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THE EFFECT OF ULTRAVIOLET AND INFRA-RED RADIATION TO THE THIN FILMS AND INFRA-RED ABSORPTION OF CERTAIN OILS

by

NELSON GING

A THESIS

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Introduction

For the past few years, numerous investigations have been made with different mineral, vegetable, and animal oils used as stickers of spraying material in insecticides. None of them has proved satisfactory, generally, because certain plants are injured. So far, no explanation has been found.

The writer assumes that the injury is due chiefly to some of the physical properties of the oils. He has determined the surface tension, interfacial tension, spreading coefficient, and the effect of ultraviolet rays on the oils and found very interesting phenomena regarding the formation of the oil film.

The writer will seek to find out what properties of the oils are responsible for that injury. So far, he has found the characteristic of oil films can be divided into three groups. To the first group belong those oils the area of whose films is gradually increased by applying the ultraviolet light to the surface of water: for example, some of the oils have the tendency to spread out very thin and are less compressible, others are very compressible.

Compressibility and elasticity play an important part in spraying material. The writer wants to conduct further investigation into these characteristics.

The area and pressure measurements of different kinds of oil films are limited only to those oils which are insoluble in water and non-volatile at room temperature. These oil films usually form a two-dimensional liquid or solid, and, in very rare cases, they have been found in two-dimensional ideal gases. It has been found that some oils spread over the surface of water while others do not. The explanation is illustrated by a formula which is called spreading coefficient

$$F_S = V_A - V_B - V_{ab}$$

F_S = spreading coefficient

V_A = surface tension of liquid A

V_B = surface tension of liquid B

V_{ab} = interfacial tension of these two liquids

There are many oils and fats which, when dropped on the surface of water, will spread out to form an extremely thin film at the order of magnitude 10^{-7} cm. in thickness. All such substances, which spread on water, have general characteristics, that is, containing a certain group in the molecule. The most common type of all these groups is the OH group of the COOH group. They call that a hydro-philic type. When a drop of pure mineral oil or saturated hydrocarbon is dropped on the surface of water, it floats on the water surface as a circular lens called a hydrobolic type.

In view of the great importance of the spreading coefficient of the oil film applied to the chemical and biological system, a few attempts have been made to examine the effect of the ultraviolet light and infra-red radiation upon the thin film on the water surface. There is not any investigation, up to the present time, which has been made upon the biological oils, the greater part of which are used for spraying material. For this reason, an investigation was undertaken to determine if there exists any effect of ultraviolet and infra-red radiation upon the thin film on the surface of water. The characteristics of the film without any radiation means also have been measured.

Procedure

Before we put the oil solution on the surface of water with the barrier at the end of the rectangular trough, any trace of oil on the surface of the water is removed by the use of paraffined movable sweeper several times. The right end of the trough may be swept at any time in order to find out if it has been contaminated by oil leaking through from the left side of the trough. The most desirable way to avoid the uncleanness from contaminated distilled water is to sweep it a few times before the film balance is placed on the water surface. The graduated circular disc, marked from 1° to 360° is used to read the pressure of the oil film. The torsion wire is attached to the disc which is fitted with a vernier and is read with 0.1° of a degree.

The description of the optical system for infra-red absorption may be conveniently described as follows: The light from a globar at L, a narrow slit shows an image of L on S_1, the entrance slit of the spectrometer. An image of the S_1 is projected upon the concave mirror M_1. The light is reflected by the mirror and travels through a salt prism and is dispersed. Then the light is reflected from the plane mirror to the concave M_3, from M_3 to the S_2 behind the S_2 a thermopile T is situated which is connected to a very sensitive galvanometer. The M_1, M_2, M_3 are gold-plated on glass. The drum is calibrated in tenths of a millimeter and the limit of the instrument is 12 . The cell is made from a selected rock salt crystal which is polished from coarse to finest sand paper and the proper thickness of crystals is selected.

The galvanometer is set on a separate table at a distance of approximately 3 meters from the lamp and the scale. About 30 minutes after the equilibrium temperature has been reached, the zero point of the galvanometer becomes constant. The apparatus is ready to start the measurement. The movable drum is set at .58 then gradually turned toward the longer wavelength and one starts reading at the desired wavelength. With the cell filled with oil in the path of the light source, the shutter must be previously covered by a wooden block or cardboard 1 cm. in thickness. The shutter is now removed. The deflection of the galvanometer as shown on the scale is recorded. Then an empty rock salt plate, or cell of the same thickness as the first is placed in the path of the light, and the deflection of the galvanometer is similarly recorded. We know that the deflection of the galvanometer is directly proportional to the amount of light falling on the thermopile. The deflection of the oil filled cell to the deflection of the empty cell gives the percentage transmission of the given substance for the particular wavelength which is indicated by the drum setting.

The results are tabulated in the following tables. In the first column under λ are indicated the wavelength settings in microns. The second and third columns represent the galvanometer deflection in millimeter, corresponding to the transmission of the rock salt plates I_0 and filled cell I respectively. In the fourth column under %T, the ratios of the deflections indicated in the second and the third columns are given and represent the percentage transmission.

The graphical representation has been employed as shown in the following figures. The wavelengths in micron are plotted as abscissae against the percentage transmission as ordinates. The minima of such curves, therefore, represent regions of absorption. The thickness of the cell, the current, used in each case is indicated on the corresponding curve.

A slow change in the zero point of the galvanometer is usually observed. The changing takes place so slowly that error from this is insignificantly small, especially since all reading for a definite wavelength is made within a period of 30 seconds.

Table I

Corn oil

Thickness .1 mm Current 5.4 Amp

	I_o	I	%T		I_o	I	%T
1.0	34	34	100	5.4	176	145	80
1.05	58	61	106	5.6	146	106	68
1.1	85	85	100	5.8	122	78	57
1.15	118	134	115	6.0	98	68	66
1.2	167	197	115	6.1	82	74	89
1.25	222	261	118	6.3	77	70	90
1.3	290	330	114	6.4	132	90	67
1.4	438	505	117	6.5	126	90	69
1.53	612	710	117	6.6	123	86	67.5
1.6	344	404	120	6.7	120	78	62
1.7	433	493	116	6.8	113	66	54.5
1.8	522	600	116.5	6.9	110	56	46
1.9	605	685	115	7.0	105	49	41
2.0	704	786	112.5	7.2	102	34	26
2.1	760	850	111.5	7.4	96	30	23.5
2.2	780	895	115	7.6	91	28	22
2.4	850	965	114	7.8	383	24	19
2.6	895	970	103	8.0	80	21	15.5
2.8	890	790	885	8.2	73	15	8
3.0	825	630	755	8.4	66	16	5
3.2	760	562	73	8.6	75	14	6
3.4	704	565	70.6	8,8	75	23	5,5
3.6	625	433	68.5	9.0	77	25	9.5
3.8	546	375	67.5	9.2	65	30	22
4.0	455	382	83	9.4	65	32	27
4.2	337	377	98	9.6	70	33	30
4.4	332	341	103	10.0	63	40	39
4.6	290	297	102.5	10.2	63	42	45
4.8	268	263	98	10.4	60	44	43
5.0	233	230	96.5	10.6	55	53	60

Table II

Soybean Oil

Thickness .1mm   Current 5.6 Amp

	I_o	I	%T		I_o	I	%T
1.0	266	288	114	5.2	342	376	112.5
1.05	354	378	110	5.4	332	342	104
1.1	506	532	106	5.6	410	402	97.5
1.15	746	820	112	5.8	338	300	85
1.2	444	510	119	6.0	310	238	67
1.25	590	682	119	6.2	466	376	76
1.3	169	188	115	6.4	382	310	74.5
1.4	250	282	117	6.6	339	260	69
1.5	340	383	116	6.8	318	234	63
1.6	430	484	115	7.0	296	200	53.5
1.7	526	615	120	7.2	290	168	36
1.8	630	755	122	7.4	232	144	24
1.9	616	760	126	7.6	158	30	20
2.0	726	936	132	7.8	155	27	17.5
2.2	730	948	124	8.0	223	35	16
2.4	650	770	121	8.2	260	80	10
2.6	670	800	134	8.4	248	84	8
2.8	658	795	122	8.6	222	68	5
3.0	656	736	114	8.8	205	70	7
3.2	610	660	111	9.0	185	65	11
3.4	640	550	84	9.2	175	78	16
3.6	546	470	84	9.4	165	78	16
3.8	543	410	71.5	9.6	160	88	28
4.0	475	366	72	9.8	170	100	30
4.2	475	458	98	10.0	174	116	38
4.4	400	448	115	10.2	180	133	41
4.6	348	405	119	10.4	172	133	46
4.8	312	358	119	10.6	165	132	50
5.0	310	338	112				

Table III

Oleic acid

Thickness .05mm Current 5. 45 Amp

	I_o	I	%T		I_o	I	%T
.90	68	71	118	5.8	131	113	37.5
1.00	107	116	116	5.9	166	115	40
1.05	126	150	128	6.0	163	115	42.3
1.1	178	212	122	6.2	150	124	63
1.15	258	317	122	6.3	140	115	64.5
1.2	356	438	126	6.4	130	113	61.5
1.25	495	623	129	6.5	128	110	69
1.3	325	380	120	6.6	178	125	51.5
1.4	446	520	119	6.7	175	125	5 51.
1.5	593	717	123	6.8	174	118	46
1.6	270	317	114	6.9	165	107	39
1.7	345	387	111	7.0	158	95	32
1.8	432	470	112	7.2	262	183	22
1.9	520	470	109	7.4	254	180	21.5
2.0	584	630	110	7.6	246	176	18.5
2.1	660	720	104	7.8	241	173	16
2.2	755	780	107.5	8.0	234	168	11
2.4	840	895	95.5	8.2	216	158	12
2.6	870	835	72	8.3	215	158	12.3
2.8	945	700	54.5	8.4	205	152	11.7
3.0	930	530	38.5	8.61	192	150	19.3
3.2	900	390	29	8.8	186	150	21.7
3.4	865	300	23	9.0	174	144	31.8
3.6	820	242	33.5	9.2	162	137	43
3.8	740	228	25	9.4	154	137	50
4.0	675	240	46	9.6	152	135	46.6
4.2	525	280	62.5	9.8	150	134	46.6
4.4	450	307	75	10.0	137	120	37
4.6	393	313	81	10.2	127	109	37.5
4.8	355	301	85	10.4	123	107	30.5
5.0	328	290	81	10.6	120	102	10
5.2	300	258	78	10.8	113	94	17.5
5.4	266	225	64.5	11.0	110	95	25
5.6	272	178	46	11.2	108	98	44.5

Table IV

Corn oil

Thickness .2 mm   Current 5.5 Amp

	I_o	I	%T		I_o	I	%T
1.3	148	142	96.5	3.8	571	232	40.5
1.4	217	213	98	3.9	522	234	45
1.5	312	296	95	4.0	476	246	52
1.6	408	392	96	4.1	440	258	59
1.7	521	486	93.5	4.2	400	260	65
1.8	621	553	89	4.3	370	260	70
1.9	710	583	82	4.4	333	245	73.5
2.0	770	617	80	4.5	308	228	74
2.1	840	656	79	4.6	293	217	74
2.2	877	668	76.5	4.7	281	203	72.5
2.3	922	702	76	4.8	268	195	72.5
2.4	1010	705	70	4.9	252	182	72.5
2.5	1020	668	66	5.0	236	163	68.
2.6	1030	618	60	5.1	215	144	65
2.7	1030	555	54	5.2	205	129	63
2.8	992	494	50	5.3	187	107	59
2.9	975	462	47.5	5.4	164	86	52
3.0	922	417	45	5.5	147	67	46
3.1	878	380	43	5.6	130	50	39
3.2	845	360	42.5	5.7	120	40	33
3.3	810	342	42	5.8	107	30	28
3.4	778	324	41.5	5.9	97	28	29
3.5	728	300	41	6.0			
3.6	675	275	40.5				
3.7	622	245	39				

Table V

Cod liver oil 3000u/g

Thickness .1 mm   Current 5.4 Amp

	I_o	I	I_o/I		I_o	I	%T
1.3	140	106	76	3.7	615	184	30
1.4	215	165	76.5	3.8	572	180	31.5
1.5	301	225	75	3.9	525	185	35
1.6	397	293	75	4.0	477	201	42
1.7	508	355	70	4.1	435	200	46
1.8	610	393	64.5	4.2	405	203	56.5
1.9	710	428	60	4.3	368	207	56.5
2.0	770	455	59	4.4	350	198	57.5
2.1	816	482	59	4.5	320	183	57.5
2.2	835	493	56	4.6	295	173	58.5
2.3	945	483	51.5	4.7	[illegible]	163	56.5
2.4	1020	478	47	4.8	274	155	56
2.5	1030	455	44	4.9	259	146	54
2.6	1010	421	42	5.0	238	118	50
2.7	1003	396	39	5.1	221	111	48
2.8	976	356	36.5	5.2	197	94	44.5
2.9	930	325	35	5.3	190	80	42
3.0	890	301	34	5.4	163	63	35
3.1	842	273	32	5.5	150	53	30
3.2	840	258	31	5.6	133	40	22.5
3.3	815	243	30	5.7	121	27	22
3.4	752	230	30.5	5.8	170	[illegible]	[illegible]
3.5	712	215	30	5.9	104	[illegible]	29
3.6	630	208	31.5	6.0	93	27	29

Table VII

Vit. D_3 1.200.000u/g

Thickness .1 mm   Current 5.4 Amp

	I_o	I	%T		I_o	I	%T
1.3	13.1	128	98	3.8	508	113	22.5
1.4	200	195	98	3.9	473	127	27
1.5	283	271	96.5	4.0	437	144	33
1.6	366	345	94.5	4.1	394	148	37.5
1.7	450	414	92	4.2	364	156	43
1.8	543	469	86.5	4.3	333	161	48.5
1.9	621	508	82	4.4	316	165	52
2.0	697	540	77.5	4.5	287	157	55
2.1	740	540	73.5	4.6	272	160	59
2.2	778	532	69	4.7	264	153	58
2.3	825	480	58	4.8	250	146	58.5
2.4	815	442	54.5	4.9	240	136	57
2.5	825	383	46.5	5.0	222	127	57.5
2.6	855	336	39.0	5.1	207	107	51.8
2.7	841	282	33.5	5.2	185	94	51
2.8	834	245	29.5	5.3	173	78	45
2.9	812	207	25.5	5.4	152	60	39.5
3.0	758	164	22.0	5.5	142	51	36
3.1	725	133	18.5	5.6	130	40	31
3.2	710	108	15.0	5.7	116	40	27
3.3	685	82	12	5.8	107	18	17
3.4	677	76	11.5	5.9	100	11	11
3.5	632	75	12	6.0	87	3	3.5
3.6	591	84	14.5	6.1	87	3	3.5
3.7	545	96	17.5				

Table VIII A

High Vit. oil No. 47761

Thickness .2 mm Current 5.4 Amp

	I_o	I	%T		I_o	I	%T
1.3	155	151	97.5	4.1	426	264	62
1.4	230	224	97.5	4.2	395	260	66
1.5	315	316	100	4.3	378	252	67
1.6	424	415	97.5	4.4	336	242	72
1.7	535	490	92	4.5	303	223	73.5
1.8	628	557	89	4.6	287	211	74
1.9	696	600	86	4.7	276	200	72.5
2.0	780	676	82	4.8	260	190	73.5
2.1	856	660	77.5	4.9	251	178	71
2.2	880	670	76.5	5.0	235	162	69
2.3	910	642	71	5.1	210	138	66
2.4	910	632	69.5	5.2	191	118	62
2.5	955	610	64	5.3	178	98	55
2.6	965	575	59	5.4	160	80	50
2.7	945	517	55	5.5	142	61	43
2.8	940	466	50	5.6	131	48	37
2.9	902	430	48	5.7	119	35	29
3.0	868	387	45	5.8	103	30	29
3.1	885	363	41	5.9	100	27	28
3.2	834	336	40	6.0	90	25	28
3.3	816	318	39	6.1	83	30	36
3.4	778	306	39.5	6.2	75	33	44
3.5	755	294	39	6.3	73	34	4
3.6	655	260	40				
3.7	605	240	40				
3.8	560	230	41				
3.9	517	234	45				
4.0	410	245	53				

Table VIIIB

High Vit. D oil

Thickness .2mm A 5.4 Amp.

	Salt	S oil	%T
1.3	135	132	96
1.4	200	198	98.5
1.5	284	270	96
1.6	370	363	99
1.7	466	425	92
1.8	556	488	88
1.9	648	545	84
2.0	724	575	80
2.1	768	595	77
2.2	845	628	75
2.3	865	635	73.5
2.4	878	616	70
2.5	902	595	66
2.6	895	552	62
2.7	898	504	56
2.8	865	455	53
2.9	865	407	47
3.0	815	370	45
3.1	778	357	45.5
3.2	756	332	44
3.3	728	298	41
3.4	713	283	40
3.5	675	268	39.6
3.6	628	250	39.7
3.7	588	236	40
3.8	538	221	41
3.9	494	220	44.5
4.0	441	237	54
4.1	410	253	62
4.2	387	259	67

	Salt	S oil	%T
4.3	358	247	69
4.4	322	234	73
4.5	300	220	73.5
4.6	284	208	73.5
4.7	275	200	72.5
4.8	268	195	72.5
4.9	248	177	72.5
5.0	235	162	69
5.1	217	141	65
5.2	201	120	60
5.3	181	98	55
5.4	163	81	50
5.5	153	65	42.5
5.6	132	50	38
5.7	118	35	30
5.8	107	30	28
5.9	98	24	24.5
6.0	95	26	27.5
6.1	86	32	37
6.2	77	30	43

Table IX

Oleic Acid

Thickness .2mm   Current 5. 5 Amp

	I_o	I	%T		I_o	I	%T
1.3	163	165	101	4.0	478	60	12.5
1.4	255	252	99	4.1	450	70	15.5
1.5	359	345	96	42	408	84	20.5
1.6	448	428	95.5	4.3	371	95	26
1.7	568	515	90	4.4	348	104	31
1.8	696	581	84	4.5	322	113	35
1.9	799	620	78	4.6	298	116	39
2.0	890	638	72	4.7	285	114	40
2.1	979	608	63	4.8	274	112	41
2.2	975	578	59	4.9	255	100	39.5
2.3	1030	552	54	5.0	240	87	36
2.4	1050	502	48	5.1	218	78	36
2.5	1050	432	41	5.2	701	65	33
2.6	1060	370	35	5.3	182	52	28.5
2.7	1050	328	31	5.4	165	36	22
2.8	1045	275	26	5.5	145	26	18
2.9	957	227	24	5.6	133	17	13
3.0	902	168	19	5.7	113	12	10.5
3.1	860	125	15	5.8	110	10	9
3.2	822	83	10	5.9	100	11	11
3.3	805	60	75	6.0	91	11	10
3.4	756	38	5	6.1	83	12	14.5
3.5	720	29	4	6.2	80	16	20
3.6	684	25	3.5	6.3	74	17	28
3.7	618	30	5	6.4	70	20	29
3,8	565	36	6.5	6.5	66	16	25
3.9	516	50	9.5				

Table X

Olive oil With ultraviolet

A	L	T
420	30	0
420	"	4
420	30	7
462	33	13
490	35	17
540	38.5	23
600	43	30

China wood oil

A	L	S.r.
700	50	42
686	49	46
672	48	50
656	47	54.5
644	46	58.5
630	45	62.5
616	44	66
600	43	70.5
588	42	73.5
574	41	75
560	40	75
546	39	75
532	38	75
490	35	77
462	33	77.5
420	30	77.5
392	28	78
350	25	78
308	22	80

China wood oil With 1 ml HCl

A	L	S R
700	50	39
630	45	39
560	40	42
504	36	44
448	32	47
406	29	56
378	27	71
364	26	76
350	25	80
336	24	83
308	22	86
252	18	90
196	14	89
182	13	89
84	6	100

A	L	Sr	Dyne
630	45	46.5	178
530	38	49	188
434	31	51	195
350	25	53	203
294	21	54	208
252	18	56	215
224	16	57.5	220
196	14	59	226
168	12	60.5	234
140	10	62	238
112	8	65	250
84	6	67	257
70	5	69	265
56	4	71.5	274
42	3	74.5	286
28	2	77	295

Table XI

Cod liver oil

A	L	T
700	50	0
700	50	4
746	533	13

Halibus fish oil with ultraviolet

A	L	T
504	36	0
546	39	4
600	43	12
656	47	17
797	57	21

Dyne	S.r.	T
165	43	0
184	48	6
207	54	14
230	60	25
242	63	31
253	66	41

Cod liver oil

Without ultraviolet

A	L	S.r/	Dyne	A	L	S.r.	a/14cm	D	S.r.	
700	50	47	180	672	48	56	215	175	45.5	0
656	47	48	184	644	46	58	222	171	445	2
588	42	49	188	600	43	60	230	178	46.5	8
504	36	51	195	560	40	62.5	240	186	49	13
448	32	53	201	518	37	65	250	196	51	19
378	27	55	209	476	34	67	257	202	52.	24
322	23	58	222	434	31	70	268	210	55	32
280	20	59	226	392	28	74	284	219	57	43
238	17	62	238	364	26	76	292			
210	15	64	245	322	23	80	308			
182	13	66	253	280	20	83	318			
154	11	69	264	252	18	87	334			
126	9	73	280	224	16	90	346			
98	7	78	300	196	14	94	360			
84	6	80	304	168	12	97	372			
70	5	84	322	140	10	102	392			
56	4	88	337	112	8	106	407			
42	3	94	360	84	6	113	434			
28	2	102	392	56	4	120	460			

Table XII

Vit. A 45960 with infra-red			Distilled Vit. A 56451			Linseed oil without infra-red		
T	L	A	T	L	A	T	L	A
0	50	700	0	50	700	0	50	700
2	45.5	637	2	46	644	3	43	600
6	42	588	5	43.5	608	16	46	644
15	37	518	10	44	608	24	49	686
21	34.5	483	15	45	630	30	49	686
26	32	448	18	48.5	679			
33	29.5	413	23	50.5	707			
			27	53.5	750			

			Without infra-red			With infra-red		
A	L	D	T	L	A	T	L	A
700	50	233	0	50	700	0	50	700
588	42	235	1	44	616	1	36	504
532	38	250	4	42.5	595	8	33	462
462	33	260	8	41	574	15	35	490
350	25	292	10	42.5	595	24	37	518
294	21	304	12	44	616	33	39	546
252	18	322	17	48.5	679			
196	14	338	23	51.5	720			
154	11	350	27	55	770			
126	9	365						
98	7	380						

Table XIII

	Chicken liver oil				Conc Vit. A.			
	L	A	S.r.	D	L	A	S.r.	D
	50	700	20	76.5	50	700	3	11.5
	48	672	25	96	47	658	12	48
	46	644	31	119	44	616	17	65.3
	45	630	36	138	43	602	20	76.5
	44	616	40	154	40	560	26	100
	43	602	45	173	39	546	28.5	107
	42	588	48	184	38	532	31	119
	37	517	56	215	35	490	38.5	148
	32	448	62	238	33	462	45	173
	26	364	68	261	28	392	62	238
22	22	308	78	300	26	364	67	257
	20	280	85	326	24	336	73	280
	18	252	92	364	21	294	80	307
	15	210	123	472	14	196	95	364
	12.5	175	147	565	11	154	111	426

Table XIV

Corn oil

Without ultraviolet

T	S.r.	D	A	L	S.r.	D
0	35	490	700	50	35.8	138
2	33.5	466	686	49	40.5	154
6	"	"	672	48	45.5	175
9	33.8	472	658	47	49.5	190
12	34.5	484	644	46	52	200
15	35.5	496	630	45	53.5	206
18	36.3	508	616	44	55	211
24	38.1	532	600	43	56.1	215
31	40.2	562	574	41	59	227
33	41.8	584	546	39	61	234
38	43.5	610	518	37	63.5	244
40	45.2	633	490	35	65	250
44	46.2	645	462	33	68	261
47	47.4	662	434	31	70.5	271
51	48.6	680	406	29	73	280
53	49.5	692	378	27	76	292
54	50.8	700	350	25	79	304
57	51.3	716	322	23	82.6	317
			294	21	86.3	
			266	19	90	346
			238	17	94	361
			210	15	98.5	378
			182	13	103	395
			154	11	108	414
			126	9	116	444
			98	8	122.5	475
			84	6	126.5	486
			70	5	131.5	506

Vit. K .0025%

T	L	A
0	50	700
2	46.8	655
4	46.5	652
6	46.5	652
8	46.7	654
10	"	"
13	47	659
15	"	"
18	47.1	660
21	"	"
24	47.2	664
27	"	"
30		"

With ultraviolet

T	S.r.	D
0	35	490
1	31.3	438
4	"	"
6	32.2	450
8	"	"
12	35.3	494
15	37.8	528
18	39.8	558
25	43.6	610
31	47.6	665
33	50	700
35	52	728
36	54	750

With ultraviolet

T	L	A
0	50	700
3	49.2	690
5	"	"
9	50	700
12	51	715
15	51.5	722
18	52.1	730
21	52.5	735
25	52.9	740
30	53.5	750

Table XV

Palmatic acid

A	L	T
504	36	0
434	31	1
392	28	3
364	23	6
319	23	13
304	22	18
297	21	19
295	21	20
292	21	21
285	20.6	22
277	19.6	24
263	18.8	28
249	17.8	31
39		

Oleic acid

A	L	S/r.	D
700	50	107	412
560	40	106.5	410
420	30	106	415
294	21	109	419
210	15	110	422
98	7	111	426
28	2	113	434

Linseed oil

A	S.r.	D
700	42	161
546	43	165
476	44	169
406	46	177
322	47	181
266	48	185
182	50	192
154	51	196
126	52	200
98	55	212
70	59	227
56	61	235
42	65	250
28	72	275

Palmatic acid with ultraviolet

A	L	S/r.	D
700	50	96	365
600	43	98.5	378
504	36	104.5	400
435	31	104.5	400
392	28	107	412
364	26	113	434
322	23	118	453
308	22	121	464
294	21	130	500
280	20	142	546
266	19	108	414
252	18	112	460
238	17	112	460
224	16	121	464
210	15	115	442

Stearic acid with ultraviolet

A	S.r.	D
700	46	177
560	46	177
462	47.5	182.5
378	49	188.5

Table XVI

Lard oil

T	S.r.	D
0	41	161
9	44	169
15	46	177
21	49	188
30	51	196

Coconut oil

T	L	A
0	62	238
3	62	234
7	62	238
17	62	238
22	62	238
30	63	243

Cream with ultraviolet

T	L	A
0	59	226
6	63	242
16	66	253
27	67	257

Lard oil

A	L	S.r.	D
700	50	51	196
672	48	54	207
644	46	57	219
616	44	60	230
574	41	63	242
532	38	66	253
472	34	71	272
420	30	76	290
364	26	79	303
308	22	83	318
266	19	85	326
224	16	88	338
168	12	92	354
140	10	94	360
90	7	97	372
70	5	102	392
40	3	112	430

Coconut oil

A	L	S.r.	D
700	50	63	243
532	38	65	248
336	24	67	255
224	16	69	265
168	12	71	273
126	9	73	280
98	7	75	288
70	5	81	310
56	4	89	342
42	3	109	418
28	2	135	520

Cream

A	L	S.r.	D
700	50	67	257
656	47	71	272
600	47	75	288
518	37	79	303
448	32	83	318
392	28	88	338
364	26	92	354
336	24	100	384
322	23	111	426
308	22	129	496

Table XVII

Alfalfa oil With 2o ml NAOH				Soybean oil With 20 ml NAOH				Alfalfa oil Without NAOH			
L	A	S.r.	D	L	A	S.r.	D	L	A	S.r.	D
50	700	37	142	50	700	44	169	50	700	36	138
46	644	39	149	48	672	44	169	48	672	39	150
44	616	39	148	46	644	45	175	46	644	40	154
42	588	40	151	44	616	45	175	44	616	40	154
38	532	40	154	42	588	46	177	42	588	41	158
36	504	41	158	40	560	46	177	40	560	41	158
34	476	42	162	38	532	46	177	38	532	42	162
32	448	42	162	36	504	46	177	36	504	42	161
30	420	43	163	34	476	47	179	34	476	42	161
28	392	43	165	32	448	47	179	25	350	43	165
24	336	45	173	30	420	48	185	22	308	44	169
22	308	46	177	28	392	49	186	19	266	45	173
18	280	47	181	26	364	49	186	13	182	46	177
16	252	49	189	24	336	49	187	11	154	47	181
14	224	50	192	22	308	49	189	9	126	49	189
13	196	52	200	20	280	50	192	8	112	50	192
12	182	53	204	18	252	51	196	7	98	51	196
11	168	54	207	16	224	52	200	6	84	53	204
10	154	56	215	14	196	53	204	5	70	56	213
9	140	58	223	12	168	54	207	4	56	60	227
8	126	61	234	11	154	55	211	3	42	66	253
7	112	62	238	10	140	56	213				
6	98	65	250	9	126	56	216				
5	84	69	265	7	98	59	227				
4	70	75	288	6	84	60	230				
3	42	107	410	4	56	66	251				
				3	42	70	269				

Table XVIII

Carotene				Carotene				Corn oil		
A	L	S.r.	D	A	L	S.r.	D	T	S.r.	D
700	50	11	42	700	50	15	58	0	41	157
672	48	16	61	672	48	22	85	17	46	177
644	46	19.5	75	644	46	27	104	17	49	188
600	43	23	88	616	44	32	123	37	51	196
560	40	27	104	588	42	37	142	55	54	208
518	37	32	123	546	39	44.5	171	68	55	212
476	34	37	140	518	37	49	188			
434	31	42	161	490	35	55	210			
406	29	45	171	462	33	60	230			
378	27	48	184	420	30	71	273			
350	25	52	200	378	27	78	300			
322	23	57	219	350	25	96	368	0	42	162
294	21	64	246	322	23	116	446	2	39	150
266	19	75	288	294	21	130	500	14	44	169
238	17	91	350	280	20	145	556	22	47	181
224	16	105	404	224	16	185	710	59	55	212

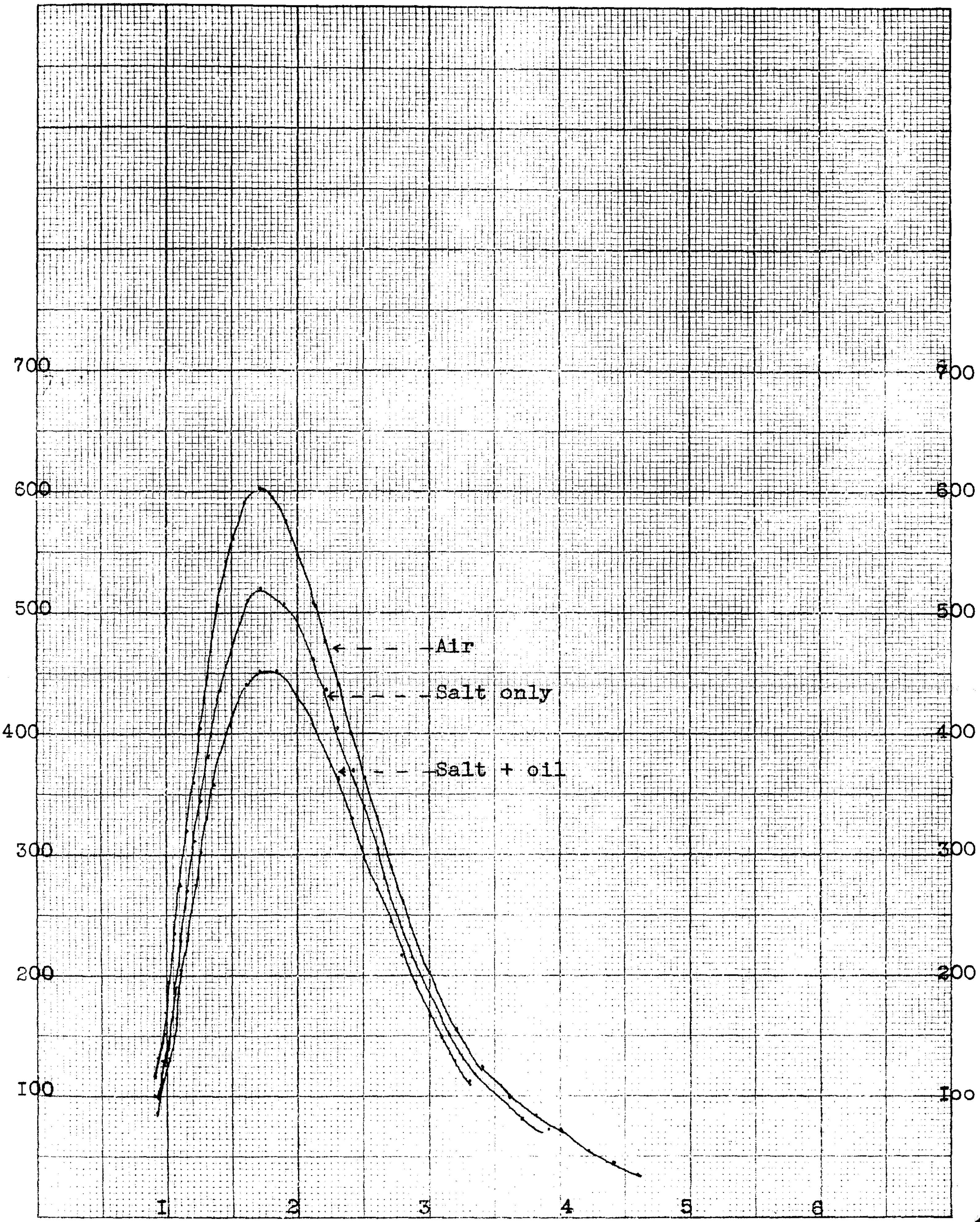
Sesame			Sesame			Sesame			Corn oil		
T	S.r.	D	T	L	A	T	L	A	T	L	A
0	10	38	0	43	165	0	43	165	16	46	177
3	10	38	7	45	173	7	43	165	21	48	184
5	12	46	16	49	188	16	47	181	35	51	196
13	15	57	27	53	204	27	50	192	50	53	204
18	15	57	33	53	212	36	52	200	64	56	215
22	13	50							0	41	157
									6	43	165

Table XIX

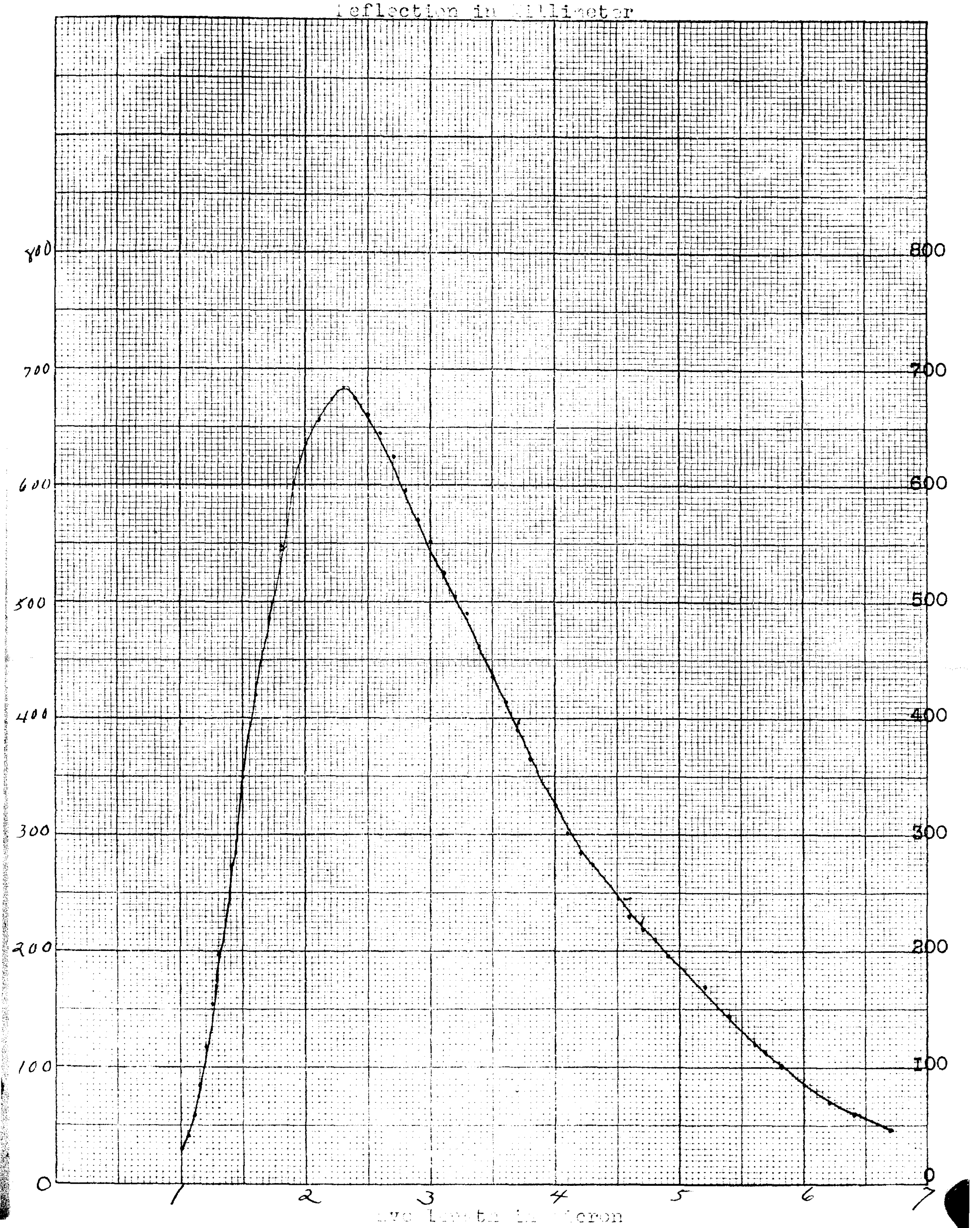
Vit. D in corn oil

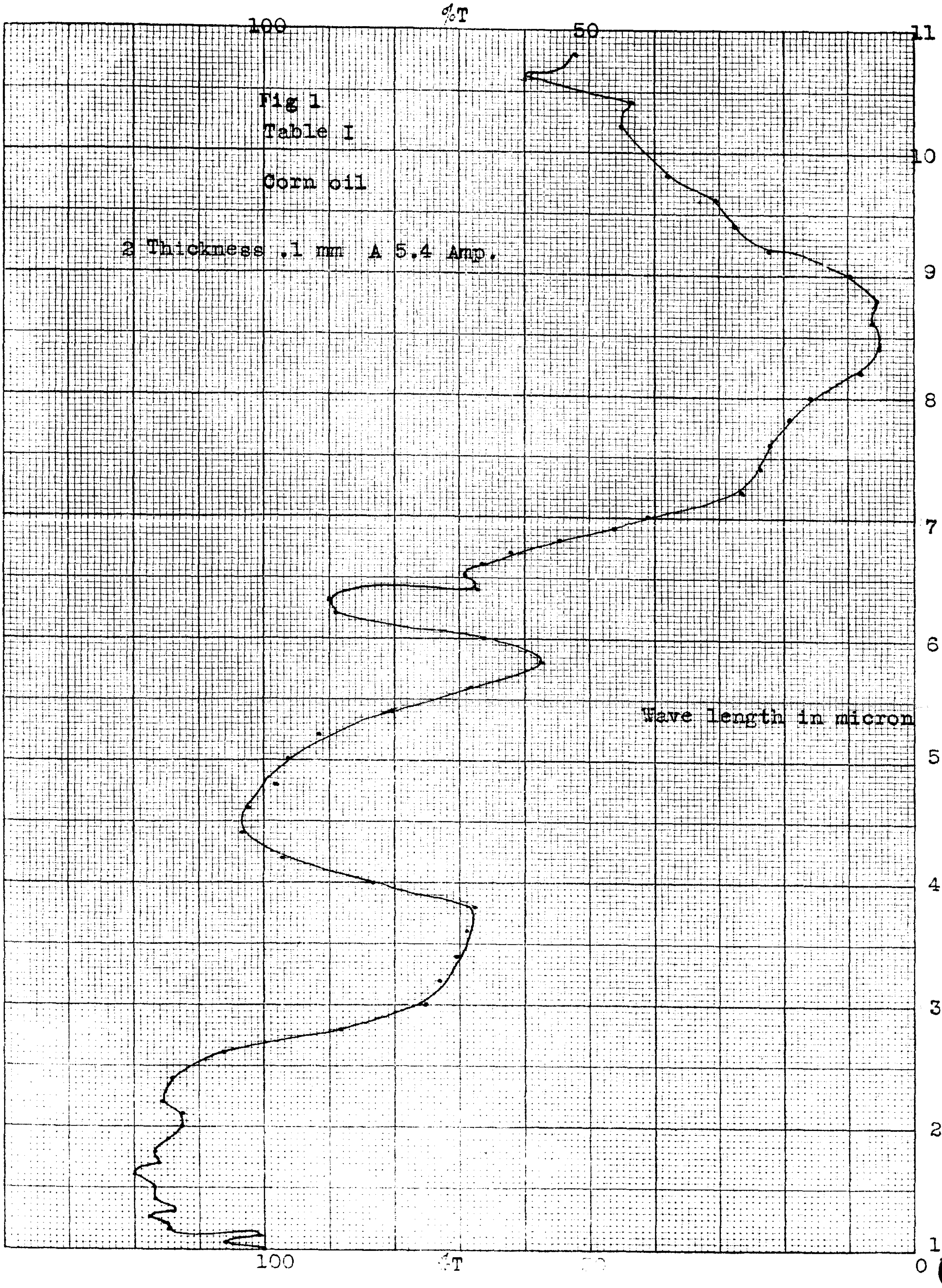
With ultraviolet			With ultraviolet			Without ultraviolet		
T	S.r.	D	T	L.	A	T	L	A
0	44	169	0	24	336	0	34.7	486
8	47	180	2	22	308	2	29.6	414
18	51	196	4	23.2	324	4	29.6	414
32	53	204	6	24.4	338	6	28.5	398
			8	25	356	9	28.9	405
			10	25.5	357	14	29.8	418
			12	26.5	372	18	30.8	432
T_2	S.r/	D						
2	49.5	190	14	27.5	385	21	32	448
4	"	"	16	28.5	395	25	33.3	466
6	520	199	18	29.5	413	28	34.3	480
8	535	208	20	308	432	31	35.3	494
11	546	209	23	32	448	34	36.2	507
16	56.6	217	26	33.9	474	43	38	532
20	57.6	220	28	35	490	47	39.1	548
24	60	230	30	35.9	503	51	40.3	564
30	61	234	32	36	514	55	41.4	580

Deflection in Millimeter



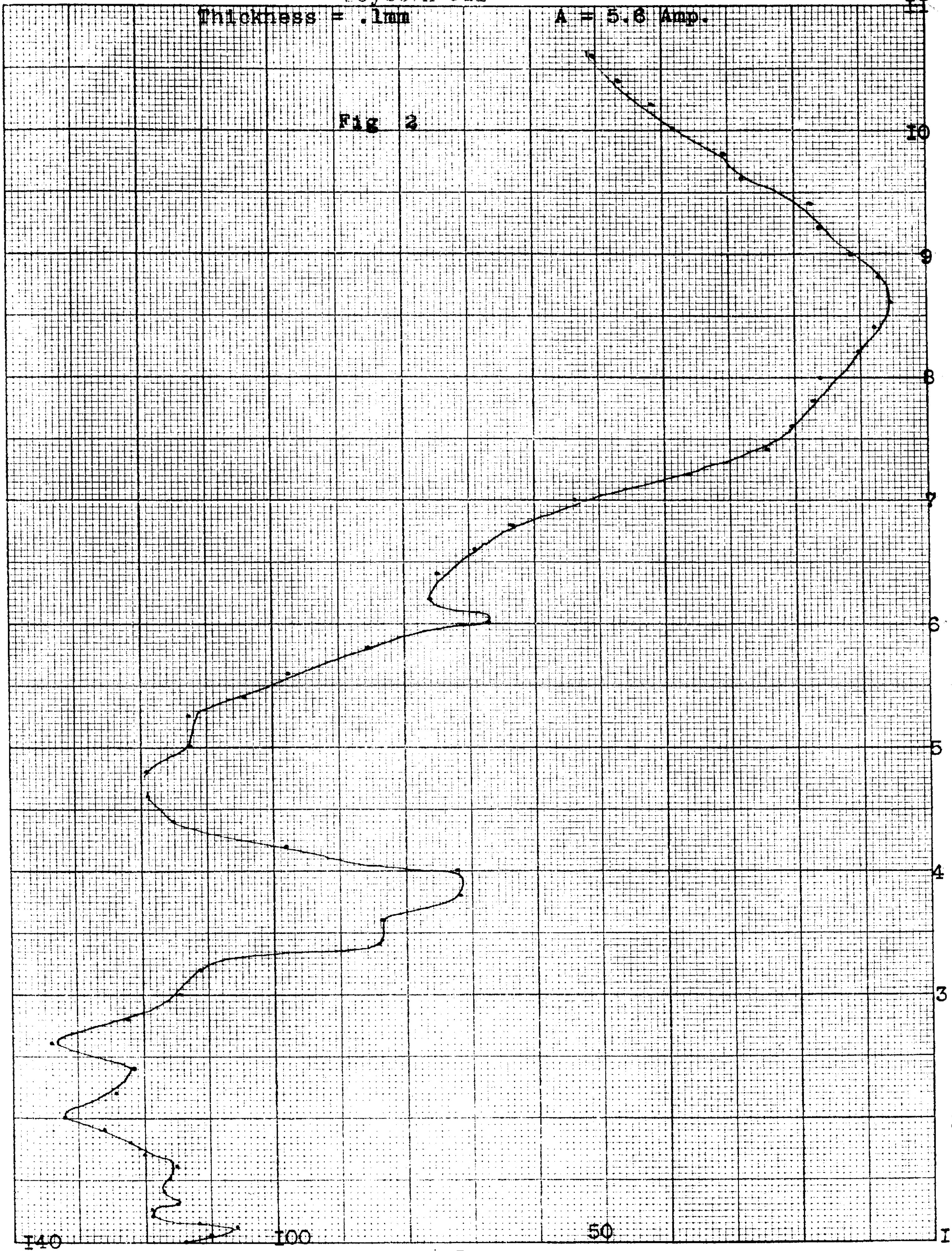
Velocity in ...


800
700
600
500
400
300
200
100
0
1
2
3
4
5
6
7



%T
100
50
Fig 1
Table I
Corn oil
2 Thickness .1 mm A 5.4 Amp.
Wave length in micron
11
10
9
8
7
6
5
4
3
2
1
0
100
%T

Table II
Soybean Oil



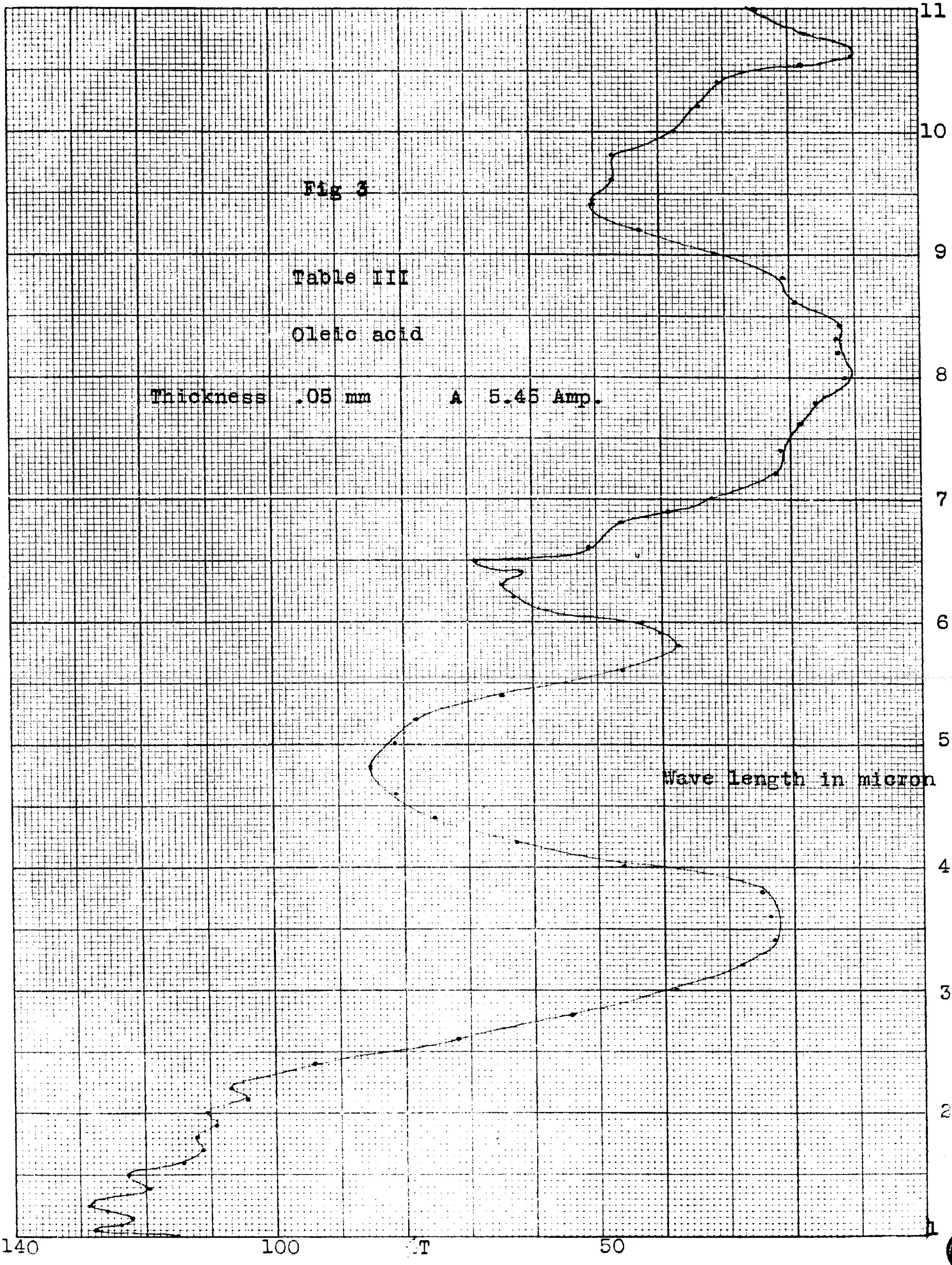


Fig 3
Table III
Oleic acid
Thickness .05 mm A 5.45 Amp.
Wave length in micron
11
10
9
8
7
6
5
4
3
2
1
140
100
T
50

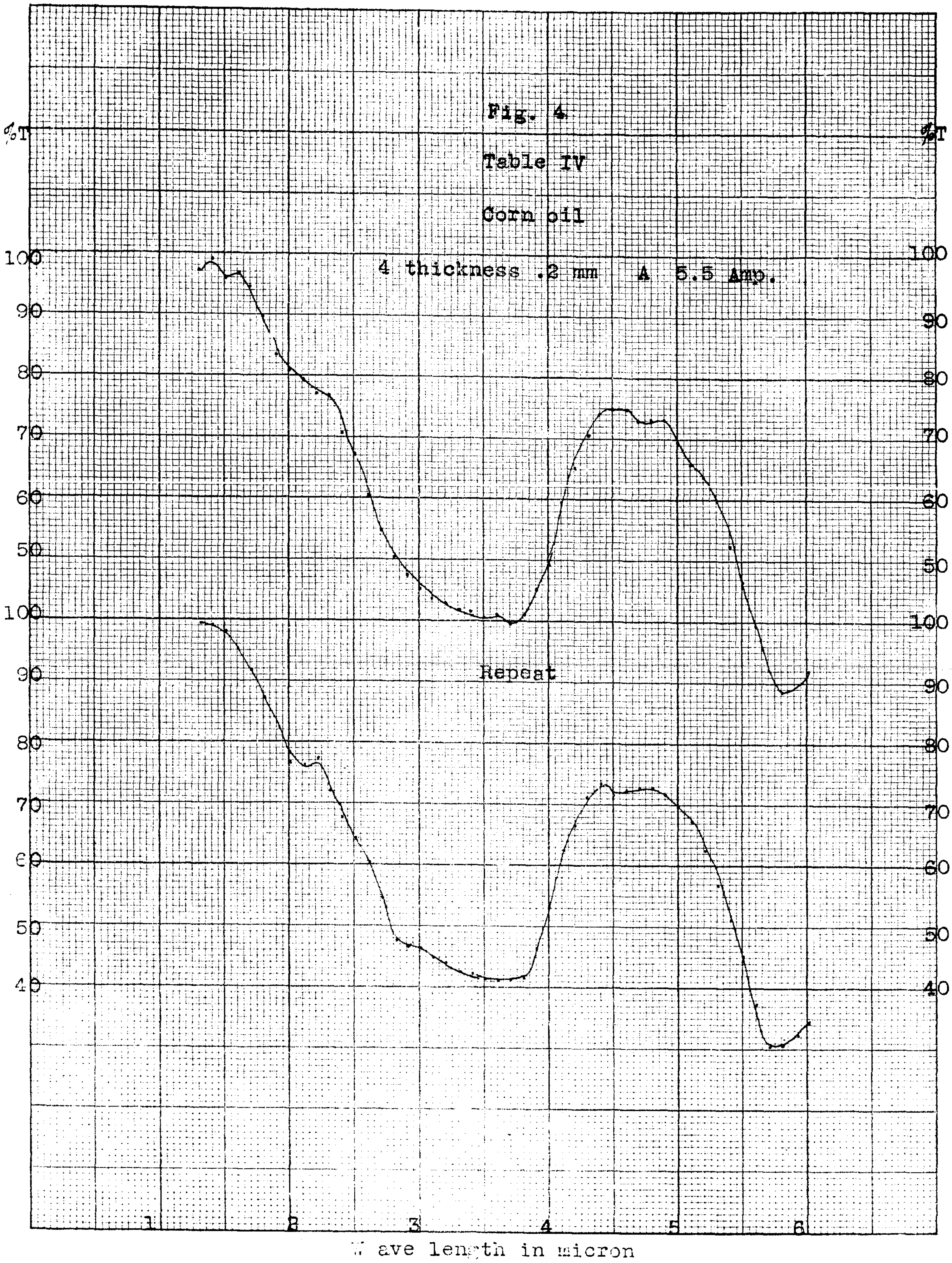


Fig. 4
Table IV
Corn oil
4 thickness .2 mm A 5.5 Amp.
Repeat
%T
%T
100
90
80
70
60
50
100
90
80
70
60
50
40
1
2
3
4
5
6
Wave length in micron

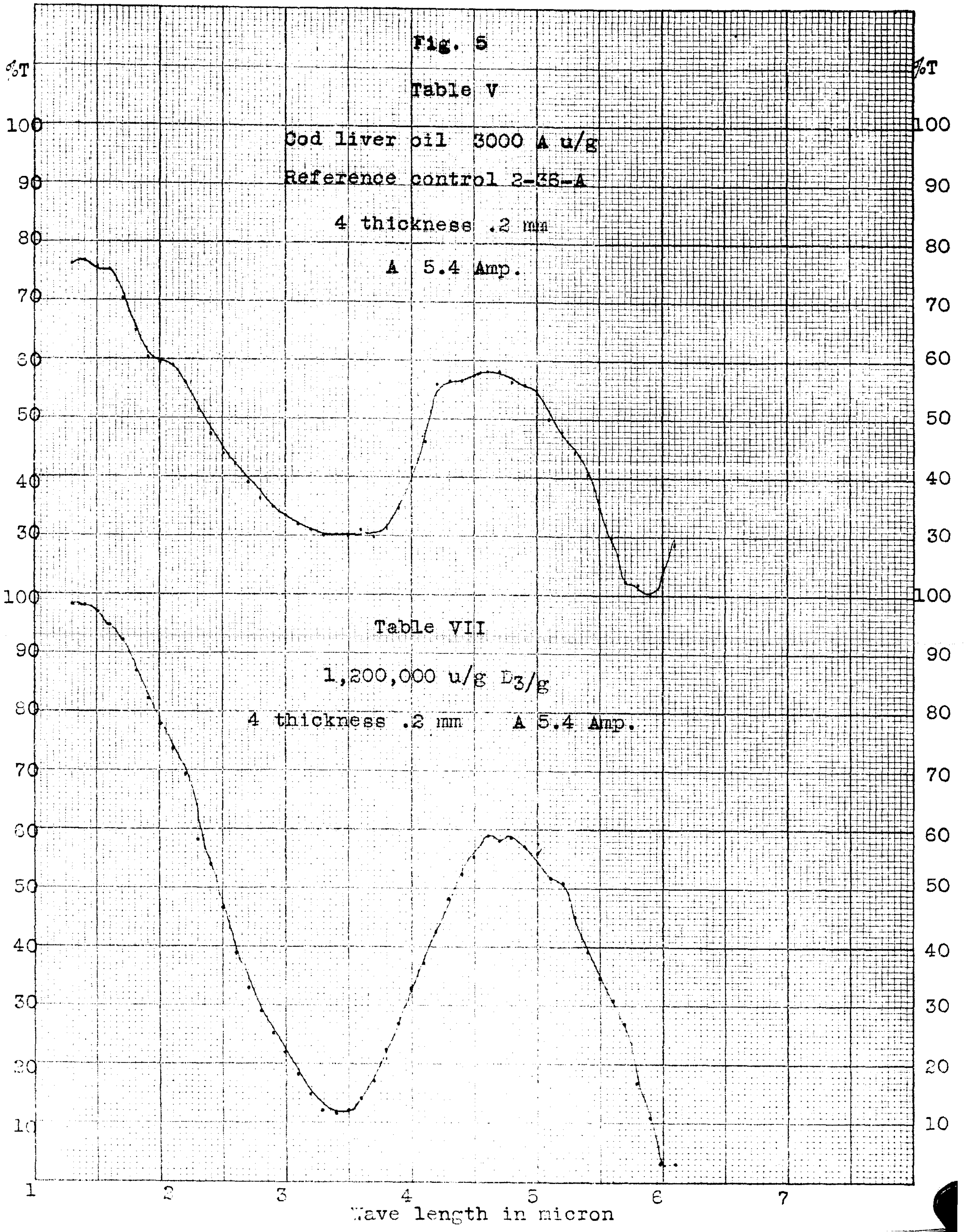
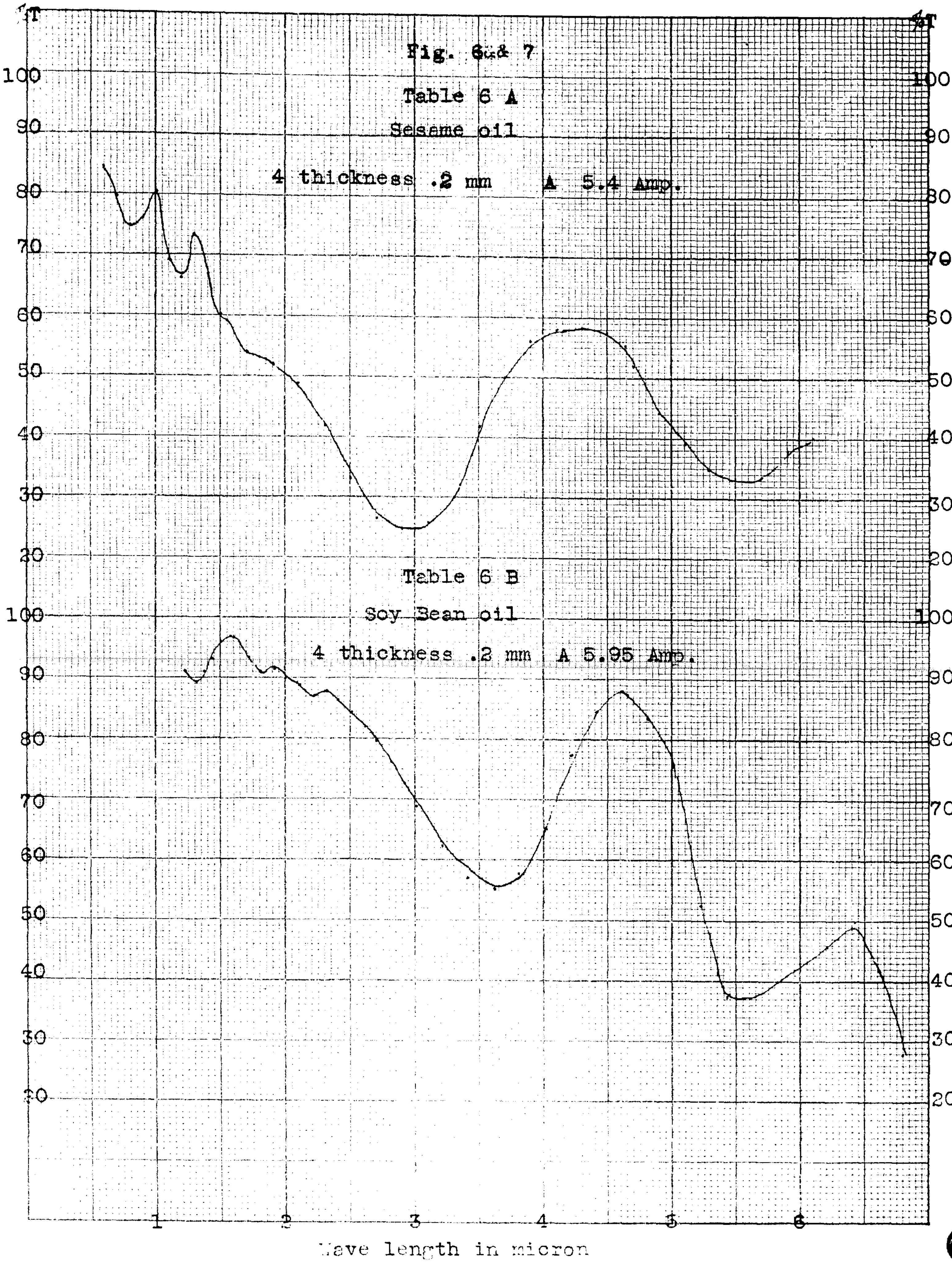


Fig. 5
Table V
Cod liver oil 3000 A u/g
Reference control 2-36-A
4 thickness .2 mm
A 5.4 Amp.
Table VII
1,200,000 u/g D3/g
4 thickness .2 mm A 5.4 Amp.
%T
100
90
80
70
60
50
40
30
10
1
2
3
4
5
6
7
Wave length in micron


%T
Fig. 6 & 7
Table 6 A
Sesame oil
4 thickness .2 mm A 5.4 Amp.
Table 6 B
Soy Bean oil
4 thickness .2 mm A 5.95 Amp.
100
90
80
70
60
50
40
30
20
1
2
3
4
5
6
Wave length in micron

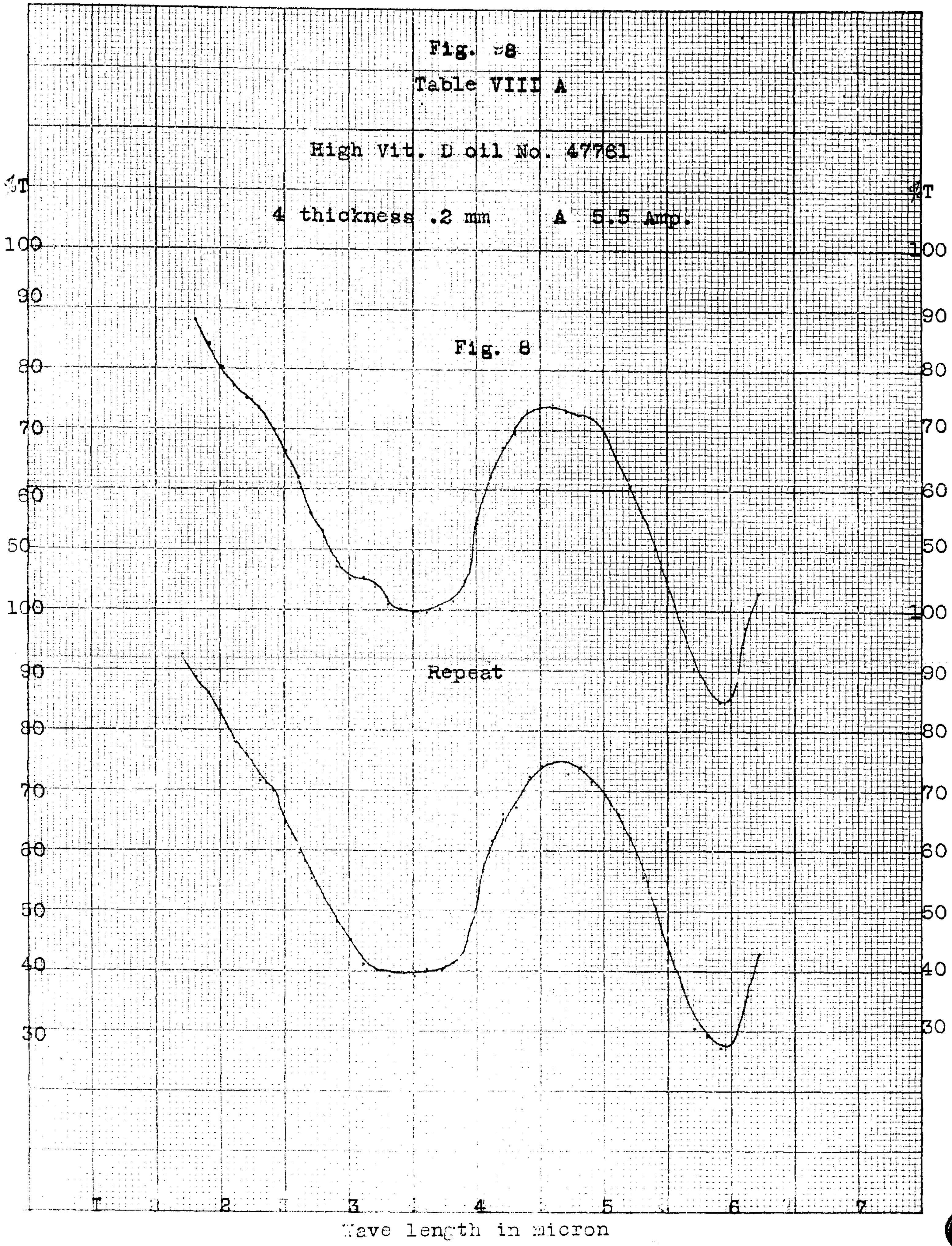


Fig. 8
Table VIII A
High Vit. D oil No. 47761
4 thickness .2 mm A 5.5 Amp.
Fig. 8
Repeat
%T
%T
100
90
80
70
60
50
40
30
1
2
3
4
5
6
7
Wave length in micron

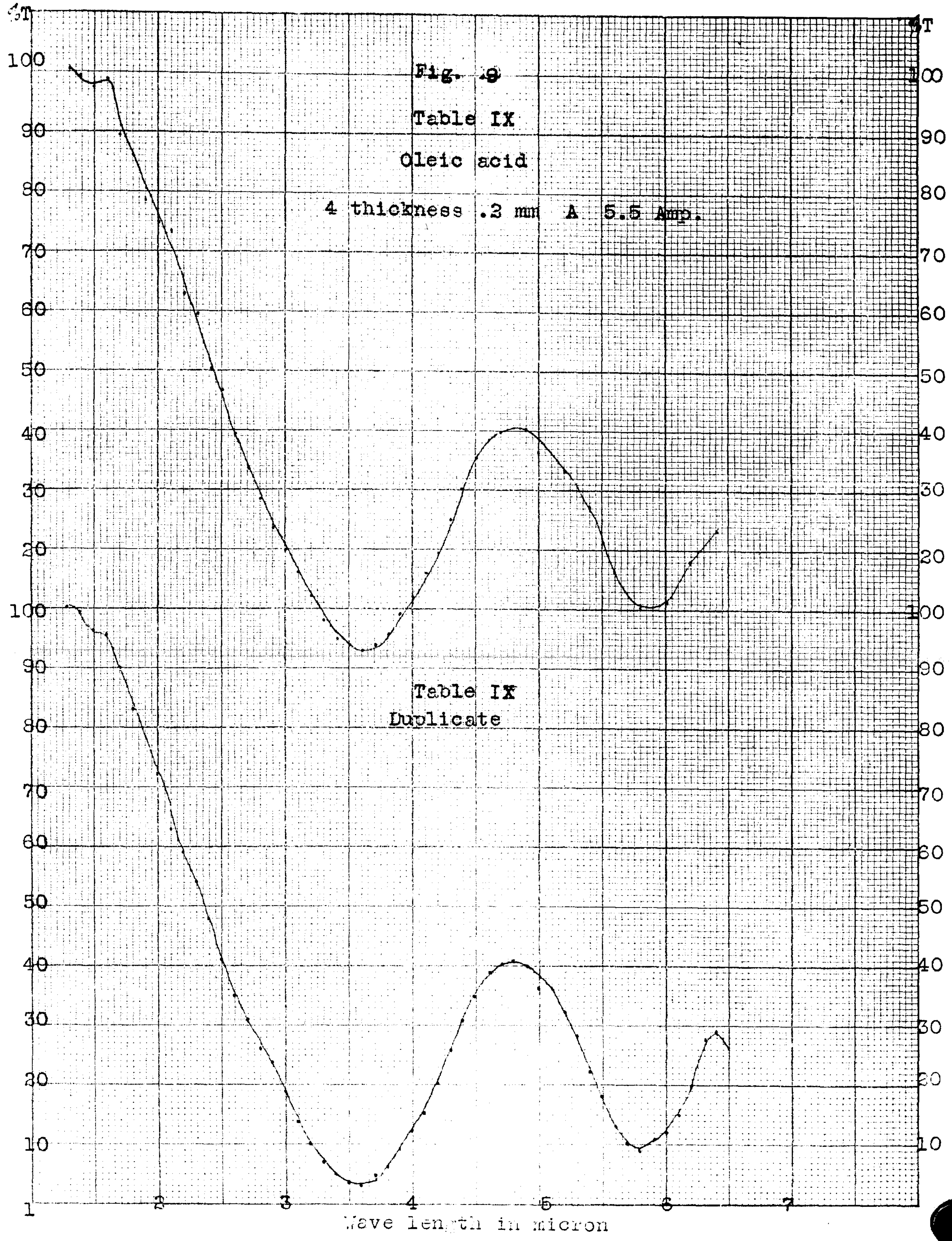
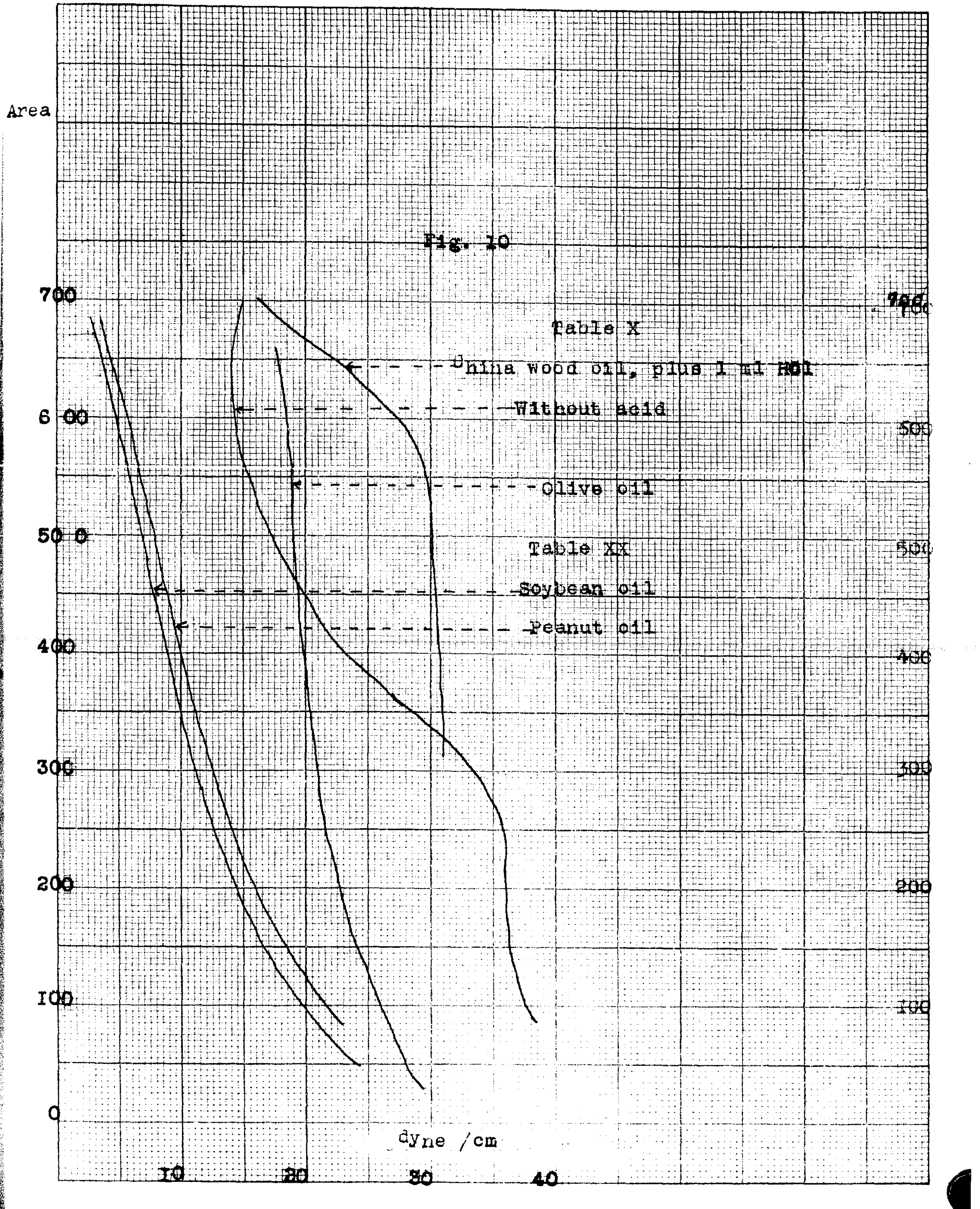
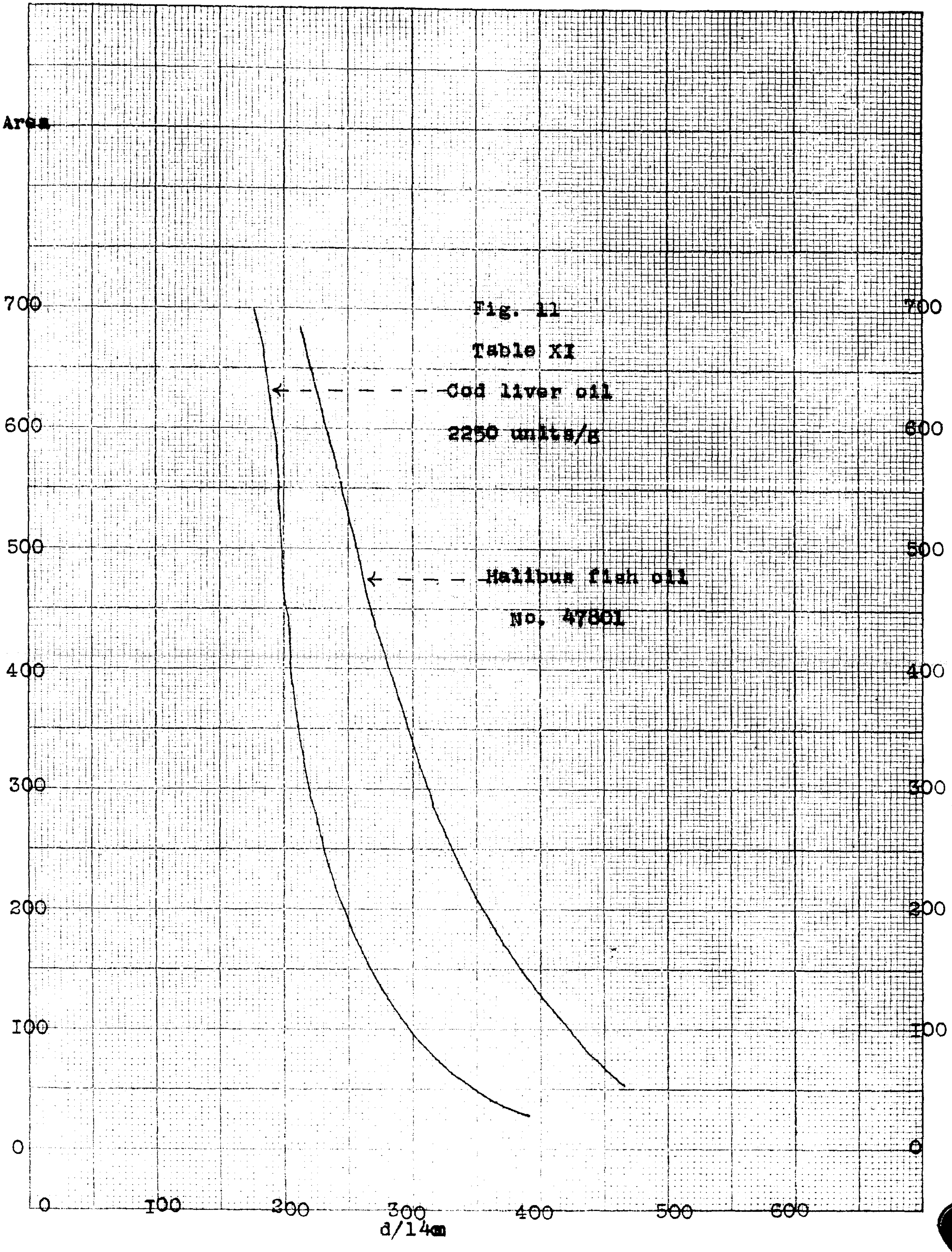


Fig. 9
Table IX
Oleic acid
4 thickness .2 mm A 5.5 Amp.
Table IX
Duplicate
%T
Wave length in micron


Area
Fig. 10
700
Table X
China wood oil, plus 1 ml HCl
Without acid
600
Olive oil
500
Table XX
Soybean oil
Peanut oil
400
300
200
100
0
dyne /cm
10
20
30
40



Area
700
600
500
400
300
200
100
0
Fig. 11
Table XI
Cod liver oil
2250 units/g
Halibus fish oil
No. 47801
0
100
200
300
400
500
600
d/14m

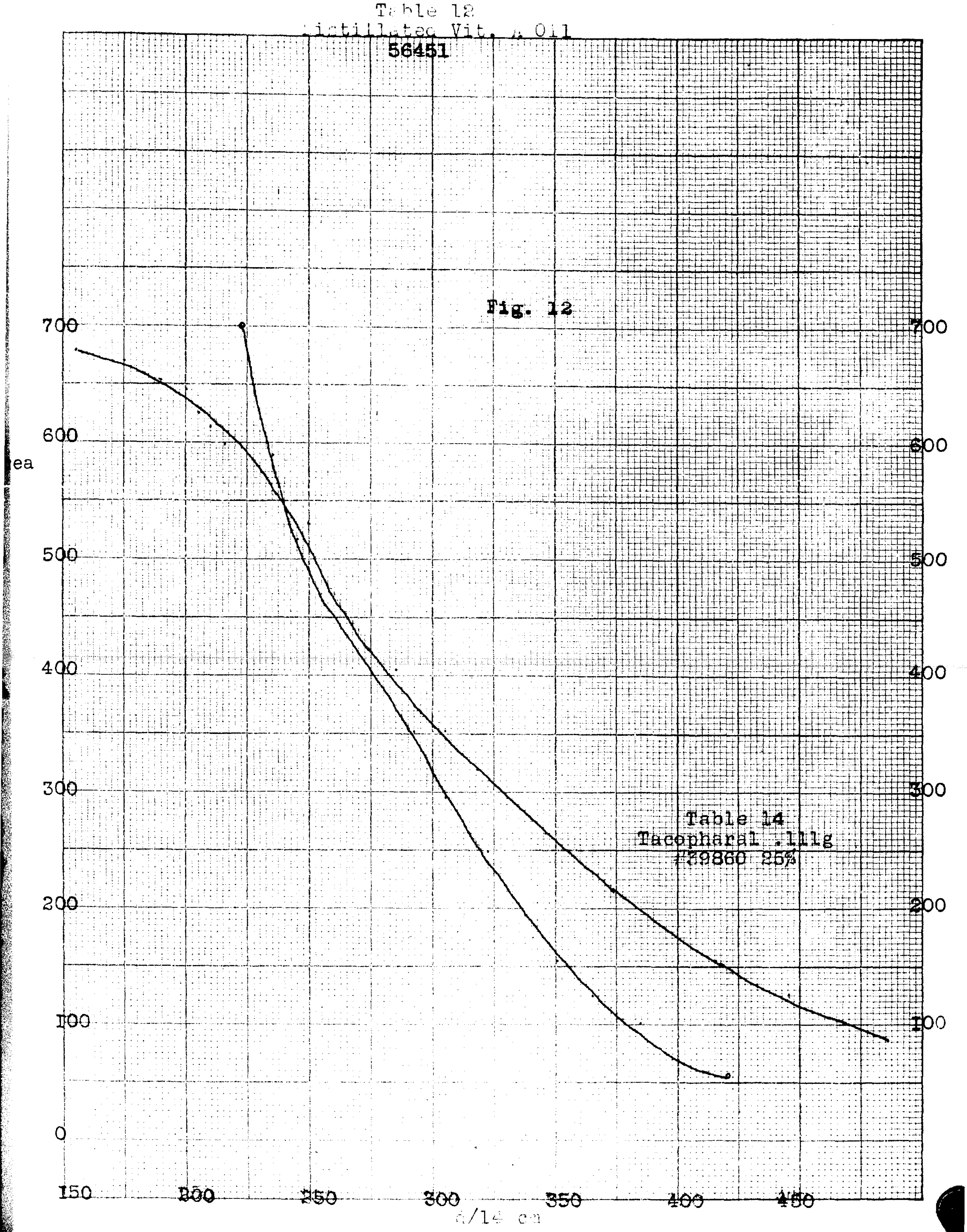


Table 12
[?]istillated Vit. A Oil
56451
Fig. 12
Table 14
Tacopharal .111g
#39860 25%
ea
700
600
500
400
300
200
100
0
150
200
250
300
350
400
450
d/14 cm

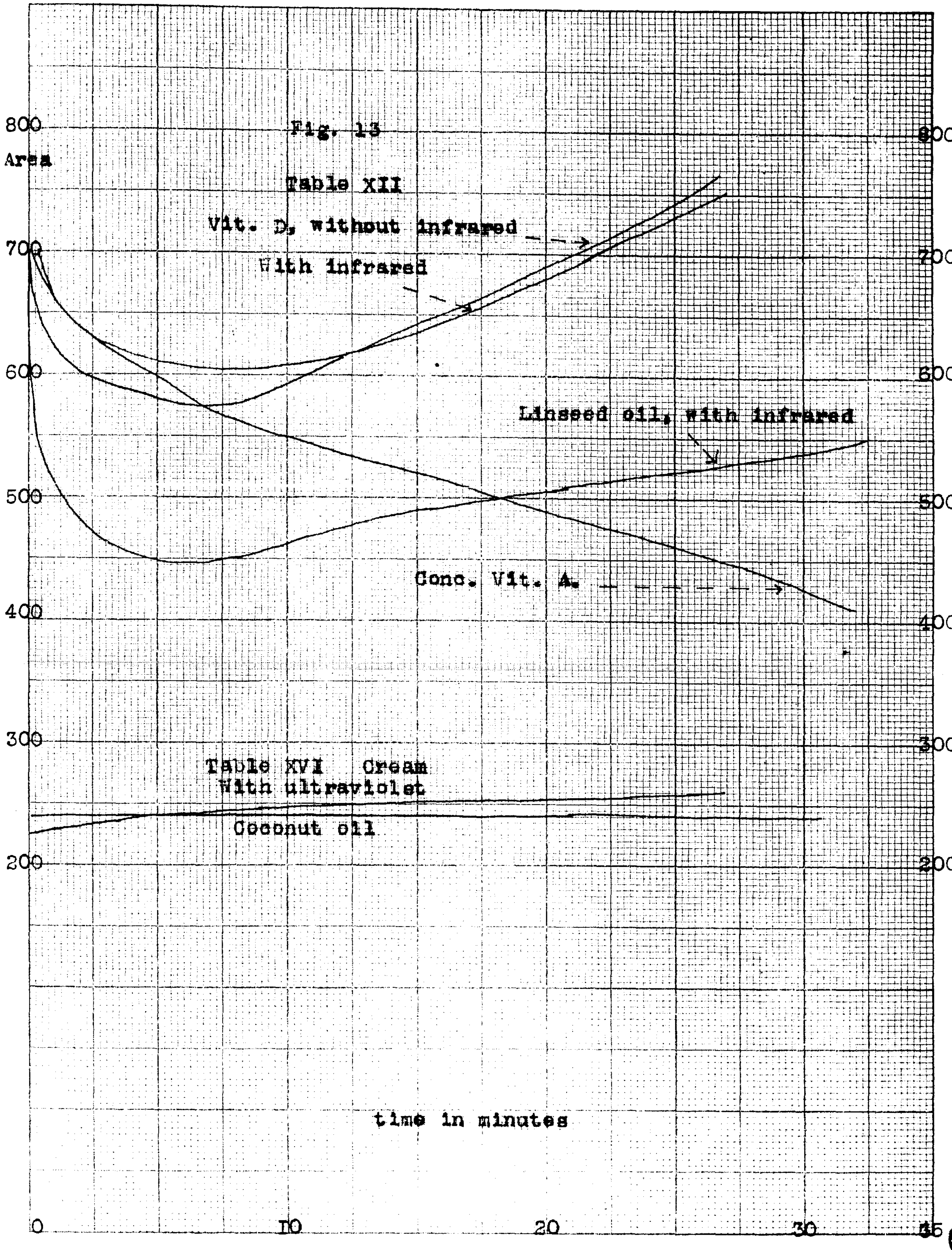


Fig. 13
Area
Table XII
Vit. D, without infrared
With infrared
Linseed oil, with infrared
Conc. Vit. A.
Table XVI Cream
With ultraviolet
Coconut oil
time in minutes
800
700
600
500
400
300
200
0
10
20
30
35

Table 13

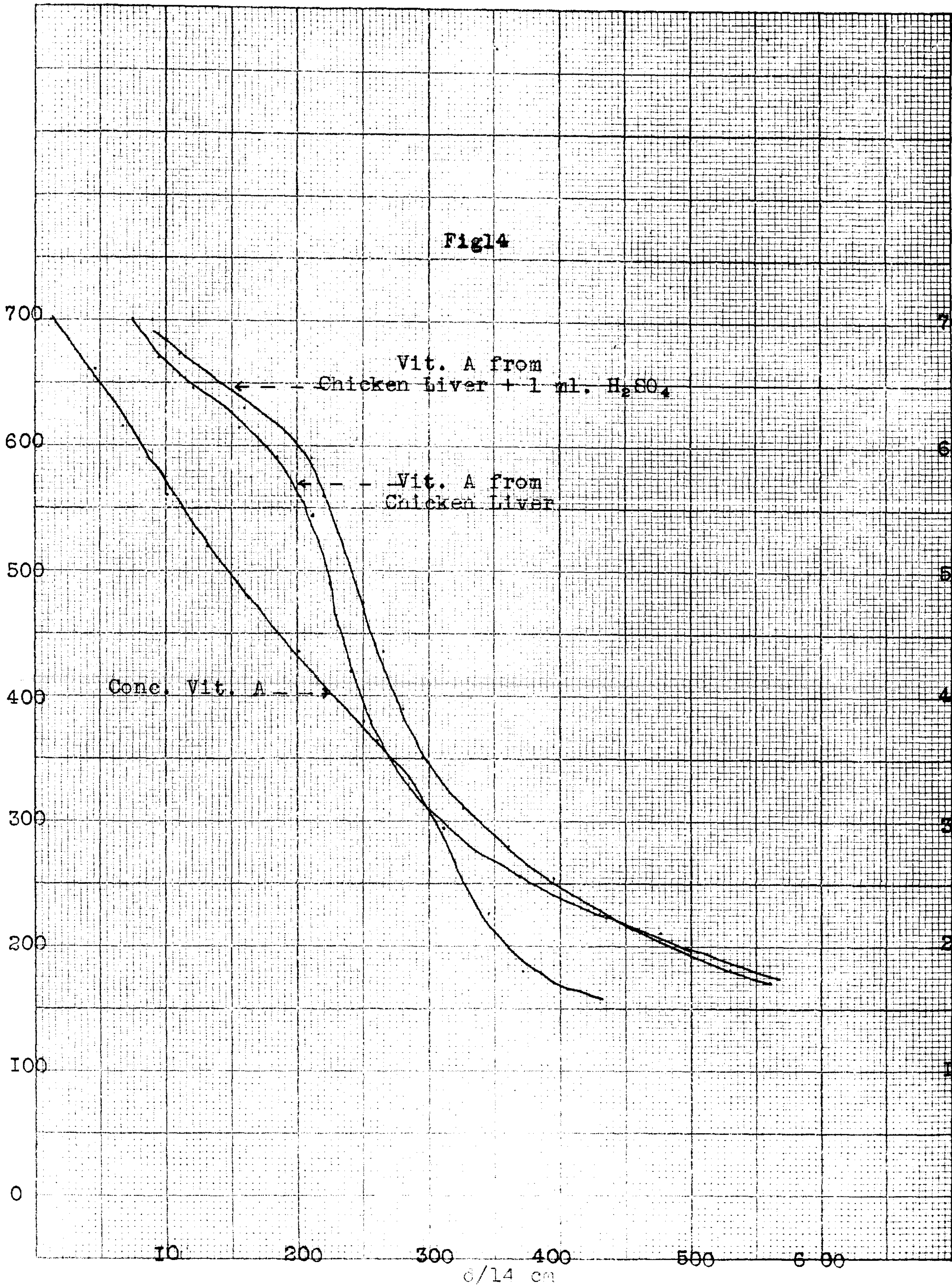


Fig14
Vit. A from
Chicken Liver + 1 ml. H_2SO_4
Vit. A from
Chicken Liver
Conc. Vit. A
700
600
500
400
300
200
100
0
10
200
300
400
500
6 00
d/14 cm

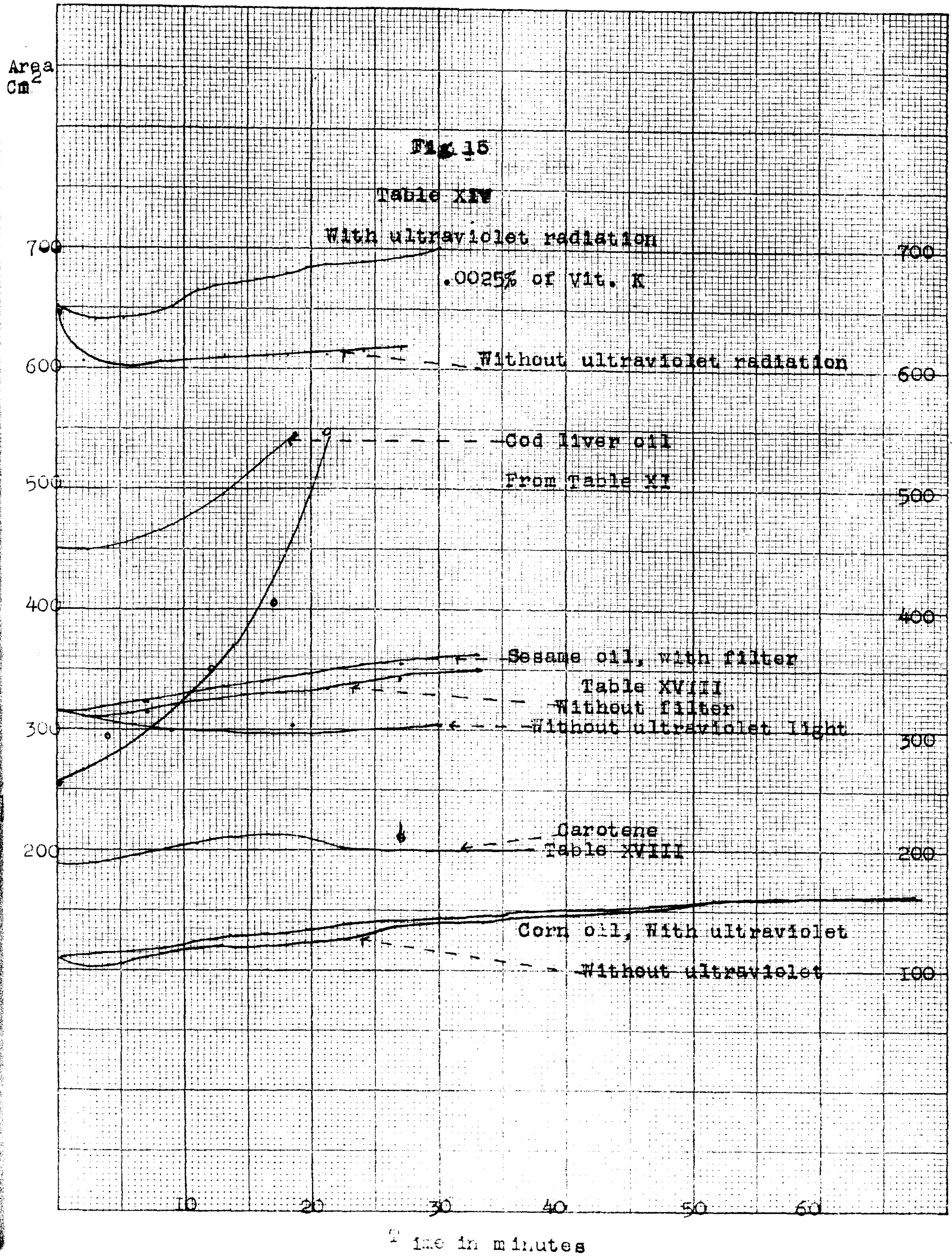

Area
Cm²
Fig 15
Table XIV
With ultraviolet radiation
.0025% of Vit. K
Without ultraviolet radiation
Cod liver oil
From Table XI
Sesame oil, with filter
Table XVIII
Without filter
Without ultraviolet light
Carotene
Table XVIII
Corn oil, With ultraviolet
Without ultraviolet
700
600
500
400
300
200
100
10
20
30
40
50
60
Time in minutes

Fig. 16

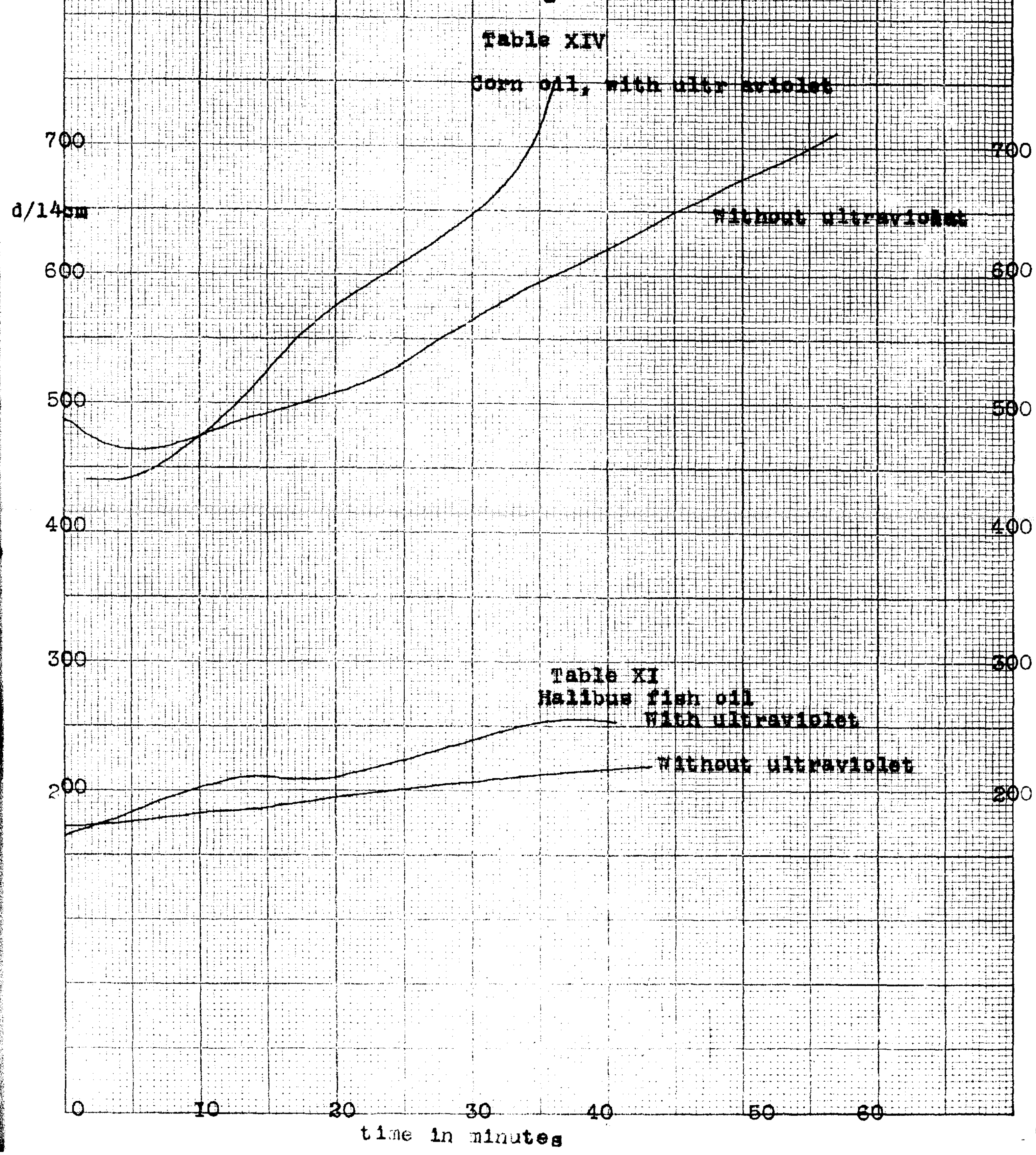
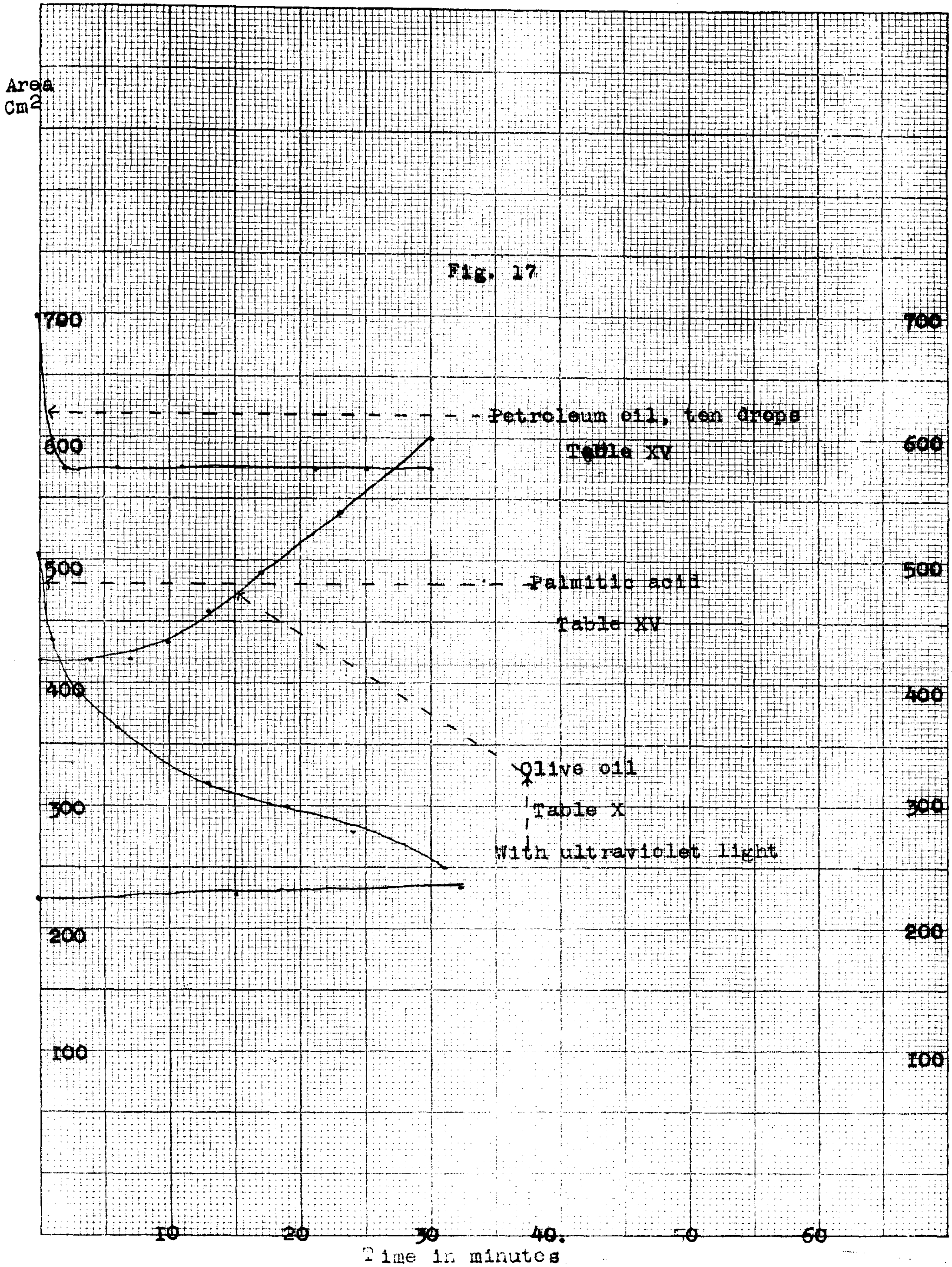
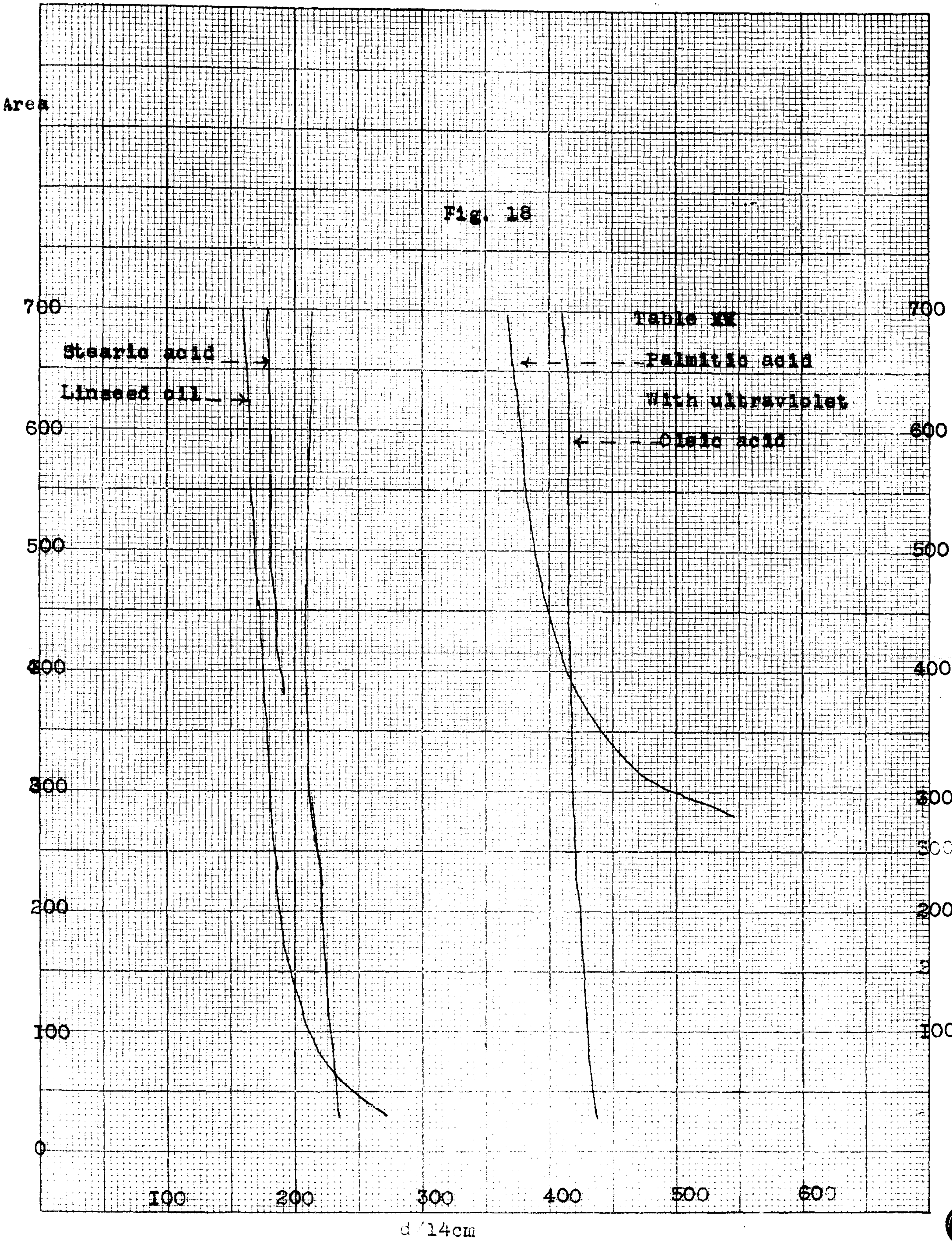


Table XIV
Corn oil, with ultr aviolet
Without ultraviolet
Table XI
Halibus fish oil
With ultraviolet
Without ultraviolet
d/14cm
700
600
500
400
300
200
0
10
20
30
40
50
60
time in minutes



Area
Cm2
Fig. 17
700
600
500
400
300
200
100
Petroleum oil, ten drops
Table XV
Palmitic acid
Table XV
Olive oil
Table X
With ultraviolet light
10
20
30
40
50
60
Time in minutes



Area
Fig. 18
Table XX
Stearic acid
Linseed oil
Palmitic acid
With ultraviolet
Oleic acid
700
600
500
400
300
200
100
0
100
200
300
400
500
600
d/14cm

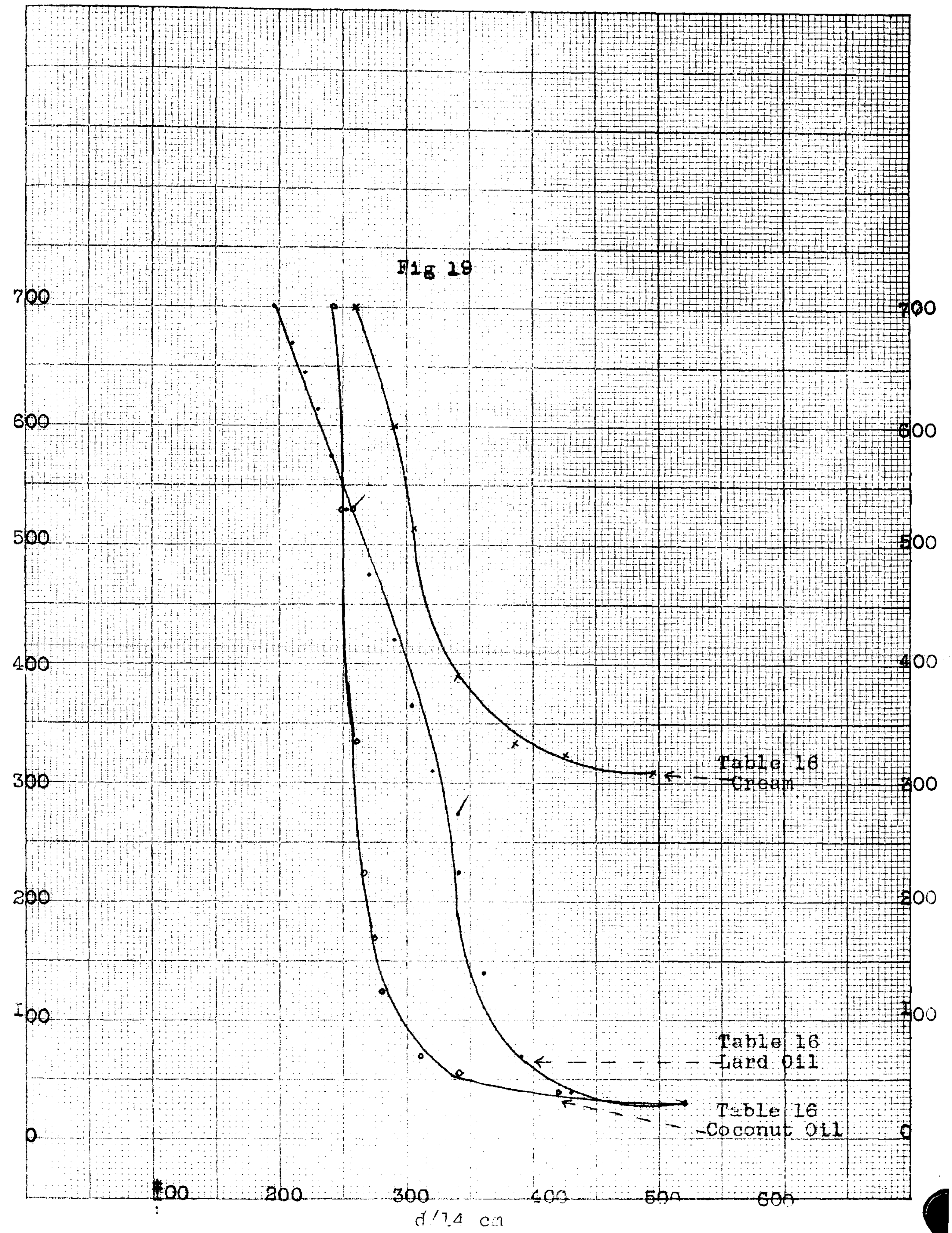
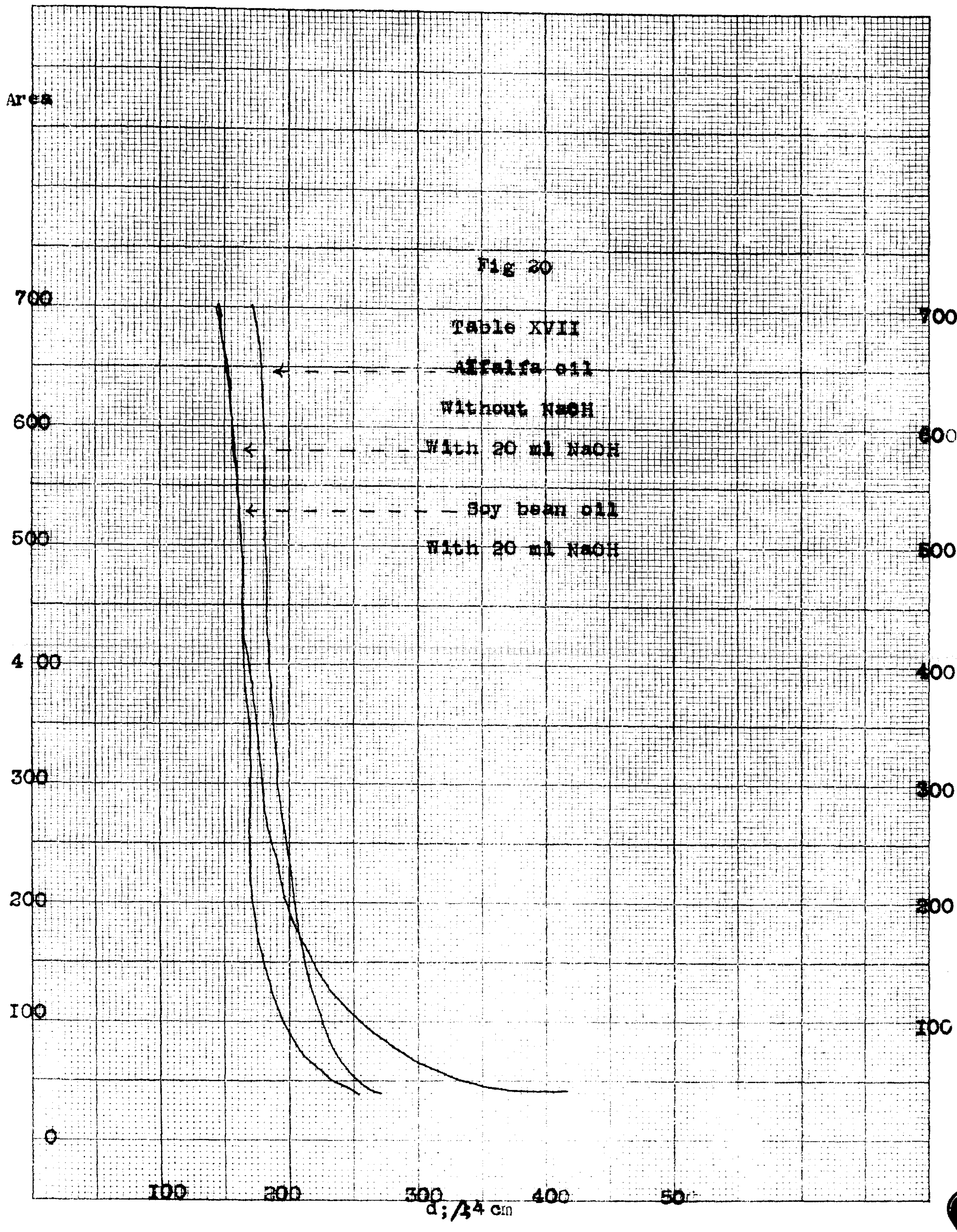


Fig 19
700
600
500
400
300
200
100
0
100
200
300
400
500
600
d/14 cm
Table 16
Cream
Table 16
Lard Oil
Table 16
Coconut Oil


Area
Fig 20
Table XVII
Alfalfa oil
Without NaOH
With 20 ml NaOH
Soy bean oil
With 20 ml NaOH
700
600
500
4 00
300
200
100
0
100
200
300
400
50
d; /4 cm

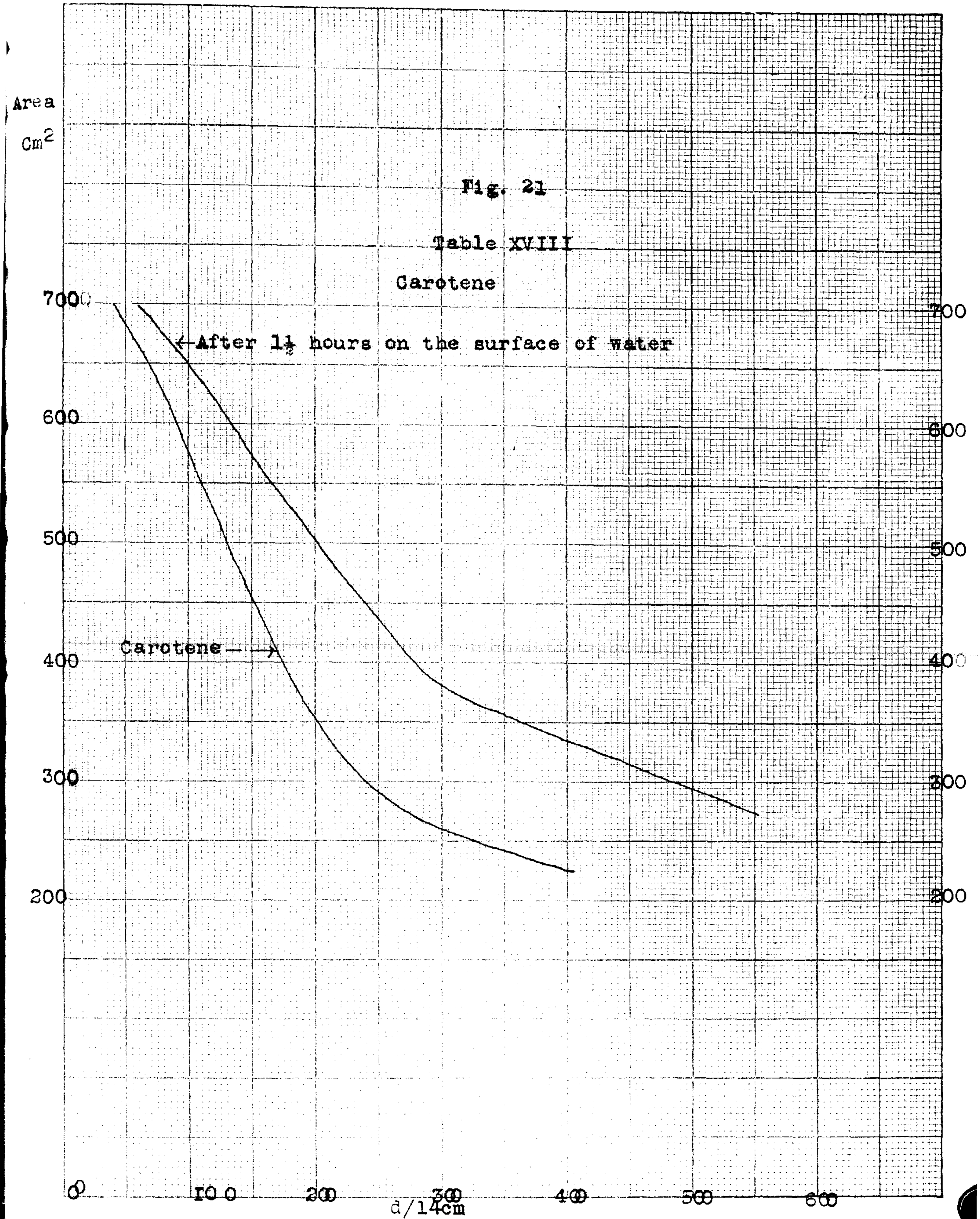
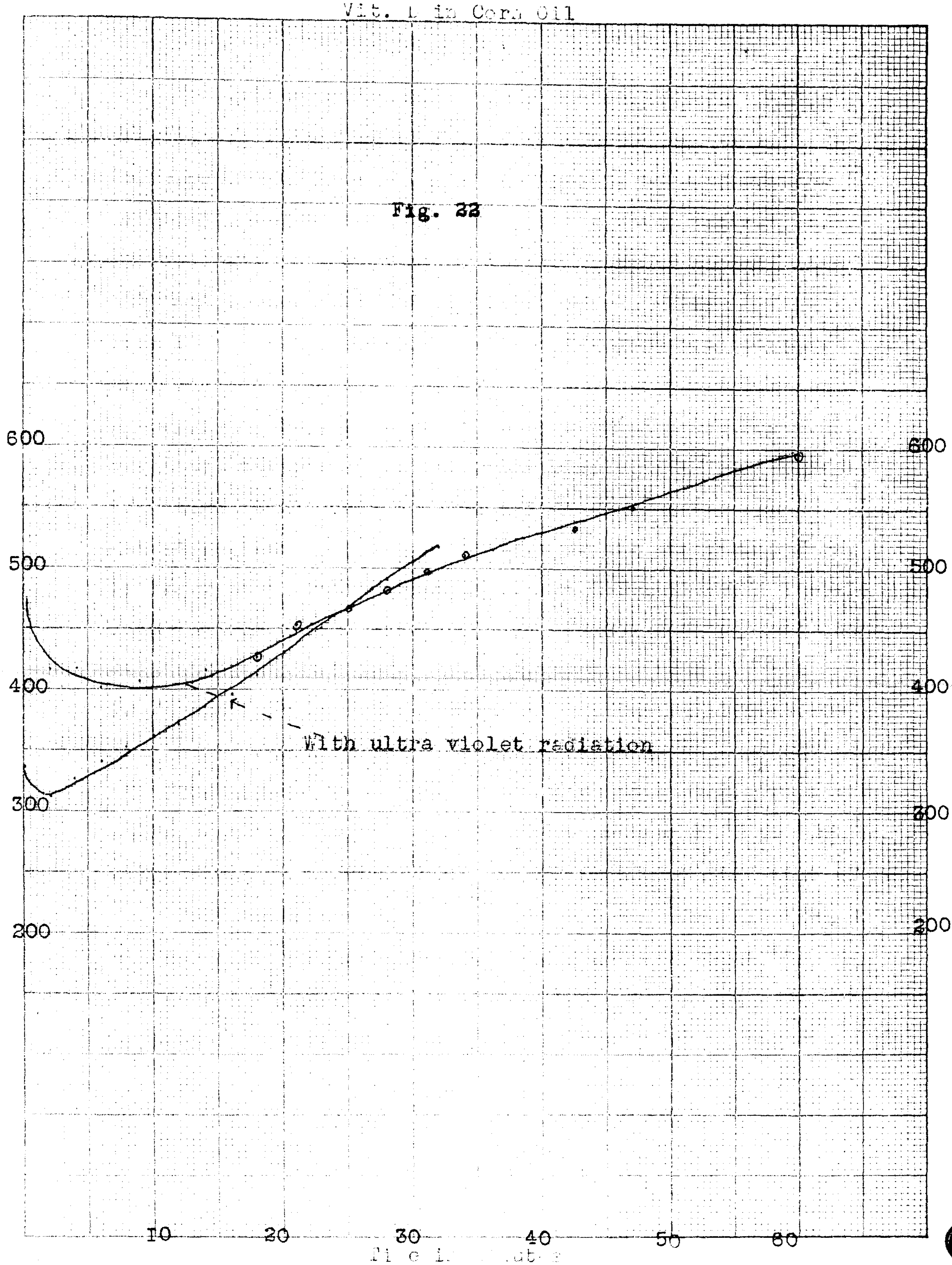

Area
Cm²
Fig. 21
Table XVIII
Carotene
700
600
500
400
300
200
←After 1½ hours on the surface of water
Carotene →
0
100
200
300
400
500
600
d/14cm

Table 19
Vit. D in Corn Oil

Fig. 22



Discussion

The galvanometer deflections are recorded in millimeters. On referring to the first few tables, we see that the percentage error involved in reading the deflections is dependent upon the magnitude of the total deflection. The deflections are small at the wavelength, shorter than 1 μ and longer than 9 μ. These curves given in figures 1 to 9 all show a similarity of region transparency at the neighborhood 3.5 μ to 6 μ. This characteristic transparency is also shown in most organic compounds which have been determined by different people.[1,2,3] An absorption band at the neighborhood 5.8 μ which occurs with marked regularity in each spectrum of the oil examined may be regarded as characteristic of the C=O linkage.[4] The absorption spectra of soybean, corn, sesame and high Vit. D oils and oleic acid have been examined between 1 μ to 12 μ and 1 μ to 6 μ. These absorption cells are usually made from polished rock salt crystals.

The absorption curves show a definte similarity in the number and the location of the bonds between 1 μ to 9 μ while there is no similarity at the region shorter than 1 .

The absorption curves of corn oil and the high Vit. D oil are about the same (Figs. 4,8). And the percentage transmissions are also the same. Both of them go down to 49 percent transmission at the wavelength 3.6 micron.

1. J. Am. Chem. Soc. 47, 2194 (1925)
2. J. Am. Chem. Soc., Bell, 50, 2940 (1928)
3. Optical Soc. of Am. 23, 92 (1933)
4. J. Am. Chem. Soc. 50, 2940 (1928)

The absorption band at the wavelength 3.6 micron for soybean oil goes down to 56 percent transmission (Fig. 6), oleic acid to 6 percent transmission (Fig. 9) and sesame oil to 25 percent transmission (Fig. 6). From these investigations, we can find out that the oleic acid absorbed relatively much more infra-red ray than the others under investigations at the wavelength 3.6 micron.

The bands at the neighborhood 3.6 micron (Figs. 1 to 9) are due to the C-H linkage.[5, 6, 7]

There are a number of curves which have been determined by the film balance method. These curves are divided into three groups. In the first group (Figs. 10, 11, 12, 18, 19, 20, 21), the film area is plotted as ordinated against the dynes per 14 cm. of the film as abscissas. In the second group (Fig. 16), the dynes per 14 cm. of the film are plotted as ordinates against the time in minutes as abscissas. In the third group (Figs. 15, 17, 22), the area of this film is plotted as ordinates against the time in minutes as absicissas.

By looking through the first group, we will see that the vegetable oils are in general more elastic than animal oils. Especially, soybean oil, oleic acid, and sesame oil are the most elastic among the vegetable oils under investigation. The elasticity and compressibility of the regulated oils are lost at a certain pressure and after the film has been pressed once or twice.

5. Salant, Proc. Nat. Acad. Sci. 12, 74 (1926)
6. Coblentz, Carnegie Inst. Pub. No. 35, 23 (1905)
7. Optical Soc. of Am. Vol. 23, 92 (1933)

The effects of ultraviolet light on the corn, olive, cod liver, Vit. K, high Vit. D and soybean oils are quite prominent as shown in the curves (Figs. 12, 14, 15, 19), but it has relatively little effect on cream, cocoanut, peanut, old corn oil, and sesame oils (Fig. 12). All of them have increased their film areas more or less by the effect of the ultraviolet light.

The effect of the ultraviolet light on the conc. Vit. A is in the reverse direction (Figs. 12, 13). In other words, the area of film of conc. Vit. A is rapidly decreased for a certain length of time. The decreasing in area is probably due to the oxidation of conc. Vit. A on the surface of water. The effects of infra-red radiation on the same oils are less prominent than the effect of ultraviolet light (Figs. 11 to 19), but they have the same effect in decreasing the area of conc. Vit. A and in increasing the other oils.

From the investigation, the H_2SO_4 and NaOH do not effect the characteristics of the film of chicken liver oil. The conc. Vit. A oil is least in compressibility and elasticity than any other oils which have been determined as shown in those curves (Fig. 13).

The areas of oil films are always increased even without ultraviolet or infra-red radiations except in the case of concentrated Vit. A oil which decreased its area. The degrees of increasing and decreasing in area are greater when the oils are radiated either by ultraviolet or by infra-red radiation.

The percentage transmissions of heat wave of the vegetable oils are nearly 100 percent at the shorter wavelength, 0.8 μ micron to 1.5 microns and the elasticity and compressibility of the same oil are lost when they have been pressed once or twice by the area pressure measurement.

From these evidences, the writer assumes that if the vegetable oil mixed with the animal oil, which has less compressibility and elasticity, will more readily spread on the surface of leaves than vegetable oils alone.

The percentage transmission at the wavelength 0.9 μ to 1.5 μ (Figs. 1 to 3) is nearly 100 percent. The thickness of oil film is 0.1 mm. The vegetable oils not only have a tendency to transmit all heat waves, but also have a tendency to store the heat at these particular wavelengths. Therefore, the leaves of certain plants have been injured or have an appearance of a burned effect. This is probably due to the oils which are used as the stickers for spraying materials.

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