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THE LABORATORY COMPANION
TO
FATS AND OILS INDUSTRIES

THE
LABORATORY COMPANION
TO
FATS AND OILS
INDUSTRIES

BY
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MANUFACTURE,' AND IN 'FATS AND OILS, INCLUDING CANDLE MANUFACTURE,'
TO THE CITY AND COUNCILS OF LONDON INSTITUTE

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PREFACE

FOR several years past I have been contemplating the idea of collecting together in readily accessible tables all numerical values required in the examination of fats and oils. This book presents these in a handy form, which has stood the test of practical experience during the somewhat lengthy time this work has been in preparation.

The book consists almost exclusively of tables ; the description of methods has not been given, nor has it been considered advisable to add any explanations as to the contents of the tables. Such information is contained in my *Chemical Analysis of Oils, Fats, and Waxes, and of the Commercial Products derived therefrom*, second edition (Macmillan and Co., 1898), to the pages of which the reader must be referred.

In Part I. only I have considered it necessary to introduce a few pages of subject matter explanatory of the system of fats and oils, as this has been considerably strengthened since the appearance of my *Chemical Analysis*. I may add that this Part I. should not be looked upon as merely a tabulated epitome of that work. A number of tables have been specially calculated to give further information and assistance in the interpretation of analytical results.

Part II. will, I hope, be found the most useful portion of the work. Numerical values, so-called constants, and variables, have been carefully scrutinised, and only the most reliable ones have been given. In some cases I had to decide on the most probable values.

It is hardly necessary to add that the literature of the subject has been taken note of down to the latest possible date, and that numerous values, extracted from my laboratory note-books, are

published here for the first time. Throughout this part the greatest attention has been paid to the requirements of the works chemist.

Part III. contains a few tables which are very frequently required, and are added to enhance the usefulness of this book as a laboratory manual. Some of these tables have been taken from Lunge and Böckmann's *Chemisch-technische Untersuchungsmethoden*.

J. LEWKOWITSCH.

LONDON, *September* 1901.

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PART I
SYSTEM AND EXAMINATION OF FATS
AND WAXES

4. SYSTEM OF FATS AND WAXES

FATTY OILS AND FATS

THE fatty oils (liquid fats) and fats occur in animals and plants in the form of the "neutral glyceryl ethers" or "triglycerides." They are also termed "neutral oils and fats" in contradistinction to those oils (liquid fats) and fats which contain more or less considerable quantities of free fatty acids. The latter must be considered as having been derived from the neutral fats by a slow process of spontaneous decomposition, in the course of which diglycerides, monoglycerides, free fatty acids, and glycerol have been formed.

The following three tables (Tables Nos. 1, 2, and 3) contain a list of monoglycerides, diglycerides, and triglycerides hitherto isolated in a pure state, and their constants as far as ascertained.

The fatty oils (liquid fats) and fats consist of mixtures of the triglycerides, such as mentioned in Table No. 3, and, besides these, of other glycerides which have not yet been prepared in a pure state.

The triglycerides may be either glycerides of one fatty acid only or "mixed glycerides," *i.e.* a glyceride in which more than one fatty acid is combined with glycerol, such as oleodistearin.

The most convenient classification of fatty oils (liquid fats) and fats for practical purposes can be based on the magnitude of the iodine value. This principle includes their subdivision into oils (liquid fats) and solid fats, according to their consistency, and also that based on their capability of absorbing oxygen, more or less rapidly, on exposure to the air at the ordinary temperature.

Arranging then, according to the iodine value, we obtain the following subdivisions, taking as two parallel branches the vegetable fats on the one hand, and animal fats on the other, not only for the sake of convenience but also for the further reason that vegetable fats can be chemically differentiated from animal fats by the occurrence of phytosterol in the former, whereas animal fats are recognised by the presence of cholesterol.

I. LIQUID FATS OR FATTY OILS

A. Vegetable Oils—

1. Drying Oils.
2. Semi-Drying Oils.
3. Non-Drying Oils.

B. Animal Oils—

1. Marine Animal Oils.
 - (a) Fish Oils.
 - (b) Liver Oils.
 - (c) Blubber Oils.
2. Terrestrial Animal Oils.

II. SOLID FATS

A. Vegetable Fats.

B. Animal Fats.

1. Drying.
2. Non-Drying.

WAXES

The waxes are, chemically considered, ethers formed by the union of fatty acids and of alcohols, not belonging to the glycerol series. Hence, by the absence of glycerol they are sharply differentiated from the oils and fats with which they have many physical properties in common. The constants of a number of "waxes" isolated in the pure state are collated in Table No. 4.

The natural waxes also, may be conveniently classified according to their iodine values, with subdivisions, in a similar manner to that adopted for fatty oils and fats, as follows:—

I. LIQUID WAXES

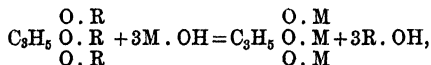
II. SOLID WAXES

- A. Vegetable Waxes.
- B. Animal Waxes.

All the better known natural fats and waxes are tabulated according to the foregoing classification, together with their origins, yields, and those numbers which are employed in analysis for their identification and examination in the tables in Part II., headed Tables 24.

B. SAPONIFICATION OF FATS AND WAXES

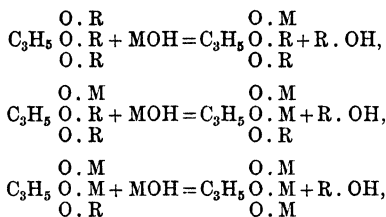
The saponification of fats takes place according to the following equation:—



where R denotes the radicle of any fatty acid, and M stands for a monovalent metal or hydrogen.

In the light of experiments made by Geitel and by the author, this

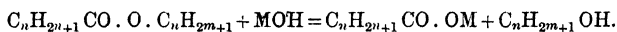
equation must be considered as a summary of the following three equations :—



expressing the fact that saponification takes place in three stages, passing from the triglyceride through the diglyceride and monoglyceride to the products of complete saponification, namely, free fatty acid and glycerol.

The difference between the old view and the new view finds its numerical expression in the Table No. 5, where the percentages of glycerol to be expected from a pure triglyceride, as saponification progresses, are placed side by side with the percentages of free fatty acids formed simultaneously.

The saponification of waxes takes place according to the following equation :—



The different constituents into which fats and waxes are resolved by the process of saponification are enumerated in the Tables Nos. 6 and 7, together with those constants that have been determined hitherto. To the table of naturally occurring fatty acids there are added in an Appendix the constants of some hydroxylated and dibasic acids that are met with in products of the fat and oil industries.

C. EXAMINATION OF FATS AND WAXES

The examination of a fat or wax must be preceded by its purification from foreign substances. This is attained by extracting the fatty matter with a volatile solvent, and evaporating off the latter.

The purified fat or wax is then examined by the following general physical, and chemical methods. (Only in special cases detection and determination of sulphur, phosphorus, metals, etc., is required.)

Physical Methods

The physical methods are confined chiefly to the determination of the

- (a) Specific gravity.
- (b) Melting and solidifying points.
- (c) Refractive power

The constants ascertained hitherto are stated in the Tables No. 24 in Part II.

For the determination of the solidifying point at low temperatures it is necessary to employ freezing mixtures, such as those given in Table No. 8.

The determination of the viscosity will in some cases give useful indications; but hitherto the viscosity has not become of sufficient importance as a constant to be able to afford discriminative value. Tables giving the viscosities will be found under the heading "Lubricants," Tables No. 25 in Part II.

Chemical Methods

The chemical methods in use refer, in the first instance, to the determination of the "constants" or "quantitative reactions." They comprise the following values:—

- (a) Saponification value.
- (b) Reichert value, or Reichert-Meissl value.
- (c) Insoluble fatty acids + Unsaponifiable (Hegner value).
- (d) Iodine value.

As a guide to the proper interpretation of the numbers so obtained and set out in the general Tables No. 24 in Part II, the Tables Nos. 9, 10, and 11 will be found useful.

Table No. 9 gives the saponification values, percentages of insoluble fatty acids (Hegner values), and yields of glycerol of mono-, di-, and triglycerides of the most frequently occurring fatty acids.

Table No. 10 states the iodine values of unsaturated fatty acids, and of their corresponding mono-, di-, and triglycerides. For the purpose of rapidly calculating the iodine value, Table No. 11 gives the logarithms of the quotient $\frac{0.2}{\text{c.c. thiosulphate}}$ for the most frequently occurring numbers.

Table No. 12 will be found useful in the interpretation of results obtained in the examination of waxes.

Besides these constants it is often required to determine the

- (a) Acetyl value,
- (b) Acid value,
- (c) Unsaponifiable matter,

since from these numbers important conclusions can be derived as to the valuation of a fat or wax under examination. These numbers not being "constants," but varying with the mode of purification and with other accidental circumstances, have been comprised under the heading "Variables" in Tables No. 24, Part II.

A reservation must, however, be made with regard to the acetyl value, which in some cases must be considered a "constant," as in castor oil (and generally in the case of triglycerides of hydroxylated fatty acids), and alcohols. Tables No. 13 and No. 14 will afford the necessary guidance in the interpretation of experimental data.

Table No. 15 gives the "acid values" of a number of pure fatty acids. The acid value is frequently expressed in terms of oleic acid. Table No. 16 will assist in readily converting one term into another.

The examination of the unsaponifiable matter will be materially expedited by a reference to Table No. 17.

Besides these foregoing methods, we have a number of chemical reactions which have not yet attained to the rank of quantitative reactions, and are usually comprised under the name of qualitative reactions. They include :—

- (a) The Elaïdin test, Table No. 18 ;
- (b) The Sulphur Chloride test, Table No. 19 ;
- (c) The Thermal test, cp. Tables No. 24 in Part II ; and
- (d) The Oxygen Absorption test, Tables Nos. 20 and 21, cp. also "Oxidised Oils," Part II.

For the further examination of the fatty acids and their separation into individual fatty acids, scientific methods must be resorted to. Those hitherto used are, however, not expeditious enough for general application. They comprise, in the first instance, the separation of the volatile from the non-volatile fatty acids, and then the separation of the solid fatty acids from the liquid acids.

An insight into the nature of the latter is obtained by examining the oxidation products on the one hand and the bromination products on the other. The Tables Nos. 22 and 23 give the numbers obtained hitherto for the best examined substances.

TABLE NO. 1.— *Monoglycerides*

	Monoglycerides.	Formula.	Molecular Weight.	Specific Gravity.		Solidifying Point.	Melting Point.	Boiling Point.		Solubility.	
				°C.	—			°C.	°C.		
1	Mono-formin . . .	$C_3H_5(O. CHO)(OH)_2$	120	...	...	...	...	0	165	Easily soluble in water and alcohol; very sparingly soluble in ether, and almost insoluble in benzene. 8 volumes are miscible with 3 volumes of water; with 5 or more volumes of water an emulsion is formed. 100 parts absolute alcohol dissolve 5.306 parts at 22.5° C. Sparingly soluble in cold ether; dissolves easily in hot alcohol and ether. Nearly insoluble in cold ether.	1
2	Mono-acetin . . .	$C_3H_5(O. C_2H_3O)(OH)_2$	134	$1\frac{1}{8}$	1.2212	...	...	2-3	130-132		2
3	Mono-butylin . . .	$C_3H_5(O. C_4H_7O)(OH)_2$	162	17	1.088	...	...	...	...		3
4	Mono-isovalerin . . .	$C_3H_5(O. C_5H_9O)(OH)_2$	176	16	1.100	...	...	...	...		4
5	Mono-palmitin . . .	$C_3H_5(O. C_{16}H_{31}O)(OH)_2$	330	...	...	...	63	...	...		5
6	Mono-stearin . . .	$C_3H_5(O. C_{18}H_{35}O)(OH)_2$	358	...	...	...	61	...	...		6
7	Mono-arachin . . .	$C_3H_5(O. C_{20}H_{39}O)(OH)_2$	386	...	...	...	...	...	...	Easily soluble in water and alcohol; less readily in ether, and with difficulty in benzene. 100 parts absolute alcohol dissolve { 0.2097 parts at 20° C. 0.5040 ,, 27° C. Sparingly soluble in cold alcohol; dissolves in 150 parts hot alcohol. Easily soluble in warm ether, chloroform, benzene, and petroleum ether. Almost insoluble in cold ether; soluble in CS ₂ . Almost insoluble in boiling alcohol.	7
8	Mono-cerotin . . .	$C_3H_5(O. C_{26}H_{51}O)(OH)_2$	470	...	...	...	78.8	...	...		8
9	Mono-melissin . . .	$C_3H_5(O. C_{30}H_{59}O)(OH)_2$	526	...	...	...	91.5-92.0	...	...		9
10	Mono-olein . . .	$C_3H_5(O. C_{18}H_{33}O)(OH)_2$	356	21	0.947	15-20	...	...	...		10

TABLE NO. 2.— *Diglycerides*

	Diglycerides.	Formula.	Molecular Weight.	Specific Gravity.		Solidifying Point.	Melting Point.	Boiling Point.		Solubility.	
				°C.	—			°C.	m.m. Pressure.		
1	Di-formin . . .	$C_3H_5(O. CHO)_2OH$	148	15	1.304	...	...	20-30	163-166	Easily soluble in water and alcohol; less readily in ether, and with difficulty in benzene.	1
2	Di-acetin . . .	$C_3H_5(O. C_2H_3O)_2OH$	176	$1\frac{1}{8}$	1.1769	...	...	40	175-176		2
3	Di-butylin . . .	$C_3H_5(O. C_4H_7O)_2OH$	232	17	1.083	...	...	760	259-261		3
4	Di-isovalerin . . .	$C_3H_5(O. C_5H_9O)_2OH$	260	16	1.059	...	...	...	...	100 parts absolute alcohol dissolve { 0.2097 parts at 20° C. 0.5040 ,, 27° C. Sparingly soluble in cold alcohol; dissolves in 150 parts hot alcohol. Easily soluble in warm ether, chloroform, benzene, and petroleum ether. Almost insoluble in cold ether; soluble in CS ₂ . Almost insoluble in boiling alcohol.	4
5	Di-palmitin . . .	$C_3H_5(O. C_{16}H_{31}O)_2OH$	568	...	...	...	61	...	...		5
6	Di-stearin . . .	$C_3H_5(O. C_{18}H_{35}O)_2OH$	624	...	...	...	76.5	...	...		6
7	Di-arachin . . .	$C_3H_5(O. C_{20}H_{39}O)_2OH$	680	...	...	...	75	...	...		7
8	Di-cerotin . . .	$C_3H_5(O. C_{26}H_{51}O)_2OH$	848	...	...	...	79.5	...	...		8
9	Di-melissin . . .	$C_3H_5(O. C_{30}H_{59}O)_2OH$	940	...	...	...	93.0	...	...	Almost insoluble in cold alcohol; dissolves readily in ether and petroleum ether. Sparingly soluble in ether.	9
10	Di-olein . . .	$C_3H_5(O. C_{18}H_{33}O)_2OH$	620	21	0.921	10-15	...	...	...		10
11	Di-erucin . . .	$C_3H_5(O. C_{22}H_{41}O)_2OH$	732	...	...	...	47.0	...	...		11
12	Di-brassidin . . .	$C_3H_5(O. C_{22}H_{41}O)_2OH$	732	...	...	...	67.0	...	...		12

TABLE NO. 3.— *Triglycerides*

	Triglycerides.	Formula.	Molecular Weight.	Specific Gravity.		Solidifying Point.	Melting Point.	Boiling Point.		Refractive Index.		Solubility.	Occurrence.	
				°C.	—			m.m. Pressure.	°C.	°C.	n _D .			
1	Acetin	$C_3H_5(O.C_2H_5O)_3$	218	$1\frac{1}{8}$	1.1603	...	...	40 760	172-172.5 258-259	15	1.4328	Miscible with alcohol, ether, chloroform, benzene. Insoluble in CS ₂ and petroleum ether. Slightly soluble in water.		1
2	Butyrim	$C_3H_5(O.C_4H_7O)_3$	302	8	1.056	...	...	10	186	20	1.4587	Soluble in absolute, and 85 per cent alcohol, and the usual organic solvents.	Cow butter.	2
				$2\frac{0}{4}$	1.0324	...	...	760	285	20	1.48587	Nearly insoluble in water.		
				$4\frac{0}{4}$	1.0143	...	...	...	...	40	1.42785			
				$6\frac{0}{4}$	0.9963	...	...	...	...	60	1.42015			
3	Valerin, Iso-	$C_3H_5(O.C_5H_9O)_3$	344	...	...	...	...	...	...	...	...	...	Dolphin oil, porpoise oil.	3
4	Caproin	$C_3H_5(O.C_6H_{11}O)_3$	386	$2\frac{0}{4}$	0.9817	-60	-25	...	...	20	1.44265	Miscible with 85 per cent alcohol and the usual organic solvents at the ordinary temperature.	Cow butter, cocoa nut oil.	4
				$4\frac{0}{4}$	0.9651	...	...	...	...	40	1.43502			
				$6\frac{0}{4}$	0.9494	...	...	...	...	60	1.42715			
5	Caprylin	$C_3H_5(O.C_8H_{15}O)_3$	470	$2\frac{0}{4}$	0.9540	-15	8.0-8.3	...	...	20	1.44817	Miscible with 85 per cent alcohol and the usual organic solvents at the ordinary temperature.	Cow butter, cocoa nut oil.	5
				$4\frac{0}{4}$	0.9382	...	...	...	...	40	1.44069			
				$6\frac{0}{4}$	0.9231	...	...	...	...	60	1.43316			
6	Caprin	$C_3H_5(O.C_{10}H_{19}O)_3$	554	$4\frac{0}{4}$	0.9205	...	31.1	...	...	40	1.44461	Dissolves sparingly in absolute alcohol at the ordinary temperature, but readily in hot alcohol, as also in the usual organic solvents.	Cow butter, cocoa nut oil.	6
				$6\frac{0}{4}$	0.9057	...	...	...	...	60	1.43697			
7	Laurin	$C_3H_5(O.C_{12}H_{23}O)_3$	638	$6\frac{0}{4}$	0.8944	...	46.4	...	...	60	1.44039	Sparingly soluble in cold absolute alcohol; easily soluble in the usual organic solvents, and in hot absolute alcohol.	Laurel oil.	7
				$1\frac{0}{4}$	0.8687	...	...	...	...	100	1.4246		Tangkallah fat, cocoa nut oil.	
8	Myristin	$C_3H_5(O.C_{14}H_{27}O)_3$	722	$6\frac{0}{4}$	0.8848	...	56.5	...	...	60	1.44285	Very sparingly soluble in cold absolute alcohol; easily soluble in hot absolute alcohol, and in the usual organic solvents.	Nutmeg butter, dika oil.	8
9	Palmitin	$C_3H_5(O.C_{16}H_{31}O)_3$	806	$8\frac{0}{4}$	0.8657	45-47	65.1	...	...	80	1.43807	Almost insoluble in cold absolute alcohol, dissolves in hot alcohol and in the usual organic solvents.	Most fats and oils.	9
10	Stearin	$C_3H_5(O.C_{18}H_{35}O)_3$	890	$65\frac{5}{4}$	0.9235	70.0	71.6	...	...	...	...	Almost insoluble in cold absolute alcohol, more soluble in hot absolute alcohol. Sparingly soluble in cold ether and petroleum ether; readily in the hot solvents. Dissolves readily in cold benzene and chloroform.	Most fats and oils.	10
				$8\frac{0}{4}$	0.8621	...	...	...	...	80	1.43987			
11	Arachin	$C_3H_5(O.C_{20}H_{39}O)_3$	974	...	...	...	...	...	...	...	...	Very slightly soluble in ether.	Arachis oil.	11
12	Cerotin	$C_3H_5(O.C_{26}H_{51}O)_3$	1226	...	...	...	76.5-77	...	...	...	...	Very slightly soluble in ether.		12
13	Melissin	$C_3H_5(O.C_{30}H_{59}O)_3$	1394	...	...	...	89	...	...	...	...			13
14	Olein	$C_3H_5(O.C_{18}H_{35}O)_3$	884	15	0.900	...	...	...	...	...	...	Insoluble in dilute alcohol; more readily soluble in absolute alcohol than palmitin or stearin. Easily soluble in the usual organic solvents.	Most fats and oils.	14
15	Elaidin	$C_3H_5(O.C_{18}H_{33}O)_3$	884	...	...	...	38	...	...	...	...			15
16	Erucin	$C_3H_5(O.C_{22}H_{41}O)_3$	1052	...	...	...	31.0	...	...	...	...	Nearly insoluble in alcohol; readily soluble in the usual organic solvents.	Rape oil.	16
17	Brassidin	$C_3H_5(O.C_{22}H_{41}O)_3$	1052	...	...	...	47.0	...	...	...	...			17
18	Ricinolein	$C_3H_5(O.C_{18}H_{33}O)_3$	932	...	0.959-0.984	-60	-25	760	360	...	...	Miscible with absolute alcohol and glacial acetic acid; soluble in 96 per cent alcohol and methyl alcohol. Sparingly soluble in petroleum ether.	Castor oil.	18
<i>Mixed Glycerides—</i>														
19	Acetodiformin	$C_3H_5(O.C_2H_5O)(O.CHO)_2$	190	0	1.2490	...	...	...	...	...	...			19
20	Oleodistearin	$C_3H_5(O.C_{18}H_{33}O)(O.C_{18}H_{35}O)_2$	888	70	0.8928	40.8	45-46	27	157	...	...		Mkany fat, kokum butter.	20
21	Elaidodistearin	$C_3H_5(O.C_{18}H_{33}O)(O.C_{18}H_{35}O)_2$	888	...	...	...	61	...	...	...	...			21

TABLE No. 4.—*Waxes*

Waxes.	Formula.	Molecular Weight.	Solidifying Point.	Melting Point.	Solubility.	Occurrence.
			°C.	°C.		
Cetyl Palmitate, Cetin	$C_{16}H_{33}.O.CO.C_{15}H_{31}$	480	...	55	Nearly insoluble in cold alcohol; easily soluble in boiling alcohol	Spermaceti
Octodecyl Palmitate	$C_{18}H_{37}.O.CO.C_{15}H_{31}$	508	...	59	...	Opium wax
Ceryl Palmitate	$C_{26}H_{53}.O.CO.C_{15}H_{31}$	620	76	79	...	Beeswax
Myricyl Palmitate, Myricin	$C_{30}H_{61}.O.CO.C_{15}H_{31}$	676	...	72	...	...
Cetyl Stearate	$C_{16}H_{33}.O.CO.C_{17}H_{35}$	508	...	55-60	...	...
Ceryl Cerotate	$C_{26}H_{53}.O.CO.C_{25}H_{51}$	762	...	82-5	...	...
Cocceryl Coccerate, Coccerin	$C_{30}H_{60}(O.C_{31}H_{61}O_2)_2$	1382	...	106	Nearly insoluble in cold alcohol or ether; dissolves with great difficulty in cold benzene and glacial acetic acid	Chinese wax Cochineal wax
Cholesteryl Palmitate	$C_{26}H_{53}.O.CO.C_{15}H_{31}$	610	...	77-78	...	Blood serum
Cholesteryl Oleate	$C_{26}H_{53}.O.CO.C_{17}H_{33}$	636	...	41	Soluble in ether, chloroform, and benzene; but only sparingly soluble in alcohol	Blood serum
Cholesteryl Stearate	$C_{26}H_{53}.O.CO.C_{17}H_{35}$	638	...	65	Nearly insoluble in alcohol; slightly soluble in ether	...
Isocholesteryl Stearate	$C_{26}H_{53}.O.CO.C_{17}H_{35}$	638	...	72	Very slightly soluble in boiling alcohol	...
Cholesteryl Cerotate	$C_{26}H_{53}.O.CO.C_{25}H_{51}$	764	...	85-5	...	...

TABLE NO. 5.—*Saponification of a Pure Triglyceride*
(Molecular Weight 860)

OLD THEORY.		NEW THEORY.	
Fatty Acids.	Glycerol.	Fatty Acids.	Glycerol.
Per cent.	Per cent.	Per cent.	Per cent.
95.52	10.85	95.52	10.85
95.31	10.82	95.69	10.429
95.09	10.78	95.88	9.975
94.86	10.72	96.07	9.538
94.65	10.58	96.31	8.910
94.45	10.27	96.68	8.019
94.37	9.82	96.80	7.767
94.69	8.47	97.94	4.985
95.77	6.34	98.51	3.681
97.33	3.86	99.24	1.837
97.54	3.32	99.39	1.466
98.20	2.45	99.52	1.115
98.98	1.51	99.69	0.743
99.53	0.67	99.85	0.372
100.00	0.00	100.0	0.00

TABLE NO. 6. —Fatty Acids

	Acids.	Formula.	Molecular Weight.	Specific Gravity.		Solidifying Point.	Melting Point.	Boiling Point.		Refractive Index.		Solubility.	Occurrence.	
				°C.	—			m.m. Pressure.	°C.	°C.	n _D .			
1	Acids, C _n H _{2n} O ₂ — Acetic	C ₂ H ₄ O ₂	60	15 86	1.0515 1.0064	+17.5	...	760	118.1	...	...	Miscible with water, alcohol and ether in all proportions	Macassar oil.	1
2	Butyric	C ₄ H ₈ O ₂	88	0 14 19.1 20 20.9 20.9 20.9	0.9746 0.9580 0.9599 0.9590 0.8983 0.8141	−19	−6.5 −7.9	760	162.3	20	1.39906	...	Cow butter.	2
3	Valeric, Iso-	C ₅ H ₁₀ O ₂ = (CH ₃) ₂ CH.CH ₂ .CO ₂ H	102	0 20	0.9467 0.9310	−57	−51	10.48 45.92 760	72.4 199.2 173.7	...	...	Dissolves in 23.6 parts of water	Porpoise oil, dolphin oil.	3
4	Caproic	C ₆ H ₁₂ O ₂	116	20 40	0.9274 0.917	below −18	...	732	199.7	20	1.41635	Not miscible with water, though slightly soluble in it	Cow butter, cocoa nut oil.	4
5	Caprylic	C ₈ H ₁₆ O ₂	144	0 20	0.9270 0.9100	12	16.5	10 761	123.5-124.3 236-237	20	1.42825	Soluble in 400 parts of boiling water; very sparingly soluble in cold water	Cow butter, cocoa nut oil, human fat.	5
6	Capric	C ₁₀ H ₂₀ O ₂	172	40 4	0.8858	...	31.3-31.4	13 100 760	153-154 199.5-200 268-270	40	1.42855	Sparingly soluble in boiling water; nearly insoluble in cold water	Cow butter, cocoa nut oil.	6
7	Umbellulic	C ₁₁ H ₂₂ O ₂	186	...	...	...	21-23	760	275-280	...	...	...	Chaulmoogra oil.	7
8	Lauric	C ₁₂ H ₂₄ O ₂	200	20 40 60 70 70	0.883 0.875 0.8642 0.8495	...	43.6	0 15 16 100	102 176 180 225	60	1.42665	Very slightly soluble in boiling water	Laurel oil, cocoa nut oil.	8
9	Myristic	C ₁₄ H ₂₈ O ₂	228	50 4	0.8622 0.8584	...	53.8	0 15 100	121-122 196.5 250.5	60	1.43075	Completely insoluble in water; dissolves with difficulty in cold alcohol and ether	Nutmeg butter; dika oil, quince oil, cocoa nut oil. Spermaceti, wool wax.	9
10	Isocetic	C ₁₅ H ₃₀ O ₂ (?)	242	...	...	...	55	...	...	...	...	...	Curcas oil.	10
11	Palmitic	C ₁₆ H ₃₂ O ₂	256	60 70 80	0.8527 0.8465 0.8412	62.6	62.62	0 15 100	168-139 215 271.5	80	1.42693	Not readily soluble in cold alcohol, nor in cold petroleum ether. Easily soluble in both menstrua in the hot	Most animal and vegetable fats; beeswax, spermaceti.	11
12	Daturic	C ₁₇ H ₃₄ O ₂	270	...	...	...	54.5; 57	15	223-225	...	...	...	Seeds of thorn-apple.	12
13	Stearic	C ₁₈ H ₃₆ O ₂	284	11 90 100	1.0000 0.8454 0.8386	69.3	69.32	0 15 100 760	154.5-155.5 232 291 360	80	1.43003	Less soluble in cold alcohol than palmitic acid	Most animal and vegetable fats.	13
14	Arachidic	C ₂₀ H ₄₀ O ₂	312	...	...	...	77	...	...	...	...	...	Arachis oil, ram-butan tallow, rape oil, maize oil.	14
15	Behenic	C ₂₂ H ₄₄ O ₂	340	...	...	79-77	83-84	...	...	...	...	100 parts alcohol of 90 per cent by volume dissolve at 17° C. : 0.102 grms. 100 parts ether dissolve at 16° C. : 1.922 grms.	Ben oil.	15
16	Lignoceric	C ₂₄ H ₄₈ O ₂	368	...	...	...	80.5	...	...	...	...	Very sparingly soluble in cold alcohol	Arachis oil.	16
17	Carnaubic	C ₂₄ H ₄₈ O ₂	368	...	...	69-67	72.5	...	...	...	...	Sparingly soluble in cold methyl alcohol	Carnauba wax, wool wax.	17
18	Hyenic	C ₂₅ H ₅₀ O ₂	382	...	...	...	77-78	...	...	...	...	...	Carnauba wax,	18
19	Cerotic	C ₂₆ H ₅₂ O ₂	396	70	0.8359	...	77.8	...	...	...	...	Almost insoluble in cold alcohol; soluble in boiling alcohol	beeswax.	19
20	Melissic	C ₃₀ H ₆₀ O ₂	452	...	...	...	91	...	...	...	...	Almost insoluble in ether and methyl alcohol	Beeswax.	20

TABLE No. 6, *continued*.—*Fatty Acids*

	Acids.	Formula.	Molecular Weight.	Specific Gravity.		Solidifying Point.	Melting Point.	Boiling Point.		Refractive Index.		Solubility.	Occurrence.			
				°C.	—			°C.	°C.	m.m. Pressure.	°C.				°C.	n _D .
<i>Acids, C_nH_{2n-2}O₂—</i>																
1	Tiglic	C ₈ H ₈ O ₂	100	7 ⁴ / ₄	0.9641	...	64.5	760	198.5	...	...	Dissolves sparingly in cold, easily in hot water	Croton oil.	1		
2	Hypogæic	C ₁₆ H ₃₀ O ₂	254	...	...	...	33-34	10	230	...	...		...	Arachis oil, maize oil.	2	
3	Gaidic	C ₁₆ H ₃₀ O ₂	254	...	...	...	39	15	236	...	...		...	Caspian seal oil.	3	
4	Physetoleic	C ₁₆ H ₃₀ O ₂	254	...	...	...	30	...	...	...	...	...	Spores of Lycopodium.	4		
5	Lycopodic	C ₁₆ H ₃₀ O ₂	254	...	...	...	...	...	...	...	...	...	Most animal and vegetable oils.	5		
6	Oleic	C ₁₈ H ₃₄ O ₂	282	14 ¹⁸ / ₁₁₅	0.8908	4	14	0	153	15	1.4638	Insoluble in water; readily soluble in alcohol, even if somewhat dilute		6		
7	Elaidic	C ₁₈ H ₃₄ O ₂	282	115	0.898	...	...	10	223	20	1.4620					
				20	0.895	...	...	15	232.5	30	1.4585					
				30	0.889	...	...	30	249.5	40	1.4546					
				50	0.875	...	...	50	264.0	50	1.4509					
				74 ¹⁸ / ₄	0.8540	...	...	100	285.5-286	60	1.4471					
				74 ¹⁸ / ₄	0.8505	...	44.5	0	154	...	...					
				10	225	...	...									
8	Isooleic	C ₁₈ H ₃₄ O ₂	282	...	...	...	44-45	...	...	...	...	Very easily soluble in alcohol, less readily in ether	Distilled stearine.	8		
9	Rapic	C ₁₈ H ₃₄ O ₂	282	...	...	...	...	...	...	...	...				...	
10	Doeglic	C ₁₉ H ₃₆ O ₂	296	...	...	...	...	...	...	...	...				...	
11	Jecoleic	C ₁₉ H ₃₆ O ₂	296	...	...	...	...	...	...	...	...	...	Arctic sperm oil.	10		
12	Erucic	C ₂₁ H ₄₂ O ₂	338	5 ⁵ / ₄	0.8602	...	33-34	0	179	...	...	Very easily soluble in alcohol	Rape oil, mustard seed oils, fish oils (?).	12		
13	Brassicidic	C ₂₂ H ₄₂ O ₂	338	57 ¹ / ₄	0.8585	56	65-66	10	254.5	...	...					
								15	264	...	...					
								30	281	...	...					
								0	160	...	...					
14	Isoerucic	C ₂₂ H ₄₂ O ₂	338	...	...	52-51	54-56	10	256	...	...	Sparingly soluble in alcohol and ether		14		
								15	265	...	...					
								30	282	...	...					
								...	...	...	...					
<i>Acids, C_nH_{2n-4}O₂—</i>																
15	Eleomargaric	C ₁₇ H ₃₀ O ₂	266	...	...	...	48	...	...	...	...	Dissolves readily in alcohol and ether	Chinese wood oil.	15		
16	Eleostearic	C ₁₇ H ₃₀ O ₂	266	...	...	...	71	...	...	...	...				Drying oils.	16
17	Linolic	C ₁₈ H ₃₂ O ₂	280	14	0.9206	below -18	...	...	...	...	...					
18	Tariric	C ₁₈ H ₃₂ O ₂	280	...	...	...	50.5	...	...	...	...	...	Fat from Picramnia.	18		
19	Telfairic	C ₁₈ H ₃₂ O ₂	280	...	...	6	...	13	220-225	...	...	...	Koëme oil.	19		
<i>Acids, C_nH_{2n-6}O₂—</i>																
20	Linolenic	C ₁₈ H ₃₀ O ₂	278	15 ⁵ / ₈	0.9228	...	...	...	...	...	...	Readily soluble in alcohol and the usual organic solvents	Drying oils.	20		
21	Isolinolenic	C ₁₈ H ₃₀ O ₂	278	...	...	...	...	...	...	...	...				Linseed oil.	21
<i>Acids, C_nH_{2n-8}O₂—</i>																
22	Isanic	C ₁₄ H ₂₀ O ₂	220	...	...	...	41	...	...	...	...	...	Seeds from I'sano.	22		

TABLE No. 6, continued.—Fatty Acids

	Acids.	Formula.	Molecular Weight.	Specific Gravity.		Solidifying Point.	Melting Point.	Boiling Point.		Refractive Index.		Solubility.	Occurrence.	
				°C.	—			m.m. Pressure.	°C.	°C.	n_D .			
1	Therapic (?)	$C_{17}H_{36}O_2$	262	...	...	...	...	...	...	...	...	...	Cod liver oil.	1
2	?	$C_{20}H_{32}O_2$	304	...	...	...	...	...	...	...	...	...	Cod liver oil.	2
3	?	$C_{24}H_{40}O_2$	360	...	...	...	...	...	...	...	...	...	Cod liver oil.	3
<i>Acids, $C_nH_{2n}O_3$—</i>														
4	Lanopalmic	$C_{16}H_{32}O_3$	272	...	...	85-83	87-88	...	...	...	...	Insoluble in water, but dissolves in it in presence of alcohol on boiling; soluble in the usual organic solvents	Wool wax.	4
5	Cocceric	$C_{31}H_{62}O_3$	482	...	...	...	92-93	...	...	...	...	Dissolves sparingly in cold alcohol, ether, benzene, petroleum ether, and glacial acetic acid	Cochineal wax.	5
<i>Acids, $C_nH_{2n-2}O_3$—</i>														
6	Ricinoleic	$C_{18}H_{34}O_3$	298	15.5	0.9509	-6-10	4-5	15	250	...	...	Easily soluble in alcohol and ether	Castor oil.	6
7	Ricinelaiddic	$C_{18}H_{34}O_3$	298	...	...	...	52-53	...	...	...	...	...	...	7
8	Ricinic	$C_{18}H_{34}O_3$	298	...	...	...	81	15	250-252	...	...	...	...	8
9	?	$C_{18}H_{34}O_3$	298	...	0.8931	...	...	...	...	...	...	...	Quince oil.	9
<i>Acids, $C_nH_{2n}O_4$—</i>														
Monobasic Acids—														
10	Dihydroxystearic	$C_{18}H_{36}O_4$	316	...	...	...	141-143	...	...	...	...	Insoluble in ether, petroleum ether, benzene; dissolves in boiling alcohol	Castor oil.	10
11	Lanocerac	$C_{30}H_{60}O_4$	484	...	...	103-101	104-105	...	...	...	...	Sparingly soluble in ether and warm benzene	Wool wax.	11
<i>Acids, $C_nH_{2n-2}O_4$—</i>														
Dibasic Acids—														
12	Japanic	$C_{20}H_{40}(COOH)_2$	370	...	>1.0	...	117.7-117.9	...	...	...	...	Sparingly soluble in the usual solvents	Japan wax.	12
APPENDIX														
I. Hydroxylated Acids—														
<i>(a) Monohydroxylated Acids,</i>														
<i>$C_nH_{2n}O_3$—</i>														
13	β -Hydroxystearic	$C_{18}H_{35}O_2(OH)$	300	...	...	68-65	83-85	...	...	...	...	Sparingly soluble in alcohol and ether	...	13
14	α -Hydroxystearic	$C_{18}H_{35}O_2(OH)$	300	...	...	...	77-79	...	...	...	...	More readily soluble in ether, and less in absolute alcohol than the β -acid	...	14
15	Lactone of γ -Hydroxystearic (Stearolactone)	$C_{18}H_{34}O_2$	282	...	...	...	47-48	...	...	...	...	Insoluble in water; dissolves easily in alcohol ether, and petroleum ether	...	15
<i>(b) Dihydroxylated Acids,</i>														
<i>$C_nH_{2n}O_4$—</i>														
16	Tigliceric (Dihydroxytiglic)	$C_5H_8O_2(OH)_2$	134	...	...	...	88	...	...	...	...	Easily soluble in water; soluble in alcohol and acetone; insoluble in petroleum ether, chloroform, and benzene	...	16
17	Di-hydroxypalmitic	$C_{16}H_{30}O_2(OH)_2$	288	...	...	...	115	...	...	...	...	Readily soluble in alcohol and ether	...	17
18	Di-hydroxystearic	$C_{18}H_{34}O_2(OH)_2$	316	...	...	122-119	136.5	...	...	...	...	Completely insoluble in water; not readily soluble in cold alcohol; sparingly soluble in ether	...	18
19	Di-hydroxystearidic	$C_{18}H_{34}O_2(OH)_2$	316	...	...	...	99-100	...	...	...	...	Easily soluble in alcohol and ether	...	19
20	p-Di-hydroxystearic	$C_{18}H_{34}O_2(OH)_2$	316	...	...	...	79	...	...	...	...	...	...	20
21	Di-hydroxyjeceoleic	$C_{19}H_{36}O_2(OH)_2$	330	...	...	...	114-116	...	...	...	...	...	...	21
22	Di-hydroxybehenic	$C_{22}H_{42}O_2(OH)_2$	372	...	...	...	132-133	...	...	...	...	Dissolves readily in warm alcohol; insoluble in cold ether	...	22
23	Iso-Di-hydroxybehenic	$C_{22}H_{42}O_2(OH)_2$	372	...	...	88-87	99-100	...	...	...	...	...	...	23
24	p-Di-hydroxybehenic	$C_{22}H_{42}O_2(OH)_2$	372	...	...	82-80	86-88	...	...	...	...	...	...	24

TABLE No. 6, continued.—Fatty Acids

	Acids.	Formula.	Molecular Weight.	Specific Gravity.		Solidifying Point.	Melting point.	Boiling Point.		Refractive Index.		Solubility.	Occurrence.
				°C.	—			°C.	°C.	m.m. Pressure.	°C.		
(c) <i>Trihydroxylated Acids</i> , C _n H _{2n} O ₅ —													
1	Tri-hydroxystearic . . .	C ₁₈ H ₃₃ O ₂ (OH) ₃	332	...	..	...	140-142	...	...	...	...	Dissolves with difficulty in hot water ; likewise in cold alcohol and ether ; warm alcohol and glacial acetic acid dissolve it readily. Insoluble in carbon bisulphide, chloroform, benzene, and petroleum ether	1
2	α-Iso-tri-hydroxystearic . .	C ₁₈ H ₃₃ O ₂ (OH) ₃	332	...	...	...	110-111	...	...	...	...	Readily soluble in ether and benzene	2
3	β-Iso-tri-hydroxystearic . .	C ₁₈ H ₃₃ O ₂ (OH) ₃	332	...	...	...	114-115	...	...	...	...	Sparingly soluble in hot water, ether, chloroform, and petroleum ether ; readily soluble in alcohol	3
(d) <i>Tetrahydroxylated Acid</i> , C _n H _{2n} O ₆ —													
4	Sativic	C ₁₈ H ₃₂ O ₂ (OH) ₄	348	...	...	...	173	...	...	...	...	Very sparingly soluble in hot water ; insoluble in cold water, ether, chloroform, carbon bisulphide, and benzene. Dissolves readily in hot alcohol and glacial acetic acid	4
(e) <i>Hexahydroxylated Acids</i> , C _n H _{2n} O ₈ —													
5	Linusic	C ₁₈ H ₃₀ O ₂ (OH) ₆	380	...	...	...	203-205	...	...	...	...	More soluble in water than sativic acid. Insoluble in ether ; sparingly soluble in alcohol	5
6	Isolinusic	C ₁₈ H ₃₀ O ₂ (OH) ₆	380	...	...	...	173-175	...	...	...	...	Sparingly soluble in cold water ; readily soluble in hot water and hot alcohol. Insoluble in ether, benzene, carbon bisulphide and chloroform	6
II. Dibasic Acids—													
7	Suberic	C ₈ H ₁₂ (COOH) ₂	174	...	...	...	140	0 10 15 50 100	152.5 219.5 230 258.5 279.0	...	...	Dissolves sparingly in cold water ; 100 parts ether dissolve 0.809 parts at 15° C. ; almost insoluble in chloroform	7
8	Azelaic	C ₇ H ₁₄ (COOH) ₂	188	...	...	...	106.2	0 10 15 50 100	158 225.5 237 265 286.5	...	...	Sparingly soluble in cold water ; 100 parts ether dissolve 2.68 parts at 15° C. Very easily soluble in alcohol	8
9	Sebacic	C ₈ H ₁₆ (COOH) ₂	202	...	...	...	133-133.5	0 10 15 50 100	164 232 243.5 273 294.5	...	...	Sparingly soluble in cold water ; readily soluble in alcohol and ether	9

TABLE No. 7. —Alcohols

		Formula.	Mole- cular Weight.	Specific Gravity.		Solidi- fying Point.	Melting Point.		Boiling Point.		Solubility.	Occurrence.	
				°C.	—		°C.	°C.	m.m. Pres- sure.	°C.			
<i>Alcohols, C_nH_{2n+2}O—</i>													
1	Cetyl alcohol (Ethal)	C ₁₆ H ₃₄ O	242	$\frac{49.5}{4}$ 0.8105 $\frac{79.7}{4}$ 0.7984 $\frac{98.7}{4}$ 0.7837	0.8176 0.8105 0.7984 0.7837	...	50	0	119	Dissolves in alcohol ; easily soluble in ether and benzene	Spermaceti.	1	
2	Octadecyl alcohol	C ₁₈ H ₃₈ O	207	$\frac{59}{4}$ 0.8124 $\frac{70}{4}$ 0.8048 $\frac{90.1}{4}$ 0.7849	0.8124 0.8048 0.7849	...	59	15	760 344 210.5	...	Spermaceti.	2	
3	Carnaubyl alcohol	C ₂₄ H ₅₀ O	354	...	...	68-67	68-69	...	...	Soluble in alcohol	Wool wax.	3	
4	Ceryl alcohol	C ₂₆ H ₅₄ O	382	...	...	...	79	...	...	Soluble in alcohol	Chinese wax.	4	
5	Isoceryl alcohol	C ₂₇ H ₅₆ O	396	...	...	...	62	...	...	Soluble in alcohol	Wool wax.	5	
6	Myricyl (melissyl) alcohol	C ₃₀ H ₆₂ O	438	...	...	...	85 ; 88	...	...	Nearly insoluble in cold alcohol, easily soluble in hot alcohol	Bees wax.	6	
<i>Alcohols, C_nH_{2n}O—</i>													
7	Lanolin alcohol (?)	C ₁₂ H ₂₄ O	182	...	...	...	102-104	...	...	Insoluble in ether, sparingly soluble in cold alcohol, chloroform, and benzene	Wool wax.	7	
<i>Alcohols, C_nH_{2n+2}O₂—</i>													
8	?	C ₂₅ H ₅₂ O ₂	384	...	...	...	103.5— 103.8	...	...	Dissolves sparingly in boiling petrol- eum ether ; somewhat more readily in ether and in benzene	Carnauba wax.	8	
9	Cocceryl alcohol	C ₃₀ H ₆₂ O ₂	454	...	...	...	101-104	...	...	Dissolves in hot alcohol	Cochineal wax.	9	
10	Psyllostearyl alcohol	C ₃₃ H ₆₈ O ₂	496	...	...	...	86-87	...	...	Almost insoluble in ether ; sparingly soluble in petroleum ether ; easily soluble in benzene		10	
<i>Alcohols, C_nH_{2n+2}O₃—</i>													
11	Glycerol	C ₃ H ₈ O ₃	92	$\frac{1.5}{9}$ $\frac{1.5}{9}$ $\frac{1.5}{9}$ $\frac{1.5}{9}$ 1.26358 1.26468 1.2620 1.26348	1.26358 1.26468 1.2620 1.26348	...	crystals melt at 20° C.	12.5	179.5	Miscible with alcohol and water ; spar- ingly soluble in ether ; insoluble in petroleum ether, chloroform, carbon bisulphide, and benzene	Constituent of all fats and fatty oils.	11	
<i>Alcohols, C_nH_{2n-8}O₂—</i>													
12	Cholesterol	C ₂₆ H ₄₄ O	372	...	1.067	...	148.5	...	...	Insoluble in water ; sparingly soluble in cold alcohol ; easily soluble in ether, chloroform, carbon bisulphide, less readily in petroleum ether	Wool wax.	12	
13	Isocholesterol	C ₂₆ H ₄₄ O	372	...	...	...	137-138	...	...	...	Wool wax.	13	
14	Phytosterol	C ₂₆ H ₄₄ O	372	...	...	...	132-134	...	...	...	Vegetable fats and oils.	14	

TABLE NO. 8.—Freezing Mixtures

Required per 100 parts of Snow, to produce	Temperature. °C.
13·5 parts potassium nitrate and 26 parts ammonium chloride .	− 17·8
33 „ sodium chloride	− 21·3
52 „ ammonium nitrate and 55 parts sodium nitrate .	− 25·8
9 „ potassium nitrate and 67 parts ammonium rhodanate .	− 28·2
13 „ ammonium chloride and 37·5 parts sodium nitrate .	− 30·7
32 „ potassium nitrate and 59 parts ammonium rhodanate .	− 30·6
2 „ potassium nitrate and 112 parts potassium rhodanate .	− 34·1
39·5 „ ammonium rhodanate and 54·5 parts sodium rhodanate .	− 37·4
143 „ crystallised calcium chloride (CaCl ₂ +2H ₂ O) . . .	− 50·0

TABLE NO. 9 *see page 26.*

TABLE NO. 10.—Iodine Values of Unsaturated Fatty Acids
and of their Glycerides

Fatty Acid.	Formula.	Iodine Value of Fatty Acids.	Iodine Value of		
			Monoglyceride.	Diglyceride.	Triglyceride.
Tiglic	C ₅ H ₈ O ₂	254·00	145·98	198·43	225·44
	C ₁₂ H ₂₂ O ₂	128·28	93·38	112·39	120·57
	C ₁₄ H ₂₆ O ₂	112·39	84·67	100·00	106·42
Hypogaëic } Physetoleic } Lycopodic }	C ₁₆ H ₃₀ O ₂	100·00	77·44	90·07	95·25
Asellie	C ₁₇ H ₃₂ O ₂	94·78	74·27	85·81	90·50
Oleic } Elaidic } Isooleic }	C ₁₈ H ₃₄ O ₂	90·07	71·35	81·93	86·20
Rapic }					
Dœglic } Jecoleic }	C ₁₉ H ₃₆ O ₂	85·81	68·65	78·39	82·29
Erucic }					
Brassidic } Isœrucic }	C ₂₂ H ₄₂ O ₂	75·15	61·65	69·40	72·43
Elœomargaric .	C ₁₇ H ₃₀ O ₂	190·98	149·41	172·79	182·29
Linolic } Tariric }	C ₁₈ H ₃₂ O ₂	181·42	143·50	164·93	173·58
Millet Oil }					
Linolenic } Isolinolenic }	C ₁₈ H ₃₀ O ₂	274·10	216·47	249·02	262·15
Jecoric }					
Isanic	C ₁₄ H ₂₆ O ₂	461·82	345·57	409·67	436·67
Therapic	C ₁₇ H ₂₆ O ₂	387·78	302·38	350·34	369·90
Ricinoleic } Ricinisooleic }	C ₁₈ H ₃₄ O ₃	85·23	68·28	77·91	81·76

TABLE NO. 9.—Saponification Values, Percentages of Insoluble fatty Acids, and Yields of Glycerol from Mono-, Di-, and Tri-glycerides

Glyceride of Acid.		MONOGLYCERIDE.					DI- GLYCERIDE.					TRIGLYCERIDE.				
		Formula.	Molecular Weight.	Saponi- fication Value.	In- soluble Fatty Acids.	Glyce- rol.	Formula.	Molecular Weight.	Insoluble Fatty Acids.	Saponi- fication Value.	Glycerol.	Formula.	Molecular Weight.	Insoluble Fatty Acids.	Saponi- fication Value.	Glycerol.
1	Acetic . . .	$C_3H_5(OH)_2(O \cdot C_2H_3O)$	134	428.7	0	68.65	$C_3H_5(OH)(O \cdot C_2H_3O)_2$	176	0	637.6	52.27	$C_3H_5(O \cdot C_2H_3O)_3$	218	0	772.0	42.20
2	Butyric . . .	$C_3H_5(OH)_2(O \cdot C_4H_7O)$	162	346.3	0	56.80	$C_3H_5(OH)(O \cdot C_4H_7O)_2$	232	0	483.7	39.66	$C_3H_5(O \cdot C_4H_7O)_3$	302	0	557.3	30.46
3	Valeric . . .	$C_3H_5(OH)_2(O \cdot C_5H_9O)$	176	318.8	0	52.27	$C_3H_5(OH)(O \cdot C_5H_9O)_2$	260	0	431.5	35.38	$C_3H_5(O \cdot C_5H_9O)_3$	344	0	489.2	26.74
4	Caproic . . .	$C_3H_5(OH)_2(O \cdot C_6H_{11}O)$	190	295.3	0	48.42	$C_3H_5(OH)(O \cdot C_6H_{11}O)_2$	288	0	389.6	31.94	$C_3H_5(O \cdot C_6H_{11}O)_3$	384	0	436.1	23.96
5	Caprylic . . .	$C_3H_5(OH)_2(O \cdot C_8H_{15}O)$	218	257.3	...	42.20	$C_3H_5(OH)(O \cdot C_8H_{15}O)_2$	344	...	326.2	26.74	$C_3H_5(O \cdot C_8H_{15}O)_3$	470	...	358.1	19.58
6	Capric . . .	$C_3H_5(OH)_2(O \cdot C_{10}H_{19}O)$	246	228.1	...	37.40	$C_3H_5(OH)(O \cdot C_{10}H_{19}O)_2$	400	...	280.5	23.00	$C_3H_5(O \cdot C_{10}H_{19}O)_3$	552	...	303.7	16.67
7	Lauric . . .	$C_3H_5(OH)_2(O \cdot C_{12}H_{23}O)$	274	204.7	...	33.58	$C_3H_5(OH)(O \cdot C_{12}H_{23}O)_2$	456	...	246.1	20.18	$C_3H_5(O \cdot C_{12}H_{23}O)_3$	638	...	263.8	14.42
8	Myristic . . .	$C_3H_5(OH)_2(O \cdot C_{14}H_{27}O)$	302	185.8	75.50	30.46	$C_3H_5(OH)(O \cdot C_{14}H_{27}O)_2$	512	89.05	219.1	17.97	$C_3H_5(O \cdot C_{14}H_{27}O)_3$	722	94.75	233.1	12.74
9	Palmitic . . .	$C_3H_5(OH)_2(O \cdot C_{16}H_{31}O)$	330	170.0	77.58	27.88	$C_3H_5(OH)(O \cdot C_{16}H_{31}O)_2$	568	90.15	197.6	16.20	$C_3H_5(O \cdot C_{16}H_{31}O)_3$	806	95.29	208.8	11.42
10	Stearic . . .	$C_3H_5(OH)_2(O \cdot C_{18}H_{35}O)$	358	156.7	79.33	25.70	$C_3H_5(OH)(O \cdot C_{18}H_{35}O)_2$	624	91.02	179.8	14.74	$C_3H_5(O \cdot C_{18}H_{35}O)_3$	890	95.73	189.1	10.34
11	Oleic . . .	$C_3H_5(OH)_2(O \cdot C_{18}H_{33}O)$	356	157.6	79.22	25.85	$C_3H_5(OH)(O \cdot C_{18}H_{33}O)_2$	620	90.95	181.0	14.84	$C_3H_5(O \cdot C_{18}H_{33}O)_3$	884	95.70	190.4	10.41
12	Linolic . . .	$C_3H_5(OH)_2(O \cdot C_{18}H_{31}O)$	354	158.5	79.10	25.99	$C_3H_5(OH)(O \cdot C_{18}H_{31}O)_2$	616	90.90	182.1	14.93	$C_3H_5(O \cdot C_{18}H_{31}O)_3$	878	95.67	191.7	10.48
13	Linolenic . . .	$C_3H_5(OH)_2(O \cdot C_{18}H_{29}O)$	352	159.9	78.98	26.14	$C_3H_5(OH)(O \cdot C_{18}H_{29}O)_2$	612	90.83	183.3	15.03	$C_3H_5(O \cdot C_{18}H_{29}O)_3$	872	95.63	193.0	10.55
14	Ricinoleic . . .	$C_3H_5(OH)_2(O \cdot C_{18}H_{33}O_2)$	372	150.9	80.12	24.74	$C_3H_5(OH)(O \cdot C_{18}H_{33}O_2)_2$	652	91.43	172.1	14.11	$C_3H_5(O \cdot C_{18}H_{33}O_2)_3$	932	95.93	180.6	9.87
15	Erucic . . .	$C_3H_5(OH)_2(O \cdot C_{22}H_{41}O)$	412	136.2	82.04	22.33	$C_3H_5(OH)(O \cdot C_{22}H_{41}O)_2$	732	92.35	153.3	12.57	$C_3H_5(O \cdot C_{22}H_{41}O)_3$	1052	96.39	160.0	8.74
16	Cerotic . . .	$C_3H_5(OH)_2(O \cdot C_{26}H_{51}O)$	470	119.3	84.26	19.58	$C_3H_5(OH)(O \cdot C_{26}H_{51}O)_2$	848	93.40	132.3	10.85	$C_3H_5(O \cdot C_{26}H_{51}O)_3$	1226	96.90	137.3	7.50
17	Hydroxystearic . . .	$C_3H_5(OH)_2(O \cdot C_{18}H_{35}O_2)$	374	150.0	80.20	24.60	$C_3H_5(OH)(O \cdot C_{18}H_{35}O_2)_2$	656	91.47	171.1	14.03	$C_3H_5(O \cdot C_{18}H_{35}O_2)_3$	938	95.95	179.4	9.81
18	Dihydroxystearic . . .	$C_3H_5(OH)_2(O \cdot C_{18}H_{35}O_3)$	390	143.9	81.02	23.59	$C_3H_5(OH)(O \cdot C_{18}H_{35}O_3)_2$	688	91.87	163.1	13.37	$C_3H_5(O \cdot C_{18}H_{35}O_3)_3$	986	96.15	170.7	9.33
19	Trihydroxystearic . . .	$C_3H_5(OH)_2(O \cdot C_{18}H_{35}O_4)$	406	138.2	81.78	22.66	$C_3H_5(OH)(O \cdot C_{18}H_{35}O_4)_2$	720	92.23	155.9	12.78	$C_3H_5(O \cdot C_{18}H_{35}O_4)_3$	1034	96.35	162.8	8.90
20	Sativic . . .	$C_3H_5(OH)_2(O \cdot C_{18}H_{35}O_5)$	422	133.0	82.48	21.80	$C_3H_5(OH)(O \cdot C_{18}H_{35}O_5)_2$	752	92.56	149.2	12.24	$C_3H_5(O \cdot C_{18}H_{35}O_5)_3$	1082	96.50	155.0	8.51
21	Linusic . . .	$C_3H_5(OH)_2(O \cdot C_{18}H_{35}O_7)$	454	123.6	83.70	20.26	$C_3H_5(OH)(O \cdot C_{18}H_{35}O_7)_2$	816	93.15	137.5	11.28	$C_3H_5(O \cdot C_{18}H_{35}O_7)_3$	1178	96.77	142.4	7.81
22	Acid, $C_{17}H_{34}O_2$. . .	$C_3H_5(OH)_2(O \cdot C_{17}H_{33}O)$	344	163.1	...	26.74	$C_3H_5(OH)(O \cdot C_{17}H_{33}O)_2$	596	...	188.3	15.44	$C_3H_5(O \cdot C_{17}H_{33}O)_3$	...	...	...	10.85
23	Acid, M. W. = 275 . . .	...	349	160.8	...	26.36	$C_3H_5(OH)(OR)_2(R = 274)$	606	...	185.2	15.18	$C_3H_5(OR)_3(R = 274)$	...	...	...	10.66

TABLE No. 11

Logarithms for the Quotient $\frac{0.2}{\text{cc. Thiosulphate}}$

cc. Thio- sulphate.	Log. $\frac{0.2}{\text{cc}}$	cc. Thio- sulphate.	Log. $\frac{0.2}{\text{cc}}$
14.0	1549020	16.3	0888424
14.05	1533537	16.35	0875122
14.1	1518109	16.4	0861862
14.15	1502736	16.45	0848641
14.2	1487417	16.5	0835461
14.25	1472151	16.55	0822320
14.3	1456940	16.6	0809219
14.35	1441781	16.65	0796158
14.4	1426675	16.7	0783135
14.45	1411622	16.75	0770152
14.5	1396620	16.8	0757207
14.55	1381670	16.85	0744301
14.6	1366771	16.9	0731433
14.65	1351924	16.95	0718603
14.7	1337127	17.0	0705811
14.75	1322380	17.05	0693056
14.8	1307683	17.1	0680339
14.85	1293035	17.15	0667659
14.9	1278437	17.2	0655016
14.95	1263888	17.25	0642409
15.0	1249387	17.3	0629839
15.05	1234935	17.35	0617305
15.1	1220531	17.4	0604808
15.15	1206174	17.45	0592346
15.2	1191864	17.5	0579920
15.25	1177602	17.55	0567529
15.3	1163386	17.6	0555173
15.35	1149216	17.65	0542853
15.4	1135093	17.7	0530567
15.45	1121015	17.75	0518316
15.5	1106983	17.8	0506100
15.55	1092996	17.85	0493918
15.6	1079054	17.9	0481770
15.65	1065157	17.95	0469655
15.7	1051303	18.0	0457575
15.75	1037494	18.05	0445528
15.8	1023729	18.1	0433514
15.85	1010007	18.15	0421534
15.9	0996329	18.2	0409586
15.95	0982693	18.25	0397671
16.0	0969100	18.3	0385789
16.05	0955550	18.35	0373939
16.1	0942041	18.4	0362122
16.15	0928575	18.45	0350336
16.2	0915150	18.5	0338583
16.25	0901766		

TABLE No. 12.—*Saponification Values of Waxes*

Pure Waxes.	Formula.	Molecular Weight.	Saponification Value.	Iodine Value.
Cetyl Palmitate, Cetin . . .	$C_{16}H_{33} \cdot O \cdot CO \cdot C_{15}H_{31}$	480	116.9	0
Octodecyl Palmitate . . .	$C_{18}H_{37} \cdot O \cdot CO \cdot C_{15}H_{31}$	508	110.4	0
Ceryl Palmitate . . .	$C_{26}H_{53} \cdot O \cdot CO \cdot C_{15}H_{31}$	620	90.5	0
Myricyl Palmitate, Myricin . . .	$C_{30}H_{61} \cdot O \cdot CO \cdot C_{15}H_{31}$	676	83.0	0
Cetyl Stearate . . .	$C_{16}H_{33} \cdot O \cdot CO \cdot C_{17}H_{35}$	508	110.4	0
Ceryl Cerotate . . .	$C_{26}H_{53} \cdot O \cdot CO \cdot C_{25}H_{53}$	762	73.6	0
Cocceryl Coccerate, Coccerin . . .	$C_{30}H_{60} \cdot (O \cdot C_{31}H_{61}O_2)_{1/2}$	1382	81.2	?
Cholesteryl Palmitate . . .	$C_{26}H_{43} \cdot O \cdot CO \cdot C_{15}H_{31}$	610	92.0	41.63
Cholesteryl Oleate . . .	$C_{26}H_{43} \cdot O \cdot CO \cdot C_{17}H_{33}$	636	88.2	79.87
Cholesteryl Stearate . . .	$C_{26}H_{43} \cdot O \cdot CO \cdot C_{17}H_{35}$	638	87.9	39.81
Isocholesteryl Stearate . . .	$C_{26}H_{43} \cdot O \cdot CO \cdot C_{17}H_{35}$	638	87.9	39.81
Cholesteryl Cerotate . . .	$C_{26}H_{43} \cdot O \cdot CO \cdot C_{26}H_{53}$	764	73.4	33.87

TABLE NO. 13.—*Acetylated Glycerides. Saponification Values, Percentages of Insoluble Fatty Acids, and Acetyl Values of Mono-, Di-, and Tri-glycerides*

	Glyceride of Acid.	ACETYLATED MONOGLYCERIDE.					ACETYLATED DIGLYCERIDE.					ACETYLATED TRIGLYCERIDE.				
		Formula.	Molec- ular Weight.	Saponi- fication Value.	In- soluble Fatty Acids.	Acetyl Value.	Formula.	Molec- ular Weight.	Saponi- fication Value.	Insoluble Fatty Acids.	Acetyl Value.	Formula.	Molec- ular Weight.	Saponi- fication Value.	Insoluble Fatty Acids.	Acetyl Value.
1	Acetic . . .	$C_3H_5(O.C_2H_3O)_2$ ($O.C_2H_3O$)	218	772.0	...	772.0	$C_3H_5(O.C_2H_3O)_2$ ($O.C_2H_3O$)	218	772.0	...	772.0	...	...	...	...	0
2	Butyric . . .	$C_3H_5(O.C_4H_7O)_2$ ($O.C_4H_7O$)	246	684.2	...	684.2	$C_3H_5(O.C_4H_7O)_2$ ($O.C_4H_7O$)	274	614.2	...	...	...	...	...	...	0
3	Valeric . . .	$C_3H_5(O.C_5H_9O)_2$ ($O.C_5H_9O$)	260	647.3	...	...	$C_3H_5(O.C_5H_9O)_2$ ($O.C_5H_9O$)	302	557.3	...	...	...	...	...	...	0
4	Caproic . . .	$C_3H_5(O.C_6H_{11}O)_2$ ($O.C_6H_{11}O$)	274	614.2	...	...	$C_3H_5(O.C_6H_{11}O)_2$ ($O.C_6H_{11}O$)	330	510.0	...	...	...	...	...	...	0
5	Caprylic . . .	$C_3H_5(O.C_8H_{13}O)_2$ ($O.C_8H_{13}O$)	302	557.3	...	...	$C_3H_5(O.C_8H_{13}O)_2$ ($O.C_8H_{13}O$)	386	436.0	...	...	...	...	...	...	0
6	Capric . . .	$C_3H_5(O.C_{10}H_{15}O)_2$ ($O.C_{10}H_{15}O$)	330	510.0	...	...	$C_3H_5(O.C_{10}H_{15}O)_2$ ($O.C_{10}H_{15}O$)	442	380.8	...	...	...	...	...	...	0
7	Lauric . . .	$C_3H_5(O.C_{12}H_{23}O)_2$ ($O.C_{12}H_{23}O$)	358	470.1	...	...	$C_3H_5(O.C_{12}H_{23}O)_2$ ($O.C_{12}H_{23}O$)	498	338.0	...	...	...	...	...	...	0
8	Myristic . . .	$C_3H_5(O.C_{14}H_{27}O)_2$ ($O.C_{14}H_{27}O$)	386	436.0	59.06	290.7	$C_3H_5(O.C_{14}H_{27}O)_2$ ($O.C_{14}H_{27}O$)	554	303.8	82.30	101.3	...	...	...	...	0
9	Palmitic . . .	$C_3H_5(O.C_{16}H_{31}O)_2$ ($O.C_{16}H_{31}O$)	414	406.6	61.83	271.0	$C_3H_5(O.C_{16}H_{31}O)_2$ ($O.C_{16}H_{31}O$)	610	276.0	83.92	91.99	...	...	...	...	0
10	Stearic . . .	$C_3H_5(O.C_{18}H_{35}O)_2$ ($O.C_{18}H_{35}O$)	442	380.8	64.26	259.9	$C_3H_5(O.C_{18}H_{35}O)_2$ ($O.C_{18}H_{35}O$)	666	252.7	85.28	84.24	...	...	...	...	0
11	Oleic . . .	$C_3H_5(O.C_{18}H_{33}O)_2$ ($O.C_{18}H_{33}O$)	440	382.4	64.07	255.0	$C_3H_5(O.C_{18}H_{33}O)_2$ ($O.C_{18}H_{33}O$)	662	254.3	85.18	84.74	...	...	...	...	0
12	Linolic . . .	$C_3H_5(O.C_{18}H_{31}O)_2$ ($O.C_{18}H_{31}O$)	438	384.3	63.93	256.2	$C_3H_5(O.C_{18}H_{31}O)_2$ ($O.C_{18}H_{31}O$)	658	255.8	85.12	85.28	...	...	...	...	0
13	Linolenic . . .	$C_3H_5(O.C_{18}H_{29}O)_2$ ($O.C_{18}H_{29}O$)	436	386.0	63.76	257.3	$C_3H_5(O.C_{18}H_{29}O)_2$ ($O.C_{18}H_{29}O$)	654	257.4	85.00	85.78	...	...	...	...	0
14	Ricinoleic . . .	$C_3H_5[O.C_{18}H_{33}O(O.C_2H_3O)]_2$	498	450.0	59.84	338.0	$C_3H_5[O.C_{18}H_{33}O(O.C_2H_3O)]_2$	778	360.6	76.60	216.3	$C_3H_5[O.C_{18}H_{32}O(O.C_2H_3O)]_3$	1058	318.2	84.49	159.1
15	Erucic . . .	$C_3H_5(O.C_{22}H_{41}O)_2$ ($O.C_{22}H_{41}O$)	496	339.3	68.14	226.2	$C_3H_5(O.C_{22}H_{41}O)_2$ ($O.C_{22}H_{41}O$)	774	217.5	87.34	72.5	...	...	...	...	0
16	Cerotic . . .	$C_3H_5(O.C_{26}H_{51}O)_2$ ($O.C_{26}H_{51}O$)	554	303.8	71.49	202.5	$C_3H_5(O.C_{26}H_{51}O)_2$ ($O.C_{26}H_{51}O$)	890	189.1	88.80	63.05	...	...	...	...	0
17	Hydroxystearic . . .	$C_3H_5[O.C_{18}H_{34}O(O.C_2H_3O)]_2$	500	448.7	60.0	336.7	$C_3H_5[O.C_{18}H_{34}O(O.C_2H_3O)]_2$	782	358.7	76.72	215.3	$C_3H_5[O.C_{18}H_{34}O(O.C_2H_3O)]_3$	1064	316.3	84.56	158.1
18	Dihydroxystearic . . .	$C_3H_5[O.C_{18}H_{33}O(O.C_2H_3O)]_2$	558	502.8	56.64	402.2	$C_3H_5[O.C_{18}H_{33}O(O.C_2H_3O)]_2$	898	43.73	70.37	312.4	$C_3H_5[O.C_{18}H_{33}O(O.C_2H_3O)]_3$	1238	407.8	76.67	271.9
19	Trihydroxystearic . . .	$C_3H_5[O.C_{18}H_{32}O(O.C_2H_3O)_3]$	616	546.4	53.89	455.4	$C_3H_5[O.C_{18}H_{32}O(O.C_2H_3O)_3]$	1014	498.0	65.48	387.4	$C_3H_5[O.C_{18}H_{32}O(O.C_2H_3O)_3]$	1412	476.8	70.54	357.6
20	Sativic . . .	$C_3H_5[O.C_{18}H_{31}O(O.C_2H_3O)_4]$	674	582.7	51.63	499.3	$C_3H_5[O.C_{18}H_{31}O(O.C_2H_3O)_4]$	1130	546.1	61.59	446.8	$C_3H_5[O.C_{18}H_{31}O(O.C_2H_3O)_4]$	1586	530.5	65.81	424.3
21	Linusic . . .	$C_3H_5[O.C_{18}H_{29}O(O.C_2H_3O)_6]$	790	639.2	48.11	56.82	$C_3H_5[O.C_{18}H_{29}O(O.C_2H_3O)_6]$	1362	611.0	55.81	535.5	$C_3H_5[O.C_{18}H_{29}O(O.C_2H_3O)_6]$	1934	609.2	58.94	522.1
22	$C_{17}H_{34}O_2$. . .	$C_3H_5[O.C_{17}H_{33}O]_2$	428	393.3	63.10	26.22	$C_3H_5[O.C_{17}H_{33}O]_2$	638	263.8	84.66	87.95	...	...	...	...	0
23	Acid Mol. W. 275	...	433	388.6	63.5	259.1	...	648	259.7	84.80	86.5	...	...	...	...	0

TABLE No. 14.—*Acetyl Values of Alcohols.*

Alcohol.	Acetate of Alcohol.			Acetyl Value.
	Formula.	Molecular Weight.	Saponification Value.	
Cetyl alcohol .	$C_{16}H_{33}O.C_2H_3O$	284	197.6	197.6
Ceryl alcohol .	$C_{26}H_{53}O.C_2H_3O$	424	132.3	132.3
Myricyl alcohol	$C_{30}H_{61}O.C_2H_3O$	480	116.9	116.9
Glycerol .	$C_3H_5(O.C_2H_3O)_3$	218	772.0	772.0
Cholesterol .	$C_{26}H_{43}O.C_2H_3O$	414	135.5	135.5

TABLE No. 15.—*Acid Values of Fatty Acids.*

Acid.	Formula.	Molecular Weight.	Acid Value.
Acetic . . .	$C_2H_4O_2$	60	935.0
Butyric . . .	$C_4H_8O_2$	88	637.5
Caproic . . .	$C_6H_{12}O_2$	116	483.6
Caprylic . . .	$C_8H_{16}O_2$	144	389.6
Capric . . .	$C_{10}H_{20}O_2$	172	326.2
Lauric . . .	$C_{12}H_{24}O_2$	200	280.5
Myristic . . .	$C_{14}H_{28}O_2$	228	246.1
Palmitic . . .	$C_{16}H_{32}O_2$	256	219.1
Stearic . . .	$C_{18}H_{36}O_2$	284	197.5
Oleic . . .	$C_{18}H_{34}O_2$	282	198.9
Linolic . . .	$C_{18}H_{32}O_2$	280	200.4
Linolenic . . .	$C_{18}H_{30}O_2$	278	198.2
Ricinoleic . . .	$C_{18}H_{34}O_3$	298	188.3
Arachidic . . .	$C_{20}H_{40}O_2$	312	179.8
Erucic . . .	$C_{22}H_{42}O_2$	338	166.0
Cerotic . . .	$C_{26}H_{52}O_2$	396	141.7
Hydroxystearic .	$C_{18}H_{36}O_3$	300	187.0
Dihydroxystearic	$C_{18}H_{36}O_4$	316	177.6
Trihydroxystearic	$C_{18}H_{36}O_5$	332	169.0
Sativic . . .	$C_{18}H_{36}O_8$	348	161.2
Linusic . . .	$C_{18}H_{36}O_8$	380	147.6

TABLE No. 16

Conversion of Acid Value into Oleic Acid

Acid Value.	Oleic Acid. Per cent.
1	0.5027
2	1.0054
3	1.5081
4	2.0108
5	2.5135
6	3.0162
7	3.5189
8	4.0216
9	4.5243

TABLE No. 17

Some Unsaponifiable Substances and their Constants

	Formula.	Melting Point. °C.	Iodine Absorp- tion.	Acetates.		Increase in Weight on Boiling with Acetic Anhydride.
				Saponi- fication Value.	Melting Point. °C.	Per cent.
Paraffin wax, Ceresine	...	38-82	3.9-4.0	...	...	0
Cetyl alcohol . . .	$C_{16}H_{34}O$	50	0	197.5	22-23	17.2
Octodecyl alcohol . .	$C_{18}H_{38}O$	59	0	180.0	31	15.5
Ceryl alcohol . . .	$C_{27}H_{56}O$	79	0	128.1	65	10.6
Myricyl alcohol . . .	$C_{30}H_{62}O$	85	0	116.7	70	9.6
Cholesterol . . .	$C_{28}H_{44}O$	148.5	68.3	135.5	92	11.3
Isocholesterol . . .	$C_{26}H_{44}O$	137-138	68.3	135.5	below 100	11.3
Phytosterol . . .	$C_{28}H_{44}O$	137-138	68.3	135.5	...	11.3
Mixed alcohols from sperm oil	?	25.5- 27.5	64.6- 65.8	161-190	...	...
Mixed alcohols from neutral wool fat	?	...	36	160.9	...	...
Mixed alcohols from crude wool fat	?	...	...	150.6	...	...
Mixed alcohols from beeswax	?	75-76	...	99-103	...	6.5-7.7
Mixed alcohols from carnaüba wax	?	85	...	123	...	10.21

TABLE No. 18.—*Elaidin Test*

Description of Mass.	Yielded by
(1) Solid, hard	Olive oil, Almond oil, Arachis oil, Lard oil, Sperm oil, (Neat's foot oil).
(2) Butter-like	Neat's foot oil, Arctic sperm oil, Mustard seed oil, (Arachis, Sperm, and Rape Oils).
(3) Pasty or buttery, separating from a fluid portion	Rape oil, Sesamé oil, Cotton seed oil, Sunflower oil, Niger seed oil, Cod liver oil, Seal oil, Whale oil, Porpoise oil.
(4) Liquid products	Linseed oil, Hemp seed oil, Walnut oil, Drying oils generally.

TABLE No. 19.—*Sulphur Chloride Test*

Oils and Fats treated with S_2Cl_2 ; 5 grms. of fat with 2 c.c. S_2Cl_2 ,
and 2 c.c. CS_2 (Lewkowitsch).

A. *Product completely soluble in Carbon Bisulphide*

Class of Oil.	Kind of Oil or Fat.	Mass thickens after Minutes.
Liquid waxes .	Sperm oil, No. 1	20
	Sperm oil, No. 2	45
	Arctic sperm oil, No. 1	45
	Arctic sperm oil, No. 2	55
	Arctic sperm oil, No. 3	30
Vegetable fats	Palm oil	Does not thicken.
	Palm nut oil	
	Cocoa nut oil	
	Mowrah seed oil	
Animal fats .	Beef tallow	
	Mutton tallow .	
	Lard	
	Butter fat	

B. *Product not completely soluble in Carbon Bisulphide*

Class of Oil.	Kind of Oil.	Solidifies after Minutes.		Soluble in CS ₂ .
		In the Cold.	On the Water-bath.	
				Per cent.
Drying oils	Linseed oil	10	2	14.4
	Hemp seed oil	11	...	9.2
	Poppy seed oil	21	...	10.6
Fish oils	Japan fish oil	9	...	12.4
Liver oils	Cod liver, fresh	15	...	4.4
	Cod liver, rancid	1 $\frac{1}{2}$	...	6.4
Blubber oils	Seal oil	11	...	4.4
	Whale oil	13	...	3.0
	Cotton seed oil	20	4	24.0
Semi-drying oils	Sesamé oil	21	...	18.4
	Colza oil	23	...	2.8
	Rape oil	12	2	4.2
	Croton oil	18	...	25.4
	Castor oil	1 $\frac{1}{2}$	at once	3.8
Non-drying oils	Peach oil	26	...	4.8
	Almond oil, sweet	27	...	4.0
	Almond oil, bitter	28	...	3.4
	Arachis oil	30	...	6.0
	Olive oil	22	4	4.2
	Sheep's foot oil	36	...	6.0
	Horses' foot oil	20	...	13.6
	Neat's foot oil	23	...	9.4
	Lard oil	10	...	15.0
	Tallow oil	12	...	29.8

TABLE NO. 20.—*Oxygen Absorption by Livache's Test*

Kind of Oil.	Gain in Weight of 100 parts		
	Of Oil after		Of Fatty Acids after
	Two days.	Seven days.	Eight days.
Linseed oil . . .	14.3	...	11.0
Stillingia oil . . .	8.72	12.45 (8 days)	
Walnut oil . . .	7.9	...	6.0
Poppy seed oil . . .	6.8	...	3.7
Cotton seed oil . . .	5.9	...	0.8
Beechnut oil . . .	4.3	...	2.6
Colza oil . . .	0.0	2.9	2.6
Rape oil . . .	0.0	2.9	0.9
Sesamé oil . . .	0.0	2.4	2.0
Arachis oil . . .	0.0	1.8	1.3
Olive oil . . .	0.0	1.7	0.7

TABLE NO. 21

Oxygen Absorption by Bishop's Test

(Oils mixed with 2 per cent Manganese Resinate and spread over precipitated silica)¹

Oils.	Specific Gravity.	Absorption of Oxygen in Per Cent. "Degrees of Oxidation."	Mean Values.
Linseed oil, French	0·9327	17·70-16·40	17·05
" " La Plata	0·9304	15·45-15·00	15·20
Hemp seed oil	0·9287	14·55-14·30	14·40
Poppy seed oil, French	0·924	14·50-13·90	14·20
Walnut oil, French	0·924	13·70	13·70
Cotton seed oil	0·924	8·60	8·60
" " without stearine	0·923	9·60-9·30	9·45
Sesamé oil, Senegal	0·9215	8·95-8·50	8·70
" " Indian	0·921	7·40	7·40
Arachis oil, African	0·916	6·70	6·70
" " white	0·916	6·50	6·50
Colza oil, French	0·9142	6·40 (?)	6·40 (?)
" " Indian	0·9137	5·90-5·80 (?)	5·85 (?)
Olive oil	0·9155	5·30 (?)	5·30 (?)

¹ Cp. Oxidised Oils, Part II.

TABLE No. 22
Hydroxylated Acids obtained on oxidising unsaturated Fatty Acids

Acid.	Formula.	Melting Point °C.	Solubility of the													
			Acids in		Barium Salts in											
					Water.											
											Ether.					
Water.		Alcohol.		Cold. Hot.		Cold. Hot.										
Cold.	Hot.	Cold.	Hot.	Cold.	Hot.	Cold.	Hot.									
Dihydroxystearic .	$C_{18}H_{34}O_2(OH)_2$	137	Insoluble	Insoluble	Sparingly soluble	Soluble	Sparingly soluble	Insoluble	Insoluble							
Sativic . . .	$C_{18}H_{32}O_2(OH)_4$	173	Insoluble	Sparingly soluble	Sparingly soluble	Soluble	Insoluble	Insoluble	Insoluble							
Linusic . . .	$C_{18}H_{30}O_2(OH)_6$	203-205	Sparingly soluble	Soluble	Sparingly soluble	Sparingly soluble	Insoluble	Sparingly soluble	Readily soluble							
Isolinusic . .	$C_{18}H_{30}O_2(OH)_6$	173-175	Sparingly soluble	Readily soluble	Soluble	Soluble	Insoluble	Sparingly soluble	Readily soluble							

TABLE No. 23—*Bromoderivatives of Unsaturated Fatty Acids*

Bromoderivative from	Name of Acid.	Formula.	Molecular Weight.	Melting Point.	Containing Bromine.	Solubility in						
						Per cent.	Alcohol.	Ether.	Chloroform.	Petroleum Ether.	Benzene.	Glacial Acetic Acid.
Oleic acid	Dibromostearic	$C_{18}H_{34}O_2Br_2$	442	Oil	36·18	Readily soluble	Readily soluble	Readily soluble	Readily soluble	Readily soluble	Readily soluble	
Elaidic acid	Oleic dibromide	$C_{18}H_{34}O_2Br_2$	442	27	36·18	Readily soluble	Readily soluble	Readily soluble	Readily soluble	Readily soluble	Readily soluble	
Linolic acid	Dibromoeleaidic	$C_{18}H_{32}O_2Br_2$	600	113-114	53·33	Easily soluble	Easily soluble	Easily soluble	Easily soluble	Easily soluble	Easily soluble	
Tariric acid	Tetrabromostearic	$C_{18}H_{32}O_2Br_4$	600	125	53·33	Easily soluble	Easily soluble	Easily soluble	Easily soluble	Easily soluble	Easily soluble	
Telfairic acid	Linolic tetra- bromide	$C_{18}H_{32}O_2Br_4$	600	57-58	53·33	Easily soluble	Easily soluble	Easily soluble	Easily soluble	Easily soluble	Easily soluble	
Linolenic acid	Hexabromostearic	$C_{18}H_{30}O_2Br_6$	758	177	63·32	Very sparingly soluble	Very sparingly soluble	Very sparingly soluble	Very sparingly soluble	Very sparingly soluble	Very sparingly soluble	
Therapic acid	Linolenic hexa- bromide	...	...	180-181	...	...	...	...	...	...	...	
Hydroxy acid in Quincea oil	(Octobromo-hepta- decylic acid ?)	$C_{17}H_{28}O_2Br_9$	902	...	70-95	Almost insoluble	Almost insoluble	Almost insoluble	Almost insoluble	Almost insoluble	Almost insoluble	
Ricinoleic .	Therapic octobro- mide	$C_{18}H_{34}O_3Br_2$ $C_{18}H_{34}O_3Br_2$	458 458	108 Oil	34·91 34·91	...	...	...	...	...	...	
Ricinelaïdic	Dibromoricinoleic Ricinelaidic di- bromide	$C_{18}H_{34}O_3Br_2$	458	Oil	34·91	...	...	...	...	...	...	

PART II

FATS, OILS, AND WAXES, AND THE COMMERCIAL
PRODUCTS DERIVED THEREFROM

A. FATS, OILS, WAXES, AND THEIR CONSTANTS AND VARIABLES

THE Tables No. 24 contain a list of all known fats, oils, and waxes arranged within the classifications given in Part I. A, according to the magnitude of their iodine values. It may, however, be pointed out that it has not been considered advisable to slavishly follow this principle, and such oils and fats as are undoubtedly related to one another have, therefore, been placed together regardless of the iodine numbers.

The figures given comprise the constants of fats and oils on the one hand, and of the mixed fatty acids on the other. Between the two are placed numbers obtained for the variables.

In the case of waxes there have further been added constants for the alcohols (+ unsaponifiable) contained in the waxes.

In many instances the limits between which the experimental numbers lie have been given; in others I had to decide on the mean figures or on the most probable ones.

TABLE NO. 24 A.—

DRESSING OILS.				CON-					
Name of Oil.	Source.	Native Country.	Yield from Seed or Fruit.	Specific Gravity.		Solidifying Point.	Melting Point.	In-soluble Fatty Acids + Un-saponifiable (Hehner Value).	Reichert (R.) or Reichert-Meissl (R.M.) Value.
			Per cent.	C.		°C.	°C.	Per cent.	c.c. to norm. KOH.
1 Linseed . .	Linum usitatissimum	The East	38-40	15	0.9315-0.9345	- 27	- 20	95.5	...
2 Tung oil, Chinese (Japanese) wood oil	Aleurites cordata (Elaeococca vernicia)	China and Japan	40-41	15	0.9360-0.9432	below - 17	...	96.2	...
3 Lallemantia .	Lallemantia iberica	Caucasus, Russia	29-30	20	0.9336	- 35	...	93.3	1.55 (R.)
4 Candle nut	Aleurites moluccana	South Sea Islands	62-64	15.5	0.9256	...	liquidate - 18	95.5	...
5 Stillingia . .	Stillingia sebifera	China	19	15	0.9432	...	...	94.4	0.93 (R.M.)
6 Cedar nut . .	Pinus cembra	Alps, Siberia	...	15	0.930	...	...	92.6	...
7 Garden rocket	Hesperis matronalis	Southern Europe	28-30	15	0.9335	- 22 to - 23	...	...	...
8 Hemp seed	Cannabis sativa	Asia	30-35	15	0.9255-0.9280	- 27	...	...	...
9 Walnut, Nut.	Juglans regia	Persia, Himalaya	63-65	15.0	0.9250-0.9260	27.5	...	95.4	...
10 Safflower . .	Carthamus tinctorius	Egypt, India	30-32	15.5	0.9251-0.9280	...	...	95.37	1.54 (R.M.)
11 Poppy seed	Papaver somniferum	Asia Minor	41-50	15.0	0.9240-0.9270	- 18	...	95.2	0.0
12 Henbane . .	Hyoscyamus niger	Europe	35-37	15	0.939	...	...	94.7	0.99 (R.)
13 Amora . .	Amora rohituka	India	...	15.5	0.9386	...	...	93.23	1.64 (R.M.)
14 Niger seed	Guizotia oleifera	Abyssinia, India	40-45	15.5	0.9248-0.9270	- 9	...	94.1	0.11-0.63 (R.M.)
15 Sunflower	Helianthus annuus	Mexico, Peru	21-22	15.0	0.9240-0.9258	- 18.5	...	95.0	...
16 Celosia . .	Celosia cristata	East India, China	...	...	...	10° C.	...	...	...
17 Argemone .	Argemone mexicana	East and West Indies	...	15.5	0.9247-0.9259	...	...	95.07	...
18 Fir seed . .	Pinus sylvestris	Europe	32	15	0.9312	- 27 to - 30	...	...	...
19 Fir seed . .	Pinus Picea	Europe	32-33	15	0.9215-0.9250	- 18 to - 20	...	...	...
20 Madia . .	Madia sativa	Chili	32-33	15	0.9235	- 12 to - 15	...	...	...
21 Indian laurel	Laurus indica	...	...	15	0.926	below - 15	...	...	...
22 Tobacco seed	Nicotiana tabacum	America	38-40	15	0.9232	- 25	...	...	...
23 Weld seed	Reseda luteola	Europe	30-32	15	0.9058	- 20	...	...	...
24 Isano (Ungueko)	...	French Congo	60	23	0.973	below - 15	...	...	...
25 Mohamba . .	...	French Congo	12	...	0.915	below - 15	...	...	...

Vegetable Oils

[illegible]

SEMI-DRYING OILS.				CON-					
Name of Oil.	Source.	Native Country.	Yield from Seed or Fruit.	Specific Gravity.		Solidifying Point.	Melting Point.	In-soluble Fatty Acids + Un-saponifiable (Helmer Value).	Reichert (R.) or Reichert-Meisst (R.M.) Value.
			Per cent.	°C.		°C.	°C.	Per cent.	c.c. to norm. KOH.
1 Cameline (German Sesamé)	Camelinasativa	Europe	31-34	15	0.9200-0.9260	-18	...	...	...
2 Soja bean . . .	Soja hispida	China and Japan	...	15	0.9242-0.9270	-8	...	95.5	...
3 Pumpkin seed	Cucurbita pepo	The East	20-25	15	0.9237	-15.5	...	96.2	...
4 Maize-Corn . .	Zea Mays	America	6-10	15.5	0.9213-0.9255	-10 to -20	...	93.96	4.5 (R. M.)
5 Kapok . . .	Bombax pentandrum, or Eriodendron anfractuosum	E. and W. Indies	30-32	18	0.9199	...	...	94.9	...
6 Wheat . . .	Triticum vulgare	West Asia	12-5	15	0.9245-0.9292	...	...	...	...
7 Basswood . . .	Tilia americana	...	...	15	0.938	-10	...	...	...
8 Cotton seed . .	Gossypium herbaceum	Asia, Africa, America	24-26	15	0.9220-0.9250	...	3-4	95.96	...
9 Sesamé . . .	Sesamum orientale, and Sesamum indicum	India, Levant, Egypt, Antilles, etc.	50-57	15	0.9230-0.9237	-5	...	95.7	1.2 (R. M.)
10 Luffa seed . .	Luffa aegyptica	East India	...	15.5	0.9254	...	...	91.8	1.43 (R. M.)
11 Beech nut . . .	Fagus sylvatica	Europe	43-45	15	0.9200-0.9225	-17	...	95.2	...
12 Brazil nut . .	Bertholletia excelsa	S. America	66-67	15	0.9180-0.9185	0-4	...	...	...
13 Curcas, purging nut	Jatropha Curcas	W. Indies, S. America	55-57	15.5	0.9204	-8	...	95.3	0.5 (R. M.)
14 Garden cress .	Lepidium sativum	Europe	23-25	15.5	0.9200-0.9221	-15	...	95.6	0.44 (R. M.)
15 Ravison . . .	Wild Brassica campestris	Southern Russia	33-40	15.5	0.9183-0.9217	-8	...	...	...
16 Hedge-mustard	Raphanus Raphanistrum	Europe	35-40	15	0.9175	-8	...	...	...
17 Rape (Colza) .	Brassica campestris	Europe	33-43	15.5	0.9132-0.9168	-2 to -10	...	95.1	0.3
18 Black mustard	Sinapis nigra	Europe	31-33	15	0.916-0.920	-17	...	95.1	...
19 White mustard	Sinapis alba	Europe	25-26	15.5	0.914-0.916	-8 to -16	...	96.2	...
20 Radish seed . .	Raphanus sativus	China	45-50	15	0.9175	-10 to -17.5	...	95.9	0.33 (R. M.)
21 Jamba . . .	Brassica campestris, var. ?	...	24	15	0.9154	-10 to -12	...	...	...
22 Croton . . .	Croton Tiglium	East India	53-56	15	0.9500	-16	...	89.0	12.13.6 (R. M.)
23 Grape seed . .	Vitis vinifera	Asia	10-20	15	0.935	-10 to -13	...	92.13	0.46 (R. M.)
24 Castor . . .	Ricinus communis	East Indies	46-53	15.5	0.9600-0.9679	-10 to -18	...	...	1.4
25 Small Fennel	Nigella sativa	...	...	15.5	0.9248	...	...	88.8 ¹	5.4 ¹ (R. M.)

¹ The somewhat abnormal values are due

tinued—Vegetable Oils

STANTS.										VARIABLES.				CONSTANTS OF THE MIXED FATTY ACIDS.												
Saponi- fication Value.	Iodine Value.	Thermal Test.		Refractive Index.						Acetyl Value.	Acetyl Value.	Acid Value.	Uns- sat- Ma	Specific Gravity.	Solidifying Point.		Melting Point.	Satura- tion No.	Iodine Value.			Refractive Index.		Thermal Test.		
		Maumené.	Bromi- nation.	°C.	°C.	°C.	°C.	Degrees.	°C.						Degrees.	°C.			Degrees.	°C.	Degrees.	°C.	°C.	Titer, °C.	°C.	Mgms. KOH.
Mgms. KOH.	Per cent.	°C.	°C.	°C.	°C.	°C.	°C.	Degrees.	°C.	Degrees.	°C.	Degrees.	Mgms. KOH.	Per	°C.	°C.	Titer, °C.	°C.	Mgms. KOH.	Mixed Acids.	Liquid Acids.	°C.	°C.	Mm.c.	Bm.	
188	135-142	82-117	...	...	...	22	+32	...	...	...	...	...	...	...	...	14-13	...	18-20	...	136.8	165.4	...	...	...	...	1
192.7	121.7	60	...	...	...	...	...	...	...	...	...	...	4.5	0	...	...	24	...	28	...	119	...	...	...	...	2
188.4	123-130	...	...	...	...	...	...	25	70.2-72.5	...	...	...	...	...	...	24.5	...	28-29	197	...	...	...	...	...	...	3
188-193	113-125	81-86	21.5	...	...	...	...	...	...	...	...	...	7.5-8.75	1.7-20.6	1.35	6	16-11	...	18-20	198.4	119.5	140-144	...	...	...	4
181	116	95	...	...	...	...	...	...	...	...	...	...	...	...	...	0.9162	24-23	...	29	191	108	...	...	...	...	5
187-190	115.4	...	...	20	1.48325	...	...	...	71.5	...	...	...	11.2	4	...	...	29.7	...	39.5	...	123.3	...	...	...	...	6
178.1	111.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7
193-195	108-110	75-90	19.4	15	1.4743- 1.4752	22	+17 to +23	25	67.6-69.4	...	...	7.6-18	0.0	0.73-1.64	15.5	0.9206- 0.9219	32-35	32-35	35-38	202-208	111-115	147-151	60	1.4460	...	8
189-193	103-108	65.5	23-23.9	15	1.4748- 1.4762	22	+13 to +17	25	68	...	...	...	0.23- 66 (!)	0.95-1.32	...	...	23.5	22.9- 23.8	26-32	200.4	110.45	129-136	60	1.4461	...	9
187.8	108.51	...	...	...	...	...	...	40	62	...	...	...	28.8	...	...	...	...	...	...	...	...	...	...	...	...	10
191-196	104-111	64	...	...	...	22	16.5 to 18	...	...	...	...	...	...	...	...	...	17	...	23-24	...	114	...	...	...	...	11
192.4	106.2	51	...	...	...	...	...	...	...	...	...	...	...	...	...	...	32-25	...	29	...	108	...	...	...	...	12
193.2	98-110	65-66	...	25	1.4681- 1.4687	...	...	25	65 40 56.5 60.5	...	...	7.5	0.7-8.5	0.5-0.58	...	...	26.5- 25.7	28	27.5-30.5	...	105.1	...	...	...	...	13
178-183	109	92-95	...	...	...	...	...	40	...	...	...	...	4.18- 10.55	...	...	...	...	16-18	...	111.4	...	...	...	...	...	14
174-179	101-122	65-76	...	...	...	22	+18 to +25	20	73-74	...	...	...	4.8-12.0	1.45-1.66	100	0.8802	...	...	...	...	124.2	...	...	...	...	15
174	105	...	...	...	...	...	...	25	70.5 to 71.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16
170-179	94-102	55-64	17-20	15	1.4720- 1.4757	22	+16 to +20	25	68	...	...	14.7	1.4-13.2	0.58-1.0	100	0.8758	16	12-13	16-19	185.0	99-103	121-125	60	1.4991	...	17
174	96-110	43	...	...	...	...	...	40	59.5	...	...	...	1.36-7.35	...	...	...	15.5	...	16.0	...	109.6	...	...	...	...	18
170-174	92-97	14-49	...	...	...	...	...	40	58.5	...	...	...	5.4	...	...	...	...	15-16	...	95.3	...	...	...	...	...	19
173-178	93-96	51	...	...	...	...	...	40	57.5	...	...	...	14.5	...	...	...	15-13	...	20	...	97.1	...	...	...	...	20
172.3	95.4	52	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16-11	...	19-21	173.9	96.1	...	...	...	...	21
210-215	102-104	...	...	...	...	22	+35	27	77.5	...	...	19-32	...	0.5	...	...	16.7	19	...	201	111.5	...	...	...	...	22
178.5	96	53	...	...	...	...	...	...	...	...	...	...	16.2	...	...	...	20-18	...	24	187.4	99	...	...	...	...	23
183-186	83-86	46-47	15	15	1.4799	22	+39 to +42	25	78	146.7- 150	...	0.14- 14.61	...	15.5	0.9509	3	...	13	192.1	87-93	106.9	60	1.4546	...	...	24
196.4	116.2	...	...	...	...	...	...	40	58.5	...	...	...	97.4 (!)	...	...	...	...	...	...	...	...	...	...	...	...	25

to the high acidity of the sample examined.

TABLE NO. 24 A—con-

NON-DRYING OILS.				CON-					
Name of Oil.	Source.	Native Country.	Yield from Seed or Fruit.	Specific Gravity.		Solidifying Point.	Melting Point.	In-soluble Fatty Acids + Un-saponifiable (Hehner Value).	Reichert (R.) or Reichert-Meissl (R.M.) Value.
			Per cent.	°C.				Per cent.	c.c. of norm. KOH.
1 Quince . . .	Cydonia vulgaris	Asia	...	15	0.9220	...	...	95.2	0.5 (R. M.)
2 Cherry kernel	Prunus cerasus	Europe	35-36	15	0.9234	-19 to -20	...	...	...
3 Cherry laurel	Prunus lauro-cerasus	Caucasus	...	15	0.9230	-19 to -20	...	...	...
4 Apricot kernel	Prunus Armeniaca	Asia	40-45	15.5	0.9195	-14	...	95.4	0.0
5 Plum kernel	Prunus domestica	Europe	25-30	15	0.9160-0.9195	-5 to -6	...	...	...
6 Peach kernel	Prunus persica	Persia	32-35	15	0.918-0.9215	below -20	...	...	...
7 Wheat meal	Triticum vulgare	West Asia	...	100	0.9068	...	...	...	2.8 (R. M.)
8 Acorn . . .	Quercus agrifolia	...	...	15	0.9162	10	...	...	...
9 Almond . . .	Prunus amygdalus	Mediterranean	45-55	15	0.9175-0.9195	-10 to -20	...	96.2	...
10 Sanguinella (Dogwood)	Cornus guinea	Europe	17-20	15	0.9210	-15	...	...	...
11 Californian nutmeg	Tunion californicum	California	...	15	0.9072	...	...	...	...
12 Arachis . . .	Arachis hypogaea	W. Africa, India	43-45	15	0.9170-0.9209	-3 to 0	0	95.8	...
13 Rice . . .	Oryza sativa	East India	8-15	...	...	...	...	...	...
14 Tea seed (Chinese)	Camellia theifera	China	30-35	15	0.917-0.927	-5	...	...	...
15 Tea seed (Assam)	Camellia oleifera	China	43-45	15	0.9200	-12	...	91.5	...
16 Pistachio . . .	Pistacia vera, P. lentiscus	Southern Europe	...	15	0.9185	-8 to -10	...	...	...
17 Hazel nut . . .	Corylus avellana	Europe	50-60	15	0.9146-0.9170	-17	...	95.6	0.99 (R. M.)
18 Koëme . . .	Telfairia pedata	S. E. Africa	33	15	0.9180	+7	...	...	...
19 Birch seed . . .	Betula alba	...	...	...	...	...	...	...	...
20 Louc-Moucseed	...	...	...	...	...	...	...	...	...
21 Olive . . .	Olea europaea	Southern Europe	40-60	15	0.916-0.918	-6 to +2	...	95	0.3
22 Olive kernel	Olea europaea	Southern Europe	12-15	15	0.9184-0.9191	...	...	...	...
23 Coffee berry	Coffea arabica	E. Africa	...	15	0.9510-0.9525	6-3	...	...	1.7 (R. M.)
24 Ungnadia . . .	Ungnadia speciosa	Texas	46-50	15	0.9120	-12	...	94.12	...
25 Ben . . .	Moringa oleifera	Egypt, India	35-36	15	0.9120-0.9198	0	...	...	...
26 Strophantus seed	Strophantus hispidus	...	...	13	0.9254	...	...	95.3	0.5 (R. M.)
27 Tropaeolum	Tropaeolum majus	S. America	46-50	...	...	...	...	...	...
28 Paradise nut	Lecythis zabucaya	Brazil, Guyana	40-42	15	0.8950	4	...	...	...
29 Secale . . .	Secale cornutum	...	...	13	0.9254	...	...	96.3	...

tinued—Vegetable Oils

STANTS.										VARIABLES.			CONSTANTS OF THE MIXED FATTY ACIDS.												
Saponi- fication Value.	Iodine Value.	Thermal Test.		Refractive Index.						Acetyl Value.	Acid Value.	Unsaponi- fiable Matter.	Specific Gravity.		Solidifying Point.		Melting Point.	Satura- tion No.	Iodine Value.			Refractive Index.		Thermal Test.	
		Maumené.	Bromi- nation.			Oleo-refractometer.		Butyro- refractometer.																	
Mgrms. KOH.	Per cent.	°C.	°C.	°C.		°C.	Degrees.	°C.	Degrees.	Mgrms. KOH.	Per cent.	°C.		°C.	Titer. °C.	°C.	Mgrms. KOH.	Mixed Acids.	Liquid Acids.	°C.			Mmē.	Brm.	
181.8	113.0	...	...	...	1.4729	...	...	...	...	...	31.7	...	...	...	...	...	...	...	...	...	...	...	...	...	1
193-195	110-114	45	...	...	...	...	...	...	...	...	...	...	...	15-13	...	19-21	189	109	124.7	...	...	...	...	2	
194	108.9	44.5	...	...	...	...	...	...	...	...	...	...	...	17-15	...	20-22	...	112.1	...	...	...	...	...	3	
192.5	96-108	42-46	...	...	...	...	...	25	66.6	...	0.64	...	...	0	...	3.4	194	103	111.5	...	...	...	...	4	
191.5	93.3-	44.7	...	...	...	...	...	...	...	...	0.55	...	...	15-13	...	20-22	200.5	103 (!)	98.6	...	...	...	...	5	
192.5	100.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3.5	...	...	...	...	...	...	...	6	
192.5	93-109	42.5	...	...	...	22	+7.5 to +11.5	25	66.1-67.2	...	...	...	...	...	13- 13.5	10-18	200.9	94-101	101.9	...	...	...	...	7	
166.5 (?)	101.5	...	...	25	1.4851	...	...	25	92	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	
199.3	100.7	60	...	...	1.4731	...	...	...	...	...	...	...	...	...	...	25	...	...	...	...	...	...	...	9	
191	93-97	52.5	17.6- 20	60	1.4555	22	+8 to +10.5	25	64.4	...	1.5	...	...	5	10.1- 11.8	13-14	204	93-96.5	101.7	60	1.4461	...	...	10	
192.1	100.8	52	...	...	...	...	...	...	...	...	...	...	...	31-29	...	34-37	195.1	102.8	...	...	...	...	...	11	
191.3	94.7	77	...	...	1.4766	...	...	...	...	...	...	...	...	...	...	19	...	...	...	...	...	...	...	12	
190-196	83-100	45-51	...	60	1.4545	22	+4 to +7	25	66-67.5	...	1.2-32 (!)	0.54-0.94	100	0.8790	26	29.2	201.6	96-103	105-128	60	1.4461	...	...	13	
193.2	96.4	...	...	...	...	...	...	...	...	...	62-154 (!)	...	...	...	...	...	...	...	...	...	...	...	...	14	
195.5	88	...	...	...	...	22	+8	...	...	...	...	...	...	...	...	...	...	...	99.6- 104.4	...	...	...	...	15	
194.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	
191.3	87.3	44.7	...	...	...	...	...	...	...	...	...	...	...	13.5	...	18-20	...	88.9	...	...	...	...	...	17	
192.0	83-90	36	...	...	...	...	...	...	...	3.2	...	0.5	...	19-20	...	22-24	200.6	90.3	91.3-97.6	...	...	...	...	18	
174.8 (!)	86.2	...	...	...	...	...	...	25	63-64	...	0.34	...	...	41	...	44	...	...	...	...	...	...	...	19	
211	83.6	...	...	...	...	...	...	...	...	...	...	...	...	12.5	...	...	...	...	...	...	...	...	...	20	
...	87.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21	
185-196	79-88	41.5-45	15	15	1.4698- 1.4716	22	0 to +3.5	25	62.4	10.64	1.9-50	0.46-1.0	100	0.8749	22-17	17.2- 26.4	24-27	193	86-90	95.5- 103.5	60	1.4410	...	22	
183	87.4	...	...	25	1.4682	...	...	...	...	...	2.3.5	...	...	...	...	...	...	...	...	...	...	...	...	23	
173-177	85-87	54	...	25	1.4777	...	...	25	79	...	4.52	...	...	36-34	...	38-40	175	89.5	...	...	...	...	...	24	
191.5	82.0	...	...	...	...	...	...	...	...	...	...	...	...	10	...	19	...	86.5	...	...	...	...	...	25	
...	82	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	26	
187.9	73.02	...	...	...	...	...	...	...	...	...	...	...	...	30-28	...	...	...	...	...	...	...	...	...	27	
...	73.7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	28	
173.6	71.64	...	...	...	...	...	...	15	61.4	...	...	...	...	28.5	...	37.6	...	72.3	...	...	...	...	...	29	
178.4	71.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	42-39.5	...	...	...	...	...	...	...	29	

MARINE ANIMAL OILS				CON-					
Name of Oil.	Source.	Native Country.	Specific Gravity.		Solidifying Point.	Melting Point.	In-soluble Fatty Acids + Unsaponifiable* (Hehner Value).	Reichert (R.) or Reichert-Meissl (R.M.) Value.	
			°C.						°C.
1 Menhaden . .	Alosa menhaden	West Coast of North America	15.5	0.927-0.933	- 4	...	...	1.2	
2 Sardine . . .	Clupea sardinus	Mediterranean	15	0.9330	...	...	94.5	...	
3 Japanese sardine (Japan fish)	Clupea sardinus (?)	Japan	15	0.9160	...	20 - 22	96.97	...	
4 Herring . . .	Clupea harengus	Northern Europe	15.5	0.9202-0.939	...	...	95.64	...	
5 Stickleback . .	Gasterosteus trachurus	Europe	...	...	...	...	95.78	...	
6 Sturgeon . . .	Accipenser sturio	Black Sea, Caspian Sea	15	0.9236	...	...	...	...	
7 Sprat	Clupea sprattus	North Sea, Baltic	15.5	0.9284	...	...	...	...	
8 Cod liver . . .	Gadus morrhua	Northern Atlantic	15	0.9210-0.9270	0 to - 10	...	95.3	...	
9 Haddock liver .	Merluccius æglefinus	North Sea	15	0.9298	...	...	93.3	...	
10 Skate liver . .	...	...	15	0.9307	...	...	94.74	...	
11 Tunny fish . .	Thynnus vulgaris	Mediterranean	...	...	...	...	95.79	...	
12 Shark liver (Arctic)	Scymnus borealis	Northern Atlantic	15	0.9163	...	...	86.9	...	
13 Coal fish liver .	Gadus merlangus (vireus)	North Sea, Baltic	15	0.925	...	...	...	...	
14 Hake liver . .	Merluccius communis	North Sea	15.5	0.9270	...	...	...	...	
15 Ray liver . . .	Raja clavata (batis)	Coasts of Europe	15.5	0.9280	...	...	...	...	
16 Ling liver . . .	Molva vulgaris	North Sea	15	0.9200	...	...	...	...	
17 Seal	Phoca vitulina	Greenland, White Sea	15	0.9155-0.9263	- 2 to - 3	...	95.45	0.07 to 0.22	
18 Whale	Balena mysticetus	Arctic Seas	15.5	0.9250	below - 2	...	93.5	0.7-2.04	
19 Dolphin (Black fish) body oil	Delphinus globiceps	Northern Seas	15	0.9180	below - 3	...	93.07	5.6	
20 Dolphin jaw oil .	Delphinus globiceps	...	...	...	...	...	66.28	65.92	
21 Porpoise body oil	Delphinus phocaena	North Atlantic	15	0.9258	- 16	...	...	23.5	
22 Porpoise jaw oil	Delphinus phocaena	"	15	0.9258	...	...	70.23	47.77 to 65.8	
23 Cramp fish . . .	...	America	15	0.909	...	...	...	...	
24 Sunfish oil . .	...	America	15	0.901	...	...	...	...	
TERRESTRIAL ANIMAL OILS									
25 Sheep's foot . .	Ovis aries	...	15	0.9175	0 to 15	...	...	...	
26 Horses' foot . .	Equus caballus	...	15	0.913-0.927	...	...	...	...	
27 Egg	Gallus domesticus	...	15	0.9144	8 - 10	22.25	95.16	0.40-0.7 (R.M.)	
28 Neat's foot . .	Bos taurus	...	15	0.914-0.916	0.1.5	...	...	...	

B. COMMERCIAL PRODUCTS OF THE FATS AND OILS INDUSTRIES .

1. LUBRICANTS .

TABLE NO. 25 A

Viscosities of some Oils and Fats

Kind of Oil.	Number of Seconds in Redwood's Vis- cosimeter, 50 c.c. of water at 70° F. = 25.4 Seconds.	Kind of Oil.	Number of Seconds in Redwood's Vis- cosimeter, 50 c.c. of water at 70° F. = 25.4 Seconds.
Linseed	212	Garden cress	322
Tung oil	858-1433 (water 28 sec.)	Radish seed	385
Walnut	232	Arachis	307-429
Safflower	249-1-294	Olive	312
Poppy seed	254-259	Mahua	90-107
Amoora	376	Phulwara	110-4
Niger seed	263-293	Malabar Tallow	101-104
Argemone	269-272	Kokum butter	101
		Cocanut oil	64

TABLE NO. 25 B

50 c.c. of water at 60° F. requiring 25.5 seconds.

°F	Rape Oil. Refined.	Sperm Oil.	Neat's foot Oil	Beef Tallow.	American Mineral Oil			Russian Mineral Oil.		
					Sp. gr. 0.885.	Sp. gr. 0.913.	Sp. gr. 0.923.	Sp. gr. 0.909.	Sp. gr. 0.915.	Sp. gr. 0.884
50	712.5				145.0	425.0	1030.0	2010.0	2520.0	
60	540.0	177.0	170.0		105.0	295.5	680.0	1235.0	1980.0	
70	405.0	136.8	366.0		90.0	225.0	485.0	820.0	1320.0	
80	326.0	113.0	280.0		73.0	171.0	375.0	580.0	900.0	
90	260.0	96.0	219.25		63.5	136.0	262.0	426.0	610.0	
100	213.5	80.5	174.75		54.0	111.0	200.0	315.0	440.0	1015.0
110	169.0	70.5	147.1		50.0	89.5	153.0	226.0	335.0	739.5
120	147.0	60.5	126.0		47.0	78.0	126.0	174.0	245.0	531.0
130	123.5	57.0	112.0		44.75	63.5	101.0	135.5	185.0	398.5
140	105.5	50.75	88.4		41.0	58.0	82.0	116.0	145.0	317.5
150	95.5	49.0	75.5		37.5	52.0	70.5	95.0	115.0	250.0
160	85.0	47.5	70.0		...	46.0	63.5	83.5	93.5	200.0
170	76.0	46.0	62.0		...	...	58.0	70.5	77.5	161.0
180	69.0	44.5	56.5		...	...	52.5	61.5	67.5	134.5
190	64.5	43.0	53.0		...	...	47.0	56.5	61.0	115.5
200	58.5	42.0	50.4	54.75	...	...	42.0	48.5	54.0	99.25
210	54.0	40.75	48.5	...	...	...	40.0	...	...	85.0
220	50.0	39.0	47.0	...	...	...	38.0	...	...	77.0
230	47.25	36.75	45.8	...	...	...	...	...	...	70.5
240	45.5	35.75	44.6	...	...	...	...	...	...	64.5
250	43.25	34.75	44.0	40	...	...	...	...	...	59.25
260	...	33.75	43.5	...	...	...	...	...	...	54.0
270	...	32.75	43.0	...	...	...	...	...	...	48.5
280	...	31.85	41.5	...	...	...	...	...	...	46.5
290	...	30.75	41.0	...	...	...	...	...	...	44.25
300	...	30.0	38.0	...	...	...	...	...	...	42.4
310	...	...	35.0	...	...	...	...	...	...	...
320	...	...	33.8	...	...	...	...	...	...	...

TABLE No. 25 C

Kind of Oil.	Specific gravity at 15.5° C.	Number of Seconds required at		
		15.5° C.	50° C.	100° C.
Sperm oil	0.881	80	47	38
Seal oil (pale)	0.924	131 (?)	56 (?)	43 (?)
Northern whale oil	0.931	186	65	46
Menhaden oil	0.932	172	40	...
Sesamé oil	0.921	168	65	50
Arachis oil	0.922	180	64	...
Cotton seed oil (refined)	0.925	180	62	40
Niger seed oil	0.927	176	59	43
Olive oil	0.916	187	62	43
Rape oil	0.915	261	80	45
Castor oil	0.965	2420	330	60

TABLE No. 25 D

	Specific Gravity at 60° F.	Viscosity (Redwood's Viscosimeter)			Flash Point. Close Test.	Cold Test.	
		70° F.	120° F.	180° F.			
		Standard for Viscosity. Sperm Oil at 70° C. = 100					
<i>Refined Mineral Oils—</i>							
Scotch	0.890-0.895	100-130	40-50		320-350	32	
	0.885-0.890	75-100	35-40		300-325	32	
	0.875-0.880	50-60	25-30		300-325	32	
American	0.915-0.920	100-125	90-100	35-40	375-425	32	
	0.905-0.910	200-225	55-65		350-400	32	
	0.885-0.890	75-100	35-40		325-350	32	
	0.875-0.880	65-75	30-35		325-350	32	
Russian	0.910-0.915	1200-1500	200-250	50-70	100-125	25	
	0.905-0.912	700-800	125-150	45-50	350-375	25	
	0.895-0.900	220-250	60-65		325-350	15	
	0.895-0.900	125-175			300-325	10	
Standard for Viscosity. Tallow at 180° C. = 100.							
American summer, dark	0.890-0.895		250-300	70-75	400-425	40-50	
" medium	0.880-0.885	550-700	110-125	40-50	350-400	25-30	
" winter	0.880-0.885	350-400	90-100	35-40	325-375	25-30	
Russian residuum	0.910-0.915	750-1000	150-200	45-60	250-300	25-30	
<i>Natural and Filtered Mineral Oils—</i>							
American heavy dark	0.900-0.905		1750-2000	350-400	500-550	40-45	
" extra dark	0.900-0.905		2000-2500	400-450	525-575	35-40	
" medium dark	0.895-0.900		1200-1400	300-350	500-525	40-45	
" heavy filtered	0.890-0.895		1400-1500	300-350	500-550	60-70	
" medium filtered	0.890-0.895		1000-1200	250-300	500-525	65-70	
" light filtered	0.885-0.890		885-1000	200-250	450-500	75-80	
" fluid filtered	0.885-0.890		1200-1400	320-350	500-550	40-45	
" "	0.885-0.890		900-1000	225-275	450-500	45-50	
						No. of Samples	
						Flash Points. °F.	
Southern sperm oil	0.8807	100.1	45.4	457.5*	41.7	34	420-485
Arctic sperm oil	0.8804	105.3	47.2	446.2*	39.2	59	390-485
White whale oil	0.9207	187.7	71.3	476.0*	27.2	35	430-530
Neat's foot oil	0.9178	217	82.4	470.3*	34.4	17	410-540
Lard oil	0.9172	223.2	79.4	493.9*	39.6	18	425-545
Olive oil	0.9167	213.2	75.0	437.5*	27	24	410-465
Rape oil, East India, refined	0.916	250.4	88.1	478.6*	26.4	89	410-510
" Black Sea, refined	0.9209	226.9	78.8	465.4*	27	25	430-490
Cotton seed oil, refined	0.9235	190.4	69.8	523 *	30	22	500-540
Castor oil	0.963	2500	390	487 *	0		

* Mean Values.

TABLE No. 25 E

Kind of Oil or Fat.	Specific Gravity at 17.5° C.	Viscosity (Engler's Viscosimeter).			
		20° C.	50° C.	100° C.	150° C.
Rape oil, crude . . .	0.920	9.03	4.0	1.78	1.34
Rape oil, refined . . .	0.911	11.88	4.9	2.05	1.40
Olive oil	0.914	10.3	3.78	1.80	
Castor oil	0.963		16.46	3.01	
Linseed oil	0.930	6.36	3.2	1.76	
Tallow	0.951		5.19	2.50	1.73
Neat's foot oil	0.916	11.63	4.44	1.92	

TABLE No. 25 F

Oils.	Specific Gravity at 17.5° C.	Flash Point, °C.	Viscosity (Engler's Viscosimeter).	
			At 50° C.	At 100° C.
Russian cylinder oils . . .	0.911-0.923	183-238	10.2-16.2	2.0-2.8
„ machine oils	0.893-0.920	138-197	5.8-6.3	1.5-1.8
„ spindle oils	0.893-0.895	163-167	3.1-3.4	1.4-1.5
American cylinder oils . . .	0.886-0.899	280-283		4.1-4.8
„ machine oils	0.884-0.920	187-260	4.2	1.6
„ spindle oils	0.908-0.911	187-200	3.1-3.3	1.4-1.6
Rape oil, crude	0.920	265	4.0	1.7
„ „ refined	0.911	305	4.9	2.0
Olive oil	0.914	305	3.7	1.8
Castor oil	0.963	275	16.4	3.0
Linseed oil	0.930	285	3.2	1.7
Tallow	0.951	265	5.2	2.5

2. WOOL OILS—CLOTH OILS

TABLE No. 26—Analyses of Ordinary Wood Oils

Source or Name.	Flash Point.	Specific Gravity at 15.5°C	Free Fatty Acids.	Neutral Fat.	
				Unsapo- nifiable.	By Difference.
	F.	Per cent	Per cent	Per cent.	Per cent.
Distilled oleine from recovered grease				26.8	4.0
"	"	0.8894	77.21	35.9	8.8
"	"	0.9083	55.31	34.5	11.283
"	"		54.92		
"	"	0.9031	55.02	34.66	9.2
"	"	0.8980	56.26	29.46	11.95
"	"	0.9050	53.65	16.32	28.65
"	"	0.9000	59.83	38.92	
"	"	0.9091	64.42	9.95	25.63
"	"	0.941		41.7	
	Flash Point.	Moisture.	Sapo- nifiable.4	Unsapo- nifiable.	
	F.	Per cent	Per cent	Per cent.	
Brown oleine, compound oil of English distilled and foreign oil	396	0.77	86.28	12.95	..
Brown foreign oleine, Belgian	354	0.75	80.56	13.69	..
Brown "oleine cloth oil, "manufactured"	349	0.64	73.78	25.58	..
"Black oil," recovered after using foreign and English distilled oleine (flannel district, Lancashire)	367	1.27	69.08	29.65	..
"Brown grease" recovered after using Gallipoli oil	419	1.07	69.16	29.77	..
Distilled oleine from brown grease and once recovered olive oil	342	0.77	62.04	37.19	..
"Black oil" recovered after using oleine and better class "cloth oils" (half "seck," half waste)	369	1.11	69.39	38.50	..
Brown oleine, distilled from brown grease	338	0.69	46.96	52.35	..
"Black oil," recovered after using recovered and low cloth oils (from waste)	331	0.67	32.03	67.30	..
"Brown pulling oil" (for rags), brown grease and hydrocarbons	374	0.74	21.01	78.25	..

1 Calculated as oleic acid.

² Mean molecular weight 286.

³ Consisting of 7.02 per cent of fatty acids and 4.26 per cent of combined alcohols.

† By difference.

TABLE No. 27—*Analyses of Emulsion Wool Oils*

Name of Oil.	Na ₂ O, Per cent.	NH ₃ , Per cent.	Water, Per cent.	Fatty Matter, Per cent.	Fatty Acids, Per cent.	Neutral Fat, Per cent.	Unsaponifiable, Per cent.	Soda Soap Anhydrous, Per cent.	Gummy Substances, Per cent.	K ₂ CO ₃ , Glycerol.
"Patent oil" ...	0.91	0.32	84.45 76.67	16.16 20.86	...	8.7	6.9	0.91	0.72	
"Soluble Noline" (calculated)	...	...	34 56.18	...	70.0 45.0	7.0	...	1.5 8.1	...	4.55 14.05

TABLE No. 28—*Heat Test of Wool Oils (by Mackey's Cloth Oil Tester)*

No.	Oil Used.	Temp. in 1 hr.	Temp. in 1 hr. 15 m.	Temp. in 1 hr. 30 m.	Temp. in 2 hrs.	Maximum.
		C. = F.	C. = F.	C. = F.	C. = F.	C. = F.
1	Cotton seed	125 = 257	242 = 468	...	...	242 = 468
2	" "	121 = 250	242 = 468	252 = 540	...	242 = 468
3	" "	128 = 262	212 = 414	225 = 437	...	284 = 543
4	" "	124 = 255	210 = 410	...	...	225 = 437
5	" "	116 = 241	192 = 378	200 = 392	...	248 = 478
6	" "	118 = 244	191 = 376	202 = 396	...	200 = 392
7	" "	117 = 243	190 = 374	194 = 381	...	202 = 396
8	" "	112 = 234	177 = 351	204 = 399	...	194 = 381
9	Olive fatty acids	114 = 237	177 = 351	...	...	211 = 412
10	" "	105 = 221	165 = 329	...	...	196 = 385
11	" "	102 = 216	135 = 275	208 = 406	...	293 = 559
12	White Australian oleine	103 = 217	115 = 239	191 = 376	...	236 = 439
13	Olive	98 = 208	102 = 216	104 = 219	...	230 = 446
14	Oleine	98 = 208	101 = 214	102 = 216	...	241 = 466
15	9% oleine	98 = 208	100 = 212	102 = 216	...	110 = 230
16	Belgian oleine	98 = 208	99 = 210	100 = 212	...	172 = 342
17	Olive (neutral)	97 = 207	100 = 212	101 = 214	...	173 = 343
18	" "	97 = 207	100 = 212	101 = 214	...	235 = 455
19	" "	97 = 207	...	101 = 214	...	228 = 442
20	Cotton	139 = 282	...	...	...	235 = 455
21	Olive	99 = 210	101 = 214	102 = 216	103 = 217	200 = 392
22	Mixture of 50% of No. 20 and 50% of No. 21	102 = 216	117 = 243	...	...	113 = 235
23	" 25 " "	99 = 210	105 = 221	112 = 234	...	200 = 392
24	" 10 " "	99 = 210	102 = 216	105 = 221	127 = 261	200 = 392

3. SOD OILS—DÉGRAS

TABLE NO. 29
Analyses of some Oils and the Sod Oils made therefrom

Name of Oil.	Specific Gravity.		Refractive Index.		Fatty Acids Insoluble in Petroleum Ether.		Acid Value.		Saponification Value.		Iodine Value.	
	Original Oil.	Dégrad.	Original Oil.	Dégrad.	Original Oil.	Dégrad.	Original Oil.	Dégrad.	Original Oil.	Dégrad.	Original Oil.	Dégrad.
Shark liver oil . . .	0.9158	0.9212	1.4735	1.4752	0.91	1.70	7.0	8.4	157.2	143.2	90	82.4
Seal oil . . .	0.9258	0.9465	1.4760	1.4790	2.70	14.41	6.1	26.1	193.8	190.5	96.5	68.4
Mixed fatty acids from seal oil . . .	0.9354	0.9473	...	...	3.0	15.51						
Cod liver oil . . .	0.9274	0.9836	1.4755	1.4780	0.87	19.40	13.6	28.3	187.9	183.4	14.8	100.5
Mixed fatty acids from cod liver oil . . .	0.9375	0.9612	...	...	1.21	18.44						
Whale oil . . .	0.9270	0.9423	1.4755	1.4758	3.44	6.19	10.6	10.6	190.4	181.5	85	71

TABLE No. 30

Analyses of some American Sod Oils

Sod oil.	Ash.	Moisture.	Oil, etc., Soluble in Petroleum Ether.	Soap, etc., Soluble in Alcohol.	Hide Fragments.	Ash Insoluble in Petroleum Ether and Alcohol.	Total.	Degrass-Former.	Magns. KOH.	Free Fatty Acid.	Reichert-Meissl Value.	Iodine Value.		Unsaponifiable.	Iodine Value of Unsaponifiable.
												Per cent.	Per cent.		
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per 1 gram. of oil.	Per cent.	Ge. % norm. KOH.	Per cent.	Per cent.	Per cent.	Per cent.
1. Yellow	0.96	25.27	72.60	1.90	0.66	0.12	100.55	0.93	99.07	27.43	1.87	52.45	20.60		31.76
2. Brown	0.70	3.38	88.61	7.05	1.05	0.15	100.24	15.98	206.51	72.64	2.66	60.54	0.95		9.38
3. Brown	0.215	2.75	96.60	1.32	1.09	0.16	101.92	2.73	111.52	44.69	2.33	43.56	41.46		16.89
4. Yellow	0.05	19.48	...	...	...	...	...	...	108.75	26.13	2.24	55.02	18.95		22.48
5. Brown	1.045	15.45	75.37	7.24	1.26	0.47	99.79	6.33	140.59	73.18	2.41	46.69	14.90		20.80
6. Yellow	0.68	30.87	59.74	8.81	0.49	0.06	99.97	2.65	85.70	32.99	1.35	49.03	14.99		23.66
7. Brown	0.37	4.59	89.59	3.09	2.99	0.15	100.41	21.41	181.53	19.40	1.66	59.06	0.58		3.22
8. Brown	0.77	33.46	58.81	5.40	2.24	0.35	100.26	17.73	135.83	17.96	3.72	44.17	2.80		52.07
9. Brown	0.55	1.01	95.69	2.44	0.79	0.13	100.06	13.91	186.53	34.00	2.58	77.53	0.37		71.58
10. Brown, thick	0.36	40.61	56.62	3.19	0.31	0.22	100.95	0.65	64.94	47.51	2.02	22.79	21.81		13.80
11. Brown, thin	0.28	3.94	94.38	2.57	0.15	0.16	101.20	2.74	101.48	39.63	2.33	47.19	29.85		25.19
12. Brown	0.46	23.70	73.36	0.68	1.29	0.15	99.18	8.41	109.94	20.32	3.37	41.01	6.32		20.95

TABLE NO. 31.—*Analyses of some Dégras*

	1	2	3	4	5	6	7
Water Per cent	18·90	14·84	12·93	28·90	19·20	5·39	8·90
Ash „	0·25	0·13	0·55	0·70	0·07	0·25	1·21
Hide fragments . . „	0·30	0·30	0·09	0·58	0·27	...	1·59
Oils „	69·71	74·65	80·00	66·93	75·66	84·87	72·15
Unsaponifiable . . „	6·84	6·05					
Resinous substance „	4·00	4·05	5·81	3·52	4·80	9·46	16·15

	Dégras-former.	Melting Point of Fatty Acids.	Soap.	Original Dégras.	
				Hide Fragments.	Water.
	Per cent.	°C.	Per cent.	Per cent.	Per cent.
French dégras, anhydrous, No. 1	19·14	18·0-28·5	0·73	0·07	16·5
„ „ „ 2	18·43	28·5-29·0	0·49	0·12	20·5
„ „ „ 3	18·10	31·0-31·5	0·68	0·18	12·0
Sod oil „ „ 1	20·57	33·5-34·0	3·95	5·7	35·0
„ „ „ 2	18·63	27·5-27·0	3·45	5·9	28·0
„ „ „ 3	17·84	28·0-28·5	3·00	4·5	30·5

TABLE No. 32.—*Analyses of Some Dégras*

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No. of Sample.	Water.	Iodine Value.			Acid Value.			Saponification Value.			Ether Value.		Constant Saponification Value.	Constant Ether Value (Difference between 13 and 14)
		Original Dégras.	Anhydrous Dégras.	Insoluble Fatty Acids.	Acetylated Fatty Acids.	Original Dégras.	Anhydrous Dégras.	Original Dégras.	Anhydrous Dégras.	Original Dégras (Difference between 7 and 9).	Anhydrous Dégras (Difference between 8 and 10).	Constant Acid Value.		
	Per cent.													
1	19.1	60.4	74.7	70.5	73.1	30.5	37.7	...	...	...	...	185.5	224.3	38.8
2	12.9	55.9	64.2	58.6	52.7	63.3	72.7	96.2	110.4	32.9	37.7	102.8	131.5	28.7
3	12.4	67.8	77.4	75.4	90.4	35.2	40.2	97.0	110.7	62.2	70.5	129.6	172.9	43.4
4	15.9	65.9	78.4	70.2	66.6	42.1	50.1	113.4	134.8	71.3	84.7	162.9	193.7	30.8
5	16.4	65.0	77.8	78.5	76.2	44.1	52.7	114.9	137.4	70.8	84.7	163.5	185.9	22.4
6	11.5	67.8	76.6	76.5	75.7	57.4	64.9	96.3	108.8	38.9	43.9	175.8	229.6	53.8
7	13.9	83.3	96.7	95.9	88.9	...	...	...	...	...	...	182.5	215.6	33.1
8	17.3	69.2	83.7	93.4	102.7	23.9	28.9	83.4	100.8	59.5	71.9	96.7	197.1	100.4
9	16.6	67.5	80.9	...	...	43.4	52.0	117.8	141.2	74.4	89.2	...	...	...
10	5.3	70.5	74.4	79.3	73.0	51.2	54.1	118.6	125.2	67.4	71.1	179.5	210.2	30.7
11	...	127.7	127.7	142.3	127.4	...	...	...	163.8	...	...	180.8	212.2	31.4
12	...	...	126.7	106.0	101.9	...	...	...	186.0	...	...	159.3	213.2	53.9
Mean of 1-10		...	78.5	77.6	77.7	...	50.4	...	121.2	...	70.8	153.2	195.6	42.4

TABLE No. 33.—*Analyses of Dégras and Similar Products*

No.		Water.	Ash.	Insoluble in Petroleum Ether.	Fatty Matter.	Unsaponifiable Matter.	Oxidised Acids (Dégras, former.)	Anhydrous Fat.		
								Acid Value.	Saponification Value.	Iodine Value.
1	Dégras	Per cent. 13·31	Per cent. 0·32	Per cent. 0·31	Per cent. 86·1	Per cent. 3·1	Per cent. 11·03	108·0	185·8	69·0
2	"	10·05	0·18	0·24	89·5	3·4	14·13	119·0	188·0	52·8
3	"	10·24	0·28	0·28	89·2	1·0	1·49	104·0	181·8	70·7
4	"	8·49	0·06	0·31	91·1	0·91	9·25	34·5	208·5	106·0
5	"	17·33	0·27	0·14	82·3	2·51	0·95	29·2	206·0	122·0
6	"	10·59	0·20	0·10	89·1	3·1	10·93	112·0	181·2	63·9
7	"	1·53	0·70	0·04	97·7	1·85	16·17	112·0	170·0	62·5
8	Moëllon, pure	18·45	0·07	0·09	81·4	2·04	11·65	25·7	215·5	89·1
9	"	19·88	0·03	0·46	79·63	0·45	1·46	47·4	214·0	115·0
10	Moëllon-dégras	11·65	0·63	0·98	86·74	3·27	2·01	17·4	196·7	126·0
11	Oxidised blubber oil	10·43	0·50	0·21	88·86	1·44	1·61	17·0	192·3	129·0
12	Oxidised emulsion fat	7·45	0·41	0·08	92·1	2·72	9·74	17·0	196·3	107·8
13	Dégras	13·88	0·14	0·22	86·8	40·6	4·06	35·0	99·8	52·9
14	"	14·16	0·58	0·97	84·3	18·9	3·73	32·4	137·4	80·6
15	"	25·46	0·07	1·25	73·22	14·29	5·99	33·0	206·4	101·8
16	"	18·79	0·05	0·31	80·44	23·61	5·33	31·0	135·4	72·3
17	Dégras-moëllon.	15·79	0·06	0·22	83·94	28·1	1·84	40·5	113·2	72·1
18	Dégras	7·59	0·26	0·38	91·8	33·12	3·39	39·7	93·0	49·9
19	" Mutton-dégras "	16·49	0·31	0·74	82·5	8·5	5·51	39·4	194·0	104·5
20	Dégras-moëllon	14·29	0·29	0·38	85·04	14·1	4·96	38·4	180·0	102·0
21	Dégras	20·37	0·08	0·45	79·1	40·3	2·95	24·0	86·0	49·5
22	"	30·29	0·25	0·22	69·24	2·23	6·55	54·6	201·0	90·0
23	Fat from sod oil	...	...	...	100·0	0·71	16·84	71·3	234·0	61·0

TABLE No. 34—Analyses of *Dégras*

No.	Specific Gravity at 18° C.	Water.		Ash.	Insoluble in Petroleum Ether.		Unsat. Saponifiable Matter.	Oxidised Acids (Dégras former).		Acid Value of		Saponification Value of		Iodine Value of	
		Per cent.	Per cent.		Per cent.	Per cent.		Original Sub. stance.	in Anhy-drous Sub. stance.	Original Sub. stance.	Anhy-drous Sub. stance.	Original Sub. stance.	Anhy-drous Sub. stance.	Original Sub. stance.	Anhy-drous Sub. stance.
1	Natural dégras from Chamoising	1.0025	31.13	1.83	5.07	0.47	2.36	18.03	26.38	35.75	51.75	155.0	221.0	35.7	52.3
2	" "	0.9993	39.60	1.79	5.18	0.20	1.26	14.09	23.41	25.08	41.72	144.0	239.0	34.0	56.4
3	Fish oil, used in dégras manufacture	0.9172	0.20	0.03	...	0.0	1.30	3.79	3.80	9.39	...	192.3	192.3	139.7	139.7
4	Commercial "dégras," German	0.9435	17.74	0.11	0.15	0.0	1.16	9.66	11.77	16.64	20.02	172.0	209.0	69.0	83.8
5	" " French.	0.9495	18.13	0.32	trace	0.0	19.61	2.03	2.48	22.49	27.46	131.2	160.0	64.4	78.9
6	" " French.	0.9445	17.35	0.49	trace	0.03	2.25	6.65	8.04	11.72	14.18	164.0	198.0	95.6	115.6
7	" " French.	0.9466	20.78	0.38	trace	0.04	1.88	9.44	11.92	11.55	19.62	160.0	193.0	53.8	65.3
8	" " German	0.9493	22.89	0.60	0.23	0.02	8.75	9.11	11.81	11.83	15.35	126.0	163.4	44.7	58.0
9	" " German	0.9493	21.33	0.55	0.30	0.06	15.77	4.30	5.47	11.49	14.61	105.0	129.0	39.6	50.4
10	" " French.	0.9498	21.40	0.10	0.12	0.02	30.56	5.40	6.87	19.29	24.54	95.0	120.9	45.4	57.7
11	" " Belgian	0.9506	22.70	0.08	0.32	0.04	22.26	6.18	7.99	18.77	24.28	92.5	119.2	46.1	59.6
12	" " Belgian	0.9516	10.89	0.31	0.86	0.02	17.59	4.90	5.50	12.63	14.27	136.0	152.6	50.2	50.7

4. OXIDISED OILS

a. BLOWN OILS

TABLE No. 35.—Some Constants and Variables of Blown Oils

I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.			XV.	XVI. = X. - (V. + XV.).		
No.	Oil.	Specific Gravity at 15.5° C. (Water 15.5 = 1).	Free Acid Calculated as Oleic.	Unsataponifiable Matter.	Saponification Value.	Reichert-Meissl Value.	Iodine Value.	Specific Temperature Reaction.	Insoluble Acids (Hehner Value).	Soluble Volatile Acids.	Soluble Non-Volatile Acids.	Iodine Value of In- soluble Acids.	Molecular Weight of			Oxidised Acids.	Non-volatile Fatty Acids freed from Oxidised Acids and Unsataponifiable Matter.		
			Per cent.	Per cent.					Per cent.	Per cent.						Per cent.	Per cent.	Molecular Weight.	Melting Point °C.
1	Rape	0.9141	5.10	0.65	173.9	...	100.5	135	94.76	0.52									
2	No. 1, blown 5 hours .	0.9275	5.01	...	183.0	...	88.4												
3	No. 1, blown 20 hours	0.9615	7.09	0.76	194.9	...	63.2	...	85.94	9.20	0.82	66.5	327.0	241	72				
4	Commercial blown rape oil	0.9674	4.88	...	267.5	8.8	65.3	...	88.64	...	...	...	294.1						
5	Sperm	0.8797	1.97	36.32	130.4	...	82.1												
6	No. 4, blown 25 hours	0.8989	3.27	34.65	142.3	...	67.1		82.40	11.16	9.00	70.2	317.0	...	76				
7	Commercial blown rape	0.9672	4.93	2.80	197.7	...	63.6	253	84.97	1.90	1.94	62.7	296.0	...	104				
8	Commercial blown cotton seed	0.9740 At 20° C. Water 20° = 1	3.38	1.00	213.2	...	56.4	227											
9	Commercial blown seal	0.9815	16.5	...	221.0	...	78.2	...	73.4										
10	Cotton seed Oxidised cotton seed obtained by ex- posure on chamois leather and ex- hausting with petroleum ether	...	1.1	1.05	190.4	...	108.8	...	94.22	...	...	...	...	...	...	0.27	92.9	278.1	35.36
11	After 8 days	...	6.69	1.13	223.1	...	55.4	...	85.34	...	...	...	...	...	...	20.62	63.59	276.2	45.46
12	After 12 days	...	6.94	1.33	227.5	...	46.3	...	83.62	...	...	...	...	...	...	19.13	63.16	273.2	46
13	Oil obtained by sub- sequent exhaustion with ether of the leather extracted with petroleum ether	...	16.79	0.72	271.3	...	29.1	...	74.20	...	...	...	...	...	...	37.72	35.76	269.1	51

TABLE No. 36.—*Analyses of some Oils and their Blown Oils (Lewkowitsch)*

	ORIGINAL OIL.				ACETYLATED OIL.					X.
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	
	Specific Gravity, at 15.5° C.	Saponification Value.	Total Volatile Fatty Acids per Gramme in terms of Milligrammes KOH.	Oxidized Acids. Per cent.	Saponification Value.	Hel. Value.	Apparent Acetyl Value.	True Acetyl Value.	VIII. $\times .55$.	Difference V.-II.
Linseed oil.	...	...	0.8	...	205.6	96.2	12.5	11.7	6.4	
Linseed oil, blown two hours at 120° C.	0.9334	189.8	1.68	1.2	200.9	94.4	18.9	17.22	9.47	11.1
Linseed oil, blown four hours at 120° C.	0.9403	191.3	3.0	1.7	203.9	91.6	22.5	19.5	10.72	12.6
Linseed oil, blown six hours at 120° C.	0.9446	192.4	8.3	5.03	208.2	93.2	25.5	17.2	9.46	15.8
Linseed oil, blown ten hours at 120° C.	0.9460	192.7	0.9	7.1	211.8	92.1	32.6	31.7	17.4	19.1
Cotton-seed oil.	...	...	0.1	...	200.2	95.7	7.7	7.6	4.18	
Cotton-seed oil, blown two hours at 120° C.	0.9262	194.3	2.88	0.51	203.9	94.8	14.2	11.32	6.23	9.6
Cotton-seed oil, blown four hours at 120° C.	0.9291	194.9	2.44	0.87	212.0	92.9	22.9	20.46	11.25	17.1
Cotton-seed oil, blown six hours at 120° C.	0.9350	196.1	4.60	0.94	215.2	91.9	30.0	25.4	13.97	19.1
Cotton-seed oil, blown ten hours at 120° C.	0.9346	196.8	4.16	1.28	218.4	91.4	35.0	30.84	16.96	21.6
Premier jus.	...	...	0.58	...	199.6	...	3.3	2.72	1.49	
Premier jus, blown four hours at 120° C.	...	202.3	...	0.70	211.6	92.6	18.8	...	...	
Oleic acid.	...	...	0.95	...	203.7	99.9	3.0	2.05	1.13	9.3
Oleic acid, blown two hours at 120° C.	0.9098	201.9	2.9	0.62	211.1	98.5	14.2	11.3	6.21	6.2
Oleic acid, blown four hours at 120° C.	0.9121	206.0	3.6	2.6	217.3	99.4	18.2	14.6	8.03	11.3
Oleic acid, blown six hours at 120° C.	0.9123	208.3	4.3	3.5	223.3	97.8	23.9	19.6	10.78	15.0
Oleic acid, blown ten hours at 120° C.	0.9238	213.4	2.9	6.0	227.5	97.5	22.3	19.4	10.67	14.1
Blown rape oil, commercial.	0.9714	205.6	8.9	24.95	...	...	62.04	53.14	29.22	
Blown cotton-seed oil, commercial.	0.9722	213.7	16.06	26.45	...	...	65.6	48.54	26.7	
Boiled oil, commercial, I.	...	188.7	1.6	6.5	207.4	91.5	25.6	24.0	13.2	18.7
Boiled oil, commercial, II.	...	186.1	1.1	4.63	199.7	92.8	18.0	16.9	9.29	13.6
Drying oil, prepared with ozone, I.	...	...	3.2	2.15	208.2	91.5	29.7	26.5	14.57	
Drying oil, prepared with ozone, II.	...	...	4.2	3.85	211.6	91.7	24.3	20.1	11.06	
Oxidised acids from solidified linseed oil	...	199.2	...	100.0	316.0	...	130.2	...	71.6	136.8

{ Acid value
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4. OXIDISED OILS

(b) BOILED OILS AND THEIR RAW MATERIALS

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TABLE
Oxygen Absorption by the
(Approximate

		Increase in							
		1½ Days.	2 Days.	2½ Days.	3 Days.	3½ Days.	4 Days.	4½ Days.	5 Days.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	Linseed oil, Indian	0.3-3.0	...	1.7-8.8	...	6.2-15.9	...	12.3- 17.2	...
2	„ artists' oil	1.3-1.8	...	...	...	2.7-14.3	...	5.6- 18.3	...
3	„ kept five years in well-corked bottle	2.2-2.7	...	10.5-?	...	19.7-19.9	...	De- crease	...
4	„ kept three years in not well-corked bottle	?-6.2	...	14.2- 15.3	...	15.1-15.7	...	De- crease	...
5	Tung oil, A	0.4	...	...	0.8-3.6	...	...	9.1-10.9	...
6	„ B	0.9-2.6	...	?-12.4	?-15.9	3.1-?	...	10.5-15.0	...
7	„ C	...	...	11.1- 10.6	...	...	...	12.9-14.8	...
8	„ D	...	...	10.6	...	...	...	14.8	...
9	Hemp seed oil	?-2.4	...	?-9.0	...	?-12.8	13.6-?	?-13.4	...
10	Poppy seed oil	1.3	...	3.2	...	5.1	...	8.3	...
11	Rape oil	4.9	...	5.3	...	...	...	...	...
12	„ blown	3.1	...	4.2	...	...	...	...	...
13	Peach kernel oil	...	2.5	...	2.5	...	...	4.3	...
14	Olive oil	...	0.8	...	...	...	1.7	...	...
15	Palm kernel oil	...	0.2	...	...	...	...	0.6	...

No. 37

Glass-Plate Method (Weger)
numbers only)

Weight after													
6 Days.	6½ Days.	8 Days.	9 Days.	11 Days.	13 Days.	15 Days.	17 Days.	20 Days.	26 Days.	29 Days.	42 Days.	54 Days.	
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	
16.8- 17.3	...	De- crease ?-18.7	Decrease										1
15.4- 16.7	...												2
													3
													4
12.2-?	...	13.4- 13.6	Decrease										5
12.9- 14.6	...	14.1-?	Decrease										6
De- crease													7
De- crease													8
De- crease													9
11.6	13.4	...	Decrease										10
...	7.6												11
...	4.9	...	...	...	6.6	7.7	...	...	...	...	8.0		12
4.6	...	6.2	...	6.8	7.1	7.1	...	7.4	8.6	10.5			13
1.7	...	...	...	3.1	3.6	...	4.2	5.2					14
...	...	...	0.6	...	0.8	...	1.8	...	...	...		1.2	15

		3 Hours.	5 Hours.	8½ Hours.	9 Hours.	12 Hours.	16 Hours.	1 Day.
1	Linseed oil, Indian, heated a short time to 150° C. . .	..	...	..	...	...	...	...
2	" " " blown in the cold 25 hours . . .	..	...	..	...	...	...	...
3	" " " blown in the cold 25 hours, then 25 hours at 150° C. . .	..	...	..	...	...	...	...
4	" " Artists', freed from mucilage, by rapid heating to 280° C. . .	..	...	..	...	...	...	...
5	" " " freed from mucilage, by rapid heating to 280° C., then heated to 360° C. for a short time . . .	..	...	..	...	...	...	...
6	" " heated to 250° C. by superheated steam . . .	..	...	..	...	...	...	...
7	" " fatty acids, filtered off from solid acids. . .	..	...	..	...	...	...	14.4
8	Boiled oil	..	...	..	...	...	...	9.0-4.8
9	" " prepared in the cold with 2 per cent. lead manganate resinate from linseed oil . . .	14.1	17.5	..	...	...	...	..
10	" " from same oil, freed from mucilage and treated with 2 per cent. as above . . .	15.3	17.4	..	...	...	...	..
11	" " from same oil, blown in the cold and treated with 2 per cent. as above . . .	12.8	16.7	..	...	...	...	17.1
12	" " from same oil, blown at 150° C. and treated as above . . .	14.5	16.5	..	...	...	...	16.5
13	" " from tanked oil, prepared in the cold with Mn resinate (0.1 per cent. in the boiled oil) . . .	..	..	..	2.3- 11.5	...	...	14.7- 16
14	" " same boiled oil, heated to 170-180° C. for a short time . . .	..	..	..	..	7.14.3	...	13.7- 15.4
15	" " prepared commercially with litharge . . .	2-3.2	..	2-12.9	..	14.6-?	...	14.6- 14.8
16	" " prepared commercially with manganic oxide hydrated (0.3 per cent. at 220° C.) . . .	2-0.9	..	2-1.3	..	0.8- 13.6	...	3.7- 14.7
17	" " by heating raw oil with 0.4 per cent. PbO to 200° C. . .	..	..	..	..	..	...	7.8
18	" " by heating raw oil with 3 per cent. red lead to 200° C. . .	..	..	..	..	...	...	12.1
19	" " "electric"	..	...	..	6.8-6.2	..	...	13.5- 13.4
20	" " "ozonised," prepared with PbMn resinate . . .	..	..	5	...	...	...	12.9
21	" " PbMn, English	..	...	...	15.2	...	...	14.8
22	" " double boiled	..	...	...	..	16.4	...	16.4
<i>Varnish Oils, prepared by dissolving in 3 parts of boiled oils (Mn)—</i>								
23	(a) 2 parts rosin "J" at 130° C.	...	...	...	...	1.7-?	11.2- 11.2	11.2
24	(b) " " heated previously 20 hours to 150° C.	...	...	...	...	11-?	13.1- 12.6	12.6
25	(c) " " hardened with 8 per cent. CaO, and dissolved at 170-180° C.	...	...	...	...	11.3-?	11.9- 15.6	11.9
26	(d) 2 parts Dammar resin at 170-180° C.	...	...	..	...	11-?	11- 11.7	11.7
27	(e) 2 parts Zanzibar copal at 170-180° C.	...	...	...	...	13.2-?	13.4- 13.2	13.4
28	(f) 2 parts Manila copal at 170-180° C.	...	...	...	...	...	12.0	12.0
<i>Rosin Oils—</i>								
29	A. Specific gravity 0.980 at 14° C.	...	...	...	...	...	...	-3.1 to -1.9
30	" Same oil after dissolving in it 6 per cent. PbMn resinate at 120° C.	...	...	...	...	...	...	8.5-3.4
31	B. Obtained from oil A after distilling off 30 per cent.	...	...	...	...	..	..	-1.8
32	" Oil B after dissolving in it 6 per cent. PbMn resinate at 120° C.	...	...	...	...	...	...	14.9

TABLE No. 43.—*Some Commercial Driers*

		Proportion of Metal.		Minimum temperature at which the compound forms "boiled" oil.	Remarks.
		Theory.	Means in commercial product.		
		Per cent.	Per cent.	°C.	
1	Manganese dioxide	63.2	55 (50-60)	abt. 250	Degree of fineness plays an important part.
2	Manganese oxide hydrated	62.5	15-50	170-200	
3	Manganese peroxide hydrated	52.4	15-50	better at 200-220	
4	Lead oxide (Litharge)	92.8	about 93		
5	Red lead (Minium)	91.2	about 91	in the cold.	Melt in water of crystallisation; used best as anhydrous salts.
6	Manganese borate	..	15 (5-22)		
7	Manganese acetate, cryst.	22.5	about 22		
8	Sugar of lead, cryst.	54.6	about 54		
9	Manganese oxalate	30.4	about 30	above 280	
10	Manganese carbonate	41.4	about 41	about 280	
11	Manganese resinate, precipitated	abt. 7.7	about 7	Soluble in the cold.	Soluble driers.
12	Manganese resinate, fused	abt. 5.3	2.5-4.5		
13	Manganese linoleate	abt. 8.9	about 9		
14	Mangano-lead resinate, fused	..	...		
15	Mangano-lead linoleate	..	...		
16	"Siccative powdered"	..	0.5-3		

5. VULCANISED OILS

TABLE No. 44.—*Vulcanised Oils—India Rubber Substitutes*

Oils vulcanised with S_2Cl_2 .		Sulphur.	Chlorine.	Water.	Residue on Ignition.	Fatty Acids.	Iodine Value.	Acetyl Value.	Sulphur.	Chlorine.	Iodine Value.
Linseed oil	rubber substitute from raw oil.	Per cent. 9.34	Per cent. 8.84	Per cent. 3.02	Per cent. ...	Per cent. 79.6	Per cent. 56.3	21.0	Per cent. 9.88	Per cent. Trace	160.3
Linseed oil	" " blown oil	4.78	4.85	0.85		81.67	52.6	19.6	4.06	0.60	(141.2 121.0)
Rape oil	" " commercial oil	8.28	7.62			86.89	32.5	31.0	8.34	Trace	101.5
Rape oil	" " blown oil	6.59	5.95			87.95	26.9		6.54	Trace	102.8
Poppy seed oil	" " blown oil	7.68	7.44			74.90	33.6		8.32		133.3
Cotton seed oil	" " blown oil	6.23	5.36				30.3	51.3	6.44	Trace	91.5
Castor oil	" " with minimum of S_2Cl_2	4.82	6.70			85.35	35.2		5.32	Trace	(136.2 147.4 152.1)
Castor oil	" " maximum "	10.60	8.95				21.9	105.6		0.26	105.6
Commercial Products.											
White substitute,	No. 1	6.4	5.0	0.85	0.8	90.45	30.9		6.12	0.83	91.3
" "	No. 2	6.17	5.86	1.0	5.51	73.58	31.0		6.45	0.43	91.2
" "	No. 3	8.25	8.88				32.6		8.15		102.3
Brown substitute,	No. 1	15.48	0.7				42.0		14.14		129.0
" "	No. 2	17.71	0.36				42.0		15.20		125.6

6. CANDLE - MAKING

TABLE No. 45

*Milk of Lime in Degrees Baumé obtained from 1 Kilogram
Caustic Lime*

1 Kilogram Caustic Lime yields Milk of Lime of			1 Kilogram Caustic Lime yields Milk of Lime of		
Degrees Baumé.	Later.	Kilograms.	Degrees Baumé.	Later.	Kilograms.
10	7.50	9.44	38	3.39	5.07
11	7.10	9.01	39	3.37	5.05
12	6.70	8.60	40	3.35	5.03
13	6.30	8.20	41	3.34	5.01
14	5.88	7.80	42	3.32	5.00
15	5.50	7.43	43	3.31	4.98
16	5.25	7.16	44	3.30	4.96
17	5.01	6.92	45	3.29	4.95
18	4.80	6.70	46	3.28	4.93
19	4.68	6.51	47	3.27	4.92
20	4.42	6.38	48	3.26	4.90
21	4.24	6.18	49	3.25	4.89
22	4.16	6.05	50	3.24	4.88
23	4.05	5.92	51	3.23	4.87
24	3.95	5.81	52	3.220	4.86
25	3.87	5.72	53	3.215	4.85
26	3.81	5.63	54	3.210	4.84
27	3.75	5.56	55	3.205	4.83
28	3.70	5.49	56	3.200	4.82
29	3.65	5.43	57	3.195	4.81
30	3.60	5.36	58	3.190	4.800
31	3.56	5.31	59	3.185	4.795
32	3.52	5.27	60	3.180	4.790
33	3.49	5.22	61	3.175	4.780
34	3.47	5.19	62	3.170	4.775
35	3.45	5.16	63	3.165	4.770
36	3.43	5.13	64	3.160	4.760
37	3.41	5.10	65	3.150	4.750

TABLE NO. 46.—*Percentages of Caustic Lime in Milk of Lime*

Degrees Baumé.	Per cent.	100 Liter contain Kilo- grams CaO.	Degrees Baumé.	Per cent.	100 Liter contain Kilo- grams CaO.
10	10·60	13·3	38	19·72	29·5
11	11·12	14·2	39	19·80	29·6
12	11·65	15·2	40	19·88	29·8
13	12·16	16·1	41	19·95	29·9
14	12·68	17·0	42	20·03	30·1
15	13·20	18·0	43	20·10	30·2
16	13·72	18·9	44	20·16	30·3
17	14·25	19·8	45	20·22	30·4
18	14·77	20·7	46	20·27	30·5
19	15·23	21·6	47	20·32	30·6
20	15·68	22·4	48	20·37	30·7
21	16·10	23·3	49	20·43	30·7
22	16·52	24·0	50	20·48	30·8
23	16·90	24·7	51	20·53	30·9
24	17·23	25·3	52	20·57	31·0
25	17·52	25·8	53	20·62	31·1
26	17·78	26·3	54	20·66	31·1
27	18·04	26·7	55	20·70	31·2
28	18·26	27·0	56	20·74	31·3
29	18·46	27·4	57	20·78	31·3
30	18·67	27·7	58	20·82	31·4
31	18·86	27·9	59	20·85	31·4
32	19·02	28·2	60	20·89	31·5
33	19·17	28·4	61	20·93	31·5
34	19·31	28·7	62	20·97	31·6
35	19·43	28·9	63	21·00	31·6
36	19·53	29·1	64	21·03	31·7
37	19·63	29·3	65	21·05	31·7

TABLE NO. 47.—*Sulphuric Acid required to saturate 100 Kilograms of Lime*

Degrees Baumé.	Containing Acid of 66° Baumé. Per cent.	Kilograms Acid required for 100 Kilograms CaO.	Kilograms Water to be added to 100 Kilograms Acid to obtain Acid of Degrees Baumé.				
			5° B.	10° B.	15° B.	20° B.	25° B.
66	100·0	175·0	2477	1318	831	554	400
65	97·04	180·3	2471	1313	826	548	395
64	94·10	186·0	2465	1303	820	543	389
63	91·16	196·5	2455	1297	810	532	380
62	88·22	198·4	2451	1294	807	529	376
61	85·28	205·2	2446	1288	801	525	370
60	82·24	212·5	2439	1280	794	516	362
59	80·72	216·8	2434	1276	789	512	358
58	79·12	221·2	2430	1272	785	508	354
57	77·52	226·0	2425	1267	780	503	349
56	75·92	230·5	2421	1263	775	498	344
55	74·32	235·4	2416	1255	770	494	339
54	72·70	240·7	2411	1252	765	488	334
53	71·17	245·9	2405	1247	760	481	328
52	69·30	252·5	2399	1241	754	476	322
51	68·05	257·2	2494	1235	748	471	318
50	66·49	263·3	2386	1230	743	465	314
49	64·37	271·9	2379	1222	734	457	303
48	62·80	278·7	2372	1214	727	450	297
47	61·32	285·4	2366	1208	721	443	289
46	59·85	292·4	2359	1201	714	436	272
45	58·05	302·0	2349	1188	704	427	273

TABLE No. 48

Melting Points of Mixtures of Lauric Acid with Myristic, Palmitic, and Stearic Acids (Heintz)

Lauric Acid.	Myristic Acid.		Palmitic Acid.		Stearic Acid.	
	Per cent.	Melting Point.	Per cent.	Melting Point.	Per cent.	Melting Point.
		°C.		°C.		°C.
100	0	43·6	0	43·6	0	43·6
90	10	41·3	10	41·5	10	41·5
80	20	38·5	20	37·1	20	38·5
70	30	35·1	30	38·3	30	43·4
60	40	36·7	40	40·1	40	50·8
50	50	37·4	50	47·0	50	55·8
40	60	43·0	60	51·2	60	59·0
30	70	46·7	70	54·5	70	62·0
20	80	49·6	80	57·4	80	64·7
10	90	51·8	90	59·8	90	67·0
0	100	53·8	100	62·0	100	69·2

TABLE No. 49

Melting Points of Mixtures of Myristic Acid with Palmitic and Stearic Acids (Heintz)

Myristic Acid.	Palmitic Acid.		Stearic Acid.	
	Per cent.	Melting Point.	Per cent.	Melting Point.
		°C.		°C.
100	0	53·8	0	53·8
90	10	51·8	10	51·7
80	20	49·5	20	47·8
70	30	46·2	30	48·2
60	40	47·0	40	50·4
50	50	47·8	50	54·5
40	60	51·5	60	59·8
30	70	54·9	70	62·8
20	80	58·0	80	65·0
10	90	60·1	90	67·1
0	100	62·0	100	69·2

TABLE NO. 50

Melting Points of Mixtures of Palmitic Acid with Stearic Acid

Palmitic Acid.	Stearic Acid.	Melting Point.		
		Heintz.	Hehner and Mitchell.	De Visser.
Per cent.	Per cent.	°C.	°C.	°C.
100	0	62·0	61·8	62·618
90	10	60·1	59·0	59·31
85	15	...	...	57·80
80	20	57·5	56·5	56·53
75	25	...	...	55·46
71	29	...	...	54·92
70	30	55·1	54·2	54·85
68	32	...	...	55·12
67·5	32·5	55·2	54·5	
66	34	...	...	55·38
64	36	...	...	55·62
63	37	...	...	55·75
62	38	...	...	55·88
61	39	...	...	56·00
60	40	56·3	55·5	56·11
59	41	...	...	56·19
58	42	...	...	56·25
57	43	...	...	56·31
56	44	...	...	56·36
55	45	...	...	56·38
54	46	...	...	56·39
53	47	...	...	56·40
52	48	...	...	56·40
51	49	...	...	56·41
50	50	56·5	55·6	56·42
49	51	...	...	56·44
48	52	...	...	56·50
47	53	...	...	56·63
46	54	...	...	56·85
45	55	...	...	57·20
40	60	60·3	59·4	58·76
30	70	62·9	61·5	61·73
20	80	65·3	64·2	64·51
10	90	67·2	66·5	67·02
0	100	69·2	68·5	69·32

TABLE NO. 51.—*Acid Values and Mean Molecular Weights of Mixtures of Stearic and Palmitic Acids*

Acid Value. Mgrms. of KOH per 1 grm.	Mean Molecular Weight.	100 parts of the mixture contain	
		Stearic Acid.	Palmitic Acid.
197.5	284.0	100	—
198.5	282.6	95	5
199.5	281.2	90	10
200.5	279.8	85	15
201.5	278.4	80	20
202.5	277.0	75	25
203.5	275.6	70	30
204.6	274.2	65	35
205.6	272.8	60	40
206.7	271.4	55	45
207.77	270.0	50	50
208.86	268.6	45	55
209.95	267.2	40	60
211.06	265.8	35	65
212.18	264.4	30	70
213.30	263.0	25	75
214.45	261.6	20	80
215.60	260.2	15	85
216.77	258.8	10	90
217.95	257.4	5	95
219.13	256.0	—	100

TABLE NO. 52.—*Solidifying Points of Mixtures of Commercial Stearic and Oleic Acids (Dalcian)*

Solidifying Point.	Commercial Stearic Acid.	Oleic Acid.	Solidifying Point.	Commercial Stearic Acid.	Oleic Acid.
C.	Per cent.	Per cent.	C.	Per cent.	Per cent.
35	25.20	69.80	44	47.50	47.50
35.5	26.40	68.60	44.5	49.40	45.60
36	27.30	67.70	45	51.30	43.70
36.5	28.75	66.25	45.5	52.25	42.75
37	29.80	65.20	46	53.20	41.80
37.5	30.60	64.40	46.5	55.10	39.90
38	31.25	63.75	47	57.95	37.05
38.5	32.15	62.85	47.5	58.90	36.10
39	33.44	61.55	48	61.75	33.25
39.5	34.30	60.80	48.5	66.50	28.50
40	35.15	59.85	49	71.25	23.75
40.5	36.10	58.90	49.5	72.20	22.80
41	38.00	57.00	50	75.05	19.95
41.5	38.95	56.05	50.5	77.10	17.90
42	39.90	55.10	51	79.50	15.50
42.5	42.75	52.27	51.5	81.90	13.10
43	43.70	51.30	52	84.00	11.00
43.5	44.65	50.35	52.5	88.30	6.70
			53	92.10	2.90

TABLE No. 53

Solidifying Points of "Stearines" obtained by the Acid Saponification Process (De Schepper and Geitel)

Solidi- fying Point.	Percentage of "Stearine" of Solidifying Point.							
	Palm Oil.				Tallow.			
°C.	48°	50°	52°	55.4°	48°	50°	52°	54.8°
5	...	...	...	...	...	...	...	...
10	4.2	3.6	3.3	2.6	3.2	2.7	2.3	2.1
15	10.2	9.8	7.8	6.6	7.5	6.6	5.7	4.8
20	17.4	15.0	14.4	11.0	13.0	11.4	9.7	8.2
25	26.2	22.4	19.3	16.2	19.2	17.0	14.8	12.6
30	34.0	30.5	26.6	22.3	27.9	23.2	21.4	18.3
35	45.6	40.8	35.8	29.8	39.5	34.5	30.2	25.8
36	48.5	43.2	38.0	31.8	42.5	36.9	32.5	27.6
37	51.8	45.5	40.3	33.6	46.0	40.0	34.9	29.6
38	55.5	48.8	42.6	35.8	49.5	42.6	37.5	32.0
39	59.2	51.8	45.6	38.2	53.2	45.8	40.3	34.3
40	63.0	55.2	48.6	40.6	57.8	49.6	43.5	37.0
41	66.6	58.7	52.0	43.0	62.2	53.5	47.0	40.0
42	70.5	62.2	55.2	45.5	66.6	57.6	50.5	42.9
43	74.8	66.0	58.8	48.5	71.8	62.0	54.0	46.0
44	79.2	70.2	62.0	51.4	77.0	66.2	58.4	49.8
45	84.0	74.5	66.0	54.3	81.8	71.0	62.6	53.0
46	89.4	78.8	69.8	57.8	87.5	75.8	67.0	56.8
47	94.3	83.0	74.0	61.0	93.3	80.9	71.5	60.8
48	100.0	88.0	78.6	65.0	100.0	87.2	76.6	65.0
49	...	94.2	83.5	69.1	...	93.0	84.7	69.5
50	...	100.0	89.0	73.4	...	100.0	87.0	74.5
51	...	...	94.5	78.0	...	...	93.5	79.8
52	...	...	100.0	82.8	...	...	100.0	84.8
53	...	...	...	87.6	...	...	...	90.1
54	...	...	...	92.2	...	...	...	95.3
55	...	...	...	97.5	...	...	(54.8)	100.0
55.4	...	...	...	100.0	...	...	...	...

TABLE NO. 54.—“*Stearine*” in *Red Oils* from the *Acid Saponification Process*

Solidifying Point of the Mixture.	Stearine of Solidifying Point 48° C.	Solidifying Point of the Mixture.	Stearine of Solidifying Point 48° C.	Solidifying Point of the Mixture.	Stearine of Solidifying Point 48° C.
°C.	Per cent.	°C.	Per cent.	°C.	Per cent.
5·4	...	20	12·1	35	39·5
6	0·3	21	13·2	36	43·0
7	0·8	22	14·5	37	46·9
8	1·2	23	15·7	38	50·5
9	1·7	24	17·0	39	54·5
10	2·5	25	18·5	40	58·9
11	3·2	26	20·0	41	63·6
12	3·8	27	21·7	42	68·5
13	4·7	28	23·3	43	73·5
14	5·6	29	25·2	44	78·9
15	6·6	30	27·2	45	83·5
16	7·7	31	29·2	46	89·0
17	8·8	32	31·5	47	94·1
18	9·8	33	33·8	48	100·0
19	11·1	34	36·6		

TABLE NO. 55.—*Percentages of Oleic Acid in Red Oils (Mangold)*

Iodine Value.	Product contains		Iodine Value.	Product contains		Iodine Value.	Product contains	
	Oleic Acid.	“Stearine.”		Oleic Acid.	“Stearine.”		Oleic Acid.	“Stearine.”
	Per cent.	Per cent.		Per cent.	Per cent.		Per cent.	Per cent.
0	0	100	31	34·41	65·59	62	68·83	31·17
1	1·11	98·89	32	35·52	64·48	63	69·94	30·06
2	2·22	97·78	33	36·63	63·37	64	71·05	28·95
3	3·33	96·67	34	37·74	62·26	65	72·16	27·84
4	4·44	95·56	35	38·85	61·15	66	73·27	26·73
5	5·55	94·45	36	39·96	60·04	67	74·38	25·62
6	6·66	93·34	37	41·07	58·93	68	75·49	24·51
7	7·77	92·23	38	42·18	57·82	69	76·60	23·40
8	8·88	91·12	39	43·29	56·71	70	77·71	22·29
9	9·99	90·01	40	44·40	55·60	71	78·82	21·18
10	11·10	88·90	41	45·51	54·49	72	79·93	20·07
11	12·21	87·79	42	46·62	53·38	73	81·04	18·96
12	13·32	86·68	43	47·73	52·27	74	82·15	17·85
13	14·43	85·57	44	48·84	51·16	75	83·26	16·74
14	15·54	84·46	45	49·95	50·05	76	84·37	15·63
15	16·65	83·35	46	51·06	48·94	77	85·48	14·52
16	17·76	82·24	47	52·17	47·83	78	86·59	13·41
17	18·87	81·13	48	53·28	46·72	79	87·70	12·30
18	19·98	80·02	49	54·39	45·61	80	88·82	11·18
19	21·09	78·91	50	55·50	44·49	81	89·93	10·07
20	22·20	77·80	51	56·62	43·38	82	91·04	8·96
21	23·31	76·69	52	57·73	42·27	83	92·15	7·85
22	24·42	75·58	53	58·84	41·16	84	93·26	6·74
23	25·53	74·47	54	59·95	40·05	85	94·37	5·63
24	26·64	73·36	55	61·06	38·94	86	95·48	4·52
25	27·75	72·25	56	62·17	37·83	87	96·59	3·41
26	28·86	71·14	57	63·28	36·72	88	97·70	2·30
27	29·97	70·03	58	64·39	35·61	89	98·81	1·19
28	31·08	68·92	59	65·50	34·50	90·07	100	0
29	32·19	67·81	60	66·61	33·39			
30	33·30	66·70	61	67·72	32·28			

TABLE NO. 56

Melting Points of Mixtures of Palmitic and Cerotic Acids
(Lewkowitsch)

Palmitic Acid.	Cerotic Acid.	Melting Point.
Per cent.	Per cent.	°C.
100	0	60.0
90	10	56.0
85	15	56.5
75	25	60.5
60	40	65.5
50	50	68.6
40	60	70.0
.0	100	78.5

TABLE NO. 57

Melting Points of Fractions Obtained from Scotch Paraffin Waxes

No. of Fraction.	Of Melting Point 126° F.	Of Melting Point 111° F.	Of Melting Point 102° F.
1	119.0	103.0	94.0
2	120.0	104.0	94.0
3	120.5	104.0	95.0
4	121.0	105.0	96.0
5	121.0	106.0	96.0
6	121.0	107.0	97.5
7	121.5	107.5	98.0
8	122.0	108.0	98.5
9	122.5	108.5	99.0
10	123.0	109.0	99.0
11	124.0	110.5	100.0
12	125.0	112.0	102.0
13	126.0	113.0	103.5
14	127.0	113.5	105.0
15	128.0	114.5	106.5
16	129.0	116.0	108.0
17	130.0	117.0	109.0
18	132.0	119.0	110.0
19	134.0	123.0	112.5
20	138.0	125.0	113.0

TABLE No. 58

Specific Gravity of Paraffin Waxes (Allen)

No.	Origin of Sample.	Specific Gravity.		Solidifying Point.
		Solid, at 15° C.	Liquid, at 99° C.	°C.
1	Shale oil . . .	0·8666	0·7481	44·0
2	" " . . .	0·8961	0·7494	47·0
3	" " . . .	0·9000	0·7517	52·0
4	" " . . .	0·9111	0·7572	58·5
5	American petroleum	0·9083	0·7535	53·8
6	Ozokerit . . .	...	0·7531	61·5
7	Rangoon tar . . .	0·8831	0·7571	49·0

TABLE No. 59

Specific Gravities of Melted Paraffin Waxes (I. I. Redwood)

°F. at which determined.	Melting Point 108° F.	Melting Point 114° F.	Melting Point 120·5° F.	Melting Point 122·25° F.	Melting Point 122·75° F.	Melting Point 128·25° F.	Melting Point 133·25° F.
160	0·77069	0·77193	0·77391	0·77079	0·77023	0·77573	0·77723
155	0·77119	0·77330	0·77531	0·77149	0·77163	0·77653	0·77853
150	0·77309	0·77473	0·77657	0·77319	0·77283	0·77803	0·78003
145	0·77509	0·77620	0·77777	0·77519	0·77463	0·77973	0·78153
140	0·77679	0·77763	0·77847	0·77689	0·77633	0·78133	0·78333
135	0·77899	0·77953	0·78147	0·77869	0·77843	0·78303	
130	0·78049	0·78113	0·78267	0·78029	0·77973		
125	0·78199	0·78343	0·78441				
120	0·78359	0·78473					
115	0·78529						

TABLE No. 60

Specific Gravities of Solid Paraffin Waxes at 60° F. (I. I. Redwood)

Melting Point 106° F.	Melting Point 111·5° F.	Melting Point 120·5° F.	Melting Point 122·25° F.	Melting Point 125·75° F.	Melting Point 131° F.
0·87525	0·88230	0·89895	0·90105	0·90350	0·90865

TABLE No. 61

Solubility of Paraffin Wax

Solvent.	Grms. of Paraffin Wax dissolved by		Weight of Solvent required to dissolve completely 1 Part of Paraffin Wax.
	100 grms.	100 c.c.	Grs.
Carbon bisulphide	12.99	...	7.6
Petroleum ether, boiling up to 75° C.; spec. grav.=0.7233	11.73	8.48	8.5
Oil of turpentine; spec. grav.=0.857, boiling point 158°-166° C.	6.06	5.21	16.1
Cumene comm. boiling up to 160° C.; spec. grav.=0.867	4.28	3.72	23.4
Cumene fract., 150°-160° C.; spec. grav.=0.847	3.99	3.39	25.0
Xylene comm. B.P., 135°-143° C.; spec. grav.=0.866	3.95	3.43	25.1
Xylene fract., 136°-138° C.; spec. grav.=0.864	4.39	3.77	22.7
Toluene comm., 108°-110° C.; spec. grav.=0.866	3.83	3.34	26.1
Toluene fract., 108.5°-109.5° C.; spec. grav.=0.866	3.92	3.41	25.5
Chloroform	2.42	3.61	41.3
Benzene	1.99	1.75	50.3
Ethyl ether	1.95	...	50.8
Isobutyl alcohol, spec. grav.=0.804	0.285	0.228	352.9
Acetone, 55.5°-56.5° C.; spec. grav.=0.797	0.262	0.209	378.7
Ethyl acetate	0.238	...	419.0
Ethyl alcohol, 99.5° Tr.	0.219	...	453.6
Amyl alcohol, 127°-129° C.; spec. grav.=0.813	0.202	0.164	495.3
Propionic acid	0.165	...	595.3
Propyl alcohol	0.141	...	709.4
Methyl alcohol, 65.5°-66.5° C.; spec. grav.=0.798	0.071	0.056	1447.5
Methyl formate	0.060	...	1648.7
Glacial acetic acid	0.060	0.063	1668.6
Ethyl alcohol, 64.3° Tr.	0.046	...	2149.5
Acetic anhydride	0.025	...	3856.2
Formic acid (cryst.)	0.013	0.015	7689.2
Ethyl alcohol, 75° Tr.	0.0003	...	330000.0

TABLE NO. 62

Melting Points of Candle Material from "Mixed Paraffin Wax (Scotch) and Stearine" (I. I. Redwood)

A

Paraffin Wax.		Stearine.		Mixture.
Per cent.	Melting Point.	Per cent.	Melting Point.	Melting Point.
	°F.		°F.	°F.
90	102	10	121	100
80	"	20	"	98·50
70	"	30	"	100·0
60	"	40	"	104·50
50	"	50	"	110·50
40	"	60	"	111·0
30	"	70	"	113·50
20	"	80	"	117·50
10	"	90	"	119·0

B

Paraffin Wax.		Stearine.		Mixture.
Per cent.	Melting Point.	Per cent.	Melting Point.	Melting Point.
	°F.		°F.	°F.
90	120	10	123	118
80	"	20	"	116·50
70	"	30	"	114
60	"	40	"	112
50	"	50	"	110
40	"	60	"	109
30	"	70	"	113
20	"	80	"	118·50
10	"	90	"	119·50

C

Paraffin Wax.		Stearine.		Mixture.
Per cent.	Melting Point.	Per cent.	Melting Point.	Melting Point.
	°F.		°F.	°F.
90	120·25	10	129·75	118·50
80	"	20	"	116·75
70	"	30	"	114·50
60	"	40	"	112·25
50	"	50	"	113
40	"	60	"	118·75
30	"	70	"	122
20	"	80	"	124·50
10	"	90	"	127

D

Paraffin Wax.		Stearine.		Mixture.
Per cent.	Melting Point.	Per cent.	Melting Point.	Melting Point.
	°F.		°F.	°F.
90	125	10	121	123
80	"	20	"	121
70	"	30	"	119
60	"	40	"	117·50
50	"	50	"	114
40	"	60	"	111
30	"	70	"	107
20	"	80	"	114
10	"	90	"	117

E

Paraffin Wax.		Stearine.		Mixture.
Per cent.	Melting Point.	Per cent.	Melting Point.	Melting Point.
	°F.		°F.	°F.
90	130	10	121	128
80	"	20	"	125·50
70	"	30	"	123
60	"	40	"	121
50	"	50	"	118·50
40	"	60	"	114
30	"	70	"	109
20	"	80	"	115·50
10	"	90	"	118

F

Paraffin Wax.		Stearine.		Mixture.
Per cent.	Melting Point.	Per cent.	Melting Point.	Melting Point.
	°F.		°F.	°F.
90	132·50	10	129·75	130·50
80	"	20	"	128·50
70	"	30	"	126·50
60	"	40	"	124·25
50	"	50	"	121·0
40	"	60	"	117·75
30	"	70	"	119·50
20	"	80	"	125·25
10	"	90	"	127·50

TABLE No. 63

*Melting Points of Candle Material from mixed Paraffin Wax
(Thuringian) and "Stearine" (Scheithauer)*

Paraffin Wax.	Of Melting Point.	"Stearine" Acid of Melting Point 54° C.	Melting Point of Mixture.
Per cent.	°C.	Per cent.	°C.
90·0	36·5	10·0	36·5
66·6	"	33·3	39·0
33·3	"	66·6	45·75
10·0	"	90·0	51·75
90·0	37·5	10·0	36·5
66·6	"	33·3	35·5
33·3	"	66·6	47·0
10·0	"	90·0	52·0
90·0	40·75	10·0	39·75
66·6	"	33·3	40·50
33·3	"	66·6	47·50
10·0	"	90·0	52·0
90·0	45·0	10·0	44·0
66·6	"	33·3	40·75
33·3	"	66·6	48·0
10·0	"	90·0	52·5
90·0	48·5	10·0	47·5
66·6	"	33·3	45·0
33·3	"	66·6	47·75
10·0	"	90·0	52·50
90·0	50·0	10·0	49·0
66·6	"	33·3	47·0
33·3	"	66·6	47·5
10·0	"	90·0	52·5
90·0	54·0	10·0	53·0
66·6	"	33·3	49·0
33·3	"	66·6	47·0
10·0	"	90·0	52·5
90·0	56·5	10·0	55·5
66·6	"	33·3	52·0
33·3	"	66·6	47·5
10·0	"	90·0	52·5

TABLE NO. 64

Mixed Ceresine and Beeswax Candle Material

Yellow Beeswax.	Yellow Ceresine.	Specific Gravity of the Mixture.	White Beeswax.	White Ceresine.	Specific Gravity of the Mixture.
100	0	0.963	100	0	0.973
90	10	0.961	90	10	0.968
80	20	0.9575	80	20	0.962
70	30	0.953	70	30	0.956
60	40	0.950	60	40	0.954
50	50	0.944	50	50	0.946
40	60	0.937	40	60	0.938
30	70	0.933	30	70	0.934
20	80	0.931	20	80	0.932
10	90	0.929	10	90	0.930
0	100	0.922	0	100	0.918

TABLE NO. 65

Mixed Ceresine and Paraffin Wax Candle Material (Berlinerblau)

Ceresine.	Paraffin Wax.	Melting Point.	Solidifying Point.	Specific Gravity at		
				15° C.	83°-85° C.	95° C.
Per cent.	Per cent.	°C.	°C.			
100	0	70.73	69.5	0.921	0.7835	0.774
95	5	69.73	68.5	0.919		
90	10	68.72	66.5	0.9175	0.7800	
80	20	66.71.5	65.0	0.914	0.7775	
70	30	64.5-70	63.0	0.910	0.7750	
60	40	62.69	62.0	0.907		
50	50	58.5-67	60.0	0.904	0.7705	
40	60	56.5-65	59.0	0.900		
30	70	54.5-62	57.0	0.897		
20	80	52.5-58.5	54.0	0.894		
10	90	49.5-54.5	49.0	0.892		
0	100	47.52	47.0	0.889	0.7655	0.756

7. SOAP MANUFACTURE

TABLE No. 67

Percentages of Caustic Soda and Caustic Potash in Caustic Lyes

Degrees Twaddell.	Specific Gravity.	Na ₂ O. Per cent.	NaOH. Per cent.	K ₂ O. Per cent.	KOH. Per cent.
0.7	1.0035	0.23	0.30	0.35	0.45
1.4	1.0070	0.47	0.61	0.70	0.90
2.1	1.0105	0.70	0.90	1.05	1.30
2.8	1.0141	0.93	1.20	1.40	1.70
3.6	1.0177	1.26	1.60	1.80	2.15
4.4	1.0213	1.55	2.00	2.20	2.60
5.1	1.0249	1.83	2.36	2.55	3.05
5.8	1.0286	2.10	2.71	2.90	3.50
6.6	1.0323	2.35	3.03	3.35	4.00
7.4	1.0360	2.60	3.35	3.80	4.50
8.2	1.0397	2.85	3.67	4.25	5.05
9.0	1.0435	3.10	4.00	4.70	5.60
9.7	1.0473	3.35	4.32	5.05	6.00
10.4	1.0511	3.60	4.64	5.40	6.40
11.2	1.0549	3.85	4.96	5.80	6.80
12.0	1.0588	4.10	5.29	6.20	7.40
12.7	1.0627	4.32	5.58	6.55	7.80
13.4	1.0667	4.55	5.87	6.90	8.20
14.2	1.0706	4.82	6.21	7.30	8.70
15.0	1.0746	5.08	6.55	7.70	9.20
15.8	1.0787	5.37	6.76	8.10	9.65
16.6	1.0827	5.67	7.31	8.50	10.10
17.3	1.0868	5.84	7.66	8.85	10.50
18.2	1.0909	6.20	8.00	9.20	10.90
19.1	1.0951	6.46	8.34	9.65	11.45
20.0	1.1000	6.73	8.68	10.10	12.00
20.8	1.1035	7.06	9.05	10.45	12.45
21.6	1.1077	7.30	9.42	10.80	12.90
22.4	1.1120	7.55	9.74	11.25	13.35
23.2	1.1163	7.80	10.06	11.60	13.80
24.1	1.1206	8.65	10.51	12.00	14.30
25.0	1.1250	8.50	10.97	12.40	14.80
25.9	1.1294	8.84	11.42	12.80	15.25
26.8	1.1339	9.18	11.84	13.20	15.70
27.6	1.1383	9.49	12.24	13.55	16.10
28.4	1.1423	9.80	12.64	13.90	16.50
29.4	1.1474	10.15	13.00	14.35	17.15
30.4	1.1520	10.50	13.55	14.80	17.60
31.4	1.1566	10.82	13.86	15.20	18.10
32.4	1.1613	11.14	14.37	15.60	18.60
33.6	1.1660	11.43	14.75	16.00	19.05
34.2	1.1707	11.73	15.13	16.40	19.50
35.1	1.1755	12.03	15.50	16.80	20.00
36.0	1.1803	12.33	15.91	17.20	20.50
37.0	1.1852	12.66	16.38	17.60	20.95
38.0	1.1901	13.00	16.77	18.00	21.40
39.0	1.1950	13.35	17.22	18.40	21.90
40.0	1.2000	13.70	17.67	18.80	22.50
41.0	1.2050	14.05	18.12	19.20	22.85
42.0	1.2101	14.40	18.58	19.60	23.30
43.0	1.2152	14.74	19.08	19.95	23.75

TABLE NO. 67—*continued**Percentages of Caustic Soda and Caustic Potash in Caustic Lyes*

Degrees Twaddell.	Specific Gravity.	Na ₂ O. Per cent.	NaOH. Per cent.	K ₂ O. Per cent.	KOH. Per cent.
44.0	1.2202	15.18	19.58	20.30	24.20
45.1	1.2255	15.57	20.08	20.70	24.65
46.2	1.2308	15.96	20.59	21.10	25.10
47.1	1.2361	16.36	21.00	21.50	25.60
48.2	1.2414	16.76	21.42	21.90	26.10
49.3	1.2468	17.18	22.03	22.30	26.50
50.4	1.2522	17.55	22.64	22.70	27.00
51.5	1.2576	17.85	23.15	23.10	27.50
52.6	1.2632	18.35	23.67	23.50	28.00
53.7	1.2687	18.78	24.24	23.85	28.45
54.8	1.2743	19.23	24.81	24.20	28.90
55.9	1.2800	19.61	25.30	24.60	29.35
57.0	1.2857	20.00	25.80	25.00	29.80
58.2	1.2905	20.40	26.31	25.40	30.25
59.4	1.2973	20.80	26.83	25.80	30.70
60.5	1.3032	21.02	27.31	26.25	31.25
61.6	1.3091	21.55	27.80	26.70	31.80
62.8	1.3151	21.95	28.31	27.10	32.25
64.0	1.3211	22.35	28.83	27.50	32.70
65.2	1.3272	23.67	29.38	27.90	33.20
66.4	1.3333	23.20	29.93	28.30	33.70
67.7	1.3395	23.75	30.57	28.80	34.30
69.0	1.3458	24.20	31.22	29.30	34.90
70.2	1.3521	24.68	31.85	29.75	35.40
71.4	1.3585	25.17	32.47	30.20	35.90
72.7	1.3649	25.68	33.08	30.60	36.40
74.0	1.3714	26.12	33.69	31.00	36.90
75.3	1.3780	26.61	34.38	31.40	37.35
76.6	1.3846	27.10	34.96	31.80	37.80
78.5	1.3913	27.60	35.65	32.25	38.35
79.4	1.3981	28.10	36.25	32.70	38.90
80.7	1.4049	28.58	36.86	33.10	39.40
83.0	1.4187	29.56	38.13	33.95	40.40
84.8	1.4267	30.08	38.80	34.40	40.90
86.2	1.4328	30.54	39.39	34.90	41.50
87.6	1.4400	31.00	39.99	35.40	42.10
89.0	1.4472	31.50	40.75	35.95	42.75
90.6	1.4545	32.10	41.41	36.50	43.40
92.2	1.4619	32.65	42.12	37.00	44.00
93.6	1.4694	33.20	42.83	37.50	44.60
95.1	1.4769	33.80	43.66	38.00	45.20
96.6	1.4845	34.40	44.38	38.50	45.80
98.1	1.4922	35.05	45.27	39.05	46.45
99.6	1.5000	35.70	46.15	39.60	47.10
101.2	1.5079	36.30	46.87	40.15	47.70
102.8	1.5158	36.90	47.60	40.60	48.30
104.4	1.5238	37.45	48.81	41.05	48.85
106.0	1.5319	38.00	49.02	41.50	49.40

TABLE NO. 68, *see pages 112-115.*

TABLE No. 69

Caustic Alkali Solutions required to saponify Fats of Mean Molecular Weight 860 (Tallow, Cottonseed Oil, Olive Oil, etc.)

Weight of Fat in Tons.	Gallons of Solution.							
	20° Twaddell=S. G. 1.1.		40° Twaddell=S. G. 1.2.		60.0 Twaddell=S. G. 1.3.		71° Twaddell=S. G. 1.355.	
	NaOH.	KOH.	NaOH.	KOH.	NaOH.	KOH.	NaOH.	KOH.
.05	16.37	16.60	7.37	8.12	4.45	5.43	3.57	4.52
.1	32.74	33.21	14.74	16.24	8.90	10.87	7.15	9.04
.15	49.10	49.81	22.11	24.35	13.36	16.30	10.72	13.56
.2	65.47	66.42	29.48	32.47	17.81	21.73	14.30	18.08
.25	81.84	83.02	36.85	40.59	22.26	27.17	17.87	22.60
.3	98.21	99.63	44.22	48.71	26.71	32.60	21.44	27.12
.35	114.57	116.23	51.59	56.82	31.17	38.03	25.02	31.64
.4	130.94	132.84	58.96	64.94	35.62	43.47	28.59	36.16
.45	147.31	149.44	66.33	73.06	40.07	48.90	32.17	40.68
.5	163.68	166.05	73.70	81.18	44.52	54.33	35.74	45.20
.55	180.04	182.65	81.07	89.30	48.98	59.77	39.31	49.72
.6	196.41	199.26	88.44	97.41	53.43	65.20	42.89	54.24
.65	212.78	215.86	95.81	105.53	57.88	70.63	46.46	58.75
.7	229.15	232.47	103.18	113.65	62.33	76.07	50.04	63.27
.75	245.52	249.07	110.55	121.77	66.79	81.50	53.61	67.79
.8	261.88	265.67	117.92	129.88	71.24	86.94	57.18	72.31
.85	278.25	282.28	125.29	138.00	75.69	92.37	60.76	76.83
.9	294.62	298.88	132.66	146.12	80.14	97.80	64.33	81.35
.95	310.99	315.49	140.03	154.24	84.60	103.24	67.91	85.87
1.0	327.35	332.09	147.41	162.36	89.05	108.67	71.48	90.39
2.0	654.71	664.19	294.81	324.71	178.10	217.34	142.96	180.78
3.0	982.06	996.28	442.22	487.07	267.14	326.01	214.44	271.18
4.0	1309.42	1328.37	589.62	649.42	356.19	434.68	285.92	361.57
5.0	1636.77	1660.47	737.03	811.78	445.24	543.35	357.41	451.96
6.0	1964.12	1992.56	884.43	974.14	534.29	652.01	428.89	542.35
7.0	2291.48	2324.65	1031.84	1136.49	623.34	760.68	500.37	632.74
8.0	2618.83	2656.74	1179.24	1298.85	712.38	869.35	571.85	732.14
9.0	2946.19	2988.84	1326.65	1461.20	801.43	978.02	643.33	813.53
10.0	3273.54	3320.93	1474.05	1623.56	890.48	1086.69	714.81	903.92

TABLE No. 68

Influence of Temperatures on the Specific Gravities of Solutions of Caustic Soda

		0° C.	5° C.	10° C.	15° C.	20° C.	25° C.	30° C.	35° C.	40° C.	45° C.	50° C.	55° C.	60° C.	65° C.	70° C.	75° C.	80° C.	85° C.	90° C.	95° C.	100° C.	
1	Spec. Grav. .	1.367	1.364	1.362	1.360	1.357	1.355	1.353	1.350	1.348	1.345	1.342	1.339	1.336	1.333	1.331	1.328	1.326	1.323	1.321	1.318	1.316	1
2	Baumé .	38.8	38.5	38.4	38.2	38.0	37.8	37.7	37.4	37.3	37.0	36.8	36.5	36.3	36.1	35.9	35.7	35.5	35.3	35.1	34.8	34.7	2
3	Spec. Grav. .	1.357	1.354	1.352	1.350	1.347	1.345	1.343	1.340	1.337	1.335	1.332	1.330	1.327	1.324	1.322	1.319	1.316	1.314	1.311	1.308	1.306	3
4	Baumé .	38.0	37.8	37.6	37.4	37.2	37.0	36.9	36.6	36.4	36.2	36.0	35.8	35.6	35.3	35.2	34.9	34.7	34.5	34.3	34.0	33.8	4
5	Spec. Grav. .	1.347	1.344	1.342	1.340	1.338	1.336	1.333	1.330	1.327	1.325	1.322	1.320	1.317	1.314	1.312	1.309	1.306	1.304	1.301	1.298	1.296	5
6	Baumé .	37.2	36.9	36.8	36.6	36.5	36.3	36.1	35.8	35.6	35.4	35.2	35.0	34.8	34.5	34.3	34.1	33.8	33.6	33.4	33.1	32.9	6
7	Spec. Grav. .	1.338	1.335	1.332	1.330	1.328	1.325	1.323	1.320	1.317	1.315	1.312	1.310	1.307	1.304	1.302	1.299	1.296	1.294	1.291	1.288	1.286	7
8	Baumé .	36.5	36.2	36.0	35.8	35.8	35.4	35.3	35.0	34.8	34.6	34.3	34.2	33.9	33.6	33.5	33.2	32.9	32.8	32.5	32.3	32.1	8
9	Spec. Grav. .	1.328	1.325	1.322	1.320	1.318	1.315	1.313	1.310	1.307	1.305	1.302	1.300	1.297	1.294	1.292	1.289	1.286	1.283	1.280	1.277	1.274	9
10	Baumé .	35.7	35.4	35.2	35.0	34.8	34.6	34.4	34.2	33.9	33.7	33.5	33.3	33.0	32.8	32.6	32.3	32.1	31.8	31.5	31.3	31.0	10
11	Spec. Grav. .	1.318	1.315	1.313	1.310	1.308	1.305	1.303	1.300	1.297	1.294	1.292	1.289	1.286	1.284	1.281	1.278	1.275	1.272	1.269	1.266	1.263	11
12	Baumé .	34.8	34.6	34.4	34.2	34.0	33.7	33.5	33.3	33.0	32.8	32.6	32.3	32.1	31.9	31.6	31.4	31.1	30.8	30.5	30.3	30.0	12
13	Spec. Grav. .	1.308	1.305	1.303	1.300	1.297	1.294	1.292	1.289	1.287	1.284	1.282	1.279	1.276	1.274	1.271	1.268	1.265	1.262	1.259	1.245	1.253	13
14	Baumé .	34.0	33.7	33.5	33.3	33.0	32.8	32.6	32.3	32.2	31.9	31.7	31.5	31.2	31.0	30.7	30.5	30.2	29.9	29.6	29.4	29.1	14
15	Spec. Grav. .	1.298	1.295	1.293	1.290	1.287	1.284	1.282	1.279	1.277	1.274	1.272	1.269	1.266	1.264	1.261	1.258	1.255	1.252	1.249	1.256	1.242	15
16	Baumé .	33.1	32.8	32.7	32.4	32.2	31.9	31.7	31.5	31.3	31.0	30.8	30.5	30.3	30.1	29.8	29.5	29.3	29.0	28.7	28.4	28.1	16
17	Spec. Grav. .	1.288	1.285	1.283	1.280	1.277	1.274	1.272	1.269	1.267	1.264	1.262	1.259	1.256	1.254	1.251	1.248	1.245	1.242	1.239	1.235	1.232	17
18	Baumé .	32.3	32.0	31.8	31.5	31.3	31.0	30.8	30.5	30.4	30.1	29.9	29.6	29.4	29.2	28.9	28.6	28.4	28.1	27.8	27.4	27.1	18
19	Spec. Grav. .	1.278	1.275	1.273	1.270	1.267	1.265	1.262	1.260	1.258	1.255	1.252	1.250	1.247	1.245	1.242	1.239	1.236	1.233	1.231	1.228	1.225	19
20	Baumé .	31.4	31.1	30.9	30.6	30.4	30.2	29.9	29.7	29.5	29.3	29.0	28.8	28.5	28.4	28.1	27.8	27.5	27.2	27.0	26.7	26.5	20
21	Spec. Grav. .	1.268	1.265	1.263	1.260	1.257	1.255	1.252	1.250	1.248	1.245	1.242	1.240	1.237	1.235	1.232	1.229	1.226	1.223	1.221	1.218	1.215	21
22	Baumé .	30.5	30.2	30.0	29.7	29.5	29.3	29.0	28.8	28.6	28.4	28.1	27.9	27.6	27.4	27.1	26.8	26.5	26.3	26.1	25.8	25.5	22
23	Spec. Grav. .	1.257	1.255	1.252	1.250	1.247	1.245	1.242	1.240	1.238	1.235	1.233	1.231	1.228	1.226	1.223	1.220	1.218	1.215	1.213	1.209	1.207	23
24	Baumé .	29.5	29.3	29.0	28.8	28.5	28.4	28.1	27.9	27.7	27.4	27.2	27.0	26.7	26.5	26.3	26.0	25.8	25.5	25.3	24.9	24.7	24
25	Spec. Grav. .	1.247	1.245	1.242	1.240	1.237	1.235	1.232	1.230	1.228	1.225	1.223	1.221	1.218	1.216	1.213	1.210	1.208	1.205	1.203	1.200	1.197	25
26	Baumé .	28.5	28.4	28.1	27.9	27.6	27.4	27.1	26.9	26.7	26.5	26.3	26.1	25.8	25.6	25.3	25.0	24.8	24.5	24.3	24.0	23.7	26
27	Spec. Grav. .	1.237	1.235	1.232	1.230	1.227	1.224	1.222	1.220	1.218	1.215	1.212	1.210	1.208	1.205	1.202	1.200	1.198	1.195	1.192	1.190	1.187	27
28	Baumé .	27.6	27.4	27.1	26.9	26.6	26.4	26.2	26.0	25.8	25.5	25.2	25.0	24.8	24.5	24.2	24.0	23.8	23.5	23.2	23.0	22.7	28
29	Spec. Grav. .	1.227	1.225	1.222	1.220	1.217	1.214	1.212	1.210	1.208	1.205	1.202	1.200	1.198	1.195	1.192	1.190	1.188	1.185	1.182	1.180	1.177	29
30	Baumé .	26.6	26.5	26.2	26.0	25.7	25.4	25.2	25.0	24.8	24.5	24.2	24.0	23.8	23.5	23.2	23.0	22.8	22.5	22.2	22.0	21.7	30
31	Spec. Grav. .	1.217	1.215	1.212	1.210	1.207	1.204	1.203	1.200	1.198	1.195	1.192	1.191	1.189	1.186	1.184	1.181	1.179	1.176	1.173	1.171	1.168	31
32	Baumé .	25.7	25.5	25.2	25.0	24.7	24.4	24.3	24.0	23.8	23.5	23.2	23.1	22.9	22.6	22.4	22.1	21.9	21.6	21.2	21.0	20.7	32
33	Spec. Grav. .	1.207	1.205	1.202	1.200	1.197	1.195	1.193	1.190	1.188	1.186	1.184	1.182	1.180	1.177	1.175	1.172	1.169	1.166	1.163	1.161	1.158	33
34	Baumé .	24.7	24.5	24.2	24.0	23.7	23.5	23.3	23.0	22.8	22.6	22.4	22.2	22.0	21.7	21.4	21.1	20.8	20.4	20.1	19.9	19.6	34
35	Spec. Grav. .	1.197	1.195	1.192	1.190	1.187	1.185	1.183	1.180	1.178	1.175	1.174	1.172	1.169	1.166	1.164	1.161	1.158	1.155	1.153	1.150	1.147	35
36	Baumé .	23.7	23.5	23.2	23.0	22.7	22.5	22.3	22.0	21.8	21.6	21.3	21.1	20.8	20.4	20.2	19.9	19.6	19.3	19.1	18.8	18.5	36
37	Spec. Grav. .	1.187	1.185	1.182	1.180	1.177	1.175	1.173	1.170	1.168	1.166	1.164	1.162	1.159	1.156	1.153	1.151	1.148	1.145	1.143	1.140	1.137	37
38	Baumé .	22.7	22.5	22.2	22.0	21.7	21.4	21.2	20.9	20.7	20.4	20.2	20.0	19.7	19.4	19.1	18.9	18.6	18.3	18.1	17.8	17.4	38
39	Spec. Grav. .	1.176	1.174	1.172	1.170	1.167	1.165	1.163	1.161	1.158	1.156	1.154	1.152	1.149	1.146	1.143	1.140	1.138	1.135	1.132	1.130	1.127	39
40	Baumé .	21.6	21.3	21.1	20.9	20.5	20.3	20.1	19.9	19.6	19.4	19.2	19.0	18.7	18.4	18.1	17.8	17.5	17.1	16.8	16.5	16.2	40
41	Spec. Grav. .	1.166	1.164	1.162	1.160	1.157	1.155	1.153	1.151	1.148	1.146	1.144	1.142	1.139	1.136	1.133	1.130	1.128	1.125	1.122	1.120	1.117	41
42	Baumé .	20.4	20.2	20.0	19.8	19.5	19.3	19.1	18.9	18.6	18.4	18.2	18.0	17.6	17.3	16.9	16.5	16.3	16.0	15.7	15.4	15.1	42
43	Spec. Grav. .	1.156	1.154	1.152	1.150	1.148	1.146	1.144	1.142	1.140	1.137	1.135	1.132	1.130	1.127	1.124	1.121	1.118	1.116	1.113	1.110	1.107	43
44	Baumé .	19.4	19.2	19.0	18.8	18.6	18.4	18.2	18.0	17.8	17.4	17.1	16.8	16.5	16.2	15.9	15.6	15.2	15.0	14.6	14.2	13.9	44

TABLE NO. 68— *continued*

		0° C.	5° C.	10° C.	15° C.	20° C.	25° C.	30° C.	35° C.	40° C.	45° C.	50° C.	55° C.	60° C.	65° C.	70° C.	75° C.	80° C.	85° C.	90° C.	95° C.	100° C.	
1	Spec. Grav. .	1·146	1·144	1·142	1·140	1·138	1·136	1·134	1·132	1·130	1·127	1·125	1·122	1·120	1·117	1·114	1·111	1·108	1·106	1·103	1·100	1·097	1
2	Baumé .	18·4	18·2	18·0	17·8	17·5	17·3	17·0	16·8	16·5	16·2	16·0	15·7	15·4	15·1	14·8	14·4	14·0	13·8	13·4	13·0	12·7	2
3	Spec. Grav. .	1·136	1·134	1·132	1·130	1·128	1·126	1·124	1·122	1·120	1·118	1·116	1·113	1·110	1·107	1·104	1·101	1·099	1·096	1·093	1·090	1·087	3
4	Baumé .	17·3	17·0	16·8	16·5	16·3	16·1	15·9	15·7	15·5	15·2	15·0	14·6	14·3	13·9	13·5	13·1	12·9	12·6	12·2	11·9	11·5	4
5	Spec. Grav. .	1·126	1·124	1·122	1·120	1·118	1·116	1·114	1·112	1·110	1·108	1·106	1·103	1·100	1·097	1·094	1·092	1·089	1·086	1·083	1·080	1·077	5
6	Baumé .	16·1	15·9	15·7	15·4	15·2	15·0	14·8	14·5	14·3	14·0	13·8	13·4	13·0	12·7	12·3	12·1	11·8	11·4	11·0	10·6	10·3	6
7	Spec. Grav. .	1·115	1·113	1·112	1·110	1·108	1·106	1·104	1·102	1·100	1·099	1·097	1·094	1·091	1·089	1·086	1·083	1·080	1·077	1·074	1·071	1·068	7
8	Baumé .	14·9	14·6	14·5	14·3	14·0	13·8	13·5	13·2	13·0	12·9	12·7	12·3	12·0	11·8	11·4	11·0	10·6	10·3	9·9	9·5	9·1	8
9	Spec. Grav. .	1·105	1·103	1·102	1·100	1·098	1·096	1·095	1·093	1·092	1·090	1·087	1·084	1·082	1·079	1·076	1·073	1·070	1·067	1·064	1·061	1·058	9
10	Baumé .	13·6	13·4	13·3	13·0	12·8	12·6	12·4	12·2	12·1	11·9	11·5	11·1	10·9	10·5	10·1	9·8	9·4	9·0	8·6	8·2	7·8	10
11	Spec. Grav. .	1·094	1·093	1·091	1·090	1·088	1·087	1·086	1·084	1·082	1·080	1·078	1·075	1·073	1·070	1·067	1·064	1·061	1·058	1·056	1·052	1·048	11
12	Baumé .	12·3	12·2	12·0	11·9	11·6	11·5	11·4	11·1	10·9	10·6	10·4	10·0	9·8	9·4	9·0	8·6	8·2	7·8	7·5	7·0	6·4	12
13	Spec. Grav. .	1·084	1·083	1·081	1·080	1·078	1·077	1·076	1·074	1·072	1·070	1·068	1·066	1·063	1·060	1·057	1·054	1·051	1·048	1·046	1·043	1·040	13
14	Baumé .	11·1	11·0	10·8	10·6	10·4	10·3	10·1	9·9	9·6	9·4	9·1	8·9	8·4	8·0	7·6	7·3	6·9	6·4	6·2	5·8	5·4	14
15	Spec. Grav. .	1·074	1·073	1·071	1·070	1·068	1·067	1·066	1·064	1·062	1·060	1·058	1·056	1·053	1·050	1·047	1·044	1·042	1·039	1·036	1·033	1·030	15
16	Baumé .	9·9	9·8	9·5	9·4	9·1	9·0	8·9	8·6	8·3	8·0	7·8	7·5	7·1	6·7	6·3	5·9	5·6	5·2	4·9	4·5	4·0	16
17	Spec. Grav. .	1·064	1·063	1·061	1·060	1·058	1·057	1·056	1·054	1·052	1·050	1·048	1·046	1·043	1·040	1·037	1·034	1·032	1·029	1·026	1·023	1·020	17
18	Baumé .	8·6	8·4	8·2	8·0	7·8	7·6	7·5	7·3	7·0	6·7	6·4	6·2	5·8	5·4	5·0	4·5	4·4	4·0	3·6	3·2	2·8	18
19	Spec. Grav. .	1·054	1·053	1·051	1·050	1·048	1·047	1·046	1·044	1·042	1·040	1·038	1·036	1·033	1·030	1·027	1·024	1·021	1·019	1·016	1·013	1·010	19
20	Baumé .	7·3	7·1	6·9	6·7	6·4	6·3	6·2	5·9	5·6	5·4	5·1	4·9	4·5	4·1	3·7	3·3	2·9	2·6	2·3	1·9	1·4	20
21	Spec. Grav. .	1·044	1·043	1·041	1·040	1·038	1·037	1·036	1·034	1·032	1·030	1·028	1·026	1·023	1·020	1·017	1·014	1·011	1·009	1·006	1·003	1·000	21
22	Baumé .	5·9	5·8	5·5	5·4	5·1	5·0	4·9	4·6	4·4	4·1	3·9	3·6	3·1	2·8	2·4	2·0	1·6	1·3	0·9	0·4		22
23	Spec. Grav. .	1·034	1·033	1·031	1·030	1·028	1·027	1·026	1·024	1·022	1·020	1·018	1·016	1·013	1·010	1·007	1·004	1·001	0·999	0·996	0·993	0·990	23
24	Baumé .	4·6	4·5	4·3	4·1	3·9	3·7	3·5	3·3	3·0	2·8	2·5	2·2	1·9	1·4	1·0	0·6	0·1					24
25	Spec. Grav. .	1·024	1·023	1·021	1·020	1·018	1·017	1·016	1·014	1·012	1·010	1·008	1·006	1·003	1·000	0·997	0·994	0·991	0·989	0·986	0·983	0·980	25
26	Baumé .	3·3	3·2	2·9	2·8	2·5	2·4	2·3	2·0	1·7	1·4	1·1	0·9	0·4									26
27	Spec. Grav. .	1·014	1·013	1·011	1·010	1·008	1·007	1·006	1·004	1·002	1·000	0·998	0·996	0·993	0·990	0·987	0·984	0·981	0·979	0·976	0·973	0·970	27
28	Baumé .	2·0	1·9	1·6	1·4	1·1	1·0	0·9	0·6	0·3													28

TABLE No. 70

Caustic Alkali Solutions required to saponify Fats of Mean Molecular Weight 670 (Cocoanut Oil, Palmkernel Oil)

Weight of Fat in Tons.	Gallons of Solution.							
	20° Twaddell = S. G. 1.1.		40° Twaddell = S. G. 1.2.		60° Twaddell = S. G. 1.3.		71° Twaddell = S. G. 1.355.	
	NaOH.	KOH.	NaOH.	KOH.	NaOH.	KOH.	NaOH.	KOH.
.05	21.01	21.31	9.46	10.42	5.72	6.97	4.59	5.80
.1	42.02	42.63	18.92	20.84	11.43	13.95	9.18	11.60
.15	63.03	63.94	28.38	31.26	17.15	20.92	13.76	17.40
.2	84.04	85.25	37.84	41.68	22.86	27.90	18.35	23.21
.25	105.05	106.57	47.30	52.10	28.58	34.87	22.94	29.01
.3	126.06	127.88	56.76	62.52	34.29	41.85	27.53	34.81
.35	147.07	149.19	66.22	72.94	40.01	48.82	32.11	40.61
.4	168.07	170.51	75.68	83.36	45.72	55.79	36.70	46.41
.45	189.08	191.82	85.14	93.78	51.44	62.77	41.29	52.21
.5	210.09	213.13	94.60	104.20	57.15	69.74	45.88	58.01
.55	231.10	234.45	104.06	114.62	62.87	76.72	50.46	63.81
.6	252.11	255.76	113.52	125.04	68.58	83.69	55.05	69.62
.65	273.12	277.07	122.98	135.46	74.30	90.67	59.64	75.42
.7	294.13	298.39	132.44	145.88	80.01	97.64	64.23	81.22
.75	315.14	319.70	141.91	156.30	85.73	104.61	68.81	87.02
.8	336.15	341.01	151.37	166.72	91.44	111.59	73.40	92.82
.85	357.16	362.33	160.83	177.14	97.16	118.56	77.99	98.62
.9	378.17	383.64	170.29	187.56	102.87	125.54	82.58	104.42
.95	399.18	404.95	179.75	197.98	108.59	132.51	87.16	110.22
1.0	420.19	426.27	189.21	208.40	114.30	139.49	91.75	116.03
2.0	840.37	852.54	378.41	416.80	228.60	278.97	183.50	232.05
3.0	1260.56	1278.80	567.62	625.19	342.90	418.46	275.26	348.08
4.0	1680.74	1705.07	756.83	833.59	457.20	557.94	367.01	464.10
5.0	2100.93	2131.34	946.04	1041.99	571.50	697.43	458.76	580.13
6.0	2521.12	2557.61	1135.24	1250.39	685.80	836.92	550.51	696.16
7.0	2941.30	2983.88	1324.45	1458.79	800.10	976.40	642.26	812.18
8.0	3361.49	3410.14	1513.66	1667.18	914.40	1115.89	734.02	928.21
9.0	3781.67	3836.41	1702.86	1875.58	1028.70	1255.37	825.77	1044.23
10.0	4201.86	4262.68	1892.07	2083.98	1143.00	1394.86	917.52	1160.26

TABLE NO. 71.—*German and French Alkalimetric Degrees*

Real Soda.	German degrees.	French degrees.	Real Soda.	German degrees.	French degrees.
Na ₂ O. Per cent.	Na ₂ CO ₃ . Per cent.		Na ₂ O. Per cent.	Na ₂ CO ₃ . Per cent.	
0·5	0·85	0·79	27	46·17	42·67
1	1·81	1·58	27·5	47·02	43·46
1·5	2·56	2·37	28	47·88	44·25
2	3·42	3·16	28·5	48·73	45·04
2·5	4·27	3·95	29	49·59	45·83
3	5·13	4·74	29·5	50·44	46·62
3·5	5·98	5·53	30	51·29	47·42
4	6·84	6·32	30·5	52·14	48·21
4·5	7·69	7·11	31	53·00	49·00
5	8·55	7·90	31·5	53·85	49·79
5·5	9·40	8·69	32	54·71	50·88
6	10·26	9·48	32·5	55·56	51·37
6·5	11·11	10·27	33	56·42	52·16
7	11·97	11·06	33·5	57·27	52·95
7·5	12·82	11·85	34	58·13	53·74
8	13·68	12·64	34·5	58·98	54·53
8·5	14·53	13·43	35	59·84	55·32
9	15·39	14·22	35·5	60·69	56·11
9·5	16·24	15·01	36	61·55	56·90
10	17·10	15·81	36·5	62·40	57·69
10·5	17·95	16·60	37	63·26	58·48
11	18·81	17·39	37·5	64·11	59·27
11·5	19·66	18·18	38	64·97	60·06
12	20·52	18·97	38·5	65·82	60·85
12·5	21·37	19·76	39	66·68	61·64
13	22·23	21·55	39·5	67·53	62·43
13·5	23·08	21·34	40	68·39	63·22
14	23·94	22·13	40·5	69·24	64·01
14·5	24·79	22·92	41	70·10	64·81
15	25·65	23·71	41·5	70·95	65·60
15·5	26·50	24·50	42	71·81	66·39
16	27·36	25·29	42·5	72·66	67·18
16·5	28·21	26·08	43	73·52	67·97
17	29·07	26·87	43·5	74·37	68·76
17·5	29·92	27·66	44	75·23	69·55
18	30·78	28·45	44·5	76·08	70·34
18·5	31·63	29·24	45	76·94	71·13
19	32·49	30·03	45·5	77·80	71·92
19·5	33·34	30·82	46	78·66	72·71
20	34·20	31·61	46·5	79·51	73·50
20·5	35·05	32·40	47	80·37	74·29
21	35·91	33·19	47·5	81·22	75·08
21·5	36·76	33·98	48	82·07	75·87
22	37·62	34·77	48·5	82·93	76·66
22·5	38·47	35·56	49	83·78	77·45
23	39·33	36·35	49·5	84·64	78·24
23·5	40·18	37·14	50	85·48	79·03
24	41·04	37·93	50·5	86·34	79·82
24·5	41·89	38·72	51	87·19	80·61
25	42·75	39·51	51·5	88·05	81·40
25·5	43·60	40·30	52	88·90	82·19
26	44·46	41·09	52·5	89·76	82·98
26·5	45·31	41·88	53	90·61	83·77

TABLE No. 71—*continued*.—*German and French Alkalimetric Degrees*

Real Soda.	German degrees.	French degrees.	Real Soda.	German degrees.	French degrees.
Na ₂ O.	Na ₂ CO ₃ .		Na ₂ O.	Na ₂ CO ₃ .	
53·5	91·47	84·56	66	112·85	104·32
54	92·32	85·35	66·5	113·70	105·11
54·5	93·18	86·14	67	114·56	105·90
55	94·03	86·93	67·5	115·41	106·69
55·5	94·89	87·72	68	116·27	107·48
56	95·74	88·52	68·5	117·12	108·27
56·5	96·60	89·31	69	117·98	109·06
57	97·45	90·10	69·5	118·83	109·85
57·5	98·31	90·88	70	119·69	110·64
58	99·16	91·68	70·5	120·53	111·43
58·5	100·02	92·47	71	121·39	112·23
59	100·87	93·26	71·5	122·24	113·02
59·5	101·73	94·05	72	123·10	113·81
60	102·58	94·84	72·5	123·95	114·60
60·5	103·44	95·63	73	124·81	115·39
61	104·30	96·42	73·5	125·66	116·18
61·5	105·15	97·21	74	126·52	116·97
62	106·01	98·00	74·5	127·37	117·76
62·5	106·86	98·79	75	128·23	118·55
63	107·72	99·58	75·5	129·08	119·34
63·5	108·57	100·37	76	129·94	120·13
64	109·43	101·16	76·5	130·79	120·92
64·5	110·28	101·95	77	131·65	121·71
65	111·14	102·74	77·5	132·50	122·50
65·5	111·99	103·53			

TABLE No. 72

Specific Gravities of Solutions of Sodium Carbonate at 15° C.

Twaddell.	Percentage by Weight.		Twaddell.	Percentage by Weight.	
	Na ₂ O.	Na ₂ CO ₃ .		Na ₂ O.	Na ₂ CO ₃ .
1	0·28	0·47	16	4·42	7·57
2	0·56	0·95	17	4·70	8·04
3	0·84	1·42	18	4·97	8·51
4	1·11	1·90	19	5·24	8·97
5	1·39	2·38	20	5·52	9·43
6	1·67	2·85	21	5·79	9·90
7	1·95	3·33	22	6·06	10·37
8	2·22	3·80	23	6·33	10·83
9	2·50	4·28	24	6·61	11·30
10	2·78	4·76	25	6·88	11·76
11	3·06	5·23	26	7·15	12·23
12	3·34	5·71	27	7·42	12·70
13	3·61	6·17	28	7·70	13·16
14	3·88	6·64	29	7·97	13·63
15	4·16	7·10	30	8·24	14·09

TABLE NO. 73.—*Specific Gravities of Solutions of Potassium Carbonate at 15° C. (Gerlach)*

Twaddell.	Per cent by Weight. K_2CO_3 .	Kilogram. per cubic meter. K_2CO_3 .	Lbs. per cubic foot. K_2CO_3 .	Twaddell.	Per cent by Weight. K_2CO_3 .	Kilogram. per cubic meter. K_2CO_3 .	Lbs. per cubic foot. K_2CO_3 .
1	.54	5.4	0.34	58	29.02	374.3	23.34
2	1.08	10.9	0.68	59	29.46	381.5	23.79
3	1.62	16.4	1.02	60	29.91	388.8	24.24
4	2.16	22.0	1.37	61	30.34	395.9	24.68
5	2.70	27.7	1.73	62	30.77	403.1	25.13
6	3.24	33.4	2.08	63	31.21	410.3	25.58
7	3.78	39.1	2.43	64	31.64	417.6	26.04
8	4.32	44.9	2.80	65	32.08	425.0	26.50
9	4.86	50.8	3.17	66	32.51	432.4	26.96
10	5.40	56.7	3.53	67	32.94	439.8	27.42
11	5.94	62.7	3.90	68	33.38	447.3	27.89
12	6.48	68.7	4.28	69	33.81	454.8	28.36
13	7.02	74.8	4.66	70	34.25	462.4	28.83
14	7.56	80.9	5.04	71	34.67	469.9	29.30
15	8.10	87.1	5.43	72	35.10	477.4	29.77
16	8.64	93.3	5.82	73	35.52	484.9	30.23
17	9.18	99.6	6.21	74	35.95	492.5	30.71
18	9.72	105.9	6.60	75	36.37	500.1	31.18
19	10.26	108.4	6.51	76	36.80	507.8	31.66
20	10.80	118.8	7.41	77	37.22	515.6	32.15
21	11.31	125.0	7.79	78	37.65	523.3	32.63
22	11.82	131.2	8.18	79	38.07	531.7	33.11
23	12.33	137.5	8.57	80	38.50	539.0	33.60
24	12.84	143.8	8.97	81	38.91	546.7	34.09
25	13.35	150.2	9.37	82	39.32	554.4	34.57
26	13.86	156.6	9.76	83	39.73	562.2	35.05
27	14.37	163.1	10.17	84	40.14	570.0	35.54
28	14.88	169.6	10.57	85	40.55	577.8	36.02
29	15.39	176.2	10.99	86	40.96	585.7	36.51
30	15.90	182.8	11.40	87	41.37	593.6	37.01
31	16.38	189.2	11.80	88	41.78	601.6	37.51
32	16.86	195.6	12.20	89	42.19	609.6	38.01
33	17.34	202.0	12.59	90	42.60	617.7	38.51
34	17.82	208.5	13.00	91	43.00	625.6	39.01
35	18.30	215.0	13.40	92	43.40	633.6	39.51
36	18.78	221.6	13.82	93	43.80	641.6	40.01
37	19.26	228.2	14.23	94	44.20	649.7	40.51
38	19.74	234.9	14.65	95	44.60	657.8	41.01
39	20.22	241.7	15.07	96	45.00	666.0	41.52
40	20.70	248.4	15.49	97	45.40	674.2	42.03
41	21.17	255.2	15.91	98	45.80	682.4	42.55
42	21.65	262.0	16.33	99	46.20	690.7	43.06
43	22.12	268.8	16.76	100	46.60	699.0	43.58
44	22.60	275.7	17.19	101	46.98	707.1	44.09
45	23.07	282.6	17.62	102	47.37	715.3	44.61
46	23.55	289.6	18.05	103	47.35	723.5	45.11
47	24.02	296.7	18.50	104	48.14	731.7	45.62
48	24.50	303.8	18.94	105	48.52	740.0	46.14
49	24.97	310.9	19.38	106	48.91	748.3	46.66
50	25.45	318.1	19.83	107	49.29	756.7	47.18
51	25.89	325.0	20.26	108	49.68	765.1	47.70
52	26.34	331.9	20.70	109	50.06	773.5	48.22
53	26.78	338.8	21.12	110	50.45	782.0	48.76
54	27.23	345.8	21.56	111	50.83	790.5	49.29
55	27.68	352.8	22.00	112	51.22	799.0	49.82
56	28.12	359.9	22.44	113	51.61	807.7	50.36
57	28.57	367.1	22.89	114	52.00	816.4	50.90

TABLE NO. 74

Determination of Resin in Soap by Twitchell's Method
(Lewkowitsch)

A. Volumetric Analysis

Mixed Fatty and Resin Acids.	Resin Acids.	
	Theory.	Experiment.
No.	Per cent.	Per cent.
1	9.79	9.98, 9.34, 9.79, 9.91.
2	19.69	23.97, 24.55, 22.93, 23.28, 23.98, 24.08.
3	21.45	24.96, 24.78, 23.63.
4	24.66	24.89, 25.15, 25.06, 24.23.
5	30.31	29.69, 30.12, 28.18, 29.78.
6	39.81	40.24, 40.37, 41.44, 42.13, 41.8, 40.37, 42.18, 40.55, 40.07, 40.05, 43.69, 41.12, 41.81, 40.77, 44.82.
7	45.05	45.76, 46.50, 49.61, 47.66, 46.45, 47.84, 45.34, 44.24, 44.48, 44.39.

B. Gravimetric Analysis

Mixed Fatty and Resin Acids.	Resin Acids.	
	Theory.	Experiment.
No.	Per cent.	Per cent.
1	9.79	9.38, 9.97.
2	19.69	20.46, 20.55, 19.96, ¹ 19.99, 19.44, 19.33.
3	21.45	19.25, 18.27, 19.37, 17.83, ¹ 19.54, 18.61, 18.57, 19.16.
4	24.66	20.97, 16.65, 21.76.
5	30.31	25.76, 25.06, 23.66, 26.10.
6	39.81	35.97, 38.86, 36.44, 36.14, 35.42, 35.86, 32.51, 36.29.
7	45.05	37.58, 37.23, 37.29, 36.97, 35.32, 40.06, 36.8.

¹ Emulsion.

8. GLYCERIN

TABLE NO. 75.—*Residue and Ash of Distilled Glycerines*

No.	Residue at 160° C.	Ash.	Organic Residue.	
	Per cent.	Per cent.	Per cent.	
1	0·03033	0·00603	0·0243	Chemically pure glycerin, B.P.
2	0·0276	0·00300	0·0246	
3	0·0337	0·005	0·0327	
4	0·0498	0·0138	0·0360	
5	0·0452	0·0081	0·0371	
6	0·0509	0·0066	0·0443	Commercial double distilled.
7	0·0656	0·0139	0·0517	
8	0·0748	0·0140	0·0738	
9	0·0905	0·0154	0·0751	
10	0·1047	0·0190	0·0857	
11	0·1236	0·0305	0·0931	Commercial distilled glycerin.
12	0·1621	0·0183	0·1438	
13	0·8060	0·2090	0·5970	

TABLE NO. 76.—*Specific Gravities of Aqueous Solutions of Glycerin*

Glycerol. Per cent.	LENZ.	STROHMER.	GERLACH.		NICOL.
	Spec. Grav. at 12°-14° C. Water at 12° C. = 1.	Spec. Grav. at 17·5° C. Water at 17·5 C. = 1.	Spec. Grav. at 15° C. Water at 15° C. = 1.	Spec. Grav. at 20° C. Water at 20° C. = 1.	Spec. Grav. at 20° C. Water at 20° C. = 1.
100	1·2691	1·262	1·2653	1·2620	1·26348
99	1·2664	1·259	1·2628	1·2594	1·26091
98	1·2637	1·257	1·2602	1·2568	1·25832
97	1·2610	1·254	1·2577	1·2542	1·25572
96	1·2584	1·252	1·2552	1·2516	1·25312
95	1·2557	1·249	1·2526	1·2490	1·25052
94	1·2531	1·246	1·2501	1·2464	1·24790
93	1·2504	1·244	1·2476	1·2438	1·24526
92	1·2478	1·241	1·2451	1·2412	1·24259
91	1·2451	1·239	1·2425	1·2386	1·23990
90	1·2425	1·236	1·2400	1·2360	1·23720
89	1·2398	1·233	1·2373	1·2333	1·23449
88	1·2372	1·231	1·2346	1·2306	1·23178
87	1·2345	1·228	1·2319	1·2279	1·22907
86	1·2318	1·226	1·2292	1·2252	1·22636
85	1·2292	1·223	1·2265	1·2225	1·22365
84	1·2265	1·220	1·2238	1·2198	1·22094
83	1·2238	1·218	1·2211	1·2171	1·21823
82	1·2212	1·215	1·2184	1·2144	1·21552
81	1·2185	1·213	1·2157	1·2117	1·21281
80	1·2159	1·210	1·2130	1·2090	1·21010
79	1·2122	1·207	1·2102	1·2063	1·20739
78	1·2106	1·204	1·2074	1·2036	1·20468
77	1·2079	1·202	1·2046	1·2009	1·20197
76	1·2042	1·199	1·2018	1·1982	1·19925
75	1·2016	1·196	1·1990	1·1955	1·19653
74	1·1999	1·193	1·1962	1·1928	1·19381
73	1·1973	1·190	1·1934	1·1901	1·19109
72	1·1945	1·188	1·1906	1·1874	1·18837
71	1·1918	1·185	1·1878	1·1847	1·18565
70	1·1889	1·182	1·1850	1·1820	1·18293
69	1·1858	1·179	...	...	1·18020
68	1·1826	1·176	...	...	1·17747
67	1·1795	1·173	...	...	1·17474
66	1·1764	1·170	...	...	1·17201
65	1·1733	1·167	1·1711	1·1685	1·16928
64	1·1702	1·163	...	...	1·16654
63	1·1671	1·160	...	...	1·16380
62	1·1640	1·157	...	...	1·16107
61	1·1610	1·154	...	...	1·15834
60	1·1582	1·151	1·1570	1·1550	1·15561
59	1·1556	1·149	...	...	1·15288
58	1·1530	1·146	...	...	1·15015
57	1·1505	1·144	...	...	1·14742
56	1·1480	1·142	...	...	1·14469
55	1·1455	1·140	1·1430	1·1415	1·14196
54	1·1430	1·137	...	...	1·13923
53	1·1403	1·135	...	...	1·13650
52	1·1375	1·133	...	...	1·13377
51	1·1348	1·130	...	...	1·13104
50	1·1320	1·128	1·1290	1·1280	1·12831
45	1·1183	...	1·1155	1·1145	1·11469
40	1·1045	...	1·1020	1·1010	1·10118
35	1·0907	...	1·0885	1·0875	1·08786
30	1·0771	...	1·0750	1·0740	1·07469
25	1·0635	...	1·0620	1·0610	1·06166
20	1·0498	...	1·0490	1·0480	1·04884
15	1·0374	...	...	...	1·03622
10	1·0245	...	1·0245	1·0235	1·02391
5	1·0123	...	...	...	1·01184
0	1·0000	...	1·0000	1·0000	1·00000

TABLE NO. 77

Specific Gravities and Refractive Indices of Aqueous Solutions of Glycerin (Lenz)

Glycerol.	Sp. Gr. at 12°-14° C.	Ref. Ind. at 12° 5'- 12° 8' C.	Glycerol.	Sp. Gr. at 12°-14° C.	Ref. Ind. at 12° 5'- 12° 8' C.	Glycerol.	Sp. Gr. at 12°-14° C.	Ref. Ind. at 12° 5'- 12° 8' C.
Per cent.			Per cent.			Per cent.		
100	1·2691	1·4758	66	1·1764	1·4249	32	1·0825	1·3745
99	1·2664	1·4744	65	1·1733	1·4231	31	1·0798	1·3732
98	1·2637	1·4729	64	1·1702	1·4213	30	1·0771	1·3719
97	1·2610	1·4715	63	1·1671	1·4195	29	1·0744	1·3706
96	1·2584	1·4700	62	1·1640	1·4176	28	1·0716	1·3692
95	1·2557	1·4686	61	1·1610	1·4158	27	1·0689	1·3679
94	1·2531	1·4671	60	1·1582	1·4140	26	1·0663	1·3666
93	1·2504	1·4657	59	1·1556	1·4126	25	1·0635	1·3652
92	1·2478	1·4642	58	1·1530	1·4114	24	1·0608	1·3639
91	1·2451	1·4628	57	1·1505	1·4102	23	1·0580	1·3626
90	1·2425	1·4613	56	1·1480	1·4091	22	1·0553	1·3612
89	1·2398	1·4598	55	1·1455	1·4079	21	1·0525	1·3599
88	1·2372	1·4584	54	1·1430	1·4065	20	1·0498	1·3585
87	1·2345	1·4569	53	1·1403	1·4051	19	1·0471	1·3572
86	1·2318	1·4555	52	1·1375	1·4036	18	1·0446	1·3559
85	1·2292	1·4540	51	1·1348	1·4022	17	1·0422	1·3546
84	1·2265	1·4525	50	1·1320	1·4007	16	1·0398	1·3533
83	1·2238	1·4511	49	1·1293	1·3993	15	1·0374	1·3520
82	1·2212	1·4496	48	1·1265	1·3979	14	1·0349	1·3507
81	1·2185	1·4482	47	1·1238	1·3964	13	1·0332	1·3494
80	1·2159	1·4467	46	1·1210	1·3950	12	1·0297	1·3480
79	1·2122	1·4453	45	1·1183	1·3935	11	1·0271	1·3467
78	1·2106	1·4438	44	1·1155	1·3921	10	1·0245	1·3454
77	1·2079	1·4424	43	1·1127	1·3906	9	1·0221	1·3442
76	1·2042	1·4409	42	1·1100	1·3890	8	1·0196	1·3430
75	1·2016	1·4395	41	1·1072	1·3875	7	1·0172	1·3417
74	1·1999	1·4380	40	1·1045	1·3860	6	1·0147	1·3405
73	1·1973	1·4366	39	1·1017	1·3844	5	1·0123	1·3392
72	1·1945	1·4352	38	1·0989	1·3829	4	1·0098	1·3380
71	1·1918	1·4337	37	1·0962	1·3813	3	1·0074	1·3367
70	1·1889	1·4321	36	1·0934	1·3798	2	1·0049	1·3355
69	1·1858	1·4304	35	1·0907	1·3785	1	1·0025	1·3342
68	1·1826	1·4286	34	1·0880	1·3772			
67	1·1795	1·4267	33	1·0852	1·3758			

TABLE NO. 78

Specific Gravities, Boiling Points, and Vapour Tensions of Aqueous Solutions of Glycerin (Gerlach)

Glycerol.	Parts of Glycerol compared with 100 parts of Water.	Specific Gravity.		Boiling Point. At 760 mm. Pressure.	Vapour Tension at 100° C.
		At 15° C. Water 15° C. = 1.	At 20° C. Water 20° C. = 1.		
Per cent.				°C.	mm.
100	Glycerin	1.2653	1.2620	290	64
99	9900	1.2628	1.2594	239	87
98	4900	1.2602	1.2568	208	107
97	3233.333	1.2577	1.2542	188	126
96	2400	1.2552	1.2516	175	144
95	1900	1.2526	1.2490	164	162
94	1566.666	1.2501	1.2464	156	180
93	1328.571	1.2476	1.2438	150	198
92	1150	1.2451	1.2412	145	215
91	1011.111	1.2425	1.2386	141	231
90	900	1.2400	1.2360	138	247
89	809.090	1.2373	1.2333	135	263
88	733.333	1.2346	1.2306	132.5	279
87	669.231	1.2319	1.2279	130.5	295
86	614.286	1.2292	1.2252	129	311
85	566.666	1.2265	1.2225	127.5	326
84	525	1.2238	1.2198	126	340
83	488.235	1.2211	1.2171	124.5	355
82	455.555	1.2184	1.2144	123	370
81	426.316	1.2157	1.2117	122	384
80	400	1.2130	1.2090	121	396
79	376.190	1.2102	1.2063	120	408
78	354.500	1.2074	1.2036	119	419
77	334.782	1.2046	1.2009	118.2	430
76	316.666	1.2018	1.1982	117.4	440
75	300	1.1990	1.1955	116.7	450
74	284.615	1.1962	1.1928	116	460
73	270.370	1.1934	1.1901	115.4	470
72	257.143	1.1906	1.1874	114.8	480
71	244.828	1.1878	1.1847	114.2	489
70	233.333	1.1850	1.1820	113.6	496
65	185.714	1.1710	1.1685	111.3	553
60	150	1.1570	1.1550	109	565
55	122.222	1.1430	1.1415	107.5	593
50	100	1.1290	1.1280	106	618
45	81.818	1.1155	1.1145	105	639
40	66.666	1.1020	1.1010	104	657
35	53.846	1.0885	1.0875	103.4	675
30	42.857	1.0750	1.0740	102.8	690
25	33.333	1.0620	1.0610	102.3	704
20	25	1.0490	1.0480	101.8	717
10	11.111	1.0245	1.0235	100.9	740
0	0	1.0000	1.0000	100	760

PART III

GENERAL TABLES

TABLE NO. 79

Comparison of different Thermometric Scales

Fahr.	Cels.	Réaum.	Fahr.	Cels.	Réaum.	Fahr.	Cels.	Réaum.
-40	-40.0	-32.0	+10	-12.2	-9.8	+60	+15.6	+12.4
39	39.4	31.6	11	11.7	9.3	61	16.1	12.9
38	38.9	31.1	12	11.1	8.9	62	16.7	13.3
37	38.3	30.7	13	10.6	8.4	63	17.2	13.8
36	37.8	30.2	14	10.0	8.0	64	17.8	14.2
35	37.2	29.8	15	9.4	7.6	65	18.3	14.7
34	36.7	29.3	16	8.9	7.1	66	18.9	15.1
33	36.1	28.9	17	8.3	6.7	67	19.4	15.6
32	35.6	28.4	18	7.8	6.2	68	20.0	16.0
31	35.0	28.0	19	7.2	5.8	69	20.6	16.4
30	34.4	27.6	20	6.7	5.3	70	21.1	16.9
29	33.9	27.1	21	6.1	4.9	71	21.7	17.3
28	33.3	26.7	22	5.6	4.4	72	22.2	17.8
27	32.8	26.2	23	5.0	4.0	73	22.8	18.2
26	32.2	25.8	24	4.4	3.6	74	23.3	18.7
25	31.7	25.3	25	3.9	3.1	75	23.9	19.1
24	31.1	24.9	26	3.3	2.7	76	24.4	19.6
23	30.6	24.4	27	2.8	2.2	77	25.0	20.0
22	30.0	24.0	28	2.2	1.8	78	25.6	20.4
21	29.4	23.6	29	1.7	1.3	79	26.1	20.9
20	28.9	23.1	30	1.1	0.9	80	26.7	21.3
19	28.3	22.7	31	0.6	0.4	81	27.2	21.8
18	27.8	22.2	32	+0.0	+0.0	82	27.8	22.2
17	27.2	21.8	33	0.6	0.4	83	28.3	22.7
16	26.7	21.3	34	1.1	0.9	84	28.9	23.1
15	26.1	20.9	35	1.7	1.3	85	29.4	23.6
14	25.6	20.4	36	2.2	1.8	86	30.0	24.0
13	25.0	20.0	37	2.8	2.2	87	30.6	24.4
12	24.4	19.6	38	3.3	2.7	88	31.1	24.9
11	23.9	19.1	39	3.9	3.1	89	31.7	25.3
10	23.3	18.7	40	4.4	3.6	90	32.2	25.8
9	22.8	18.2	41	5.0	4.0	91	32.8	26.2
8	22.2	17.8	42	5.6	4.4	92	33.3	26.7
7	21.7	17.3	43	6.1	4.9	93	33.9	27.1
6	21.1	16.9	44	6.7	5.3	94	34.4	27.6
5	20.6	16.4	45	7.2	5.8	95	35.0	28.0
4	20.0	16.0	46	7.8	6.2	96	35.6	28.4
3	19.4	15.6	47	8.3	6.7	97	36.1	28.9
2	18.9	15.1	48	8.9	7.1	98	36.7	29.3
1	18.3	14.7	49	9.4	7.6	99	37.2	29.8
0	17.8	14.2	50	10.0	8.0	100	37.8	30.2
+1	17.2	13.8	51	10.6	8.4	101	38.3	30.7
2	16.7	13.3	52	11.1	8.9	102	38.9	31.1
3	16.1	12.9	53	11.7	9.3	103	39.4	31.6
4	15.6	12.4	54	12.2	9.8	104	40.0	32.0
5	15.0	12.0	55	12.8	10.2	105	40.6	32.4
6	14.4	11.6	56	13.3	10.7	106	41.1	32.9
7	13.9	11.1	57	13.9	11.1	107	41.7	33.3
8	13.3	10.7	58	14.4	11.6	108	42.2	33.8
9	12.8	10.2	59	15.0	12.0	109	42.8	34.2

TABLE NO. 79—*continued*
Comparison of different Thermometric Scales

Fahr.	Cels.	Réaun.	Fahr.	Cels.	Réaun.	Fahr.	Cels.	Réaun.
+110	+43·3	+34·7	+145	+62·8	+50·2	+180	+82·2	+65·8
111	43·9	35·1	146	63·3	50·7	181	82·8	66·2
112	44·4	35·6	147	63·9	51·1	182	83·3	66·7
113	45·0	36·0	148	64·4	51·6	183	83·9	67·1
114	45·6	36·4	149	65·0	52·0	184	84·4	67·6
115	46·1	36·9	150	65·6	52·4	185	85·0	68·0
116	46·7	37·3	151	66·1	52·9	186	85·6	68·4
117	47·2	37·8	152	66·7	53·3	187	86·1	68·9
118	47·8	38·2	153	67·2	53·8	188	86·7	69·3
119	48·3	38·7	154	67·8	54·2	189	87·2	69·8
120	48·9	39·1	155	68·3	54·7	190	87·8	70·2
121	49·4	39·6	156	68·9	55·1	191	88·3	70·7
122	50·0	40·0	157	69·4	55·6	192	88·9	71·1
123	50·6	40·4	158	70·0	56·0	193	89·4	71·6
124	51·1	40·9	159	70·6	56·4	194	90·0	72·0
125	51·7	41·3	160	71·1	56·9	195	90·6	72·4
126	52·2	41·8	161	71·7	57·3	196	91·1	72·9
127	52·8	42·2	162	72·2	57·8	197	91·7	73·3
128	53·3	42·7	163	72·8	58·2	198	92·2	73·8
129	53·9	43·1	164	73·3	58·7	199	92·8	74·2
130	54·4	43·6	165	73·9	59·1	200	93·3	74·7
131	55·0	44·0	166	74·4	59·6	201	93·9	75·1
132	55·6	44·4	167	75·0	60·0	202	94·4	75·6
133	56·1	44·9	168	75·6	60·4	203	95·0	76·0
134	56·7	45·3	169	76·1	60·9	204	95·6	76·4
135	57·2	45·8	170	76·7	61·3	205	96·1	76·9
136	57·8	46·2	171	77·2	61·8	206	96·7	77·3
137	58·3	46·7	172	77·8	62·2	207	97·2	77·8
138	58·9	47·1	173	78·3	62·7	208	97·8	78·2
139	59·4	47·6	174	78·9	63·1	209	98·3	78·7
140	60·0	48·0	175	79·4	63·6	210	98·9	79·1
141	60·6	48·4	176	80·0	64·0	211	99·4	79·6
142	61·1	48·9	177	80·6	64·4	212	100·0	80·0
143	61·7	49·3	178	81·1	64·9			
144	62·2	49·8	179	81·7	65·3			

TABLE No. 80

Comparison of different Thermometric Scales

Cels.	Réaum.	Fahr.	Cels.	Réaum.	Fahr.	Cels.	Réaum.	Fahr.
-40	-32.0	-40.0	+7	+5.6	+44.6	+54	+43.2	+129.2
39	31.2	38.2	8	6.4	46.4	55	44.0	131.0
38	30.4	36.4	9	7.2	48.2	56	44.8	132.8
37	29.6	34.6	10	8.0	50.0	57	45.6	134.6
36	28.8	32.8	11	8.8	51.8	58	46.4	136.4
35	28.0	31.0	12	9.6	53.6	59	47.2	138.2
34	27.2	29.2	13	10.4	55.4	60	48.0	140.0
33	26.4	27.4	14	11.2	57.2	61	48.8	141.8
32	25.6	25.6	15	12.0	59.0	62	49.6	143.6
31	24.8	23.8	16	12.8	60.8	63	50.4	145.4
30	24.0	22.0	17	13.6	62.6	64	51.2	147.2
29	23.2	20.2	18	14.4	64.4	65	52.0	149.0
28	22.4	18.4	19	15.2	66.2	66	52.8	150.8
27	21.6	16.6	20	16.0	68.0	67	53.6	152.6
26	20.8	14.8	21	16.8	69.8	68	54.4	154.4
25	20.0	13.0	22	17.6	71.6	69	55.2	156.2
24	19.2	11.2	23	18.4	73.4	70	56.0	158.0
23	18.4	9.4	24	19.2	75.2	71	56.8	159.8
22	17.6	7.6	25	20.0	77.0	72	57.6	161.6
21	16.8	5.8	26	20.8	78.8	73	58.4	163.4
20	16.0	4.0	27	21.6	80.6	74	59.2	165.2
19	15.2	2.2	28	22.4	82.4	75	60.0	167.0
18	14.4	0.4	29	23.2	84.2	76	60.8	168.8
17	13.6	+1.4	30	24.0	86.0	77	61.6	170.6
16	12.8	3.2	31	24.8	87.8	78	62.4	172.4
15	12.0	5.0	32	25.6	89.6	79	63.2	174.2
14	11.2	6.8	33	26.4	91.4	80	64.0	176.0
13	10.4	8.6	34	27.2	93.2	81	64.8	177.8
12	9.6	10.4	35	28.0	95.0	82	65.6	179.6
11	8.8	12.2	36	28.8	96.8	83	66.4	181.4
10	8.0	14.0	37	29.6	98.6	84	67.2	183.2
9	7.2	15.8	38	30.4	100.4	85	68.0	185.0
8	6.4	17.6	39	31.2	102.2	86	68.8	186.8
7	5.6	19.4	40	32.0	104.0	87	69.6	188.6
6	4.8	21.2	41	32.8	105.8	88	70.4	190.4
5	4.0	23.0	42	33.6	107.6	89	71.2	192.2
4	3.2	24.8	43	34.4	109.4	90	72.0	194.0
3	2.4	26.6	44	35.2	111.2	91	72.8	195.8
2	1.6	28.4	45	36.0	113.0	92	73.6	197.6
1	0.8	30.2	46	36.8	114.8	93	74.4	199.4
0	0.0	32.0	47	37.6	116.6	94	75.2	201.2
+1	+0.8	33.8	48	38.4	118.4	95	76.0	203.0
2	1.6	35.6	49	39.2	120.2	96	76.8	204.8
3	2.4	37.4	50	40.0	122.0	97	77.6	206.6
4	3.2	39.2	51	40.8	123.8	98	78.4	208.4
5	4.0	41.0	52	41.6	125.6	99	79.2	210.2
6	4.8	42.8	53	42.4	127.4	100	80.0	212.0

TABLE NO. 81

Comparison of the Hydrometer Degrees according to Baumé and Twaddell with the Specific Gravities

Baumé.	Twad- dell.	Specific Gravity.	Baumé.	Twad- dell.	Specific Gravity.	Baumé.	Twad- dell.	Specific Gravity.
0	0	1.000	19.3	31	1.155	36.0	66.4	1.332
0.7	1	1.005	19.8	32	1.160	36.2	67	1.335
1.0	1.4	1.007	20.0	32.4	1.162	36.6	68	1.340
1.4	2	1.010	20.3	33	1.165	37.0	69	1.345
2.0	2.8	1.014	20.9	34	1.170	37.4	70	1.350
2.1	3	1.015	21.0	34.2	1.171	37.8	71	1.355
2.7	4	1.020	21.4	35	1.175	38.0	71.4	1.357
3.0	4.4	1.022	22.0	36	1.180	38.2	72	1.360
3.4	5	1.025	22.5	37	1.185	38.6	73	1.365
4.0	5.8	1.029	23.0	38	1.190	39.0	74	1.370
4.1	6	1.030	23.5	39	1.195	39.4	75	1.375
4.7	7	1.035	24.0	40	1.200	39.8	76	1.380
5.0	7.4	1.037	24.5	41	1.205	40.0	76.6	1.383
5.4	8	1.040	25.0	42	1.210	40.1	77	1.385
6.0	9	1.045	25.5	43	1.215	40.5	78	1.390
6.7	10	1.050	26.0	44	1.220	40.8	79	1.395
7.0	10.2	1.052	26.4	45	1.225	41.0	79.4	1.397
7.4	11	1.055	26.9	46	1.230	41.2	80	1.400
8.0	12	1.060	27.0	46.2	1.231	41.6	81	1.405
8.7	13	1.065	27.4	47	1.235	42.0	82	1.410
9.0	13.4	1.067	27.9	48	1.240	42.3	83	1.415
9.4	14	1.070	28.0	48.2	1.241	42.7	84	1.420
10.0	15	1.075	28.4	49	1.245	43.0	84.8	1.424
10.6	16	1.080	28.8	50	1.250	43.1	85	1.425
11.0	16.6	1.083	29.0	50.4	1.252	43.4	86	1.430
11.2	17	1.085	29.3	51	1.255	43.8	87	1.435
11.9	18	1.090	29.7	52	1.260	44.0	87.6	1.438
12.0	18.2	1.091	30.0	52.6	1.263	44.1	88	1.440
12.4	19	1.095	30.2	53	1.265	44.4	89	1.445
13.0	20	1.100	30.6	54	1.270	44.8	90	1.450
13.6	21	1.105	31.0	54.8	1.274	45.0	90.6	1.453
14.0	21.6	1.108	31.1	55	1.275	45.1	91	1.455
14.2	22	1.110	31.5	56	1.280	45.4	92	1.460
14.9	23	1.115	32.0	57	1.285	45.8	93	1.465
15.0	23.2	1.116	32.4	58	1.290	46.0	93.6	1.468
15.4	24	1.120	32.8	59	1.295	46.1	94	1.470
16.0	25	1.125	33.0	59.4	1.297	46.4	95	1.475
16.5	26	1.130	33.3	60	1.300	46.8	96	1.480
17.0	26.8	1.134	33.7	61	1.305	47.0	96.6	1.483
17.1	27	1.135	34.0	61.6	1.308	47.1	97	1.485
17.7	28	1.140	34.2	62	1.310	47.4	98	1.490
18.0	28.4	1.142	34.6	63	1.315	47.8	99	1.495
18.3	29	1.145	35.0	64	1.320	48.0	99.6	1.498
18.8	30	1.150	35.4	65	1.325	48.1	100	1.500
19.0	30.4	1.152	35.8	66	1.330	48.4	101	1.505

TABLE NO. 81—*continued*

Baumé.	Twad- dell.	Specific Gravity.	Baumé.	Twad- dell.	Specific Gravity.	Baumé.	Twad- dell.	Specific Gravity.
48.7	102	1.510	56.0	127	1.635	61.8	150	1.750
49.0	103	1.515	56.3	128	1.640	62.0	150.6	1.753
49.4	104	1.520				62.1	151	1.755
49.7	105	1.525	56.6	129	1.645	62.3	152	1.760
50.0	106	1.530	56.9	130	1.650	62.5	153	1.765
			57.0	130.4	1.652			
50.3	107	1.535	57.1	131	1.655	62.8	154	1.770
50.6	108	1.540	57.4	132	1.660	63.0	155	1.775
50.9	109	1.545				63.2	156	1.780
51.0	109.2	1.546	57.7	133	1.665	63.5	157	1.785
51.2	110	1.550	57.9	134	1.670	63.7	158	1.790
			58.0	134.2	1.671			
51.5	111	1.555	58.2	135	1.675	64.0	159	1.795
51.8	112	1.560	58.4	136	1.680	64.2	160	1.800
52.0	112.6	1.563				64.4	161	1.805
52.1	113	1.565	58.7	137	1.685	64.6	162	1.810
52.4	114	1.570	58.9	138	1.690	64.8	163	1.815
			59.0	138.2	1.691			
52.7	115	1.575	59.2	139	1.695	65.0	164	1.820
53.0	116	1.580	59.5	140	1.700	65.2	165	1.825
53.3	117	1.585				65.5	166	1.830
53.6	118	1.590	59.7	141	1.705	65.7	167	1.835
53.9	119	1.595	60.0	142	1.710	65.9	168	1.840
			60.2	143	1.715			
54.0	119.4	1.597	60.4	144	1.720	66.0	168.4	1.842
54.1	120	1.600	60.6	145	1.725	66.1	169	1.845
54.4	121	1.605				66.3	170	1.850
54.7	122	1.610	60.9	146	1.730	66.5	171	1.855
55.0	123	1.615	61.0	146.4	1.732	66.7	172	1.860
			61.1	147	1.735			
55.2	124	1.620	61.4	148	1.740	67.0	173	1.865
55.5	125	1.625	61.6	149	1.745			
55.8	126	1.630						

TABLE NO. 82

Degrees Baumé for Liquids lighter than Water at 15.5° C. = 60° F.

Degrees.	Specific Gravity.	Degrees.	Specific Gravity.	Degrees.	Specific Gravity.	Degrees.	Specific Gravity.	Degrees.	Specific Gravity.
10	1.0000	24	0.9090	38	0.8293	51	0.7734	64	0.7216
11	0.9929	25	0.9032	39	0.8284	52	0.7692	65	0.7179
12	0.9859	26	0.8974	40	0.8235	53	0.7650	66	0.7142
13	0.9790	27	0.8917	41	0.8187	54	0.7608	67	0.7106
14	0.9722	28	0.8860	42	0.8139	55	0.7567	68	0.7070
15	0.9655	29	0.8805	43	0.8092	56	0.7526	69	0.7035
16	0.9589	30	0.8750	44	0.8045	57	0.7486	70	0.7000
17	0.9523	31	0.8695	45	0.8000	58	0.7446	75	0.6829
18	0.9459	32	0.8641	46	0.7954	59	0.7407	80	0.6666
19	0.9395	33	0.8588	47	0.7909	60	0.7368	85	0.6511
20	0.9333	34	0.8536	48	0.7865	61	0.7326	90	0.6363
21	0.9271	35	0.8484	49	0.7821	62	0.7290	95	0.6222
22	0.9210	36	0.8433	50	0.7777	63	0.7253	100	0.6087
23	0.9150	37	0.8383						

TABLE No. 83

Specific Gravities of Hydrochloric Acids

Spec. Grav. at 15° C. (in vacuo).	Degrees Baumé.	Degrees Twad.	100 Parts correspond to						1 Liter contains Kilograms					
			HCl Per Cent.	18° Bé. Acid Per Cent.	19° Bé. Acid Per Cent.	20° Bé. Acid Per Cent.	21° Bé. Acid Per Cent.	22° Bé. Acid Per Cent.	HCl	18° Bé. Acid.	19° Bé. Acid.	20° Bé. Acid.	21° Bé. Acid.	22° Bé. Acid.
1.000	0.0	0.0	0.16	0.57	0.53	0.49	0.47	0.45	0.0016	0.0057	0.0053	0.0049	0.0047	0.0045
1.005	0.7	1	1.15	4.08	3.84	3.58	3.42	3.25	0.012	0.041	0.039	0.036	0.034	0.033
1.010	1.4	2	2.14	7.60	7.14	6.66	6.36	6.04	0.022	0.077	0.072	0.076	0.064	0.061
1.015	2.1	3	3.12	11.08	10.41	9.71	9.27	8.81	0.032	0.113	0.106	0.099	0.094	0.089
1.020	2.7	4	4.13	14.67	13.79	12.86	12.27	11.67	0.042	0.150	0.141	0.131	0.125	0.119
1.025	3.4	5	5.15	18.30	17.19	16.04	15.30	14.55	0.053	0.188	0.176	0.164	0.157	0.149
1.030	4.1	6	6.15	21.85	20.53	19.16	18.27	17.38	0.064	0.225	0.212	0.197	0.188	0.179
1.035	4.7	7	7.15	25.40	23.87	22.27	21.25	20.20	0.074	0.263	0.247	0.231	0.220	0.209
1.040	5.4	8	8.16	28.99	27.24	25.42	24.25	23.06	0.085	0.302	0.283	0.264	0.252	0.240
1.045	6.0	9	9.16	32.55	30.58	28.53	27.22	25.88	0.096	0.340	0.320	0.298	0.284	0.270
1.050	6.7	10	10.17	36.14	33.95	31.68	30.22	28.74	0.107	0.380	0.357	0.333	0.317	0.302
1.055	7.4	11	11.18	39.73	37.33	34.82	33.22	31.59	0.118	0.419	0.394	0.367	0.351	0.333
1.060	8.0	12	12.19	43.32	40.70	37.97	36.23	34.44	0.129	0.459	0.431	0.403	0.384	0.365
1.065	8.7	13	13.19	46.87	44.04	41.09	39.20	37.27	0.141	0.499	0.469	0.438	0.418	0.397
1.070	9.4	14	14.17	50.35	47.31	44.14	42.11	40.04	0.152	0.539	0.506	0.472	0.451	0.428
1.075	10.0	15	15.16	53.87	50.62	47.22	45.05	42.84	0.163	0.579	0.544	0.508	0.484	0.460
1.080	10.6	16	16.15	57.39	53.92	50.31	47.99	45.63	0.174	0.620	0.582	0.543	0.518	0.493
1.085	11.2	17	17.13	60.87	57.19	53.36	50.90	48.40	0.186	0.660	0.621	0.579	0.552	0.523
1.090	11.9	18	18.11	64.35	60.47	56.41	53.82	51.17	0.197	0.701	0.659	0.615	0.587	0.558
1.095	12.4	19	19.06	67.73	63.64	59.37	56.64	53.86	0.209	0.742	0.697	0.650	0.620	0.590
1.100	13.0	20	20.01	71.11	66.81	62.33	59.46	56.54	0.220	0.782	0.735	0.686	0.654	0.622
1.105	13.6	21	20.97	74.52	70.01	65.32	62.32	59.26	0.232	0.823	0.774	0.722	0.689	0.655
1.110	14.2	22	21.92	77.89	73.19	68.28	65.14	61.94	0.243	0.865	0.812	0.758	0.723	0.687
1.115	14.9	23	22.86	81.23	76.32	71.21	67.93	64.60	0.255	0.906	0.851	0.794	0.757	0.719
1.120	15.4	24	23.82	84.64	79.53	74.20	70.79	67.31	0.267	0.948	0.891	0.831	0.793	0.754
1.125	16.0	25	24.78	88.06	82.74	77.19	73.74	70.02	0.278	0.991	0.931	0.868	0.828	0.788
1.130	16.5	26	25.75	91.50	85.97	80.21	76.52	72.76	0.291	1.034	0.972	0.906	0.865	0.822
1.135	17.1	27	26.70	94.88	89.15	83.18	79.34	75.45	0.303	1.077	1.011	0.944	0.901	0.856
1.140	17.7	28	27.66	98.29	92.35	86.17	82.20	78.16	0.315	1.121	1.053	0.982	0.937	0.891
1.1425	18.0	...	28.14	100.00	93.95	87.66	83.62	79.51	0.322	1.143	1.073	1.002	0.955	0.908
1.145	18.3	29	28.61	101.67	95.52	89.13	85.02	80.84	0.328	1.164	1.094	1.021	0.973	0.926
1.150	18.8	30	29.57	105.08	98.73	92.11	87.87	83.55	0.340	1.208	1.135	1.059	1.011	0.961
1.152	19.0	...	29.95	106.43	100.00	93.80	89.01	84.63	0.345	1.226	1.152	1.075	1.025	0.975
1.155	19.3	31	30.55	108.58	102.00	95.17	90.79	86.32	0.353	1.254	1.178	1.099	1.049	0.997
1.160	19.8	32	31.52	112.01	105.24	98.19	93.67	89.07	0.366	1.299	1.221	1.139	1.087	1.033
1.163	20.0	...	32.10	114.07	107.17	100.00	95.39	90.70	0.373	1.326	1.246	1.163	1.109	1.054
1.165	20.3	33	32.49	115.46	108.48	101.21	96.55	91.81	0.379	1.345	1.264	1.179	1.125	1.070
1.170	20.9	34	33.46	118.91	111.71	104.24	99.43	94.55	0.392	1.391	1.307	1.220	1.163	1.106
1.171	21.0	...	33.65	119.58	112.35	104.82	100.00	95.09	0.394	1.400	1.316	1.227	1.171	1.113
1.175	21.4	35	34.42	122.32	114.92	107.22	102.28	97.26	0.404	1.437	1.350	1.260	1.202	1.143
1.180	22.0	36	35.39	125.76	118.16	110.24	105.17	100.00	0.418	1.484	1.394	1.301	1.241	1.180
1.185	22.5	37	36.31	129.03	121.23	113.11	107.90	102.60	0.430	1.529	1.437	1.340	1.279	1.216
1.190	23.0	38	37.23	132.30	124.30	115.98	110.63	105.20	0.443	1.574	1.479	1.380	1.317	1.252
1.195	23.5	39	38.16	135.61	127.41	118.87	113.40	107.83	0.456	1.621	1.523	1.421	1.355	1.289
1.200	24.0	40	39.11	138.98	130.58	121.84	116.22	110.51	0.469	1.667	1.567	1.462	1.395	1.326

TABLE No. 84

Specific Gravities of Mixtures of Pure Sulphuric Acid and Water

Specific Gravity at 15° C. (in vacuo)	Degrees Baumé.	Degrees Twaddell.	100 Parts contain				1 Liter contains Kilograms			
			SO ₃ Per cent.	SO ₄ H ₂ Per cent.	60 Degrees Acid. Per cent.	50 Degrees Acid. Per cent.	SO ₃	SO ₄ H ₂	60 Degrees Acid.	50 Degrees Acid.
1.000	0	0	0.07	0.09	0.12	0.14	0.001	0.001	0.001	0.001
1.005	0.7	1	0.68	0.83	1.06	1.33	0.007	0.008	0.011	0.013
1.010	1.4	2	1.28	1.57	2.01	2.51	0.013	0.016	0.020	0.025
1.015	2.1	3	1.88	2.30	2.95	3.68	0.019	0.023	0.030	0.037
1.020	2.7	4	2.47	3.03	3.88	4.85	0.025	0.031	0.040	0.050
1.025	3.4	5	3.07	3.76	4.82	6.02	0.032	0.039	0.049	0.062
1.030	4.1	6	3.67	4.49	5.78	7.18	0.038	0.046	0.059	0.074
1.035	4.7	7	4.27	5.23	6.73	8.37	0.044	0.054	0.070	0.087
1.040	5.4	8	4.87	5.96	7.64	9.54	0.051	0.062	0.079	0.099
1.045	6.0	9	5.45	6.67	8.55	10.67	0.057	0.071	0.089	0.112
1.050	6.7	10	6.02	7.37	9.44	11.79	0.063	0.077	0.099	0.124
1.055	7.4	11	6.59	8.07	10.34	12.91	0.070	0.085	0.109	0.136
1.060	8.0	12	7.16	8.77	11.24	14.03	0.076	0.093	0.119	0.149
1.065	8.7	13	7.73	9.47	12.14	15.15	0.082	0.102	0.129	0.161
1.070	9.4	14	8.32	10.19	13.05	16.30	0.089	0.109	0.140	0.174
1.075	10.0	15	8.90	10.90	13.96	17.44	0.096	0.117	0.150	0.188
1.080	10.6	16	9.47	11.60	14.87	18.56	0.103	0.125	0.161	0.201
1.085	11.2	17	10.04	12.30	15.76	19.68	0.109	0.133	0.171	0.213
1.090	11.9	18	10.60	12.99	16.65	20.78	0.116	0.142	0.181	0.227
1.095	12.4	19	11.16	13.67	17.52	21.87	0.122	0.150	0.192	0.240
1.100	13.0	20	11.71	14.35	18.39	22.96	0.129	0.158	0.202	0.253
1.105	13.6	21	12.27	15.03	19.26	24.05	0.136	0.166	0.212	0.265
1.110	14.2	22	12.82	15.71	20.13	25.14	0.143	0.175	0.223	0.279
1.115	14.9	23	13.36	16.36	20.96	26.18	0.149	0.183	0.234	0.292
1.120	15.4	24	13.89	17.01	21.80	27.22	0.156	0.191	0.245	0.305
1.125	16.0	25	14.42	17.66	22.63	28.26	0.162	0.199	0.255	0.318
1.130	16.5	26	14.95	18.31	23.47	29.30	0.169	0.207	0.265	0.331
1.135	17.1	27	15.48	18.96	24.29	30.34	0.176	0.215	0.276	0.344
1.140	17.7	28	16.01	19.61	25.13	31.38	0.183	0.223	0.287	0.358
1.145	18.3	29	16.54	20.26	25.96	32.42	0.189	0.231	0.297	0.371
1.150	18.8	30	17.07	20.91	26.79	33.46	0.196	0.239	0.308	0.385
1.155	19.3	31	17.59	21.55	27.61	34.48	0.203	0.248	0.319	0.398
1.160	19.8	32	18.11	22.19	28.43	35.50	0.210	0.257	0.330	0.412
1.165	20.3	33	18.64	22.83	29.25	36.53	0.217	0.266	0.341	0.426
1.170	20.9	34	19.16	23.47	30.07	37.55	0.224	0.275	0.352	0.439
1.175	21.4	35	19.69	24.12	30.90	38.59	0.231	0.283	0.363	0.453
1.180	22.0	36	20.21	24.76	31.73	39.62	0.238	0.292	0.374	0.467
1.185	22.5	37	20.73	25.40	32.55	40.64	0.246	0.301	0.386	0.481
1.190	23.0	38	21.26	26.04	33.37	41.66	0.253	0.310	0.397	0.496
1.195	23.5	39	21.78	26.68	34.19	42.69	0.260	0.319	0.409	0.511
1.200	24.0	40	22.30	27.32	35.01	43.71	0.268	0.328	0.420	0.525
1.205	24.5	41	22.82	27.95	35.83	44.72	0.275	0.337	0.432	0.539
1.210	25.0	42	23.33	28.58	36.66	45.73	0.282	0.346	0.444	0.553
1.215	25.5	43	23.84	29.21	37.45	46.74	0.290	0.355	0.455	0.568
1.220	26.0	44	24.36	29.84	38.23	47.74	0.297	0.364	0.466	0.583

TABLE No. 84—*continued*

Specific Gravity at 1° C. (in vacuo).	Degrees Baumé.	Degrees Twaddell.	100 Parts contain				1 Liter contains Kilograms			
			SO ₃ . Per cent.	SO ₄ H ₂ . Per cent.	60 Degrees Acid. Per cent.	50 Degrees Acid. Per cent.	SO ₃ .	SO ₄ H ₂ .	60 Degrees Acid.	50 Degrees Acid.
1.225	26.4	45	24.88	30.48	39.05	48.77	0.305	0.373	0.478	0.598
1.230	26.9	46	25.39	31.11	39.86	49.78	0.312	0.282	0.490	0.612
1.235	27.4	47	25.88	31.70	40.61	50.72	0.320	0.391	0.502	0.626
1.240	27.9	48	26.35	32.28	41.37	51.65	0.327	0.400	0.513	0.640
1.245	28.4	49	26.83	32.86	42.11	52.58	0.334	0.409	0.524	0.655
1.250	28.8	50	27.29	33.43	42.84	53.49	0.341	0.418	0.535	0.669
1.255	29.3	51	27.76	34.00	43.57	54.40	0.348	0.426	0.547	0.683
1.260	29.7	52	28.22	34.57	44.30	55.31	0.356	0.435	0.558	0.697
1.265	30.2	53	28.69	35.14	45.03	56.22	0.363	0.444	0.570	0.711
1.270	30.6	54	29.15	35.71	45.76	57.14	0.370	0.454	0.581	0.725
1.275	31.1	55	29.62	36.29	46.50	58.06	0.377	0.462	0.593	0.740
1.280	31.5	56	30.10	36.87	47.24	58.99	0.385	0.472	0.605	0.755
1.285	32.0	57	30.57	37.45	47.99	59.92	0.393	0.481	0.617	0.770
1.290	32.4	58	31.04	38.03	48.73	60.85	0.400	0.490	0.629	0.785
1.295	32.8	59	31.52	38.61	49.47	61.78	0.408	0.500	0.641	0.800
1.300	33.3	60	31.99	39.19	50.21	62.70	0.416	0.510	0.653	0.815
1.305	33.7	61	32.46	39.77	50.96	63.63	0.424	0.519	0.665	0.830
1.310	34.2	62	32.94	40.35	51.71	64.56	0.432	0.529	0.677	0.845
1.315	34.6	63	33.41	40.93	52.45	65.45	0.439	0.538	0.689	0.860
1.320	35.0	64	33.88	41.50	53.18	66.40	0.447	0.548	0.702	0.876
1.325	35.4	65	34.35	42.08	53.92	67.33	0.455	0.557	0.714	0.892
1.330	35.8	66	34.80	42.66	54.67	68.26	0.462	0.567	0.727	0.908
1.335	36.2	67	35.27	43.20	55.36	69.12	0.471	0.577	0.739	0.923
1.340	36.6	68	35.71	43.74	56.05	69.98	0.479	0.586	0.751	0.938
1.345	37.0	69	36.14	44.28	56.74	70.85	0.486	0.596	0.763	0.953
1.350	37.4	70	36.58	44.82	57.43	71.71	0.494	0.605	0.775	0.968
1.355	37.8	71	37.02	45.35	58.11	72.56	0.502	0.614	0.787	0.983
1.360	38.2	72	37.45	45.88	58.79	73.41	0.509	0.624	0.800	0.998
1.365	38.6	73	37.89	46.41	59.48	74.26	0.517	0.633	0.812	1.014
1.370	39.0	74	38.32	46.94	60.15	75.10	0.525	0.643	0.824	1.029
1.375	39.4	75	38.75	47.47	60.83	75.95	0.533	0.653	0.836	1.044
1.380	39.8	76	39.18	48.00	61.51	76.80	0.541	0.662	0.849	1.060
1.385	40.1	77	39.62	48.53	62.19	77.65	0.549	0.672	0.861	1.075
1.390	40.5	78	40.05	49.06	62.87	78.50	0.557	0.682	0.873	1.091
1.395	40.8	79	40.48	49.59	63.55	79.34	0.564	0.692	0.886	1.107
1.400	41.2	80	40.91	50.11	64.21	80.18	0.573	0.702	0.899	1.123
1.405	41.6	81	41.33	50.63	64.88	81.01	0.581	0.711	0.912	1.138
1.410	42.0	82	41.76	51.15	65.55	81.86	0.589	0.721	0.924	1.154
1.415	42.3	83	42.17	51.66	66.21	82.66	0.597	0.730	0.937	1.170
1.420	42.7	84	42.57	52.15	66.82	83.44	0.604	0.740	0.949	1.185
1.425	43.1	85	42.96	52.63	67.44	84.21	0.612	0.750	0.961	1.200
1.430	43.4	86	43.36	53.11	68.06	84.98	0.620	0.759	0.973	1.215
1.435	43.8	87	43.75	53.59	68.68	85.74	0.628	0.769	0.986	1.230
1.440	44.1	88	44.14	54.07	69.29	86.51	0.636	0.779	0.998	1.246
1.445	44.4	89	44.53	54.55	69.90	87.28	0.643	0.789	1.010	1.261
1.450	44.8	90	44.92	55.03	70.52	88.05	0.651	0.798	1.023	1.277
1.455	45.1	91	45.31	55.50	71.12	88.80	0.659	0.808	1.035	1.292
1.460	45.4	92	45.69	55.97	71.72	89.55	0.667	0.817	1.047	1.307
1.465	45.8	93	46.07	56.43	72.31	90.29	0.675	0.827	1.059	1.323
1.470	46.1	94	46.45	56.90	72.91	91.04	0.683	0.837	1.072	1.338
1.475	46.4	95	46.83	57.37	73.51	91.79	0.691	0.846	1.084	1.354
1.480	46.8	96	47.21	57.83	74.10	92.53	0.699	0.856	1.097	1.370

TABLE No. 84—continued

Specific Gravity at 15° C. (in vacuo).	Degrees Baumé.	Degrees Twaddell.	100 Parts contain				1 Liter contains Kilograms			
			SO ₂ Per cent.	SO ₄ H ₂ Per cent.	60 Degrees Acid Per cent.	50 Degrees Acid Per cent.	SO ₂ .	SO ₄ H ₂ .	60 Degrees Acid.	50 Degrees Acid.
1.485	47.1	97	47.57	58.28	74.68	93.25	0.707	0.865	1.109	1.385
1.490	47.4	98	47.95	58.74	75.27	93.98	0.715	0.876	1.122	1.400
1.495	47.8	99	48.34	59.22	75.88	94.75	0.723	0.885	1.134	1.417
1.500	48.1	100	48.73	59.70	76.50	95.52	0.731	0.896	1.147	1.433
1.505	48.4	101	49.12	60.18	77.12	96.29	0.739	0.906	1.160	1.449
1.510	48.7	102	49.51	60.65	77.72	97.04	0.748	0.916	1.174	1.465
1.515	49.0	103	49.89	61.12	78.32	97.79	0.756	0.926	1.187	1.481
1.520	49.4	104	50.28	61.59	78.93	98.54	0.764	0.936	1.199	1.498
1.525	49.7	105	50.66	62.06	79.52	99.30	0.773	0.946	1.213	1.514
1.530	50.0	106	51.04	62.53	80.13	100.05	0.781	0.957	1.226	1.531
1.535	50.3	107	51.43	63.00	80.73	100.80	0.789	0.967	1.239	1.547
1.540	50.6	108	51.78	63.43	81.28	101.49	0.797	0.977	1.252	1.563
1.545	50.9	109	52.12	63.85	81.81	102.16	0.805	0.987	1.264	1.579
1.550	51.2	110	52.46	64.26	82.34	102.82	0.813	0.996	1.276	1.593
1.555	51.5	111	52.79	64.67	82.87	103.47	0.821	1.006	1.289	1.609
1.560	51.8	112	53.12	65.08	83.39	104.13	0.829	1.015	1.301	1.624
1.565	52.1	113	53.46	65.49	83.92	104.78	0.837	1.025	1.313	1.640
1.570	52.4	114	53.80	65.90	84.44	105.44	0.845	1.035	1.325	1.655
1.575	52.7	115	54.13	66.30	84.95	106.08	0.853	1.044	1.338	1.671
1.580	53.0	116	54.46	66.71	85.48	106.73	0.861	1.054	1.351	1.686
1.585	53.3	117	54.80	67.13	86.03	107.41	0.869	1.064	1.364	1.702
1.590	53.6	118	55.18	67.59	86.62	108.14	0.877	1.075	1.377	1.719
1.595	53.9	119	55.55	68.05	87.20	108.88	0.886	1.085	1.391	1.737
1.600	54.1	120	55.93	68.51	87.79	109.62	0.895	1.096	1.405	1.754
1.605	54.4	121	56.30	68.97	88.38	110.35	0.904	1.107	1.419	1.772
1.610	54.7	122	56.68	69.43	88.97	111.09	0.913	1.118	1.432	1.789
1.615	55.0	123	57.05	69.89	89.56	111.82	0.921	1.128	1.446	1.806
1.620	55.2	124	57.40	70.32	90.11	112.51	0.930	1.139	1.460	1.823
1.625	55.5	125	57.75	70.74	90.65	113.18	0.938	1.150	1.473	1.840
1.630	55.8	126	58.09	71.16	91.19	113.86	0.947	1.160	1.486	1.857
1.635	56.0	127	58.43	71.57	91.71	114.51	0.955	1.170	1.499	1.873
1.640	56.3	128	58.77	71.99	92.25	115.18	0.964	1.181	1.513	1.889
1.645	56.6	129	59.10	72.40	92.77	115.84	0.972	1.192	1.526	1.905
1.650	56.9	130	59.45	72.82	93.29	116.51	0.981	1.202	1.540	1.922
1.655	57.1	131	59.78	73.23	93.81	117.17	0.989	1.212	1.553	1.939
1.660	57.4	132	60.11	73.64	94.36	117.82	0.998	1.222	1.566	1.956
1.665	57.7	133	60.46	74.07	94.92	118.51	1.007	1.233	1.580	1.973
1.670	57.9	134	60.82	74.51	95.48	119.22	1.016	1.244	1.595	1.991
1.675	58.2	135	61.20	74.97	96.07	119.95	1.025	1.256	1.609	2.009
1.680	58.4	136	61.57	75.42	96.65	120.67	1.034	1.267	1.623	2.027
1.685	58.7	137	61.93	75.86	97.21	121.38	1.043	1.278	1.638	2.046
1.690	58.9	138	62.29	76.30	97.77	122.08	1.053	1.289	1.652	2.064
1.695	59.2	139	62.64	76.73	98.32	122.77	1.062	1.301	1.667	2.082
1.700	59.5	140	63.00	77.17	98.89	123.47	1.071	1.312	1.681	2.100
1.705	59.7	141	63.35	77.60	99.44	124.16	1.080	1.323	1.696	2.117
1.710	60.0	142	63.70	78.04	100.00	124.86	1.089	1.334	1.710	2.136
1.715	60.2	143	64.07	78.48	100.56	125.57	1.099	1.346	1.725	2.154
1.720	60.4	144	64.43	78.92	101.13	126.27	1.108	1.357	1.739	2.172
1.725	60.6	145	64.78	79.36	101.69	126.98	1.118	1.369	1.754	2.191
1.730	60.9	146	65.14	79.80	102.25	127.68	1.127	1.381	1.769	2.209
1.735	61.1	147	65.50	80.24	102.82	128.38	1.136	1.392	1.784	2.228
1.740	61.4	148	65.86	80.68	103.38	129.09	1.146	1.404	1.799	2.247

TABLE NO. 84—*continued*

Specific Gravity at 15° C. (in vacuo).	Degrees Baumé.	Degrees Twaddell.	100 Parts contain				1 Liter contains Kilograms			
			SO ₃ . Per cent.	SO ₄ H ₂ . Per cent.	60 Degrees Acid Per cent.	50 Degrees Acid Per cent.	SO ₃ .	SO ₄ H ₂ .	60 Degrees Acid.	50 Degrees Acid.
1.745	61.6	149	66.22	81.12	103.95	129.79	1.156	1.416	1.814	2.265
1.750	61.8	150	66.58	81.56	104.52	130.49	1.165	1.427	1.829	2.284
1.755	62.1	151	66.94	82.00	105.08	131.20	1.175	1.439	1.845	2.303
1.760	62.3	152	67.30	82.44	105.64	131.90	1.185	1.451	1.859	2.321
1.765	62.5	153	67.65	82.88	106.21	132.61	1.194	1.463	1.874	2.340
1.770	62.8	154	68.02	83.32	106.77	133.31	1.204	1.475	1.890	2.359
1.775	63.0	155	68.49	83.90	107.51	134.24	1.216	1.489	1.908	2.381
1.780	63.2	156	68.98	84.50	108.27	135.20	1.228	1.504	1.928	2.407
1.785	63.5	157	69.47	85.10	109.05	136.16	1.240	1.519	1.947	2.432
1.790	63.7	158	69.96	85.70	109.82	137.14	1.252	1.534	1.965	2.455
1.795	64.0	159	70.45	86.30	110.58	138.08	1.265	1.549	1.983	2.479
1.800	64.2	160	70.94	86.90	111.35	139.06	1.277	1.564	2.004	2.503
1.805	64.4	161	71.50	87.60	112.25	140.16	1.291	1.581	2.026	2.530
1.810	64.6	162	72.08	88.30	113.15	141.28	1.305	1.598	2.048	2.558
1.815	64.8	163	72.69	89.05	114.11	142.48	1.319	1.621	2.071	2.587
1.820	65.0	164	73.51	90.05	115.33	144.08	1.338	1.639	2.099	2.622
1.821	...	...	73.63	90.20	115.59	144.32	1.341	1.643	2.104	2.628
1.822	65.1	...	73.80	90.40	115.84	144.64	1.345	1.647	2.110	2.635
1.823	...	...	73.96	90.60	116.10	144.96	1.348	1.651	2.116	2.643
1.824	65.2	...	74.12	90.80	116.35	145.28	1.352	1.656	2.122	2.650
1.825	...	165	74.29	91.00	116.61	145.60	1.356	1.661	2.128	2.657
1.826	65.3	...	74.49	91.25	116.93	146.00	1.360	1.666	2.135	2.666
1.827	...	...	74.69	91.50	117.25	146.40	1.364	1.671	2.142	2.675
1.828	65.4	...	74.86	91.70	117.51	146.72	1.368	1.676	2.148	2.682
1.829	...	...	75.03	91.90	117.76	147.04	1.372	1.681	2.154	2.689
1.830	...	166	75.19	92.10	118.02	147.36	1.376	1.685	2.159	2.696
1.831	65.5	...	75.35	92.30	118.27	147.68	1.380	1.690	2.165	2.704
1.832	...	...	75.53	92.52	118.56	148.03	1.384	1.695	2.172	2.711
1.833	65.6	...	75.72	92.75	118.85	148.40	1.388	1.700	2.178	2.720
1.834	...	...	75.96	93.05	119.23	148.88	1.393	1.706	2.186	2.730
1.835	65.7	167	76.27	93.43	119.72	149.49	1.400	1.713	2.196	2.743
1.836	...	...	76.57	93.80	120.19	150.08	1.406	1.722	2.207	2.755
1.837	...	...	76.90	94.20	120.71	150.72	1.412	1.730	2.217	2.769
1.838	65.8	...	77.23	94.60	121.22	151.36	1.419	1.739	2.228	2.782
1.839	...	...	77.55	95.00	121.74	152.00	1.426	1.748	2.239	2.795
1.840	65.9	168	78.04	95.60	122.51	152.96	1.436	1.759	2.254	2.814
1.8405	...	...	78.33	95.95	122.96	153.52	1.451	1.765	2.262	2.825
1.8410	...	...	79.19	97.00	124.30	155.20	1.458	1.786	2.288	2.857
1.8415	...	...	79.76	97.70	125.20	156.32	1.469	1.799	2.305	2.879
1.8410	...	...	80.16	98.20	125.84	157.12	1.476	1.808	2.317	2.893
1.8405	...	...	80.57	98.70	126.48	157.92	1.483	1.816	2.328	2.906
1.8400	...	...	80.98	99.20	127.12	158.72	1.490	1.825	2.339	2.920
1.8395	...	...	81.18	99.45	127.44	159.12	1.494	1.830	2.344	2.927
1.8390	...	...	81.39	99.70	127.76	159.52	1.497	1.834	2.349	2.933
1.8385	...	...	81.59	99.95	128.08	159.92	1.500	1.838	2.355	2.940

TABLE No. 85.—*Specific Gravities of Commercial Fuming Sulphuric Acid*

At 15°	At 20°.	At 25°.	At 30°.	At 35°.	SO ₃ Per cent.
1·8417	1·8371	1·8323	1·8287	1·8240	76·67
1·8427	1·8378	1·8333	1·8295	1·8249	77·49
1·8428	1·8388	1·8351	1·8302	1·8255	78·34
1·8437	1·8390	1·8346	1·8300	1·8257	79·04
1·8427	1·8386	1·8351	1·8297	1·8250	79·99
1·8420	1·8372	1·8326	1·8281	1·8234	80·46
1·8398	1·8350	1·8305	1·8263	1·8218	80·94
1·8446	1·8400	1·8353	1·8307	1·8262	81·37
1·8509	1·8466	1·8418	1·8371	1·8324	81·91
1·8571	1·8522	1·8476	1·8432	1·8385	82·17
1·8697	1·8647	1·8595	1·8545	1·8498	82·94
1·8790	1·8742	1·8687	1·8640	1·8592	83·25
1·8875	1·8823	1·8767	1·8713	1·8661	83·84
1·8942	1·8888	1·8833	1·8775	1·8722	84·12
1·8990	1·8940	1·8890	1·8830	1·8772	84·33
1·9034	1·8984	1·8930	1·8874	1·8820	84·67
1·9072	1·9021	1·8950	1·8900	1·8845	84·82
1·9095	1·9042	1·8986	1·8932	1·8866	84·99
1·9121	1·9053	1·8993	1·8948	1·8892	85·14
1·9250	1·9193	1·9135	1·9082	1·9023	85·54
1·9290	1·9236	1·9183	1·9129	1·9073	85·68
1·9368	1·9310	1·9250	1·9187	1·9122	85·88
1·9447	1·9392	1·9334	1·9279	1·9222	86·51
1·9520	1·9465	1·9402	1·9338	1·9278	86·72
1·9584	1·9528	1·9466	1·9406	1·9340	87·03
1·9632	1·9573	1·9518	1·9457	1·9398	87·46
cryst.	cryst.	1·9740	1·9666	1·9740	88·00

TABLE No. 86.—*Percentages of SO₃ in Commercial Fuming Sulphuric Acid*

SO ₃ by Titra- tion.	Acid contains. Per cent.		SO ₃ by Titra- tion.	Acid contains. Per cent.		SO ₃ by Titra- tion.	Acid contains. Per cent.		SO ₃ by Titra- tion.	Acid contains. Per cent.		SO ₃ by Titra- tion.	Acid contains. Per cent.	
	SO ₄ H ₂	SO ₃		SO ₄ H ₂	SO ₃		SO ₄ H ₂	SO ₃		SO ₄ H ₂	SO ₃		SO ₄ H ₂	SO ₃
81·6326	100	0	86·2244	75	25	90·8163	50	50	95·4081	25	75			
81·8163	99	1	86·4081	74	26	91·0000	49	51	95·5918	24	76			
82·0000	98	2	86·5918	73	27	91·1836	48	52	95·7755	23	77			
82·1836	97	3	86·7755	72	28	91·3673	47	53	95·9591	22	78			
82·3674	96	4	86·9591	71	29	91·5510	46	54	96·1428	21	79			
82·5510	95	5	87·1428	70	30	91·7346	45	55	96·3265	20	80			
82·7346	94	6	87·3265	69	31	91·9183	44	56	96·5102	19	81			
82·9183	93	7	87·5102	68	32	92·1020	43	57	96·6938	18	82			
83·1020	92	8	87·6938	67	33	92·2857	42	58	96·8775	17	83			
83·2857	91	9	87·8775	66	34	92·4693	41	59	97·0612	16	84			
83·4693	90	10	88·0612	65	35	92·6530	40	60	97·2448	15	85			
83·6530	89	11	88·2448	64	36	92·8367	39	61	97·4285	14	86			
83·8367	88	12	88·4285	63	37	93·0204	38	62	97·6122	13	87			
84·0204	87	13	88·6122	62	38	93·2040	37	63	97·7959	12	88			
84·2040	86	14	88·7959	61	39	93·3877	36	64	97·9795	11	89			
84·3877	85	15	88·9795	60	40	93·5714	35	65	98·1632	10	90			
84·5714	84	16	89·1632	59	41	93·7551	34	66	98·3469	9	91			
84·7551	83	17	89·3469	58	42	93·9387	33	67	98·5306	8	92			
84·9387	82	18	89·5306	57	43	94·1224	32	68	98·7142	7	93			
85·1224	81	19	89·7142	56	44	94·3061	31	69	98·8979	6	94			
85·3061	80	20	89·8979	55	45	94·4897	30	70	99·0816	5	95			
85·4897	79	21	90·0816	54	46	94·6734	29	71	99·2653	4	96			
85·6734	78	22	90·2653	53	47	94·8571	28	72	99·4489	3	97			
85·8571	77	23	90·4489	52	48	95·0408	27	73	99·6326	2	98			
86·0408	76	24	90·6326	51	49	95·2244	26	74	99·8163	1	99			

TABLE No. 87.—*Specific Gravities of Solutions of Common Salt*

Specific Gravity.	NaCl. Per cent.	Specific Gravity.	NaCl. Per cent.	Specific Gravity.	NaCl. Per cent.
1.00725	1	1.07335	10	1.14315	19
1.01450	2	1.08097	11	1.15107	20
1.02174	3	1.08859	12	1.15931	21
1.02899	4	1.09622	13	1.16755	22
1.03624	5	1.10384	14	1.17580	23
1.04366	6	1.11146	15	1.18404	24
1.05108	7	1.11938	16	1.19228	25
1.05851	8	1.12730	17	1.20098	26
1.06593	9	1.13523	18	1.20433	26.395

TABLE No. 88.—*Specific Gravities of Mixtures of Alcohol and Water at 15.5°C*

Per cent Alcohol.	Specific Gravity corresponding to		Per cent Alcohol.	Specific Gravity corresponding to		Per cent Alcohol.	Specific Gravity corresponding to	
	Per cent by Volume.	Per cent by Weight.		Per cent by Volume.	Per cent by Weight.		Per cent by Volume.	Per cent by Weight.
1	0.9985	0.9981	35	0.9592	0.9490	68	0.8949	0.8772
2	.9970	.9963	36	.9579	.9472	69	.8925	.8748
3	.9956	.9944	37	.9565	.9453	70	.8900	.8724
4	.9942	.9928	38	.9550	.9433	71	.8875	.8700
5	.9928	.9912	39	.9535	.9413	72	.8850	.8676
6	.9915	.9896	40	.9519	.9394	73	.8825	.8652
7	.9902	.9880	41	.9503	.9374	74	.8799	.8629
8	.9890	.9866	42	.9487	.9353	75	.8773	.8605
9	.9878	.9852	43	.9470	.9332	76	.8747	.8581
10	.9866	.9839	44	.9452	.9311	77	.8720	.8557
11	.9854	.9826	45	.9435	.9291	78	.8693	.8533
12	.9843	.9813	46	.9417	.9269	79	.8666	.8509
13	.9832	.9800	47	.9399	.9248	80	.8639	.8484
14	.9821	.9788	48	.9381	.9227	81	.8611	.8459
15	.9811	.9775	49	.9362	.9204	82	.8583	.8435
16	.9800	.9763	50	.9343	.9183	83	.8555	.8409
17	.9790	.9751	51	.9323	.9160	84	.8526	.8385
18	.9780	.9739	52	.9303	.9138	85	.8496	.8359
19	.9770	.9727	53	.9283	.9116	86	.8466	.8333
20	.9760	.9714	54	.9263	.9094	87	.8436	.8307
21	.9750	.9702	55	.9242	.9072	88	.8405	.8282
22	.9740	.9690	56	.9221	.9049	89	.8373	.8256
23	.9729	.9677	57	.9200	.9027	90	.8339	.8229
24	.9719	.9664	58	.9178	.9004	91	.8306	.8203
25	.9709	.9651	59	.9156	.8981	92	.8272	.8176
26	.9698	.9637	60	.9134	.8958	93	.8237	.8149
27	.9688	.9622	61	.9112	.8935	94	.8201	.8122
28	.9677	.9607	62	.9090	.8911	95	.8164	.8094
29	.9666	.9592	63	.9067	.8888	96	.8125	.8065
30	.9655	.9577	64	.9044	.8865	97	.8084	.8036
31	.9643	.9560	65	.9021	.8842	98	.8041	.8006
32	.9631	.9544	66	.8997	.8818	99	.7995	.7976
33	.9618	.9526	67	.8973	.8795	100	.7946	.7946
34	.9605	.9508						

TABLE No. 89

Percentages of Absolute Alcohol in Aqueous Solutions

Specific Gravity.	100 Volumes contain volumes		Contraction.	Specific Gravity.	100 Volumes contain volumes		Contraction.
	Alcohol.	Water.			Alcohol.	Water.	
1.0000	0	100.000	0.000	0.9323	51	52.705	3.705
0.9985	1	99.055	0.055	0.9303	52	51.711	3.711
0.9970	2	98.111	0.111	0.9283	53	50.716	3.716
0.9956	3	97.176	0.176	0.9263	54	49.722	3.722
0.9942	4	96.242	0.242	0.9242	55	48.717	3.717
0.9928	5	95.307	0.307	0.9221	56	47.712	3.712
0.9915	6	94.382	0.382	0.9200	57	46.708	3.708
0.9902	7	93.458	0.458	0.9188	58	45.693	3.693
0.9890	8	92.543	0.543	0.9156	59	44.678	3.678
0.9878	9	91.629	0.629	0.9134	60	43.664	3.664
0.9866	10	90.714	0.714	0.9112	61	42.649	3.649
0.9854	11	89.799	0.799	0.9090	62	41.635	3.635
0.9843	12	88.895	0.895	0.9067	63	40.610	3.610
0.9832	13	87.990	0.990	0.9044	64	39.586	3.586
0.9821	14	87.086	1.086	0.9021	65	38.561	3.561
0.9811	15	86.191	1.191	0.8997	66	37.526	3.526
0.9800	16	85.286	1.286	0.8973	67	36.492	3.492
0.9790	17	84.392	1.392	0.8949	68	35.457	3.457
0.9780	18	83.497	1.497	0.8925	69	34.423	3.423
0.9770	19	82.603	1.603	0.8900	70	33.378	3.378
0.9760	20	81.708	1.708	0.8875	71	32.333	3.333
0.9750	21	80.813	1.813	0.8850	72	31.289	3.289
0.9740	22	79.919	1.919	0.8825	73	30.244	3.244
0.9729	23	79.014	2.014	0.8799	74	29.190	3.190
0.9719	24	78.119	2.119	0.8773	75	28.135	3.135
0.9709	25	77.225	2.225	0.8747	76	27.080	3.080
0.9698	26	76.320	2.320	0.8720	77	26.016	3.016
0.9688	27	75.426	2.426	0.8693	78	24.951	2.951
0.9677	28	74.521	2.521	0.8665	79	23.877	2.877
0.9666	29	73.617	2.617	0.8639	80	22.822	2.822
0.9655	30	72.712	2.712	0.8611	81	21.747	2.747
0.9643	31	71.797	2.797	0.8583	82	20.673	2.673
0.9631	32	70.883	3.883	0.8555	83	19.598	2.598
0.9618	33	69.958	2.958	0.8526	84	18.514	2.514
0.9605	34	69.034	3.034	0.8496	85	17.419	2.419
0.9592	35	68.109	3.109	0.8466	86	16.324	2.324
0.9579	36	67.184	3.184	0.8436	87	15.230	2.230
0.9565	37	66.250	3.250	0.8405	88	14.125	2.125
0.9550	38	65.305	3.305	0.8373	89	13.011	2.011
0.9535	39	64.361	3.361	0.8339	90	11.876	1.876
0.9519	40	63.406	3.406	0.8306	91	10.751	1.751
0.9503	41	62.451	3.451	0.8272	92	9.617	1.617
0.9487	42	61.497	3.497	0.8237	93	8.472	1.472
0.9470	43	60.532	3.532	0.8201	94	7.318	1.318
0.9452	44	59.558	3.558	0.8164	95	6.153	1.153
0.9435	45	58.593	3.593	0.8125	96	4.968	0.968
0.9417	46	57.618	3.618	0.8084	97	3.764	0.764
0.9399	47	56.644	3.644	0.8041	98	2.539	0.539
0.9381	48	55.669	3.669	0.7995	99	1.285	0.285
0.9362	49	54.685	3.685	0.7946	100	0.000	0.000
0.9343	50	53.700	3.700				

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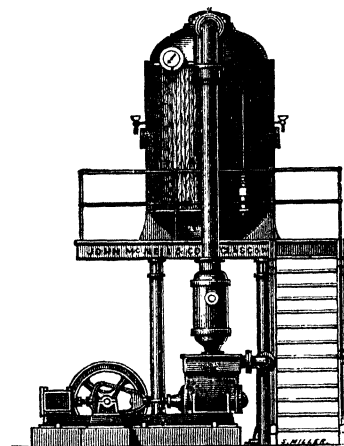
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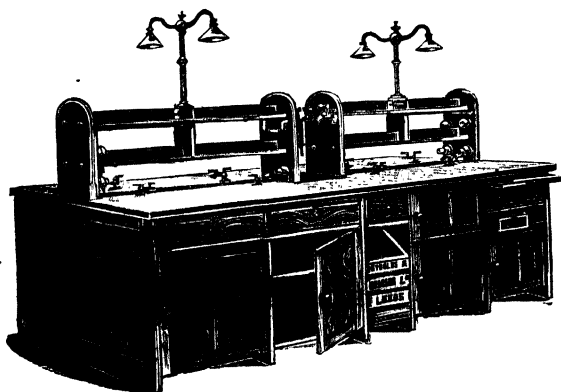
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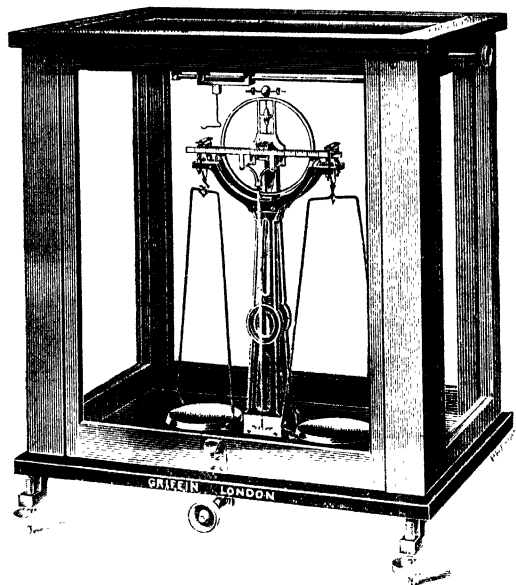
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