 600).

³ Leyden, 'Beiträge zur Pathologie des Icterus,' Berlin, 1866, p. 209.

⁴ George Harley, 'Jaundice, its Pathology and Treatment.' Lond., 1863, pp. 74, 78, and 79.

within a few hours of the ligature of the bile-duct, the glycogen disappears from the liver;¹ and this statement has been confirmed by von Wittich.² The bile-acid and bile-pigment-forming function of the liver seems to be greatly impaired; the amount of bile-pigment and bile-acids excreted by the kidneys, the only path by which they leave the body, being in the severest cases of jaundice extremely small; if Schwanda's estimations may be trusted, not more than .014 grm. of bile-pigment in the twenty-four hours;³ it is notorious how small is the amount of the bile-acids; the smallness of the amount gave rise to their presence in the urine being long denied, and, according to the most competent chemists, the amount excreted in the urine in twenty-four hours never rises to .5 grm. The amount excreted by the liver in health is certainly not less than 11 grm.; and the difference between health and jaundice has hitherto been explained by supposing the bile-acids to be oxydised in the blood. As they are already in a high degree of oxydation and are exceedingly stable bodies, it seems more probable to believe that very little or no bile-acid is secreted. Indeed, Golowin and other recent observers could find no bile-acids in the urine of persons who had suffered from long-continued jaundice.⁴

Now, most of the supporters of Meissner's theory hold that the glycogen, the bile-acids, and urea are the products of the decomposition in the liver of the albuminous substances of the blood, the carbon, hydrogen, and oxygen going to form glycogen, the oxydised nitrogen and carbon, the refuse of the process, going to form urea and bile-acids. If, therefore, the making of glycogen cease, it would seem likely that the making of bile-acids and urea would cease

¹ Wickham Legg, 'St. Bartholomew's Hospital Reports,' 1873, vol. ix, p. 161.

² Von Wittich, 'Centralblatt f. d. med. Wiss.,' 1875, p. 291.

³ Schwanda, 'Wiener med. Wochenschrift,' 1865, p. 989.

⁴ Golowin, 'Arch. f. path. Anat.,' 1871, Bd. liii, p. 433; and Pye-Smith, 'Trans. of the Path. Soc. of London,' 1873, vol. xxiv, p. 251. See also a paper by the writer on the "Functions of the Liver in Jaundice," 'British Medical Journal,' 1876, vol. ii, p. 263.

likewise. The bile-acids, it is highly probable from the evidence given, do cease to be made. If then the liver in health secrete urea in abundance it might be looked for that in jaundice the amount of urea secreted would fall very greatly in amount or even altogether be brought to nought. The following cases scarcely bear out this inference. In that of Charles Kingsley, in which the obstruction to the ducts was complete and uncomplicated, the amount of urea passed in the twenty-four hours was very little less than 30 grm., that is, about the natural amount. In other cases, in which the urea was diminished, the general health was much affected, and a decrease in the amount of urea might be looked for as a result of the complications rather than as a result of the jaundice.

The observations on the following cases were all made in the wards of St. Bartholomew's Hospital, by the courtesy of the physicians under whose care the patients were placed. The patients were all men, as women show themselves but little fitted for researches of this kind; but beyond this, no selection was made. The cases were taken as they came into the hospital, and I had opportunities of attending to them. The jaundice was deep in seven out of the ten cases. In the others it was not so intense. In all but two the motions were free from colour.

On comparing these cases together it will be seen that the amount of the urine varied very greatly. In two out of the ten the amount was great, the mean being 2234 and 2790 c.c.¹ In eight the amount was neither excessive nor low, the mean varying from 1120 to 1971 c.c. In one the amount was low, the mean being 570 c.c. As to the urea, this bore some superficial relation to the amount of the urine; the highest ranges of urea corresponding to the highest amount of water, and the lowest ranges

¹ Leyden (op. cit.) has noticed some cases of jaundice in which the amount of urine was much increased. Animals whose bile ducts are tied pass a greatly increased amount of urine, a result noticed by Feltz and Ritter after the injection of bilirubin into the veins. ('Robin's Journal de l'Anatomie,' 1875, t. xi, p. 158.)

of urea corresponding generally to the lowest amount of water. Whether the amount of urea be thought below the natural standard or not depends of course on what is looked upon as the natural standard of health. One observer thinks that 18 grm. of urea in the twenty-four hours do not fall below this standard; and if this be the case, the urea was in one case only below natural, the mean in that case being 15·975 grm. In two out of the remaining nine the urea was 18 grm. in the twenty-four hours; in one 19 grm.; in three 22 grm.; in one 27 grm.; in one 28 grm.; and in the remaining one 29 grm. But if the standard of health be set somewhat higher, as the majority of observers seem to believe, the mean given by Dr. Parkes being 33 grm.,¹ then it is clear that the amount of urea excreted in these cases was, in all, below the standard. It is noteworthy that in the one case in which the excretion of urea was found to be the highest, viz. Charles Kingsley, the obstruction to the bile-ducts was likewise found after death to be complete; more complete, indeed, than in any of the other cases examined; and in the second highest case, in which, however, no examination after death was made, the jaundice had been deep for several years and the stools had been colourless throughout that time.

The chlorides were estimated in nine out of the ten cases, but not so regularly as the urea. In five out of the nine the amount may be said to be almost natural, the mean varying from 13·801 grm. to 10·408 grm. In the remaining four the mean was 9 grm. in two, and 6 grm. in two. In one case the chlorides on one occasion ranged very high, even higher than the urea, being as 21·12 grm. of chlorides to 18·48 grm. of urea. I am disposed to give little heed to this estimation, knowing how abundant chloride of sodium is and how easy the means of deception. The amount of chlorides may be set down as generally of the natural standard.

The diets used at St. Bartholomew's are as follows :—

¹ Parkes, 'The Composition of the Urine.' London, 1860, p. 8.

Full diet.—Two pints of tea, 14 ounces of bread, $\frac{1}{2}$ a pound of dressed meat, $\frac{1}{2}$ a pound of potatoes, 2 pints of beer, and 1 ounce of butter. Half diet.—Two pints of tea, 12 ounces of bread, 4 ounces of dressed meat, $\frac{1}{2}$ a pound of potatoes, 1 pint of beer, $\frac{3}{4}$ of an ounce of butter. Milk diet.—Two pints of tea, 12 ounces of bread, $1\frac{1}{2}$ pint of milk, $\frac{3}{4}$ of an ounce of butter and gruel.

John Harris, aged 30, was admitted into Mark's Ward, under the care of Dr. Duckworth. He had been deeply jaundiced for three years, and had well-marked xanthelasma of the eyelids. The liver was very large, hard and smooth. The spleen was likewise enlarged. The temperature was never raised. The motions were always free from colour. He was out of bed during the day, and allowed to take moderate exercise in the open air. His weight at the end of the observations was 128 lbs. or 58 kilo. The diet from October 20th was half diet, with 4 ounces of wine and arrowroot. From September 8th he took bile capsules three hours after dinner. During the observations on the urine the jaundice was very deep, the complexion of the patient being almost black.

This patient died some time in 1875 at Leicester, but no examination after death took place. Hydatid tumour of the liver pressing on the gall-ducts I consider to have been the most likely diagnosis.

Date.	Quantity in c.c.		Urea in grm.		Chlorides in grm.	
1878.						
Nov. 9—10	...	2440	...	21·35	...	—
10—11	...	2370	...	20·619	...	12·324
11—12	...	2040	...	29·988	...	15·912
12—13	...	2060	...	32·96	...	14·42
13—14	...	2140	...	31·244	...	13·696
14—15	...	2340	...	34·164	...	12·656
Mean	...	2234		28·387		13·801

The urine throughout these observations contained a small amount of albumen, that is, it became opalescent

when nitric acid was added to the boiling urine. It also gave a marked Gmelin's reaction. The urine, acid at first passing, readily became alkaline. The estimation of the urea was made by Liebig's process; that of the chlorides by the volumetric method with nitrate of silver after incineration with nitrate of potash.

Charles Kingsley, aged 35, was admitted on November 18th, 1873, into Matthew's Ward, under the care of Dr. Black. He became jaundiced a twelvemonth before admission. He was deeply jaundiced, and the stools were white. The liver could be felt, smooth and firm, reaching down to the umbilicus. During the observations on the urine he was allowed to walk about the ward. The temperature varied from 97° to 99° F.

He died on December 5th, the temperature for forty-eight hours before death being as high as 105° or 106°. A large hydatid cyst pressed on the common duct, completely obstructing it.¹

Date.	Quantity in c.c.		Urea per cent.		Chlorides in grm.	
1873.						
Nov. 20—21	...	2840	...	1·04	...	11·36
25—26	...	1430	...	·88	...	—
	A good deal lost.					
26—27	...	2740	...	1·08	...	—
Mean of 2 obs.		2790	...	1·06	...	11·36
				or 29·574 daily.		

This patient would not collect all his urine. It was throughout opalescent with heat and nitric acid, showing a distinct Gmelin's reaction with nitric acid. The specific gravity varied from 1008 to 1012. The estimation of the urea was by Liebig's process; that of the chlorides after incineration with nitrate of potash.

James Kean, aged 50, was admitted on November 21st, 1873, into Luke's Ward, under the care of Dr. Southey. About nineteen months ago he was first seized with the

¹ This case has been given in full in the 'Transactions of the Pathological Society of London,' vol. xxv, 1874, p. 155.

jaundice, attended with attacks of sharp pain in the right hypochondrium, coming on about six times a day. The jaundice lasted a twelvemonth. He has now been jaundiced since November 18th. At the very beginning of the observations he was recovering from an attack of pneumonia, but the temperature throughout this attack and during the observations was never higher than 98.4° F. The man was in bed during the observations; the liver large, stretching down to within an inch of the umbilicus; the stools half fluid, all brown. The diet from November 21st was milk diet, with arrowroot and half a pint of beef tea. The medicine was a draught of effervescing tartrate of soda, with ten minims of spirits of chloroform every six hours.

He continued under observation till February, 1874, being still somewhat jaundiced, but with the liver greatly decreased in size.

Date.		Quantity in c.c.		Sp. gr.		Urea in grm.		Chlorides in grm.
1873.								
Nov. 25—26	...	2430	...	1010	...	21.384	...	—
26—27	...	Lost						
27—28	...	1970	...	1013	...	24.822	...	—
28—29	...	1570	...	1015	...	24.492	...	—
29—30	...	1445	...	1022	...	32.079	...	—
30—Dec.1	...	1865	...	1015	...	28.348	...	13.001
Dec. 1—2	...	1435	...	1020.5	...	32.321	...	13.489
2—3	...	1780	...	1015	...	29.836	...	10.918
3—4	...	1590	...	1019	...	34.98	...	—
Mean	...	1788	...	—	...	27.28	...	12.469

On the first three days of observation the urine was alkaline at the time of testing; on the first two days and on the last it became opalescent upon the action of heat and nitric acid; on the other days, not. Gmelin's reaction was present throughout. The urea was estimated by Liebig's method; the chlorides after incineration with nitrate of potash.

Thomas David Smart, aged 42, was admitted into John's Ward, under the care of Dr. Harris, on November

24th, 1873. He had been jaundiced for about three weeks; vomiting preceding the jaundice. Jaundice on November 28th was universal, but not very intense; stools white. Liver not to be felt; liver dulness about four inches vertically in nipple line; nothing else noteworthy in the belly. The motions became of a pale brown colour on November 30th; on December 3rd of a natural brown. The yellowness was much less on December 4th, and he was discharged well on December 20th. The temperature taken daily in the mouth during the observations on the urine never rose above 100° F., nor sank below 99° F.

Date.	Quantity in c.c.	Sp. gr.	Urea in grm.	Chlorides in grm.
1873.				
Nov. 28—29 ...	1665 ...	1014 ...	26.64 ...	—
29—30 ...	1400 ...	1018 ...	22.96 ...	—
30—Dec.1 ...	1300 ...	1020 ...	21.45 ...	—
A good half-pint was lost.				
Dec. 1—2 ...	1225 ...	1019 ...	22.54 ...	9.555
2—3 ...	1310 ...	1018.5 ...	25.021 ...	9.17
3—4 ...	1450 ...	1013.5 ...	19.43 ...	9.96
4—5 ...	1085 ...	— ...	18.9875 ...	13.02
Mean ...	1355 ...	— ...	22.596 ...	10.428

The urine contained no sugar throughout the observations; it was opalescent with heat and nitric acid, save on the last two days. Gmelin's reaction was present throughout, becoming fainter on the last two days. The urea was estimated by Liebig's process; the chlorides after incineration with nitrate of potash.

It is noteworthy that in this case the urea decreased on the last two days of observation, as the motions assumed a more natural colour.

William King, aged 46, was admitted on August 3rd, 1874, into Radcliffe Ward, under the care of Dr. Andrew. He was quite well until last January, when he was seized with a griping pain in the belly, which has come on now and then since. Fourteen days before admission he

became jaundiced. During the observations he was deeply jaundiced. His pulse was 64. His temperature did not rise above 98°. His fæces were colourless. His diet on September 17th and throughout the observations on the urine was milk diet and a fish daily, with a pint of arrowroot, two eggs, a pint of mutton broth, and two ounces of brandy. To this a pint of milk was added, September 22nd. He took the nitro-muriatic acid mixture of the Pharmacopœia three times a day, with a bile capsule three times a day two hours after food.

He died on November 6th. The common duct was found pressed upon by a tumour from the pancreas, and was dilated above. The tumour of the pancreas and multiple tumours of the liver were carcinomatous.¹

Date.	Quantity in cc.			Sp. gr.	Urea in grm.		Chlorides in grm.	
1874.								
Sept. 17—18	...	620	...	1025	...	18·662	...	7·376
18—19	...	490	...	—	...	17·376	...	4·165
20—21	...	540	...	1028	...	20·388	...	5·994
21—22	...	425	...	—	...	15·0025	...	5·015
22—23	...	770	...	1026	...	23·87	...	9·317
23—24	...	580	...	1025	...	17·922	...	5·394
Mean	...	570	...	—	...	18·87	...	6·21

The urine was acid throughout the observations, and became slightly opalescent with heat and nitric acid. He was deeply jaundiced throughout. The urea was estimated by Liebig's process; the chlorides directly, without incineration.

Robert Bristow, aged 38, was admitted on May 15th, 1875, into John's Ward, under the care of Dr. Church. He had been jaundiced for five years before admission. The liver descended four inches below the ribs in the nipple line, and a round swelling could be felt on it. The spleen filled the left hypochondrium. He was not very deeply jaundiced, and the stools were not free from colour.

¹ A full report of this case has been published in the 'St. Bartholomew's Hospital Reports,' 1875, vol. xi, p. 82.

The patient was allowed to get up, and temperature was natural during the observations on the urine. He was ordered full diet with a pint of milk. On June 14th a bottle of soda water daily was ordered. From May 29th he had twenty minims of compound tincture of cardamoms, fifteen grains of bicarbonate of soda in an ounce of compound infusion of gentian. On the 14th of June this was changed to three grains of quinine thrice daily.

Date.		Quantity in cc.		Sp. gr.		Urea in grm.
1875.						
June 16—17	...	1210	...	1019	...	23·595
17—18	...	1680	...	1012	...	23·52
18—19	...	1400	...	1014	...	21·00
19—20	...	Lost				
20—21	...	1340	...	1015	...	21·44
21—22	...	1340	...	1015	...	21·44
22—23	...	1640	...	1014	...	24·60
Mean	...	1433	...	—	...	22·598

The urine became slightly opalescent on the first two days of observation with heat and nitric acid, not on the remaining. There was throughout a deep Gmelin's reaction with nitric acid. The urea was estimated on Russell and West's method.¹

Thomas Johnson, aged 49, was admitted on July 19th, 1875, into Mark's Ward, under the care of Dr. Andrew. Twelve weeks before admission he was quite well. Six weeks before admission he became jaundiced. Liver on admission was enlarged, stretching two to two and a half inches below ribs. Motions perfectly free from colour, throughout his stay in hospital. Temperature varied from 98·5° to 99·4°; pulse from 84 to 100, and he was in bed during the observations. On admission he was ordered milk diet and arrowroot. A pint of beef tea was ordered on the 23rd. A warm bath was given on July 23rd. The medicine given was the alkaline calumba draught of

¹ This method is described at full in the 'Journal of the Chemical Society,' 1874, vol. xxvii, p. 749.

St. Bartholomew's Hospital Pharmacopœia, with ten minims of tincture of opium every six hours, and occasional doses of chloral (gr. xv). Death took place on August 21st, after a rise of temperature for four days before death as high as to 104° . The cause of the jaundice was cancer of the pancreas; nodules were likewise scattered through the liver, with great dilatation of the gall-ducts and bladder, and abundance of gall-stones in the gall-bladder.

Date.	Quantity in cc.			Sp. gr.	Urea in grm.		Chlorides in grm.	
1875.								
July 22—23	...	1920	...	1010	...	21.12	...	4.976
23—24	...	2090	...	1010	...	22.99	...	7.106
24—28	...	Diarrhœa						
28—29	...	2450	...	1010	...	30.40	...	9.02
29—30	...	1840	...	1010	...	21.16	...	6.624
30—31	...	2160	...	1010	...	25.92	...	8.208
Aug. 1—2	...	1370	...	1011	...	15.67	...	4.658
Mean	...	1971	...	—	...	22.87	...	6.765

Throughout these observations the urine was acid, clear, of a deep brown-green colour, and free from albumen and sugar, Gmelin's reaction being well marked. The estimation of the urea was made by Russell and West's process; that of the chlorides without incineration.

Robert Langan, aged 47, was admitted on July 29th, 1875, into Mark's ward, under the care of Dr. Andrew. He became jaundiced two months before admission for the first time in his life; he had never any pain in the belly. No enlargement of liver or spleen; no ascites. He says he has always been sober, but is easily overcome by liquor. On first rising he is accustomed to bring up a little yellow phlegm. Stools of light brown colour, particoloured. On August 3rd the stools became ashy grey, and the jaundice was noted to be less. From admission up to August 1st he was on milk diet with beef tea, changed at that date to milk diet with a pint of milk and arrowroot.

A fish daily was added on the 5th. The patient was kept in bed. The temperature varied from 97.2° to 98° F. Pulse from 60 to 72. He had a warm bath on the 3rd and 6th. For medicine he had the draught of nitro-muriatic acid of the St. Bartholomew's Hospital Pharmacopœia, with gr. xx of sulphate of magnesia three times a day. He was discharged from the hospital on September 15th, no material change having taken place. He was again seen on January 24th, 1876, no great change having taken place in the symptoms or physical signs, save a considerable increase of the jaundice during the fortnight before being again seen.

Date.		Quantity in cc.		Sp. gr.		Urea in grm.		Chlorides in grm.
1875.								
Aug. 1-2	...	1760	...	1017	...	18.48	...	21.12
2-3	...	1710	...	1013	...	17.1	...	14.364
3-4	...	1240	...	1015	...	12.4	...	7.728
4-5	...	1130	...	1018	...	14.69	...	10.17
5-6	...	1565	...	1015.5	...	17.215	...	12.9895
Mean	...	1481	...	—	...	15.975	...	13.2743

The urine was acid throughout these observations, free from sugar, but containing bile pigment, and becoming opalescent with heat and nitric acid. The urea was estimated by Russell and West's method; the chlorides without incineration.

Josias Davidson, aged 48, was admitted into John's Ward, under the care of Dr. Church, on October 23rd, 1875. He began to be jaundiced about last May. On admission he was deeply jaundiced, the stools colourless, the liver large, but surface smooth. His temperature during the observations on the urine was 98° . He had full diet with a pint of milk. He took the nitro-muriatic acid draught of the St. Bartholomew's Hospital Pharmacopœia three times a day, with twenty minims of the Sp. Chloroform. He was in bed during the obser-

vations on the urine. He died on December 12th. Numerous white nodules of cancer were found in the liver; the common duct greatly dilated, but a probe could be passed down it into the gut; no bile in the gut. The head of the pancreas was a soft white tumour, pressing on the common duct.

Date.	Quantity in cc.		Urea in grm.		Chlorides in grm.	
1875.						
Oct. 24—25	...	1150	...	20·7	...	8·05
25—26	...	1100	...	19·8	...	8·14
26—27	...	1120	...	20·16	...	10·08
27—28	...	1300	...	22·1	...	13·26
28—29	...	1190	...	17·85	...	11·186
29—30	...	850	...	12·70	...	7·82
		Some lost	or	1·4 p. c.		
Mean	...	1120	...	18·72	...	9·756

The urine was acid throughout, opalescent with heat and nitric acid, turbid on the first and last days of observation, on other days clear; it was high coloured throughout, giving Gmelin's reaction readily. The urea was estimated by Russell and West's process. The chlorides without incineration.

Frederick Sheffield, aged 53, admitted into Mark's Ward, under the care of Dr. Andrew, on November 26th, 1875. He had been feeling out of sorts for several months before admission. The jaundice had been noticed for three weeks before admission. On December 1st he was ordered full diet with arrowroot. The motions remained free from colour during observation, but the jaundice was never very deep. The temperature was never above 98·2°, and his weight was 128 lbs. or 57 kilogrammes.

He was discharged from the hospital on January 1st, 1876.

Date.	Quantity in cc.	Sp. gr.	Urea in grm.	Chlorides in grm.
1875.				
Dec. 14—15	.. 930 ...	1021 ...	13·02 ...	6·51
	Some lost		or 1·4 p. c.	or ·7 p. c.
15—16	... 420 ...	1018 ...	9·24 ...	3·528
	Some lost		or 2·2 p. c.	or ·84 p. c.
16—17	... 1190 ...	1019 ...	15·47 ...	9·996
17—18	... 1100 ...	1017 ...	19·8 ...	9·78
18—19	... 1070 ...	1023 ...	19·26 ...	9·436
19—20	... 980 ...	1015 ...	12·74 ...	6·272
	Some lost		or 1·3 p. c.	or ·64 p. c.

The urine was acid throughout, and showed abundant evidence of bile pigment. The urea was estimated by Russell and West's process; the chlorides after incineration with nitrate of potash.