

generally sufficient to allow enough of the solution to flow for one determination of the strength.

As with the ammonia, for each solution three determinations of the strength were made, and the specific gravity bottle was thrice filled and weighed. The temperature of the solution was brought to 15° C., by allowing the bottle to stand in a cool place, where the temperature fell below 15° C., refilling the bottle, and allowing the temperature to rise very slowly until the required degree was obtained. The stopper was instantly fixed, the overflowing liquid rapidly dried with blotting paper and the bottle weighed. A co-efficient for the expansion was also found in the case of each solution. After the weighings for the specific gravity had been made, the temperature was twice brought to 22° C., and the bottle weighed, and once to 25° C., and again weighed. From each of the three weighings the absolute expansion for 1° C. was found, and from the mean the co-efficient for 1° C. was calculated. The following table gives the results of the direct experiments, after making the necessary corrections for the density of water and the weight of air in the specific gravity bottle by means of Kohlrausch's formula:—

No. of Experiment.	% Am. Carb.	Specific Gravity at 15° C.	Co-efficient of Expansion for 1° C.	No. of Experiment.	% Am. Carb.	Specific Gravity at 15° C.	Co-efficient of Expansion for 1° C.
1	11.90	1.1111	.00058	12	21.58	1.0723	.00050
2	12.65	1.1362	.00065	13	19.83	1.0672	.00050
3	10.23	1.1297	.00063	14	17.88	1.0606	.00046
4	38.06	1.1230	.00059	15	15.95	1.0513	.00048
5	35.85	1.1171	.00063	16	11.75	1.0497	.00043
6	33.95	1.1115	.00058	17	12.50	1.0421	.00043
7	31.71	1.1019	.00061	18	9.46	1.0371	.00039
8	29.71	1.0935	.00060	19	8.20	1.0271	.00039
9	27.03	1.0837	.00065	20	6.58	1.0219	.00031
10	25.71	1.0823	.00056	21	1.75	1.0155	.00026
11	23.62	1.0795	.00050	22	2.36	1.0071	.00022

The co-efficients of expansion represent the decrements in weight of the solutions when the temperature is raised 1° C., the weight at 15° C. being taken as unity, and are only strictly applicable to temperatures ranging from 15° to 25° C. It is not difficult from these co-efficients to determine factors for the decrease of specific gravity when the temperature is raised 1° C., from which the specific gravity for temperatures other than 15° C. may be calculated to that degree, and thus the strength found. In the following table, which gives the percentages of ammonium carbonate in solutions having specific gravities in terms of degrees Twaddell, these factors are introduced. They have been calculated to the nearest figure in the fourth place of decimals, and, as may be seen, rise regularly from .0002 to .0007:—

Degrees Twaddell.	Specific Gravity at 15° C.	% Am. Carb.	Specific Gravity Factor for 1° C.	Degrees Twaddell.	Specific Gravity at 15° C.	% Am. Carb.	Specific Gravity Factor for 1° C.
1	1.005	1.60	.0002	16	1.080	23.78	.0006
2	1.010	3.18	.0002	17	1.085	25.31	.0006
3	1.015	4.60	.0003	18	1.090	26.82	.0007
4	1.020	6.01	.0003	19	1.095	28.33	.0007
5	1.025	7.19	.0003	20	1.100	29.83	.0007
6	1.030	8.43	.0004	21	1.105	31.37	.0007
7	1.035	10.35	.0004	22	1.110	33.15	.0007
8	1.040	11.86	.0004	23	1.115	35.08	.0007
9	1.045	13.36	.0005	24	1.120	36.88	.0007
10	1.050	14.83	.0005	25	1.125	38.71	.0007
11	1.055	16.16	.0005	26	1.130	40.51	.0007
12	1.060	17.70	.0005	27	1.135	42.20	.0007
13	1.065	19.18	.0005	28	1.140	43.99	.0007
14	1.070	20.70	.0005	29	1.145	45.79	.0007
15	1.075	22.25	.0006	30	1.150	47.50	.0007

To illustrate the applicability of the specific gravity factors, suppose we wished to determine the strength of a solution having a specific gravity of 1.108 at 19° C.

Factor for 1.108 is .0007.

Specific gravity at 15° C. = 1.108 + .0007 (19-15) = 1.1108

Do.	1.115 = 35.08	1.63 x 8
Do.	1.110 = 33.15	= 26
		50

Difference..... .005 1.63

Strength of solution of specific gravity 1.108 at 19° C. = 33.15 + .26 = 33.71 per cent.

ON THE VARYING QUANTITIES OF MALT ALBUMENOIDS EXTRACTED BY WATERS OF DIFFERENT TYPES.*

BY E. R. MORITZ AND A. HARTLEY.

THE choice of waters for processes involving fermentation has always been governed by empirical rules. Thus, a brewer will invariably prefer hard waters for pale ales and soft for his dark beers. Probably on asking the cause of this choice we should learn that hard waters did not allow the solution of so much colouring matter and albumenoids, on the assumption that the solvent power of the water was to a certain extent satiated by the mineral matters already in solution, and therefore that the excess of colouring extractives and albumenoids, which is so much to be avoided, would be prevented from coming into solution to so great an extent. The converse with soft waters.

These views are apparently confirmed by experience, but we have every reason to suppose that the cause is a far different one, and it therefore occurred to us that it would be useful to estimate accurately the amount of albumenoids extracted by waters of different types, and we have carried out our experiments in such a way that the results will be of practical value to the brewer.

The malt used in all the experiments was an average sound malt. The waters were of the following types:—

1. Distilled water.
2. New River water.

Calcium sulphate	3.22
Do. carbonate	10.53
Do. nitrate	1.29
Magnesium carbonate ..	2.55
Sodium chloride	1.98

Grains per gallon, or parts per 70,000.
3. York deep well water.

Calcium carbonate	18.21
Do. sulphate	36.77
Magnesium sulphate ..	21.81
Sodium chloride	6.69

Grains per gallon, or parts per 70,000.
No nitrates or nitrites..

After the results obtained with these waters, we synthesised others by dissolving certain salts in distilled water, these salts being such as would occur in most brewing waters.

1. Sodium chloride added at the rate of 110
 5. Magnesium sulphate 70
 6. Sodium carbonate 11
 7. Calcium nitrate 35
 8. Burton water crystal 110
- Grains to the gallon.

* In these experiments the nitrogen has been uniformly calculated into albumenoids, so that the results may be compared with other similar investigations; but, as is well known, the nitrogen is not by any means all due to albumenoids, but is divided among several classes of nitrogenous compounds.

† These Burton water crystals were supplied to us by a well-known firm of chemists, and contain in 100 parts—

Calcium oxide	31.8
Sulphuric anhydride	40.1
Chlorine	1.01
Magnesium oxide	5.48
Moisture	21.19

As in No. 8 there was a deposit, we analysed the water as it stood, and found it to contain:—

Lime	26.6	} Grains per gallon.
Sulphuric acid	58.55	
Magnesia	1.71	

The system used in the experiments was the same throughout, and is that commonly employed in determining the specific gravity of malt-extract. The extract was then boiled with hops in the proportion used in practice, and a definite bulk of hopped wort evaporated and kept at 100° C. till dry. A portion was then abstracted, ground fine, and burnt with soda lime.

In accordance with our expectations we obtained pale worts from the hard waters—more especially from the synthesised magnesium water. The water treated with calcium nitrate gave an extract scarcely darker than the magnesium worts, and this was contrary to what is generally supposed. We found that sodium carbonate has a most deterrent action upon diastase. The solutions were all dark, and much starch was left unconverted. This clogged the filters, and no trustworthy results could be obtained with water containing more than 1.4 grains to the gallon.

Before proceeding to the results of the nitrogen determinations it will be of advantage to give the densities of the worts, and it will be seen that the same waters possess different solvent properties as regards total extractives on the one hand and albumenoids on the other. The following were the specific gravities of the worts, after allowing for the specific gravity of the waters:—

Na ₂ CO ₃ .	NaCl.	MgSO ₄ .	Burton Crystals.	Ca(NO ₃) ₂ .	Distilled.	New River.	Deep Well.
1012.11	1012.58	1012.83	1013.09	1013.11	1013.26	1013.27	1013.15

PERCENTAGE OF NITROGEN EXTRACTED FROM A FRESH MALT, CONTAINING 2.01 N, EQUIVALENT TO 12.68 ALBUMENOIDS, BY WATERS OF DIFFERENT CHARACTERS.

Water.	Distilled.	Distilled treated with NaCl.	Distilled treated with MgSO ₄ .	York.	New River	Distilled treated with Na ₂ CO ₃ .	Distilled treated with Burton water crystals.	Distilled treated with Ca(NO ₃) ₂ .
Number of Determinations	1	3	3	1	1	2	1	1
Average { Nitrogen; equivalent to	0.667	0.71	0.832	0.903	0.910	0.966	0.932	1.093
{ Albumenoids	1.22	1.19	5.27	5.71	5.76	6.11	6.22	6.95

The low specific gravity of the wort prepared from the Na₂CO₃ water is due undoubtedly to the action of this salt in deterring diastatic activity.

From these results, which differ in many respects from the rules generally laid down, we have come to the conclusion that the various mineral matters play a distinct part in the solvent action of a water as regards colouring matters and albumenoids. But the differences in the amounts of the albumenoids are so small, in spite of the very widely differing waters, that we think the influence of the extracted albumenoids has been very much overrated, and we attribute the varying characteristics of the finished produce to the direct influence of the salts on fermentation.

CERTAIN DERIVATIVES OF THE SULPHONIC ACIDS OF β-NAPHTHOL.

BY I. LEVINSTEIN.

DURING the month of April, 1882, whilst engaged with the investigation of the sulphonic acids of

β-naphthol, it occurred to me to prepare the trisulphonic acid, and to conjugate with this certain diazo compounds, with a view to obtain colouring matters. I then found that the trisulphonic acid obtained by me from β-naphthol gives *practically* no colouring matters on combination with diazo-xylene, although it gives very bright colours with analogous diazo compounds. Now the singular point about this is that C. F. L. Limpach (this Journal, Vol. II. (1) p. 38, and U.S. Pats. Nos. 268505 and 268506, Dec. 5, 1882) also prepares a similar trisulphonic acid from β-naphthol to that prepared by me in April, 1882, and that Limpach's trisulphonic acid *does* give colouring matters on conjugating with diazo-xylene. I can only explain this singular fact by assuming that possibly two isomerides exist, and this matter I intend to investigate, and report at the next meeting of the Manchester Section of the Society of Chemical Industry.

THE CHEMISTRY OF COPPER SMELTING IN JAPAN.—(CONCLUSION.)

BY IWATA NAKASAWA.

Communicated by T. Takamatsu, of Tokio University.

II.—OMODANI COPPER MINE.

General Account of the Mine.—This copper mine has been known for a long time, and was worked by the Daimio Ono, whose wealth is said to have been

based upon the production of this metal; but after the fall of the Shōgun all the Daimio had to leave their property, and this mine has since fallen into the hands of the people of the village. As far as I could ascertain the detailed history of the mine is unknown. The name Omodani is applied to the village situated near the boundary of Hida and Mino, in Onogori, under the local government of Ishikawa-ken. From the town of Fukui, it is more than 20 ri to the south-east to the mine. The road between is so bad and narrow that two travellers cannot walk side by side. Transportation is chiefly effected by oxen in this district, and it is said that horses are not capable of doing the same work. The village Omodani is situated on the northern slope of the valley running north-west, through which a small brook flows. The age of these mining works may be seen on looking into the bed of this stream, which consists partly of silicious sand and partly of black slag, extending for several miles, which have been thrown away from the mine for many years. The entrances to the tunnels are found on the face of the mountain, and are so numerous, that