In the following table, from page 376 of the same Report, two lines have been added giving the percentages of nitrogen on the loss of ignition. It is then seen that there is little difference in ratio, confirming the fact stated on page 817 of the present paper, that the empirical chemical composition of the organic portion of sludges from various sources differs but little.

It is only when these are completely fermented under anaerobic conditions or allowed thoroughly to oxidise, are "weathered" so to speak, that a marked change in the chemical ratios becomes apparent. In the first case then change is mainly due to cellulose fermentation, in the second case it is the nitrogen which disappears most rapidly, though fat destruction takes place. These facts are important from the point of view of agriculture.

*Analyses of Sediments from Sewage and Effluents of Filters
Nos. 135 and 136.*

	Sewage sediment.	Sediment of filter.	
		No. 135	No. 136
Per cent. of total Nitrogen (Kjeldahl)	2.37	1.37	1.41
Per cent. of N detd. as Alb. NH_3 ..	1.30	0.70	0.78
Per cent. that Alb. NH_3 is of total N (Kjeldahl)	55.00	51.00	55.30
Albuminoid NH_3 (pts. per 100,000)	1575.00	851.00	952.00
Loss on ignition (per cent.)	58.50	27.00	31.50
Total Nitrogen (per cent. of loss on ignition)	4.0	4.9	4.4
Albuminoid Nitrogen (per cent. of loss on ignition)	2.2	2.5	2.4

The following general conclusions from the above data appear therefore to be justified:—

1. That there is no great difference in empirical chemical composition between sludges obtained by ordinary sedimentation, incipient septic action, and aerobic sedimentation as in slate beds.
2. That under conditions of vigorous anaerobic fermentation the main change is a destruction of cellulose matter with a corresponding decrease in the amount of carbon present compared to the nitrogen and hydrogen.
3. That for the final elimination of fat and of nitrogen, conditions of active oxidation are necessary.
4. Future research may more profitably be directed to the physical and biological differences between sludges of various origin and the action of special solvents and reagents upon them, rather than to their empirical chemical composition.

The authors' thanks are due to Mr. E. M. Mumford, M.Sc., and to Mr. J. M. Drummond, M.Sc., for assistance in completing the above analyses.

Communication.

ALCOHOL ESTIMATION IN THE TROPICS.

BY K. C. BROWNING, M.A., AND C. T. SYMONS, B.A.

For the last nine years one of the authors has noticed that the usual hydrometer method (i.e., by brass Sikes's hydrometer) of ascertaining the strength of aqueous alcoholic solutions at high temperatures (80° – 90° F.) gave results not in agreement with those obtained by pyknometer readings at 60° F. and *Hehner's tables* (*Analyst*, Volume 5, 1880, pp. 42–63).

Sir Charles Bedford found that in India, Sikes's tables gave incorrect spirit strengths, especially at high air temperatures and with weak spirits. He has published a set of tables for use with Sikes's glass hydrometers,

which have been adopted in India. (Corrected Sikes's tables published by the Superintendent, Government Printing, Calcutta, 1910.)

The authors, for the past two years, have been engaged in comparing the readings of glass and brass hydrometers using alcohols whose strength was determined by pyknometer readings at 60° F. and *Hehner's tables*.

They have also included a set of readings on alcohols whose strength was determined by pyknometer readings at 35° C.* using the standard tables published in 1913 by the United States Bureau of Standards.

At the same time the refractive indices of these alcohols were determined at 30° C. (using the Zeiss immersion refractometer).

This is a very convenient method of rapidly estimating alcohol strengths from 0–35% by weight of alcohol: above this strength the accuracy is not satisfactory, as will be seen from the curve annexed.

Methods.

Various forms of pyknometer were tried, Sprengel's, Perkin's, Bousfield's (*Chem. Soc. Trans.*, 1908, 679–681) using inside and outside cap stoppers, Warren's pattern (100 c.c. capacity with perforated stopper and ground on external cap), and Wade and Merriman's (*Chem. Soc. Trans.*, 1912, 2429–2443). Wade and Merriman's form was found to be by far the most satisfactory. The pyknometers were made either of "R" or quartz glass. The thermostat used for 60° F. consisted of a teak tank holding about 62 litres. It was efficiently lagged and strongly stirred by a series of paddles mounted on a shaft running along the lower portion. A small electric motor with a worm reduction gear supplied the power. Two pieces of plate glass were inserted on the upper portion of two opposite sides so that observations could be made on the level of liquid in the pyknometers while they were immersed in the water. The tank was cooled by circulating ice water through copper coils, the flow of water being controlled by an electrically worked relay.

Temperatures were taken on thermometers recently standardised at the National Physical Laboratory and the Reichsanstalt, a large Beckmann thermometer being used to show variations in temperature. It was not found possible to keep the temperature constant to more than $1/100^\circ$ C. The thermostat for measurements at 35° C. consisted of a copper tank holding about 89 litres of water. It was mounted in a table and stirred by paddles on a horizontal shaft, driven by a brass chain from a small electric motor with worm reduction gear.

At the top of the two opposite sides, plate glass windows were inserted, like those on the low temperature thermostat. The heating was done by a gas jet controlled by a Lowry spiral regulator.

* The temperature of 35° C. was adopted, as the laboratory temperature in the tropics frequently exceeds 30° C., and experiments showed that at 35° C. a very constant temperature could be maintained.

A very sensitive gas pressure regulator controlled the gas supply, and, as the room in which the thermostat was placed had a very steady temperature, it was found possible to keep the thermostat temperature steady within $\pm 1/1000^\circ \text{C}$. Wade and Merriman (Chem. Soc. Trans., 1912, 2432) have pointed out that it is necessary to keep the temperature constant within $1/1000^\circ \text{C}$. to give results accurate to one in the 6th place of decimals and within $1/100^\circ \text{C}$. to the 5th decimal place, cf. also "Density and thermal expansion of ethyl alcohol and of its mixtures with water," by Osborne, McKelvy, and Bearce (Bull. Bureau of Standards, 9, 415).

The hydrometers used were restandardised at the National Physical Laboratory at the conclusion of the series of measurements and the corrections (where necessary) are included in the tables.* All weights used were standardised at the National Physical Laboratory.

The following table gives results obtained with aqueous alcoholic solutions, the strength of which were determined at 60°F . in 100 c.c. pycnometers using Mohr's tables for the calculations.

The hydrometer readings were taken at temperatures about $84^\circ\text{--}88^\circ \text{F}$. (the usual laboratory temperature in the Tropics).

TABLE A.

Strength by pycnometer at 60°F . in % by weight alcohol.	Strength by pycnometer at 60°F . in % Proof Spirit.	Glass Hydrometer • Usual Tables. % Proof Spirit.	Glass Hydrometer Bedford's Tables. % Proof Spirit.	Brass Hydrometer • Usual Tables. % Proof Spirit.	Brass Hydrometer Bedford's Tables. % Proof Spirit.
1.06	2.34	3.4	3.0	1.8	2.1
1.96	4.29	5.0	5.6	3.3	3.7
2.07	6.52	6.05	7.6	4.95	5.5
3.95	8.65	8.75	9.5	7.3	7.9
4.87	10.67	10.75	11.65	8.0	8.7
5.55	12.14	12.3	13.3	10.5	11.45
5.84	12.77	12.9	13.75	11.25	12.15
6.40	15.07	15.1	15.9	12.6	13.5
11.38	24.69	24.5	25.3	21.6	22.55
12.16	26.35	26.4	27.2	24.95	25.7
19.17	41.15	40.6	41.8	39.05	40.15
19.67	42.20	41.37	42.9	40.52	41.77
23.54	50.25	48.05	50.35	46.92	49.05
29.53	62.40	61.1	62.85	59.7	61.45
35.15	73.62	72.6	74.1	73.3	74.80
38.67	80.43	79.00	80.2	78.5	79.65
39.17	81.40	80.1	81.4	79.4	80.6
51.00	103.12	102.7	103.05	102.38	102.63
59.86	118.30	118.1	118.8	117.5	118.1
62.95	123.52	123.15	123.5	122.9	123.25
68.58	132.56	132.15	132.5	131.8	132.15
80.92	151.15	150.6	151.1	150.4	150.9
88.90	162.12	161.8	162.7	161.5	162.3

* i.e. Tables supplied with the instruments (e.g., Oertling's). These are identical with those supplied by Dring and Fage for use with Sikes' brass hydrometer.

It will be seen that the brass hydrometer with the usual tables (those supplied by the makers of the instrument) gives quite inaccurate results, especially at low strengths and that at no strength are they even approximately satisfactory.

It will also be seen that Bedford's tables used with glass hydrometers give the more satisfactory readings, except at low strengths.

The following table gives results obtained with aqueous alcoholic solutions, the strengths of which were ascertained by pycnometer readings at 35°C . using the United States tables. The hydrometer readings were taken at temperatures from $84^\circ\text{--}88^\circ \text{F}$.

The table requires little comment; the brass hydrometer with the ordinary tables is almost useless, but with Bedford's tables gives very fair results indeed.

There seems no doubt that the new United States tables are among the most accurate that have been published and the authors consider that it would be advisable to base all alcoholic work on these.

The authors also consider that, in view of the confusion caused by the use of the term "proof spirit" it is time

* The standardisation was done by comparing the hydrometers against the standards at the N. P. L. at 51°F .

TABLE B.

Alcohol % by weight U.S. Tables.	% Proof Spirit calc. from sp. gr.	Glass Hydrometer Usual Tables. % Proof Spirit.	Glass Hydrometer Bedford's Tables. % Proof Spirit.	Brass Hydrometer Usual Tables. % Proof Spirit.	Brass Hydrometer Bedford's Tables. % Proof Spirit.
1.02	2.25	3.4	3.0	2.15	2.4
1.81	3.99	4.9	5.5	2.85	3.25
2.82	6.20	7.20	8.0	4.70	5.25
3.78	8.39	8.95	9.85	6.05	7.0
4.71	10.30	10.55	11.4	8.65	9.4
5.67	12.39	12.55	13.55	11.75	12.6
6.65	14.52	15.1	15.9	13.4	14.2
8.92	19.40	20.4	21.15	17.9	18.65
11.02	23.00	24.8	25.55	22.7	23.3
11.86	25.69	26.3	27.05	24.3	25.0
13.73	29.68	30.45	31.2	28.6	29.3
14.84	32.03	32.45	32.5	30.5	31.3
16.79	36.16	36.17	37.3	34.45	35.65
18.92	40.64	40.65	42.0	38.4	39.7
19.38	41.60	41.37	42.9	39.7	41.2
22.03	47.13	45.6	48.35	44.1	46.7
25.09	53.46	52.2	54.0	50.1	53.2
29.15	61.73	60.95	62.95	58.8	61.1
32.67	68.75	67.7	69.6	66.5	68.4
34.95	73.24	72.7	74.1	71.4	72.9
38.80	80.68	79.95	81.15	79.3	80.6
39.08	81.22	80.77	82.0	79.8	81.1
43.08	88.76	88.2	89.3	87.4	88.55
50.86	102.87	102.8	103.2	101.7	102.4
51.18	103.43	103.2	103.6	102.5	103.1
59.75	118.22	118.1	118.6	117.6	118.2
62.84	123.33	123.4	123.85	122.85	123.05
65.28	127.30	127.0	127.5	126.85	127.3
68.45	132.34	132.1	132.45	131.8	132.2
71.832	137.59	137.6	137.8	137.0	137.1
75.885	143.81	143.65	144.3	143.3	143.8
79.25	148.75	148.75	149.2	148.2	148.7
80.60	150.70	150.8	151.4	150.2	150.8
88.74	161.83	Off scale at 83°F .	—	—	—

that this was dropped, and alcohol strengths given in % of alcohol by weight or by volume.

Hydrometers should be graduated to give % of alcohol by weight or % of alcohol by volume and not % of proof spirit, and for tropical use should be standardised at say 30°C . and not 51°F .

The following table gives the refractive index of aqueous alcoholic solutions at 30°C . the strength of the alcohol being ascertained from the United States tables.

TABLE C.

Refractive Indices by Zeiss Immersion Refractometer at 30°C . Strength of alcohols determined by United States tables (at 35°C).

Alcohol, % by weight, (United States Tables).	Dip reading at 30°C .	Alcohol, % by weight, (United States Tables).	Dip reading at 30°C .
0	11.8	32.07	65.45
1.02	13.4	34.95	68.30
1.81	14.8	38.37	71.82
2.82	16.4	38.80	72.15
3.78	17.95	39.08	72.5
4.71	19.4	43.03	76.1
5.67	20.5	50.86	81.9
6.65	21.1	51.18	82.2
8.92	22.8	59.75	86.5
11.02	26.5	62.84	87.45
11.86	30.4	65.28	88.05
13.73	31.9	68.45	89.0
14.84	35.3	71.83	89.55
16.79	37.3	75.89	90.0
18.92	40.87	79.25	90.1
19.38	44.4	80.60	90.0
22.03	45.4	88.74	87.9
25.09	50.0	89.28	87.65
29.15	54.85	90.40	80.0

From this table it will be seen that the refractive index reaches a maximum at about 79.25% by weight of alcohol (cf. Holmes, Chem. Soc. Trans., 1913, 2166). A curve constructed from these figures with refractometer readings as ordinates and % of alcohol by weight as abscissae shows certain irregularities, one being marked at about 5% by weight of alcohol. The measurements have been

repeatedly and independently checked without producing any change in the curve and it is proposed to investigate these slight irregularities.

The following table is constructed from Table C :—

TABLE D.

% by weight, Alcohol (U.S.A. Tables).	Dip reading at 30° C.	% by weight Alcohol.	Dip reading at 30° C.
1	13.4	27	57.7
2	15.1	28	59.1
3	16.7	29	60.6
4	18.3	30	61.9
5	19.9	31	63.2
6	21.7	32	64.6
7	23.4	33	65.9
8	25.0	34	67.1
9	26.6	35	68.4
10	28.5	36	69.4
11	30.1	37	70.4
12	32.1	38	71.4
13	34.0	39	72.4
14	35.8	40	73.3
15	37.0	41	74.2
16	39.4	42	75.1
17	41.2	43	76.0
18	42.9	44	76.8
19	44.6	45	77.5
20	46.5	46	78.3
21	48.0	47	79.0
22	50.0	48	79.8
23	51.5	49	80.5
24	53.1	50	81.3
25	54.7	51	82.0
26	56.2		

In conclusion the authors propose to continue the investigations of the refractive index of aqueous alcoholic solutions at varying temperatures, as several points of interest have arisen in the present work which appear to merit close study.

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NOTE.—It is worth noting that the glass hydrometers alter as they age, in a somewhat large and irregular manner. For example: A 5-stem set standardised at the N.P.L. against their standards at 60° F. had in 1911 the following corrections :—

Hydro- meter No.	0	10	20	30	40	50	60	70	80	90	100
11728	0.0	0.0	0.0	0.0							
11729			0.0	0.0	0.0						
11730					-0.1	-0.1	-0.1	0.0	-0.1		
11731									-0.2	-0.2	0.0
11732											
In 1914 the same set at 60° F. gave											
11728	-0.3	-0.2	-0.2	-0.3	-0.3	-0.2	-0.2	-0.1	-0.2	-0.4	-0.1
11729			-0.2	-0.3	-0.3	-0.2	-0.2				
11730					-0.2	-0.2	-0.1	-0.1	-0.2		
11731											
11732											

Journal and Patent Literature.

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German.—1 mark each (with full particulars) to Kaiserlich Patentamt, Berlin, German.

I.—GENERAL PLANT; MACHINERY.

PATENTS.

Furnaces. W. Cross, London. From La Soc. des Perfectionnements à la Vaporisation, Paris. Eng. Pat. 14,432, June 21, 1913.

THREE inclined reciprocating grates are arranged with the two uppermost inclined from front to rear step fashion, and the third inclined in the opposite direction below the second. The fuel is fed on to the top of the upper grate from a rotating drum hopper and the ashes are similarly discharged from the bottom of the lowest grate. All the grates have closed ash-pits into which air is delivered under pressure; the front of the furnace is also closed.—W. H. C.

Separating machines; Centrifugal.—B. Hoffman. Topeka, Kans. U.S. Pats. 1,101,548 and 1,101,549, June 30, 1914; dates of appl., Oct. 21 and 24, 1911.

(1). A CLOSED drum is mounted on a hollow horizontal shaft and rotated in a vertical plane. The liquid is fed into one end of the shaft and is delivered to the inner periphery of the drum through radial branch pipes which project from the hollow shaft and have their ends turned in a direction opposite to that in which the drum rotates. The heavier liquid collects at the inner periphery of the drum, is collected by radial pipes extending from the hollow shaft and is discharged from the opposite end to that by which the liquid enters, the shaft having a partition in the centre. The lighter liquid passes directly into another passage in the hollow shaft from the axis of the drum. (2). The drum of the machine has the form of a frustum of a cone and is rotated on a vertical shaft. The liquids to be separated are fed into the drum near the axis and the separated liquids are discharged the one over the upper edge of the drum and the other through one or more openings formed in the periphery of the drum at its widest

part. These openings are normally closed by plugs kept in position by a system of levers which rotates on the shaft. A sleeve is independently rotated on the shaft lower down, so that at a predetermined speed it causes the system of levers to open the plugs and allow the liquid to be discharged.—W. H. C.

Pasty masses; Process for separating, by centrifugalising, the liquid contained in — with simultaneous dry-pressing of the separated solids. E. Bortel. Ger. Pat. 275,387, March 29, 1913.

THE pasty mass is introduced into tubular bags, *z.*, of permeable material, and these are closed and placed within

the basket of a centrifugal machine as shown in the figure. The liquid separated from the mass passes out through the