SUMMARY.

The results of this investigation are, then, as follows:

(1) The atomic weight of iodine is found to be 126.985 (Ag = 107.930), one one-hundredth of a unit higher than the value previously obtained. If silver is assumed to be 107.920 and oxygen 16.000, iodine becomes 126.973.

(2) The observation of Köthner and Aeuer that under certain conditions silver iodide occludes silver nitrate, and that this occluded salt cannot be removed by washing with water, is confirmed.

(3) Richards and Wells's value for the atomic weight of chlorine, 35.473, is substantiated.

(4) Stas's value for the atomic weight of bromine, 79.955, is shown to be very nearly correct.

CHEMICAL LABORATORY OF HARVARD COLLEGE,
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[CONTRIBUTION FROM THE DEPARTMENT OF FOOD AND DRUG INSPECTION OF THE MASSACHUSETTS STATE BOARD OF HEALTH.]

THE OPTICAL PROPERTIES OF CASTOR OIL, COD-LIVER OIL, NEAT'S-FOOT OIL, AND A FEW ESSENTIAL OILS.

BY HERMANN C. LYTHGOE.

Received May 8, 1905.

I. CASTOR OIL.

Castor oil is "a fixed oil expressed from the seeds of *Ricinus communis*. A pale yellowish or almost colorless, transparent, viscid liquid, having a faint, mild odor, and a bland, afterwards slightly acrid, and generally offensive taste; Sp. gr., 0.950 to 0.970 at 15° C.," U. S. Pharmacopoeia.

Several authorities state that castor oil rotates the plane of polarized light, although Allen claims that all the samples examined by him were inactive[1]. Deering and Redwood report that twenty-three samples of Indian castor oil, polarized in a 200 mm. tube in a Laurent instrument, gave readings from +7.6° to +9.7°[1]. This corresponds to from 21.9° to 28.0° Ventzke.

During the routine examination of drugs in this laboratory, there has been occasion to examine a large number of samples of

[1] Lewkowitsch: "Oils, Fats and Waxes," p. 420.

castor oil, most of which have been found to be pure. It is from these pure samples that the refraction table has been calculated. This table gives the readings of castor oil on the scale of the Zeiss butyro-refractometer for each half degree from 15° to 35° C., together with the corresponding values of n_D.

TABLE I.—REFRACTION OF CASTOR OIL.

Temp. °C.	Butyro-refractometer reading.	n_D.	Temp. °C.	Butyro-refractometer reading.	n_D.
35.0	72.0	1.4736	25.0	78.1	1.4773
34.5	72.3	1.4738	24.5	78.4	1.4775
34.0	72.6	1.4740	24.0	78.7	1.4776
33.5	72.9	1.4742	23.5	79.0	1.4778
33.0	73.2	1.4744	23.0	79.3	1.4780
32.5	73.5	1.4745	22.5	79.6	1.4782
32.0	73.8	1.4747	22.0	79.9	1.4784
31.5	74.1	1.4749	21.5	80.2	1.4785
31.0	74.4	1.4751	21.0	80.6	1.4787
30.5	74.7	1.4753	20.5	80.9	1.4789
30.0	75.0	1.4755	20.0	81.2	1.4791
29.5	75.3	1.4756	19.5	81.5	1.4793
29.0	75.6	1.4758	19.0	81.8	1.4795
28.5	75.9	1.4760	18.5	82.1	1.4797
28.0	76.2	1.4762	18.0	82.5	1.4798
27.5	76.5	1.4764	17.5	82.8	1.4800
27.0	76.9	1.4766	17.0	83.2	1.4802
26.5	77.2	1.4768	16.5	83.5	1.4804
26.0	77.5	1.4769	16.0	83.9	1.4806
25.5	77.8	1.4771	15.5	84.2	1.4808
25.0	78.1	1.4773	15.0	84.5	1.4809

In refracting castor oil with the butyro-refractometer, ordinary light can be employed, as but little color is given to the critical line. Owing to the extreme viscosity of the oil, a little longer time than usual must elapse before reading, in order that the sample may attain the temperature of the prisms. The prisms can easily be cleaned by the use of chloroform, as castor oil is isoluble in the petroleum ether usually employed for this purpose.

Table II gives a résumé of the analyses of the oils examined. It will be observed that the variations from the readings of the refraction table are very slight, and that the polarizations are within the limits of those of Deering and Redwood recorded above.

TABLE II.

	Variation from refraction figures, butyro scale.	Sp. gr. 15° C.	Polarization ° Ventzke, 200 mm. 20° C.
Number of samples...	44	15	15
Highest.....	±0.5	0.9622	+26.1
Lowest.....	0.0	0.9590	+23.4
Average.....	±0.25	0.9609	+24.1

Table III gives the constants of a sample of castor oil containing about 50 per cent. cottonseed oil, sold in Massachusetts[1], together with those of pure castor and cottonseed oils. The spurious nature of this sample was first pointed out by the refractometer and subsequently confirmed by other tests.

TABLE III.

	Castor oil.	Adulterated oil.	Cottonseed oil.
Butyro-refractometer reading at 20°...	81.2	75.0	70.9
Polarization, ° Ventzke.....	24.1	10.5	— 0.4
Specific gravity at 15°.....	0.961	0.9378	0.923
Iodine number (Hanus).....	85.0	99.4	109.0
Halphen test.....	....	Red	Red

II. COD-LIVER OIL.

Cod-liver oil "is a fixed oil obtained from the fresh livers of *Gadus Morrhua* and of other species of *Gadus*. A pale yellow, thin, oily liquid, having a peculiar, slightly fishy, but not rancid odor, and a bland, slightly fishy taste; sp. gr., 0.920 to 0.925 at 15° C.," U. S. Pharmacopoeia.

It is difficult to read cod-liver oil on the butyro-refractometer owing to the dispersion, the colored band extending over five scale divisions. This difficulty can be overcome by the use of sodium light, or easier, by a ray screen consisting of a parallel-sided bottle about 1.5 inches in diameter, containing a 10 per cent. solution of potassium bichromate, through which the light is allowed to pass before striking the mirror. There is, of course, no such difficulty when using the Abbé refractometer.

There is much more variation in the refraction of cod-liver oil than in the case of castor oil. Of about twenty samples the maximum variation from the butyro-refractometer readings of Table IV is ±1.3, and the average variation is ±0.6. Even with this marked variation it is easy to pick out a sample of oil to which a foreign oil has been added. Any variation from the readings of

[1] Weekly Bulletin of the State Board of Health of Massachusetts, Jan. 14, 1905.

the table exceeding 1.3 is sufficient for submitting the sample to further examination as being suspicious.

TABLE IV.—REFRACTION OF COD-LIVER OIL.

Temp. °C.	Butyro-refractometer reading.	n_D	Temp. °C.	Butyro-refractometer reading.	n_D
35.0	71.4	1.4732	25.0	77.5	1.4769
34.5	71.8	1.4734	24.5	77.8	1.4771
34.0	72.1	1.4736	24.0	78.1	1.4773
33.5	72.4	1.4738	23.5	78.4	1.4774
33.0	72.7	1.4740	23.0	78.7	1.4776
32.5	73.0	1.4742	22.5	79.1	1.4778
32.0	73.2	1.4743	22.0	79.4	1.4780
31.5	73.5	1.4745	21.5	79.7	1.4781
31.0	73.8	1.4747	21.0	80.0	1.4783
30.5	74.1	1.4749	20.5	80.3	1.4785
30.0	74.4	1.4751	20.0	80.6	1.4787
29.5	74.7	1.4753	19.5	81.0	1.4789
29.0	75.0	1.4754	19.0	81.3	1.4791
28.5	75.3	1.4756	18.5	81.6	1.4792
28.0	75.6	1.4758	18.0	81.9	1.4794
27.5	75.9	1.4760	17.5	82.2	1.4796
27.0	76.2	1.4762	17.0	82.5	1.4798
26.5	76.5	1.4763	16.5	82.9	1.4800
26.0	76.8	1.4765	16.0	83.2	1.4802
25.5	77.2	1.4767	15.5	83.5	1.4803
25.0	77.5	1.4769	15.0	83.8	1.4805

III. NEAT'S FOOT OIL.

Neat's foot oil is obtained by boiling the hoofs of neat cattle in water, but it is usually the custom in rendering establishments to use the whole leg below the knee, and no doubt the majority of the neat's foot oil of commerce is made in this manner.

Four samples of pure oil, the analyses of which are recorded in Table V, were obtained from the New England Rendering Co., Brighton, Mass. They were of a pale yellow color, and when cooled to 10° for the specific gravity determination remained liquid and perfectly clear. The one adulterated sample recorded in Table V became solid when cooled for the determination of the specific gravity.

TABLE V.—CONSTANTS OF PURE AND ADULTERATED SAMPLES OF NEAT'S FOOT OIL.

	Sp. gr. at 15°.	Butyro-refractometer reading at 20.	Iodine number (Hanus).
Pure oil	0.9133	63.3	71.3
Pure oil	0.9148	63.5	73.1
Pure oil	0.9145	63.6	73.0
Pure oil	0.9143	63.6	71.7
Adulterated oil	0.9167	61.5	60.0

The refraction Table VI was calculated from readings of the pure oils recorded in Table V.

TABLE VI.—REFRACTION OF NEAT'S FOOT OIL.

Temp. °C.	Butyro-refractometer reading.	n_D.	Temp. °C.	Butyro-refractometer reading.	n_D.
35.0	55.0	1.4626	25.0	60.7	1.4664
34.5	55.3	1.4628	24.5	60.9	1.4665
34.0	55.6	1.4630	24.0	61.2	1.4667
33.5	55.9	1.4632	23.5	61.5	1.4669
33.0	56.2	1.4634	23.0	61.8	1.4671
32.5	56.5	1.4636	22.5	62.1	1.4673
32.0	56.7	1.4637	22.0	62.4	1.4675
31.5	57.0	1.4639	21.5	62.7	1.4677
31.0	57.3	1.4641	21.0	62.9	1.4679
30.5	57.6	1.4643	20.5	63.2	1.4680
30.0	57.9	1.4645	20.0	63.5	1.4682
29.5	58.2	1.4647	19.5	63.8	1.4684
29.0	58.4	1.4649	19.0	64.2	1.4686
28.5	58.6	1.4650	18.5	64.5	1.4688
28.0	58.9	1.4652	18.0	64.8	1.4690
27.5	59.2	1.4654	17.5	65.1	1.4692
27.0	59.5	1.4656	17.0	65.4	1.4694
26.5	59.8	1.4658	16.5	65.6	1.4695
26.0	60.1	1.4660	16.0	65.9	1.4697
25.5	60.4	1.4662	15.5	66.2	1.4699
25.0	60.7	1.4664	15.0	66.5	1.4701

The readings of castor and cod-liver oils agree with those published by Lewkowitsch, Henriques, Utz, and Liverseege.

IV. ESSENTIAL OILS.

The essential oils used in this work, the results of which are reported in Table VII, were obtained from reliable manufacturers and dealers as pure oils for the understood purpose of establishing constants, and every indication is that the oils were pure.

TABLE VII.—CONSTANTS OF A FEW ESSENTIAL OILS.

Oil.	Sp. gr. at 15°.	Polarization 100 mm Ventzke.	n_D. 20°.	25°.	30°.	35°.	40°.
Peppermint	0.9056	— 79.7	1.4614	1.4593	1.4573	1.4553	1.4533
Sweet orange	0.8501	272.8	1.4731	1.4708	1.4685	1.4662	1.4637
Bitter orange	0.8523	266.6	1.4738	1.4715	1.4691	1.4667	1.4643
Lemon[1]	0.8590	175.0	1.4744	1.4722	1.4700	1.4677	1.4655
Citronella	0.8996	— 31.6	1.4813	1.4790	1.4768	1.4745	1.4722
Nutmeg	0.9090	45.7	1.4834	1.4841	1.4787	1.4764	1.4740
Lemon grass	0.9070	— 10.0	1.4858	1.4836	1.4814	1.4792	1.4770
Spearmint	0.9310	—126.4	1.4858	1.4836	1.4814	1.4792	1.4770
Cloves	1.0502	— 3.1	1.5313	1.5290	1.5268	1.5245	1.5222
Wintergreen[2]	1.1865	— 0.1	1.5363	1.5340	1.5318	1.5295	1.5272
Cassia	1.0666	0.7	1.5998	1.5973	1.5949	1.5925	1.5901
Cinnamon	1.0395	— 0.3	1.6029	1.6009	1.5988	1.5968	1.5948

A large number of essential oils have been examined during the course of drug inspection of this department, and the following list gives the maximum variation of the refraction from readings in Table VII of those oils found by other tests to have been pure.

TABLE VIII.

Wintergreen oil	±0.0018
Peppermint oil	±0.0017
Cassia oil	±0.0013
Clove oil	±0.0012
Lemon oil	±0.0011

A sufficient number of the other oils of known purity have not as yet been examined to state the variations in refraction, but at least two reliable samples of each oil obtained from different sources have been tested for refraction with closely agreeing results.

THE DETECTION OF METHYL ALCOHOL.[3]

BY HEYWARD SCUDDER.

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THE TESTS for the detection of methyl alcohol are used chiefly to distinguish it from ethyl alcohol, so their value is dependent first on a sharp distinction from ethyl alcohol, then on their delicacy and rapidity. In the following description the standard of delicacy

[1] Readings are all averages from a large number of samples.

[2] Made from the sweet birch.

[3] Presented before the New York Section of the American Chemical Society in February, 1905.