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LEATHER INDUSTRY  
IN THE  
NEAR EAST

By

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Presented to the Faculty of the American University  
of Beirut in partial fulfilment of requirements  
for the Degree of Master of Arts in  
Chemistry.

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American University of Beirut, June 12, 1944.

P R E F A C E

The chemistry of leather manufacture is progressing more rapidly now than at any previous time. Therefore the purpose of this thesis is :- First, the attempt to solve some of the problems of the Leather Industry in the Near East arising as a result of the war. Second, the scientific investigation of the effects of pH and neutral salts on the rates of diffusion in gelatin - jellies and the amounts of combination with collagen ( hide - powder ). Third, the correlation together of facts on the Leather Industry in the Near East.

The writer wishes to express his thanks to Prof. N.D. Constan for supervising the work and for offering many helpful suggestions.

Carlos M. Samour

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H I S T O R Y

Thirty thousand years or more ago there existed in Spain, and in fact Western Europe generally, a race of primitive human-beings now known as the " first true men ". During the glacial periods, which we are told threatened to exterminate every human creature on the face of the earth the life of man must indeed have been fearful beyond imagination. At such a time man needed clothes, and it is reasonable to suppose that the only covering he possessed was made up of the skins of animals that he had killed.

The prehistoric man dried his skins and used them as such for clothing after having noticed that wet skins putrefy and decay, while dry ones do not. But dry ones being hard and horny he must have tried to remedy this hardness by rubbing the dry skin with the fat of the animal, of which he must have noticed the softening effect on his own skin. By this means he was able to produce softer and more durable leathers; some of the greasy and albuminous matter used were fat, brains, milk, butter and egg-yolk, separately or mixed together, even now adays we practically use some of these same processes.

In the Fourth Glacial Age the prehistoric man must have early noticed that wood-smoke had an antiseptic and preservative effect on skins which were dried in it.

The use of vegetable tannins, though prehistoric was not so early as the smoke process, but it may have had its origin

so ancient as the smoke process, but it may have had its origin before the use of clothing and may be when people tried to introduce dyes into the skins, by using certain bark extracts as dyes. And it happened that some barks also contained tannins, as a result found that this has a superior quality over the bark which did not contain any ( of course they did not know that ) and so began using barks which gave also the effect of vegetable tannins. That is how tanning skins with vegetable tannins originated.

The art of tanning with alum and salt was still a latter introduction, and must have originated in countries where alum is found as a natural product. This art was not known in Europe or perhaps it was lost during the dark ages until introduced into Spain by the Moors.

While the savages of the West were intent upon the mere satisfaction of their animal desires, the Egyptians were considerably advanced in technical knowledge. In the tomb of Tutankh-Amen a considerable amount of leather was found, in the form of harness, seats of stools, and of sandals. Unfortunately, the damp and heat of the tomb destroyed the leather, in fact rendered it black brittle and almost pitch-like.

The discovery of parchment paper was a result of the rivalry between the libraries of Alexandria and Pergamum.

Let us pass now to the Roman civilization, which the old chronologists state was founded in 753 B.C., we find that the

leather industry was in a flourishing condition. It would be remembered that the eight gilds of the seventh century were those of the flute players, goldsmelters, smiths, dyers, cordwainers, carriers, brassworkers, and potters.

In Antioch during the Hellenistic Age we are told from an ancient inscription that tanneries used to manufacture Leather shields for the army.

England was very backward in leather manufacture up to the end of the eighteenth century, owing to the fossilising influence of much paternal legislation, and of certain excise-duties, which were only repealed in 1830. But since this time the art has made rapid strides.

The past forty years have been marked-in many parts of the world, such as Germany, France, England, U.S.A. and many others - by very considerable advance, and the application of science to the manufacture has been very noticeable.

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I N T R O D U C T I O N

Since the dawn of civilization, leather has been one of the world's most important commodities. It has become so much a part of our everyday life that we should find ourselves in a dilemma if it were taken from us. And yet, after thousands of years of daily use, its properties remain but poorly defined. Leather is not a simple and homogeneous material of definite properties, on the contrary, it is of very variable composition; it has an exceedingly complex structure; and every variation in composition or structure causes some corresponding change in the properties and serviceability. Unfortunately, the relations involved in the leather manufacture are not yet well understood.

The manufacture of leather is undoubtedly an extremely complicated chemical process. The leather industry was developed like many other great industries by man who had no chemical training whatsoever. When chemists started putting their sharp and sensitive noses in this industry-as they did in many others a sharp conflict arose between the " theoretical " and the " practical " minds. Although a practical man possessed no knowledge of chemistry, nevertheless knew how to make a serviceable and salable piece of leather. On the other hand, the theoretical man who had a good knowledge of the fundamental principles of chemistry, and with a good record in all his subjects when in college, usually spoiled every lot of leather that he tried to improve. Thus it was but natural then that the practical man

developed a contempt for the theoretical man, regarding them as ignorant meddlers and their experiments as a waste of time and money.

But it happened that the practical men got into difficulties which proved very costly and, even after these difficulties were overcome, there was no guarantee that they would not recur. Thus chemists would not have been tolerated had it not been to these difficulties that the practical man got into. Furthermore, the public taste changes with time - especially those of the ladies - forcing tanners to change their methods. The manufacture of leather involves many extremely complex processes, all of which must be in perfect balance to produce a salable product. If one of these operations is changed in any way, the balance is upset and, unless compensating changes are made in the other operations, the leather may be completely ruined. The cut - and - try method was usually employed in making these compensating changes and, because of the seemingly infinite number of possible changes, it was a matter of good fortune for the tanner to succeed before the spoilage was so great as to ruin him. For this reason he was reluctant to throw away any possible chance of assistance, and so he kept his chemist in the hope that he might prove valuable in times of distress, even if only in a small way. Although the chemist might prove a great help if allowed to meddle with the processes, he often had suggestions which, coupled with the tanner's own knowledge of leather manufacture, got the tanner out of his difficulties. Nevertheless we find glaring

examples of the farreaching effects of our ignorance in this respect. I shall cite only one of them:-

We know that the great majority of people suffer unnecessary foot discomfort because of the methods employed in tanning the leather used in making their shoes. The discomfort being due to an excessive shrinkage and expansion of the leather with changing atmospheric conditions, which can be overcome to a very considerable extent by changing the method of tanning the leather. That is by increasing the temper, elasticity, flexibility, and resilience of the leather, which is brought about by incorporating greater amounts of oil into the leather, and also the great expansion and shrinkage with change of weather conditions can be much decreased by using upper-shoe leathers tanned with vegetable tannins and not with chrome tannins, because chrome leathers increase in area by an average of about 18% when going from a dry to a moist atmosphere, while the tannin-leathers increase in area only by an average of about 6%. Also they shrink in area correspondingly when the relative humidity falls. The shoe upper is thinner and tends to reach equilibrium with the air much more quickly than the very thick sole, and so the changing size is much more effective when the upper is chrome-tanned. Nearly everybody in the Near East now wear shoes with chrome tanned uppers, because tanners are mostly preparing chrome-tanned shoe uppers, which are subject to these great size changes with atmospheric conditions. For this reason many people here suffer unnecessary foot - discomfort.

The reason for this change in size with change in atmospheric conditions ( according to Wilson ) is that the basic groups of the proteins take up water from the atmosphere more readily than the acidic groups. In chrome leather most of the basic groups are still free, in vegetable-tanned leathers the acid groups are free and therefore the tannin occupies the position that the water would otherwise take, and so the power of the leather to take up water and change in size is correspondingly diminished. The public can have whatever it demands, but it will probably be a long time before it is educated to the point of knowing what is possible to get in the way of foot comfort. Leather plays a very important part in the daily life of nearly every civilized human-being, and therefore a great service can be rendered to mankind by the development of a scientific control of all the important properties of leather.

A control of all the important properties of leather involves studies of the materials used in making leather and of their chemical reactions, as well as measurements of properties of leather which are not well defined. Animal skin contains a number of different properties, fats and other materials in variable proportions. Few materials known to the chemist are so complex as the proteins and the tannins which are employed to convert protein matter into leather. In the manufacture of leather, one also encounters bacteria, molds, enzymes, complex organic salts, emulsions of various kinds of oils, dyestuffs, and finishing materials, including waxes, gums, resins, • soluble proteins, and lacquer

and varnish materials. To solve the basic problems, of leather chemistry actually requires the elucidation of the basic problems of most other branches of chemistry.

However, the outlook is far from being hopeless. During the last forty years leather chemistry has kept pace with the unprecedented speed of development of other branches of sciences, for example:-

1. The unhairing of skins was done by lime which required from 1 - 3 weeks to cause the hair to slip easily, during which time a considerable amount of collagen became hydrolysed, especially in old liquors or in liquors not kept completely saturated with lime at all times. With increasing demand for speed of operation and conservation of the skin collagen, "sharpening agents" have been used, the principle ones being  $As_2S_5$  and 0.01 M  $Na_2S$ . The judicious use of these materials, in conjunction with lime, has reduced the time required to unhair skins from 1 - 3 weeks to 1 - 3 days.

2. The use of artificial bating material instead of dung of dogs. The latter giving rise to foul smells, and making the process more difficult to control.

3. The use of organic acids instead of bran in the drenching process. When the bran ferments it gives rise to several organic acids ( which bring about the drenching of the skins and hides ) and many other gases and bacteria, thus making the process dangerous and more difficult to control.

In the task of producing a more serviceable leather under

scientifically controlled conditions, a few definite results have been obtained and we may confidently look forward to further important developments in the near future.

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STATUS OF THE LEATHER INDUSTRY

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STATUS OF THE LEATHER INDUSTRY IN THE  
NEAR EAST.

The leather industry has not developed in the Near East except in certain parts of Palestine and in Beirut due to the presence of specialists from Europe as refugees and because people started to realize the great future that lied in front of the Leather - Industry in this part of the world and so some had the great luck of getting machinery before the war started. It is true that we have many more tanneries than twenty years ago, but the methods employed and the leather produced in most tanneries are but slightly improved.

1. STATUS OF THE LEATHER INDUSTRY IN PALESTINE

Palestine offered between 1920 and 1939 a good market for imported leather and manufacture of leather goods. Though the country had a fair supply of raw materials, yet owing to the lack of modern tanneries and factories for the manufacture of leather goods, it was compelled to export a certain percentage of undressed hides and skins, and re-import them in the form of manufactured leather, boots, saddlery, bags, etc... The demand was mostly for manufactured goods of average quality and cheap prices.

In 1927 Palestine started to export sole and finished leather but not in great quantities, which was dropping every year, so that it dropped from 96,000 Kgs. in 1929 to 5,000 Kgs. in 1938.

The chief competitors before 1922 were between high priced

English, French, American leather goods, and the cheap Egyptian kind. The Egyptian was cheaper by 50% and of course of poor quality, but holded the market, and the value of its imports into Palestine was greater than the combined imports from other countries. But in 1922 Germany appeared in the market, due to the low rate of exchange of the mark and credit facilities and commercial enterprise, this country was prominent in the import of leather and shoemakers grindery.

In 1936 there were several fairly large tanneries using modern machinery and considerable number of smaller undertakings. The principal factories working in 1936 were: Lekovitch Bros., Tel-Aviv; the Anglo-Palestine leather Co., Yazur, with a capital of £. P. 20,000; the Levathian Tannery Co., Yazur, with a capital of £. P. 15,000; Wadie Dorkhum, Jaffa; and Kiriako Kiriazi, Jaffa. They manufacture mostly sole leather, principally from local hides. Attempts to produce high - grade upper leather have not been successful, owing to the fact that local hides are usually damaged by insects.

The Leather Industry in Palestine is centered around Tel-Aviv, Abu-Gosh ( near Jaffa ) and Hebron. The best leather nowadays is produced around Tel-Aviv in Raanana and in Nathanya, while in Abu-Gosh and Hebron the old methods are still prevalent. Raanana is mainly specialized in the production of Furs *and* has *to* *few* machinery, while in Nathanya and other tanneries around Tel-Aviv like the Lekovitch Tannery and the Anglo-Palestine Leather-

Co. Produce mainly upper-shoe leather and sole leather and use mostly machineries. Hebron and Abu-Gosh produce mainly sole and sheep leather and use mostly vegetable tannins.

In 1928 there was a Government census, a census which is not very reliable and from that time on there were no census until 1940 and 1941, but they are military secrets and therefore cannot be published.

GOVERNMENT CENSUS OF 1928, FOR LEATHER AND CANVAS.

Enterprises		Persons		Employ-Capital ed Invested			Value of output in 1927.			
Num-ber	% of Total	Num-ber	% of Total	% of Price	Amount P.	% of Total	Amount P.	% of Total	% of Price	Kgm. Materials P.
67	1.9	236	1.3	3.5	34,477	1.0	47,615	1.2	410,7	27,338

2. STATUS OF THE LEATHER INDUSTRY IN SYRIA AND LEBANON.

The status of the leather industry in Syria and Lebanon is the same as that of Palestine except in production which is much greater. The quality of the Syrian leather and especially sole leather was better than that of Palestine. This is not true new for the case of the upper-shoe leather. In certain parts of Palestine especially in Raenana and Nathanya, the leather produced is as good and may be a little better than that produced in certain parts of Lebanon.

The leather industry in Lebanon is centered in <sup>Damascus</sup> two principal places: -Beirut and Mashgara. In Syria they are centered in Damascus

and Aleppo.

The leather industry was important before World War I, but it was handicapped by its crude methods of production. Since War I modern factories have been erected - mostly in the years 1930 to 1939 - especially in Damascus, Aleppo and Beirut, while old tanneries have been rapidly disappearing but some reappeared during this war because of the large profits it is bringing. Before World War II, the leather industry, with its improved methods of production, has come to satisfy the greater part of the requirements of the internal market and to do some exporting and especially now it supplies all the requirements of the internal market.

#### Leather Industry Before The World War II:-

The tanning of hides and skins of all sorts has developed greatly in the last few years. Based originally on the presence of native raw materials, it now depends to a considerable extent on foreign supplies of raw hides. Its production has greatly increased, so that in addition to supplying most of the local demand it now exports a considerable quantity of tanned hides.

In addition to local hides used for tanning, large quantities are imported from Palestine, Turkey, Egypt, India and Iraq. Some local hides are exported to Italy, France, the United States, England and Germany.

#### The Kinds Of Leather Manufactured Are :-

1. Lebanon:- Mostly cow hides, sheep and goat skins, and

small amounts of buffalo and kid skins. The buffalo hides before the War were brought mainly from India, but now only from Irak and in small quantities.

2. Syria:- They manufacture mostly sheep, goat and kid skins, and small amounts of buffalo, cow and camel hides.

Workers And Wages:-

The large tanneries have about 35 workers, the medium ones between 15 and 30, and the small ones about 5 workers.

The monthly wage of the best worker in Syria before the war was between 15 and 30 syrian pounds; while now the wage of a worker ranges from 150 to 300 syrian pounds per month.

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Price Of Hides And Skins In Syria And Lebanon From 1924-1939

Year	Price in % of Sheep and Goat Skins.	Price in % of Cow Hides.	Value of sterling pound.		
			January	July	December
1924	100	100	£.L. 4.25	£.L. 4.25	£.L. 4.37
1925	100	100	—	—	—
1926	150	150	6.48	10.87	6.14
1927	140	140	6.17	6.21	6.21
1928	140	140	—	—	—
1929	160	160	—	—	—
1930	70	150	—	—	—
1931	50	130	6.19	6.21	4.42
1932	35	80	—	—	—
1933	45	75	—	—	—
1934	50	65	—	—	—
1935	55	70	—	—	—
1936	70	75	3.73	3.80	5.26
1937	75	75	7.36	—	8.84
1938	85	80	8.84	8.84	8.83
1939	75	80	8.83	8.83	8.83

The price per kg. of sheep or goat skin in 1924 was 50 p.s. which is equivalent to 100%.

The high percentage in prices between 1926 and 1927 was due to the low rate of exchange of the franc, while between 1928 and 1931 to the low rate of exchange of the franc and also

to the world crisis.

Sheep And Goat Leather In Syria And Lebanon From 1939 to 1943

Year	Price per Kg. in L.P (Tanned)	Proportion of annual production	Proportion of local yearly consumption	Price per skin in L.P	Proportion of exports
1939	125	100 %	35 %	80	65 %
1940	125	100 %	45 %	80	45 %
1941	170	75 %	60 %	120	—
1942	300	60 %	95 %	175	5 %
1943	325	50 %	100 %	200	—

Value of Sterling pound from 1939 to 1943 was L.S. 8.83 100 % is equivalent to approximately 1,500,000 skins. The production of skins in Lebanon is approximately  $\frac{1}{3}$  of the total production of both Syria and Lebanon except in the production of cow hides in which Lebanon exceeds Syrian production.

Half of the production of the Lebanese tanneries is consumed in Syria, while a 4th. of the Syrian tanneries are sold in Lebanon.

Lebanon has imported for 1938 - 1939, an average of 3,500 to 4000 tons yearly of raw hides and skins. A part of these hides and skins were tanned, then reexported at an average of 1,500 tons, yearly. Actually, there must be added a number for the local consumption of the army.

Prices of hides and skins per kgm. for August of every year:-

(1) Salted sheep skin with wool.					(2) Lamb skins.					(3) Cow hides.				
1938	1939	1940	1941	1942	38	39	40	41	42	38	39	40	41	42
60	75	45	45	85	125	150	100	135	145	50	55	220	200	175

1. By kgm, of sheep skin ( 4 kgm. the piece ).
2. By kgm. of medium lamb skin ( 1.25 kgm. the piece )
3. By kgm. of cow hide ( 6 kgm. the piece ).

Prices in 1939 for sheep and lamb were dearer than 1940, because there were no exportations and the demand was nearly the same; while in the case of cow hides, Syria and Lebanon used to import, as a result supply decreased and therefore prices went up.

Imports and exports of Syria and Lebanon:- In addition

to local hides used for tanning, large quantities are imported mainly from Palestine, Turkey, Egypt, India and Iraq. Some local hides are exported to Italy, France, The United States, England and Germany.

The imports consist mainly of cattle hides and, to a lesser extent, goat and sheep skins. The exports are mainly hides of goats and sheep. The imports have been increasing, while the exports have been on the decline. The large quantity exported in 1933, which exceptional, was due to large shipments of hides made to the United States. The increase in the excess of imports over

exports of raw hides is an evidence of the increasing dependence of the local tanning industry on foreign supplies. Since 1928, when modern tanning methods began to develop, there has always been a more or less large excess of imports over exports. Considering the large quantities of hides supplied locally, the increasing importance of the tanning industry is clearly revealed.

With the large decrease of imports, local production supplies the greater part of the local market. It is estimated that 75 % of the " box " leather and 85 % of the sole leather used internally are furnished by the local industry. The imports of box-calf as well as of fine leather come mainly from the United States and France. The imports of sole leather come mainly from France and Egypt. Syria may be considered self-sufficient in tanned hides, however, for certain qualities of fine leather, it is dependent on foreign supplies. In sole leather it is almost self-sufficient for in addition to supplying 85 % of the internal market in 1934, about 105 tons of sole leather were exported, as compared to 122 tons of imports. The exports of tanned leather go mainly to Palestine and England.

Imports and exports of Syria and Lebanon during this war in tons:-

Skins and hides	1939		1940		1941		1942	
	Imp.	Exp.	Imp.	Exp.	Imp.	Exp.	Imp.	Exp.
Tanned and Untanned	4,299	1,985	1,980	376	1,351	154	1,862	146

Most of the imports and exports of Syria and Lebanon during

this war are raw hides and skins, especially the exports.

Materials Used In Tanneries:-

Most of the materials used in the tanneries are imported from outside e.g. degreas oil, sodium sulfide, artificial material, chromates of sodium and potassium.

The chromates were mostly imported from Germany because it was cheaper than other countries like England and America, but nowadays it is imported from America while the degreas oil is imported from England.

The tanning extracts are mostly obtained from Africa ( like quebracho ) and Izmir-Turkey ( mostly Valonia ) and in the region of Aleppo ( Aleppo galls ).

Since the war started there were no more importations and as a result tanneries were suffering from the lack of materials, but with the coming of the Allies into Syria and the Lebanon the tanneries have been able to get some materials, thus relieving the problem slightly. Nevertheless they are not enough, tanneries are being forced, on account of this, and because of the great price of materials, to resort to the use of old methods, like the use of dung of dogs instead of artificial bating material, This is specially done in Mashagara and Hebron.

Comparison Of Leather Produced In The Near East With Leathers

Imported From Other Countries Before The War.

The skins and hides imported from Europe and America are

of a much better quality than the ones produced in the Near East for two reasons :-

1. The animals are fed better and well taken care of.
2. Holes in the hides and skins caused by Anthran<sup>x</sup>.

The leather produced is also of a much higher quality than the one produced here for two main reasons:-

1. Lack of specialists. In the Near East there are very few specialists and even these are not skilful, and therefore there is no control of the materials in the processes.
2. Lack of machinery, which constitutes the difficulty of controlling the processes as the hide is tanned.

The leather produced here cannot be compared with the European, except sole leather which is done as well as in Europe for the sole reason that it needs very little technic as compared to the upper-shoe leather.

### Sanitary Conditions

Sanitary conditions in most of the tanneries in the Near East especially in the small ones, is very poor, due to the lack of government control. The tannery is rarely cleaned and the by-products are thrown near-by. Even the building is not sanitary so far as ventilation is concerned.

When a man in Europe or America thinks of creating a tannery he is forced to consider by the government and for his own good the following important points:

1. Specialists to control the tannery.
2. The possibility of drainage and disposal of effluent waste liquors and washing waters.
3. Soft water supply.
4. commercial facilities as to nearness to markets and sources of supply of raw materials.
5. Erection of a building suitable for the purpose of ventilation, fire accidents, water supply, etc...

Now, what a tanner here cares for is only a good water supply and the hell with the rest. He chooses an old building devoid of ventilation, drainage system for the disposal of waste liquors, waste material and washing waters.

As a result we therefore expect the leather produced to be of a very inferior quality.

Thus, to my opinion, in order to improve our tanneries in the Near East we must have the:-

1. Means of destroying the flies that inferiorate our skins and hides, and here is a problem to be tackled by the biologists and the government.
2. We should have government control in the tanneries as regards the disposal of waste materials, ventilation, and cleanliness.
3. Specialists, people that do understand and have had great experiance in leather manufacture and who also are chemists.

4. Machinery, in order to make the means of controlling the processes of tanning much easier.

### Methods Used

1. Old Method:- Mashghara, Beirut, Hebron, Abu-Gosh.

Upper shoe leather:- The skins are washed in a pit, then removed and put in another pit containing saturated lime and some  $\text{Na}_2\text{S}$ . After three days they are taken out, dehaired, cured by a beamster and washed. They are then put in a pit containing dung of dogs or hen until placid when they are taken out and put in successive pits containing bark extracts or leaves e.g. Sumach, until they are well tanned. They are dried, then slightly wetted and ironed with a piece of iron. Afterwards they are dyed and oiled, and thus our leather is ready.

2. Modern Method:- Beirut, Ranana, Nathanya.

Upper shoe leather:- The salted hides are soaked with water in a pit for three days until they are soft, or if sundried a little longer.

They are then drummed with saturated lime solution containing  $\text{Na}_2\text{S}$  for one day. They are afterwards unhaired and scudded in machines, put in artificial bating materials for about an hour and then pickled in a mixture of organic acids and  $\text{NaCl}$  for around one hour. The use of bating and pickling is for the following reason:-

In the final preparation of the skin for tanning, the PH

value of the solution absorbed by the skin and with which the skin is in equilibrium must be adjusted to suit the particular method of tanning to be employed. During liming, this solution has a PH value of about 12.5, during bating a PH value of about 7.5. Before the skins can be tanned properly by any of the common methods of tanning, the PH value of this solution must be lowered considerably below the value of 7.5. During vegetable tanning, the PH value of the liquors is usually less than 5, and in chrome tanning, less than four. By using tan liquors containing the excess of acid, the adjustment of the PH value may be made in the tan liquor itself. But this is often a very difficult matter where the process is not under rigid chemical control. Consequently by using organic acids before tanning ( drenching ) the PH value can be lowered to the desired value or by the use of NaCl in conjunction with organic acids ( pickling ) in order to prevent the unnecessary swelling of the hides. They are then washed in warm water ( in a drum ) at around 60 degrees centigrade.

The hides are then drummed for three hours with basic chrome liquor the first day, left overnight and drummed for two hours the second day. The hides are afterwards washed in the same drum with water to remove the excess chrome liquor and then dyed.

The hides are then taken to a machine, thinned as required from the flesh side and smoothed in a staking machine to remove wrinkles. They are then fat-liquored, put on rectangular frames.

stretched, held in place by picks and then dried in the sun. When dried they are again dyed with a pad on the grain side and afterwards ironed in a machine at a temperature of around 60 degrees centigrade.

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STATISTICS ON IMPORTS EXPORTS

AND LEATHER PRODUCTION

IN THE

NEAR EAST

P A L E S T I N EStatics on Importation and Exportation between 1924 and 1941.1924.

	Imports		Exports	
Hides and Skins Undressed	114,430	5,965	479,680	33,415
Leather and Manuf. Thereof	382,800	60,650	—	—
Chrome Alum	16,000	0,350	—	—
Vegetable Tannins	75,000	1,500	25,000	0,350
Bags, Wallets, Belts ect.	—	—	—	—
<b>Total:</b>	<b>588,230</b>	<b>68,465</b>	<b>504,680</b>	<b>33,765</b>

1925.

	Imports		Exports	
Hides and Skins Undres.	84,465	6,670	612,465	30,050
Leather and Manuf. Ther.	334,930	65,710	39,200	6,010
Chrome Alum	17,000	0,400	—	—
Vegetable Tannins	88,915	1,700	27,750	0,750
Bags, Wallets; Belts ect.	--	--	--	--
<b>Total</b>	<b>525,310</b>	<b>74,560</b>	<b>679,415</b>	<b>36,810</b>

1926.

	Imports		Exports	
Hides and Skins Underes.	48,844	3,395	443,518	23,645
Leather and Manuf. Ther.	350,437	65,360	63,600	6,715
Chrome Alum	16,000	0,350	---	---
Vegetable Tannins	86,354	1,760	33,750	0,915
Bags, Wallets; Belts ect.	---	---	---	0---
<b>Total</b>	<b>501,635</b>	<b>70,865</b>	<b>540,868</b>	<b>31,275</b>

Palestine Statics Cont.1927

	<u>Imports</u>		<u>Exports</u>	
Hides and Skins Undres.	203,764	12,000	474,245	24,515
Leather and Manuf. Ther.	504,984	87,706	103,000	12,750
Chrome Alum	15,000	0,300	---	---
Vegetable Tannins	120,582	2,700	21,850	0,315
+Bags, Wallets, Belts, ect.	---	---	---	---
<b>Total</b>	<b>844,330</b>	<b>102,700</b>	<b>609,095</b>	<b>37,580</b>

1928

Hides and Skins Undres.	119,170	15,733	661,388	36,640
Leather and Manuf. Ther.	242,280	62,624	78,900	10,050
Chrome Alum	9,000	0,200	---	---
Vegetable Tannins	183,340	3,740	5,332	0,115
+Bags, Wallets, Belts ect.	---	---	---	---
<b>Total</b>	<b>553,790</b>	<b>82,297</b>	<b>745,620</b>	<b>46,805</b>

1929

Hides and Skins Undres.	289,139	20,855	708,323	57,400
Leather and Manuf. Ther.	247,260	68,000	96,305	12,710
Chrome Alum	17,871	0,440	---	---
Vegetable Tannins	342,330	8,160	20,112	0,235
+Bags, Wallets, Belts ect.	---	---	---	---
<b>Total</b>	<b>896,600</b>	<b>97,465</b>	<b>824,740</b>	<b>70,345</b>

(+) They are included under Leather and Manuf. Thereof.

Palestine Statics Cent.1930

	Imports		Exports	
Hides and Skins Undres.	218,563	19,267	439,020	37,405
Leather and Manuf. Ther.	351,700	69,774	78,852	10,522
Chrome Alum	6,020	0,111	---	---
Vegetable Tannins	241,637	35,354	37,638	0,540
+Bags, Wallets, Belts ect.	---	---	---	---
Total	817,920	94,506	555,510	48,467

1931

Hides and Skins Undres.	271,780	18,527	561,766	22,445
Leather and Manuf. Ther.	278,425	56,790	44,900	4,820
Chrome Alum	3,040	0,052	---	---
Vegetable Tannins	255,690	4,130	13,000	0,240
+Bags, Wallets, Belts ect.	---	---	---	---
Total	808,935	79,499	619,666	27,505

1932

Hides and Skins Undres.	210,710	10,386	418,450	15,450
Leather and Manuf. Ther.	292,490	61,040	14,476	1,146
Chrome Alum	8,220	0,220	---	---
Vegetable Tannins	205,505	4,338	6,474	0,050
+Bags, Wallets, Belts, ect.	---	---	---	---
Total	716,925	75,984	439,400	16,646

(+) They are included under Leather and Manufacture Thereof.

Palestine Statics Cont.1933

	Imports		Exports	
Hides and Skins Undres.	264,320	14,517	486,070	14,632
Leather and Manuf. Ther.	318,467	73,827	19,726	1,770
Chrome Alum	4,253	0,149	---	---
Vegetable Tannins	398,720	6,237	27,594	0,187
+Bags, Wallets, Belts, ect.	---	---	---	---
Total	985,760	94,730	533,390	16,589

1934

Hides and Skins Undres.	540,215	22,120	837,355	22,845
Leather and Manuf. Ther.	419,665	102,565	29,743	8,880
Chrome Alum	9,220	0,375	---	---
Vegetable Tannins	540,215	8,065	15,922	0,120
+Bags, Wallets, Belts, ect.	---	---	---	---
Total	1,509,315	133,125	883,020	31,845

1935

Hides and Skins Undres.	311,005	14,220	1,334,074	48,467
Leather and Manuf. Ther.	519,518	125,330	25,310	7,000
Chrome Alum	9,000	0,350	---	---
Vegetable Tannins	589,740	9,570	7,200	0,075
Bags, Wallets, Belts, ect.	8,362	7,854	---	---
Total	1,437,625	157,324	1,366,584	55,542

(+) The are included under Leather and Manufacture Thereof.

Palestine Statics Cont.1936

	Imports		Exports	
Hides and Skins Undres.	600,000	30,272	2,326,000	108,070
Leather and Manuf. Ther.	490,000	102,600	10,500	0,870
Chrome Alum	6,220	0,193	---	---
Vegetable Tannins	140,880	2,570	4,200	0,025
Bags, Wallets, Belts, ect.	4,840	3,147	---	---
Total	1,241,940	138,782	2,340,700	108,965

1937

Hides and Skins Undres.	870,000	59,346	2,345,000	187,260
Leather and Manuf, ther.	737,000	166,214	4,540	0,325
Chrome Alum	9,650	0,195	---	---
Vegetable Tannins	317,000	6,100	1,620	0,010
Bags, Wallets, Belts, ect.	15,000	7,500	6,200	5,720
Total	1,948,650	239,355	2,857,360	193,315

1938

Hides and Skins Undres.	92,000	6,650	1,864,000	86,965
Leather and Manuf. Ther.	549,000	85,625	5,000	0,540
Chrome Alum	13,075	0,260	---	---
Vegetable Tannins	116,000	2,075	3,670	0,027
Bags, Wallets, Belts, ect.	9,800	4,100	4,500	4,350
Total	776,875	108,710	1,877,170	91,882

1939

Hides and Skins Undres.	253,000	15,350	1,330,000	63,146
Leather and Manuf. Ther.	760,000	134,677	2,212	0,166
Chrome Alum	2,075	0,062	---	---
Vegetable Tannins	316,900	6,033	0,700	0,005
Bags, Wallets, Belts, Ect.	16,300	5,400	3,000	2,400
Total	1,348,275	161,522	1,335,912	65,717

Palestine Statics cont.1940

Hides and Skins Undres.	966,000	29,708	646,000	42,375
Leather and Manuf. Ther.	737,000	184,314	1,200	0,360
Chrome Alum	3,730	0,144	---	---
Vegetable Tannins	505,085	15,925	0,735	0,006
Bags, Wallets, Belts, ect.	1,350	0,777	1,110	0,826
Total	2,213,165	230,868	649,045	43,567

1941

Hides and Skins Undres.	1,147,000	41,800	896,000	70,912
Leather and Manuf. Ther.	381,000	159,255	1,500	0,320
Chrome Alum	6,045	0,375	---	---
Vegetable Tannins	1,552,575	52,565	---	---
Bags, Wallets, Belts, ect.	1,098	1,117	4,292	8,000
Total	3,087,718	254,112	811,792	79,232

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# IMPORTS OF PALESTINE

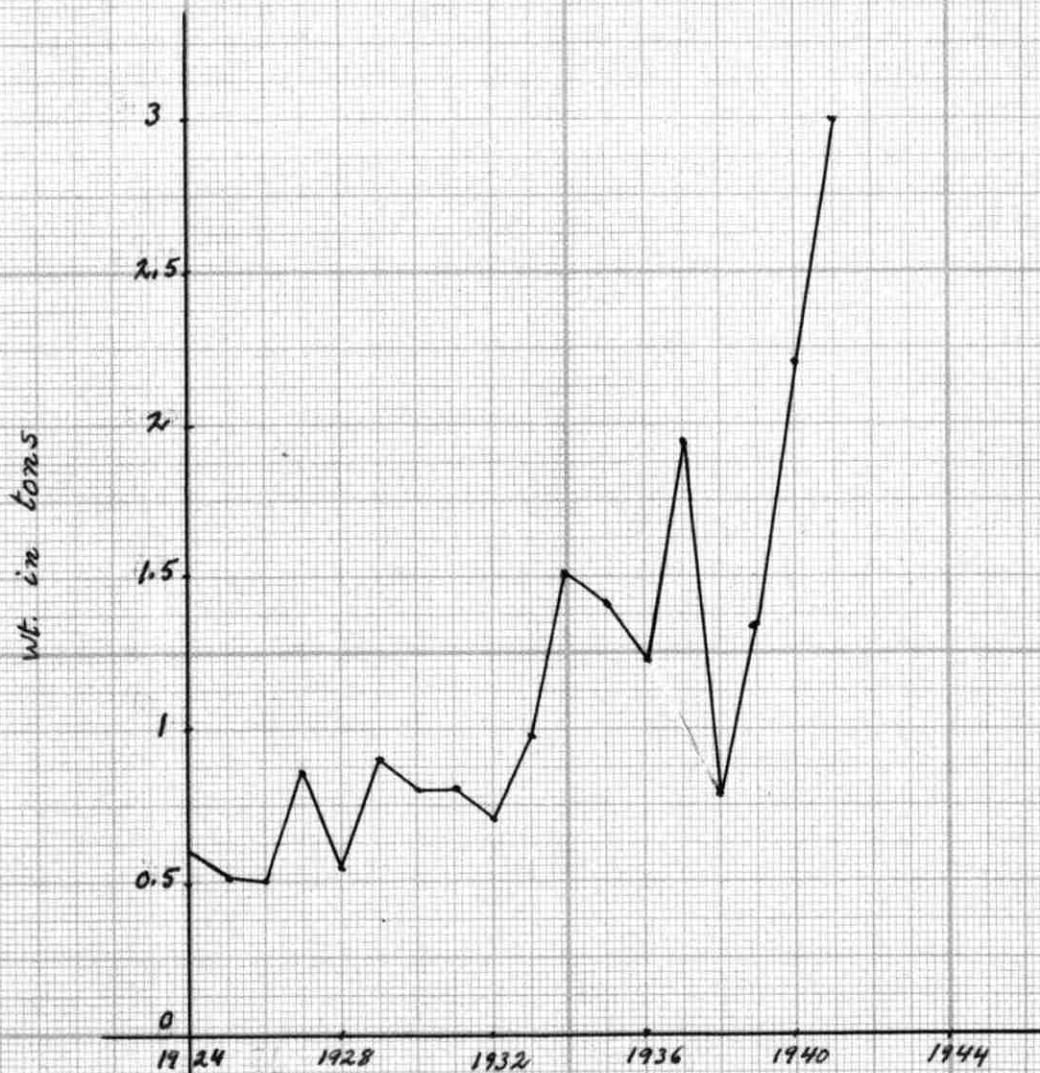


Fig. 1

# EXPORTS OF PALESTINE

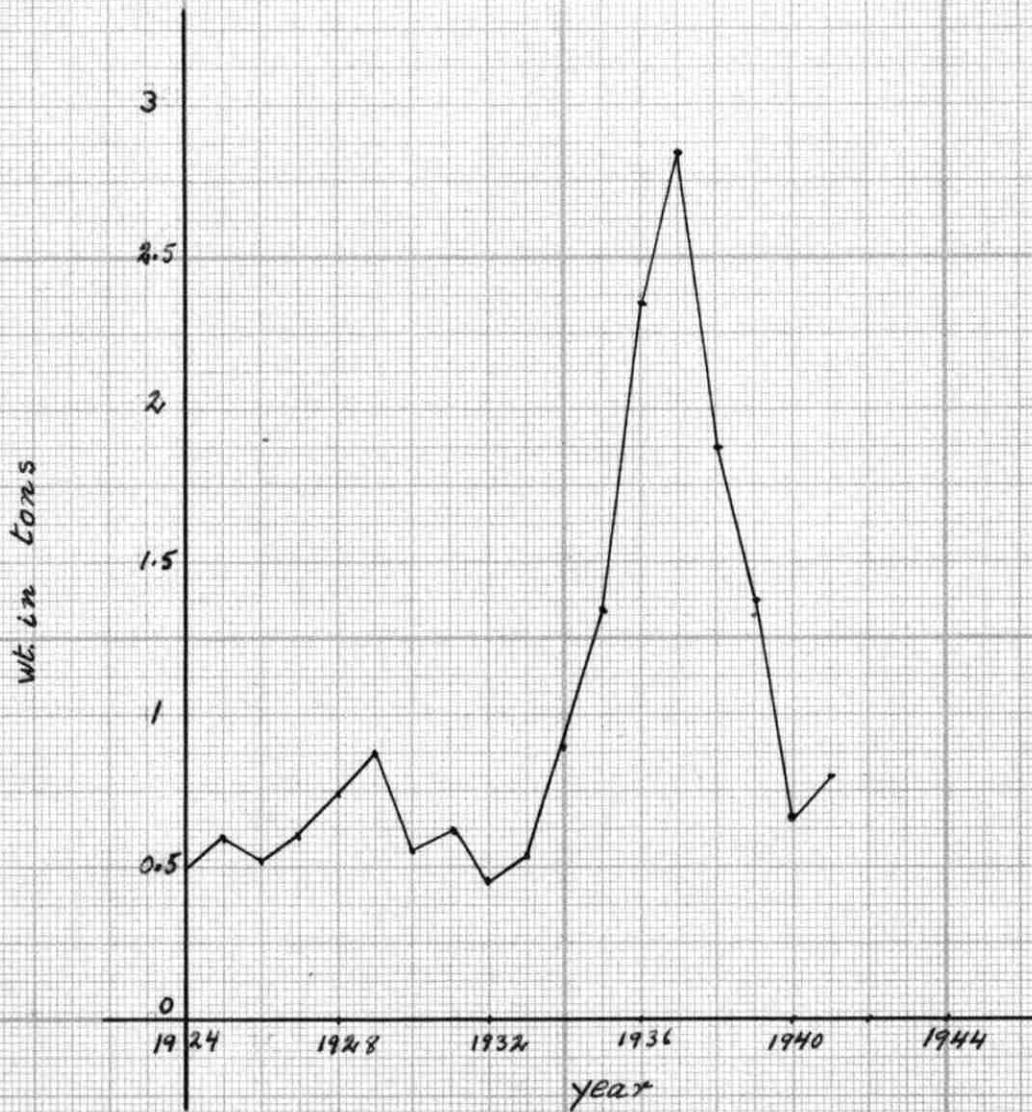


Fig. 2

SYRIA AND LEBANON1924

	Imports		Exports	
Degras Oil	---	---	---	---
W.And S. of Skins (1)	194,646	46,672	319,178	67,798
P.M. for the T.I. (2)	---	---	---	---
T. Extracts	---	---	---	---
Chromate	---	---	---	---
Skins and hides				
Pieces of work in H. and P.B. or P. and Furs (3)	S.1134,231	669,743	148,176	62,758
<b>Total</b>	<b>1328,877</b>	<b>716,415</b>	<b>467,354</b>	<b>130,556</b>

1925

Degras Oil	---	---	---	---
W. and S. of Skins	859,178	251,224	1,855,850	636,800
P.M. for the T.I.	---	---	---	---
Tanning Extracts	---	---	---	---
Chromates	---	---	---	---
Skins and Hides (1)				
Pieces of work in H.-S. (2)	1307,088	1136,824	367,840	285,996
P.B. or P. and Furs (3)				
<b>Total</b>	<b>2166,266</b>	<b>1388,048</b>	<b>2,223,690</b>	<b>922,796</b>

1926

Degras Oil	145,000	11,500	21,000	1,000
W. and S. of Skins	797,910	364,340	286,890	19,087
P.M. for the T.I.	558,000	56,300	300,000	50,500
Tanning Extracts	650,000	38,000	---	---
Chromates	45,000	11,500	---	---
Skins and hides				
Pieces of work in H.-S.	1418,790	1683,340	320,545	352,500
P.B. or P. and Furs				
<b>Total</b>	<b>3614,700</b>	<b>2164,980</b>	<b>907,435</b>	<b>422,087</b>

- (1) Waste and scrapping of Skins.
- (2) Primary Materials for the Tannery Industry.
- (3) Peltry brute or prepared and Furs.

Syria and Lebanon cont.1927

	Imports		Exports	
Degras Oil	135,000	10,750	---	---
W. and S. of Skins	1307,563	101,988	149,065	4,260
P.M. for the T.I.	474,000	570,000	445,050	62,000
Tanning Extracts	803,100	51,900	---	---
Chromates	36,000	9,500	---	---
Skins and Hides				
Pieces of work in H.-S. P. B. or P. and Furs	1578, 751	295,845	533,745	153,600
<b>Total</b>	<b>4634,414</b>	<b>1040,028</b>	<b>1127,860</b>	<b>219,860</b>

1928

Degras Oil	114,000	10,500	---	---
W. and S. of Skins	1446,600	104,265	300,000	21,000
P.M. for the T.I.	875,500	265,000	600,250	79,800
Tanning Extracts	810,000	85,000	---	---
Chromates	33,000	8,250	---	---
Skins and Hides				
Pieces of work in H.-S. P.B. or P. and Furs	899,190	230,122	598,880	132,840
<b>Total</b>	<b>4178,290</b>	<b>703,137</b>	<b>1499,130</b>	<b>233,640</b>

1929

Degras Oil	125,000	10,600	---	---
W. and S. of Skins	1413,900	104,124	280,600	19,005
P.M. for the T.I.	850,000	52,000	450,000	60,005
Tanning Extracts	600,000	35,056	---	---
Chromates	45,000	12,000	---	---
Skins And Hides				
P. of Work in H. and S. P. B. of P. and Furs	891,137	1168,500	524,540	384,250
<b>Total</b>	<b>3925,037</b>	<b>1382,280</b>	<b>1255,140</b>	<b>465,260</b>

Syria and Lebanon cont.1930

	Imports		Exports	
Degras oil	100,500	10,050	---	---
W. and S. of Skins	1810,850	142,060	320,000	20,058
Tanning Extracts	<del>557,300</del>	<del>27,200</del>	---	---
P.M. for the T.I.	950,000	9,040	649,000	82,050
Chromates	35,000	9,000	---	---
Skins and Hides				
P. of work in H. and S.	891,135	1168,500	318,410	330,162
P.B. or P. and Furs				
<b>Total</b>	<b>4487,485</b>	<b>1389,600</b>	<b>1278,410</b>	<b>432,270</b>

1931

Degras oil	114,080	10,556	---	---
W.S. and of Skins	83,820	3,818	---	---
P.M. for the T.I.	874,220	8,635	469,302	78,815
Tanning Extracts	809,380	85,278	---	---
Chromates	33,765	8,030	---	---
Skins and Hides	2871,205	1292,880	365,960	45,088
P. of work in H. and S.	33,985	108,080	654,033	208,830
P.B. or P. and Furs	6,390	20,545	25,940	17,815
<b>Total</b>	<b>4826,845</b>	<b>k537,822</b>	<b>1516,235</b>	<b>350,548</b>

1932

Degras oil	137,301	10,745	---	---
W. and S. of Skins	15,540	0,590	---	---
P.M. for the T.I.	474,703	570,812	442,467	78,264
Tanning extracts	650,292	38,155	---	---
Chromates	41,076	7,694	---	---
Skins and Hides	1637,800	592,600	471,975	167,750
P. of work in H. and S.	30,440	93,000	9,485	6,756
P.B. or P. and Furs	4,361	18,120	12,389	27,020
<b>Total</b>	<b>2992,413</b>	<b>1331,716</b>	<b>936,316</b>	<b>279,790</b>

Syria and Lebanon cont.1933

	Imports		Exports	
Degras oil	114,610	8,306	---	---
W. and S. of Skins	77,430	2,052	---	---
P.M. for the T.I.	557,910	56,295	840,066	128,030
Tanning extracts	903,320	52,010	---	---
Chromates	36,040	5,730	---	---
Skins and Hides	2208,630	579,730	3150,850	675,450
P. of work in H. and S.	32,134	98,125	23,824	15,450
P.B. of P. and Furs	12,301	13,382	34,430	59,730
<b>Total</b>	<b>3842,745</b>	<b>815,630</b>	<b>4049,170</b>	<b>858,660</b>

1934

Degras oil	145,478	10,237	---	---
W.S. and of Skins	37,630	0,993	---	---
P.M. for the T.I.	580,962	48,490	438,233	73,645
Tanning Extracts	1146,655	61,510	36,100	2,235
Chromates	44,860	5,965	---	---
Skins and Hides	2541,500	546,140	772,457	205,025
P. of work in H. and S.	34,780	98,730	43,780	19,500
P. B. or P. and Furs	7,560	14,720	10,405	9,100
<b>Total</b>	<b>4539,425</b>	<b>786,785</b>	<b>1300,975</b>	<b>309,505</b>

1935

Degras oil	125,000	9,200	---	---
W. and S. of Skins	63,803	1,707	---	---
P.M. for the T. I.	345,882	33,840	640,070	83,835
Tanning Extracts	1309,028	74,243	58,165	4,010
Chromates	45,367	5,615	---	---
Skins and Hides	3692,000	637,000	1665,660	406,125
P. of work in H. and S.	37,500	89,745	84,020	38,780
P.B. or P. and Furs	3,908	10,510	614,060	406,125
<b>Total</b>	<b>5497,488</b>	<b>861,860</b>	<b>3061,975</b>	<b>938,875</b>

Syria and Lebanon cont.1936

	Imports		Exports	
Degras oil	146,795	15,222	---	---
W. and S. of Skins	19,390	1,938	---	---
P. M. for the T. I.	402,575	62,010	619,770	76,987
Tanning Extracts	1247,600	93,730	25,120	2,103
Chromates	20,900	3,040	---	---
Skins and Hides	4505,460	849,000	2300,470	631,030
P. of work in H. and S.	53,880	71,790	38,240	19,150
P. B. or P. and Furs	3,665	11,315	13,690	9,910
<b>Total</b>	<b>6399,865</b>	<b>1105,045</b>	<b>2997,290</b>	<b>739,180</b>

1937

Degras oil	142,845	19,540	---	---
W. and S. of Skins	30,565	11,910	---	---
P. M. for the T. I.	874,320	142,900	469,905	117,925
Tanning Extracts	1571,405	484,500	30,785	7,525
Chromates	47,535	7,260	---	---
Skins and Hides	5032,160	1787,030	2806,165	1556,930
P. of work in H. and S.	44,160	144,430	20,935	33,920
P. B. or P. and Furs	5,310	24,800	17,025	7,900
<b>Total</b>	<b>7748,300</b>	<b>2622,370</b>	<b>3424,815</b>	<b>1724,250</b>

1938.

Degras oil	166,483	38,392	---	---
W. and S. of Skins	82,000	19,300	122,590	2,320
P. M. for the T. I.	786,522	102,458	561,780	104,760
Tanning Extracts	1787,305	308,600	37,940	11,404
Chromates	92,990	21,560	---	---
Skins and Hides	5108,900	2117,600	2023,715	1423,830
P. of work in H. and S.	25,817	141,370	20,025	23,180
P. B. of P. and Furs	5,597	40,230	17,270	18,720
<b>Total</b>	<b>8055,614</b>	<b>2789,510</b>	<b>3083,320</b>	<b>1584,214</b>

# SYRIAN AND LEBANESE IMPORTS

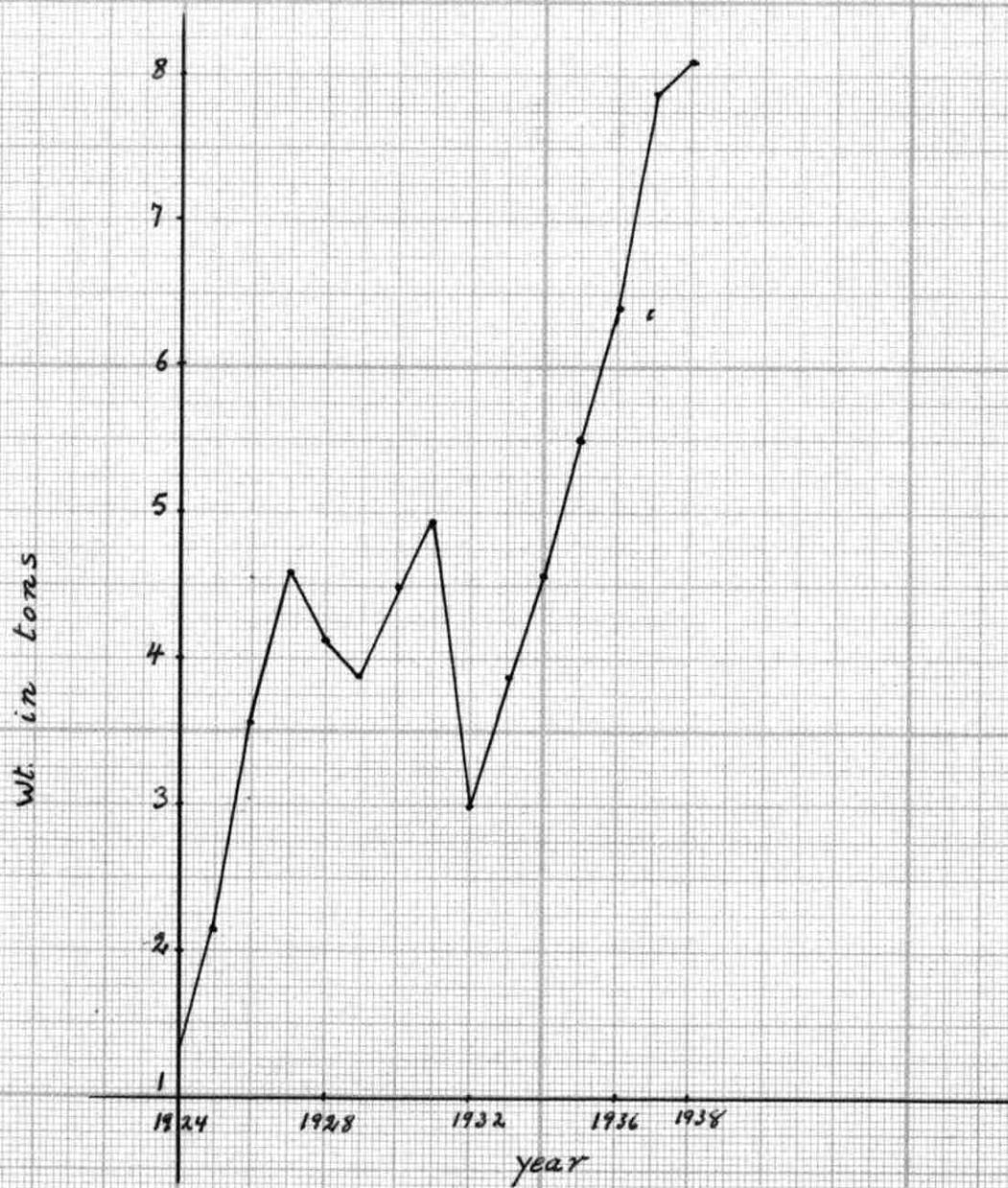


Fig. 3

# SYRIAN AND LEBANESE EXPORTS

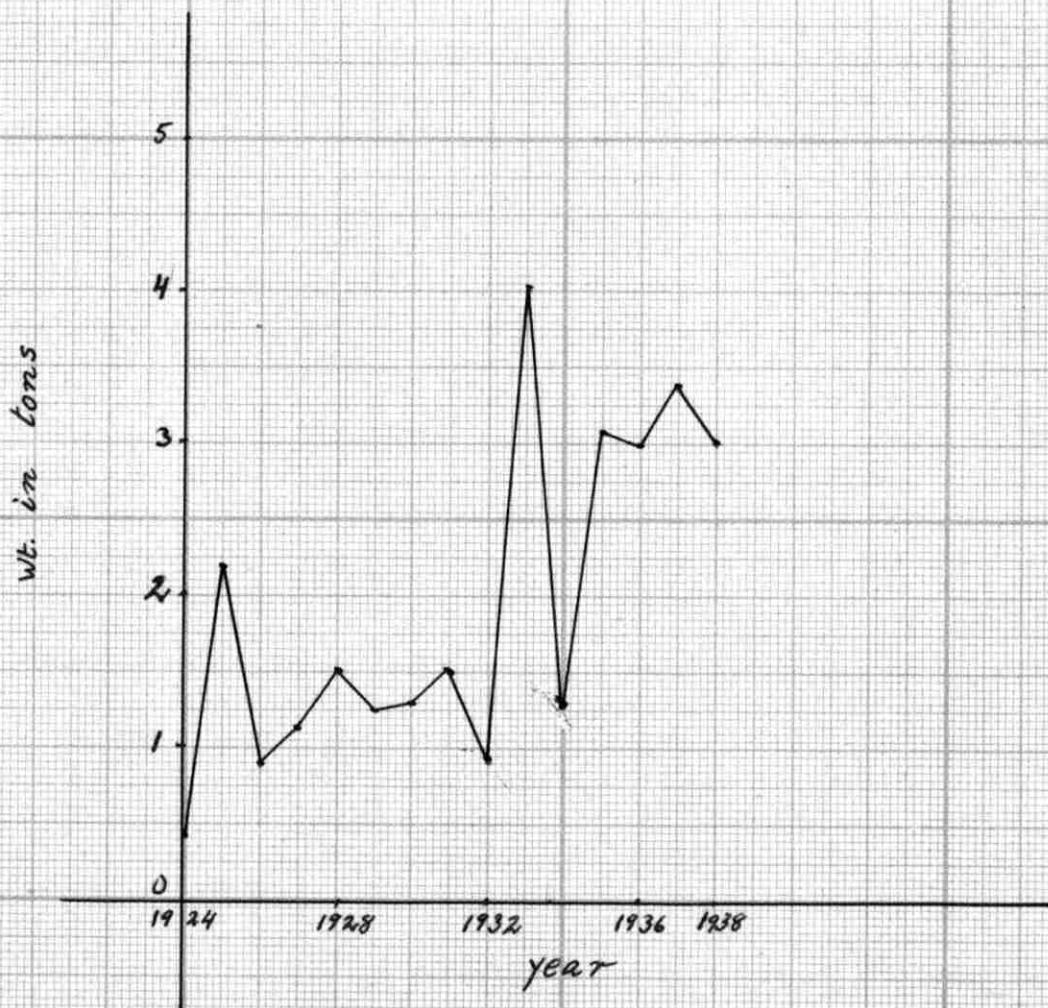


Fig. 4

SYRIAN PRODUCTION OF HIDES AND SKINS

Year	Lamb	Sheep	Cow	Goat	Buffallo	Camel	Total
1926	8,550	34,900	410	+	30	175	44,065
	8,550	139,600	2,460	+	180	1,070	151,560
1927	11,350	167,600	13,400	+	9,950	10,255	212,355
	11,350	670,400	80,400	+	59,700	61,530	863,380
1928	+	172,200	17,250	+	15,950	8,525	213,925
	+	688,800	103,500	+	95,700	49,150	937,150
1929	+	144,950	8,525	+	4,500	6,545	164,520
	+	579,800	51,150	+	27,000	38,270	696,220
1930	+	100,050	3,285	+	1,430	2,460	107,225
	+	400,200	19,710	+	8,580	14,760	443,250
1931	+	76,650	5,405	41,200	3,795	1,116	127,156
	+	302,600	32,430	164,800	22,770	6,636	529,236
1932	61,050	39,300	3,883	20,250	2,835	1,016	128,334
	61,050	157,200	23,298	80,000	17,010	6,096	304,654
1933	35,450	43,000	3,465	21,450	2,715	483	126,563
	35,450	172,000	20,790	85,800	16,290	2,898	333,228
1934	28,500	64,560	4,425	45,600	2,650	1,310	145,105
	28,500	258,240	26,910	182,400	15,900	7,860	719,810
1935	38,300	101,000	4,535	31,730	1,560	2,060	179,187
	38,300	404,000	27,210	126,520	9,360	12,360	617,750
1936	48,000	153,000	15,350	62,400	825	2,730	282,305
	48,000	612,000	92,600	249,600	4,950	16,380	1023,030
1937	77,700	206,000	19,220	125,500	830	1,510	430,760
	77,700	824,000	115,320	502,000	4,980	9,060	1533,060
1938	39,100	161,000	2,870	77,000	830	1,420	282,220
	39,100	644,000	17,220	308,000	4,980	8,520	1021,820

+ Included under Sheep.

# SYRIAN PRODUCTION

Wt. in thousands of kgs.

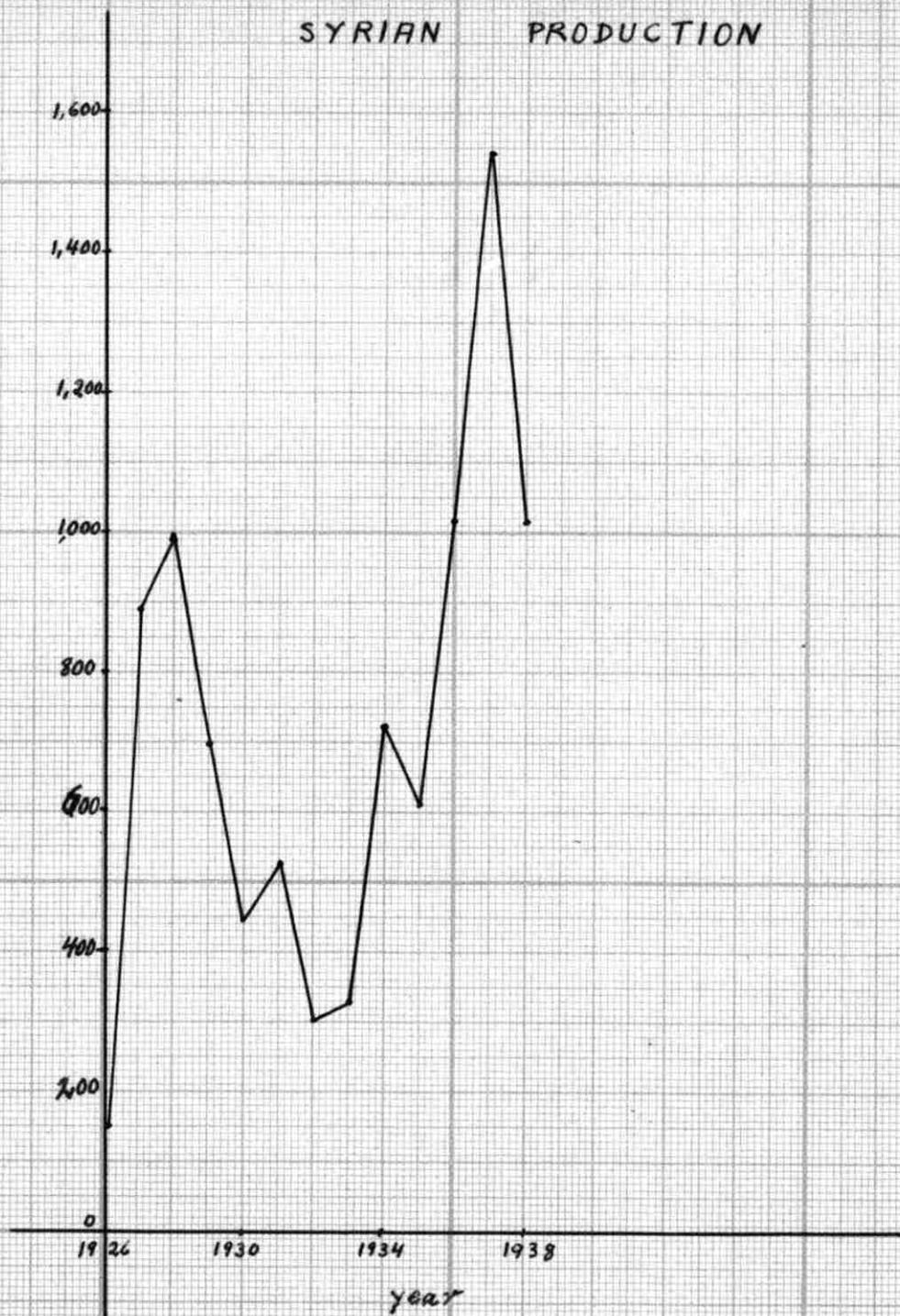


Fig. 5

LEBANESE PRODUCTION OF HIDES AND SKINS

Year	Pieces	Kgms.
1926	15,000	50,620
1927	72,000	294,460
1928	73,050	312,583
1929	65,000	232,000
1930	35,225	147,775
1931	43,150	176,415
1932	45,000	128,720
1933	43,560	111,075
1934	50,105	239,950
1935	60,100	205,920
1936	95,305	341,010
1937	150,760	511,020
1938	155,200	390,610

+++++

# LEBANESE PRODUCTION

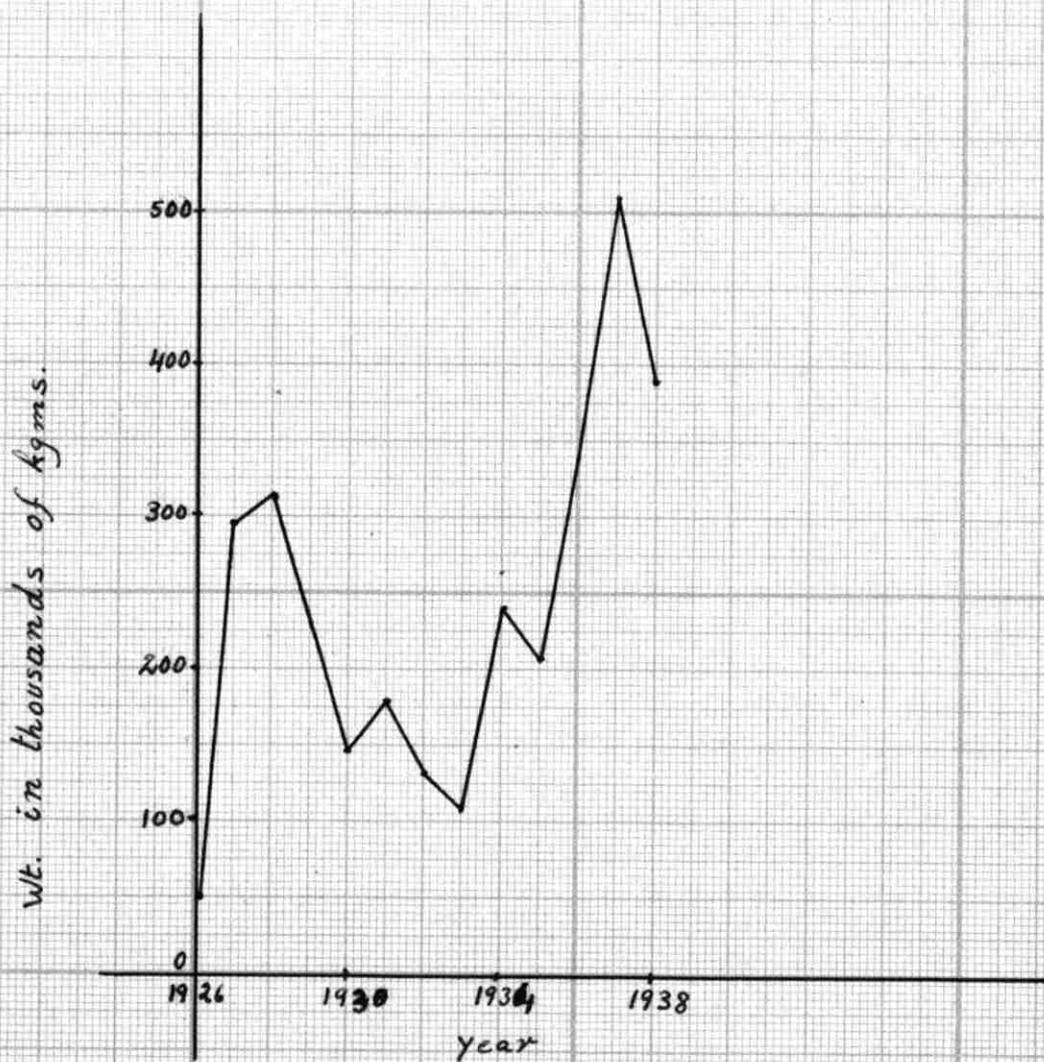


Fig. 6

VEGETABLE TANNINS FOUND IN THE  
NEAR EAST

++++++

MOST IMPORTANT VEGETABLE - TANNINS FOUND IN THE NEAR EAST1, RHUS CORIARA:- (Sumach - *صا*)Location:-

1. Lebanon:- Top of Baruk, Abayh, Beirut.
2. Syria:- West of Duma.
3. Palestine:- Jerusalem, Hebron.

Tannins:- Found in the leaves, fruits and bark.

2. PISTACIA LENTISCUS:- (Mastick - Lentisk - *لنتيسك*)LOCATION:-

1. Lebanon:- South of Tripoli, Beirut.
2. Syria:-
3. Palestine:- Bayt - Jibrin, Jaffa, Emmaus, Hifa, Mt. Carmel, Mt. Tabor, Wadi - Kishimyal ( Jordan Valley ) Ras - un - Nakourah.

Tannins:- Found in the leaves.

3. QUERCUS INFECTORIA:- ( Aleppo Oak - *الاقاقيا* )LOCATION:-

1. Lebanon:- Brumana, Baruk Cedars, Safita.
2. Syria:- Aleppo, Alexandretta, Bityas.
3. Palestine:- Tabor, Janin, Ul-Kubaybeh, South of Safad, Mt. Karmel.

Tannins:- Found in the barks and galls.

IV. QUERCUS CERRIS:- ( Turkish Oak - ( لوق ) )

Location:-

1. Lebanon:- Ain Zahalta, Cedars, Jabel Baruk, Above Ihdin, Hermon.
2. Syria:-
3. Palestine:- Northern Palestine.

Tannins:- found in Galls.

V. QUERCUS SESSILIFLORA:- ( Durmast Oak - ( بلوط ) )

Location:- Mountainous regions.

Tannins:- found in the bark

VI. QUERCUS COCCIFERA:- ( Kermes Oak - ( زان - سمریان ) )

Location:- Mountainous regions.

Tannins :- Found in the bark.

VII. QUERCUS AEGILOPS:- ( Valonia - ( ملول - جل ) )

Location:-

1. Lebanon:- Fundajek, Safita.
2. Syria:- Northern Syria.
3. Palestine:- Baniyas, Mt. Karmel, Mt. Tabor, Haera, Near Herzlia.

Tannins:- Found in the galls.

VIII. PISTACIA TEREINTHUS:- ( Terebinth - Butam - ( بطم ) )

Location:-

1. Lebanon:- Widely distributed.

2. Syria:- Widely distributed.

3. Palestine:- Banias, Petra ( Trans - Jordan ).

Tannins:- Found in the bark and galls.

IX. PISTACIA VERRA:- ( Pistachio - فسق )

Location:-

1. Lebanon:- Beirut.

2. Syria:- Ayn-ut-Tinah.

3. Palestine:- Ramah.

Tannins:- Found in the galls.

X. MIMOSA PUDICA:- ( Sensitive Mimosa - مستحسنة )

Location:- Found as wild form.

Tannins:- Found in the bark.

XI. SALIX:- ( Willow - سالك )

Location:-

1. Lebanon:- Widely distributed.

2. Syria:- Widely distributed.

3. Palestine:- Widely distributed.

T

Tannins:- found in the bark,

XII. CASTANA VESCA:- ( Chestnut - كستنة )

Location:-

1. Lebanon:-

2. Syria:- In the north.

3. Palestine:-

Tannins:- Found in bark and cupule.

XIII. POPULUS ALBA:- ( White poplar - *شور* )

Location:-

1. Lebanon:- Abayh, Tripoly, Beka'a.
2. Syria:-
3. Palestine:- Amman, Jarah, Hulah, Jerusalem etc.

Tannins:- Found in bark.

XIV. ACACIA ARABICA:- ( Gum Arabic - *لبن عربي* )

Location:-

1. Lebanon:-
2. Syria:-
3. Palestine:- Introduced in 1919 ( 10000 trees at Rishon. )

Tannins:- Found in Bark.

XV. EUCALYPTUS:- ( Eucalyptus - *كينيا* )

Location:-

1. Lebanon:- Nearly everywhere
2. Syria:- Nearly everywhere.
3. Palestine:- Thousands of trees at Hadera, and elsewhere

Tannins:- Found in bark.

XVI. PINUS HALEPENSIS:- ( Aleppo Pine - *شونيز بري* )

Location:-

XVI. PINUS HALEPENSIS:- ( Aleppo Pine - *سدر* )

Location:-

1. Lebanon:- Everywhere.
2. Syria:- Everywhere.
3. Palestine:- Everywhere.

Tannins:- Bark and in fleshy part of the stem, only  
obtained when tree is cut.

XVII. PUNICA GRANATUM:- ( Pomegrade - *رمان* )

Location:-

1. Lebanon:- Nearly everywhere.
2. Syria:- Nearly everywhere.
3. Palestine:- Nearly everywhere.

Tannins:- Found in rind of fruit, and in bark of stem  
and root.

+++++

PERCENTAGE TANNINS IN VEGETABLE TANNINS FOUND IN THE NEAR EAST-

Veg. Tan.	Country	From	Percentage Tannin
Sumach	Lebanon	Fruits	6.7
"	"	Leaves	25.00 *
"	"	Bark	
Aleppo Oak I	Syria	Galls	60.0 *
" II	"	Galls	50.0 *
" III	"	Galls	38.2 %
Turkish Oak	"	Galls	45.0
Durmast Oak	Lebanon	Bark	12.0
Kermes Oak	"	Bark	15.0 %
Valonia	Palestine	Galls	35.0 *
Terebinth	"	Cupule	50.2 *
Pistachio		Galls	
Sensitive Mimosa	"	Bark	10.0 *
Willow	Lebanon	Bark	11.0 *
Chestnut		Bark	7.0
White poplar	Lebanon	Bark	
Aleppo Pine	"	Bark	15.0
Pomegranate	"	Rind of Pom.	14.0 *
"	Palestine	Rind of Pom.	9.8
"	"	Bark of Stem	2.0
Quebracho Extract	Africa	Bark	60.0

RESULTS  
OF THE  
INVESTIGATIONS  
CARRIED  
ON  
VEGETABLE TANNINS

Data concerning Gelatin

1. For all the investigations carried on gelatin, jellies containing 4 gms. gelatin per 100 cc. water were used
2. The pH of the 4% gelatin-jelly was found to be 4.4 .
3. The isoelectric point of the gelatin was found to be 4.9.
4. The ash content of the gelatin was found to be 1.2 % .

1. Rate Of Diffusion Of Tannin-Extracts Into 4% Gelatin-Jelly  
With Same Percentage Of Non-Tannins But Different Percentage  
Of Tannins.

Kind of Tannin	% Tannin	% Non-Tan.	Rate of diffusion in cms.			
			1 day	2 days	1 week	4 weeks
Aleppo-galls (quality I)	60	28	0.8	1.05	1.9	2.8
Aleppo-galls (quality II)	50	28	0.6	0.80	1.4	2.4
Sumach (seeds)	18.	28	0.4	0.60	1.0	1.9
Bark of Pom	10	28	0.3	0.45	0.75	1.5

Tannin-extracts of two kinds of Aleppo-Galls, one of Sumach and one of the bark of Pomegrenade were prepared. The percentage of non-tannins in each was made constant, but the percentage tannin was made variable.

10 cc. of each solution were poured over 4% gelatin-jelly containing 0.1% Ferric chloride in test tubes of 1.6 cms. diameter and the rates of diffusion in each determined after the specified times. The results are given in the chart above ( Fig. 7 ) .

Tannin and some non-tannins react with Ferric chloride giving very deep blue colors, which served to indicate the extent of the penetration.

It is found that the rate of diffusion increases with

% Non-Tannins: - 28%

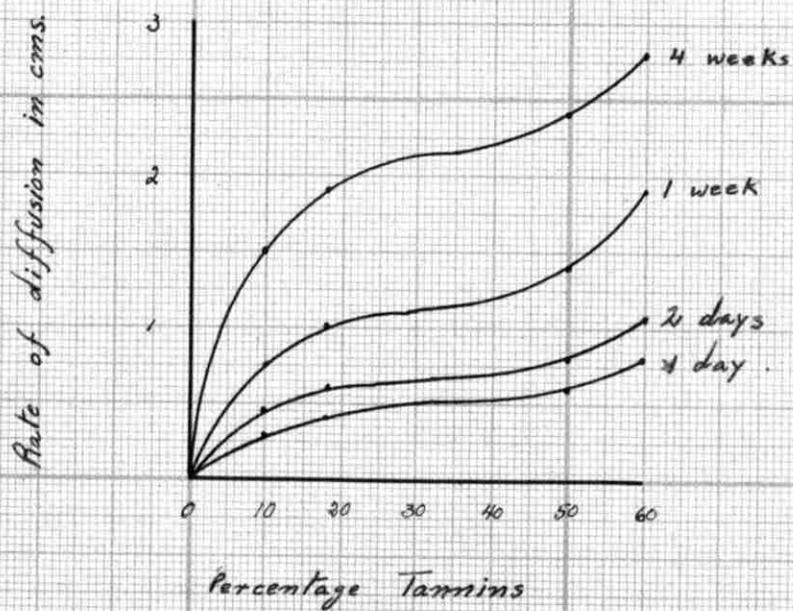


Fig. 7

increase in the percentage of tannins, but the proportionality factor of diffusion is not constant.

II. Rate Of Diffusion Of Tannin-Extracts Into 4% Gelatin-Jelly With Same Percentage Of Tannins But Different Percentage Of Non-Tannins.

Kind of Tannin	% Tannin	% Non-Tan.	Rate of diffusion in cms.				
			1 day	4 days	6 days	24 days	1 month
Alep.Galls (Quality III)	38	7.6	0.5	1.1	1.5	2.5	2.8
Alep.Galls (Quality II)	38	15.0	0.7	1.45	1.7	3.2	3.45
Alep.Galls (quality I)	38	18.0	0.8	1.6	1.85	3.4	3.7
Sumach (seeds)	38	60.0	1.1	2.5	3.40	5.5	5.8

Tannin extracts of three kinds of Aleppo galls and one kind of Sumach seeds were prepared. The percentage of tannin in each was made constant, but the percentage non-tannins were made variable.

10 cc. from each solution were poured over 4% gelatin-jelly containing 0.1 % Ferric chloride and the rate of diffusion in each test-tube determined after the specified times. The results of the experiment are shown in the above chart (Fig. 8 )

It is found that the rates of diffusion increases with increase in the percentage of non-tannins, but the proportionality factor of diffusion is not a constant.

% Tannins :- 38%

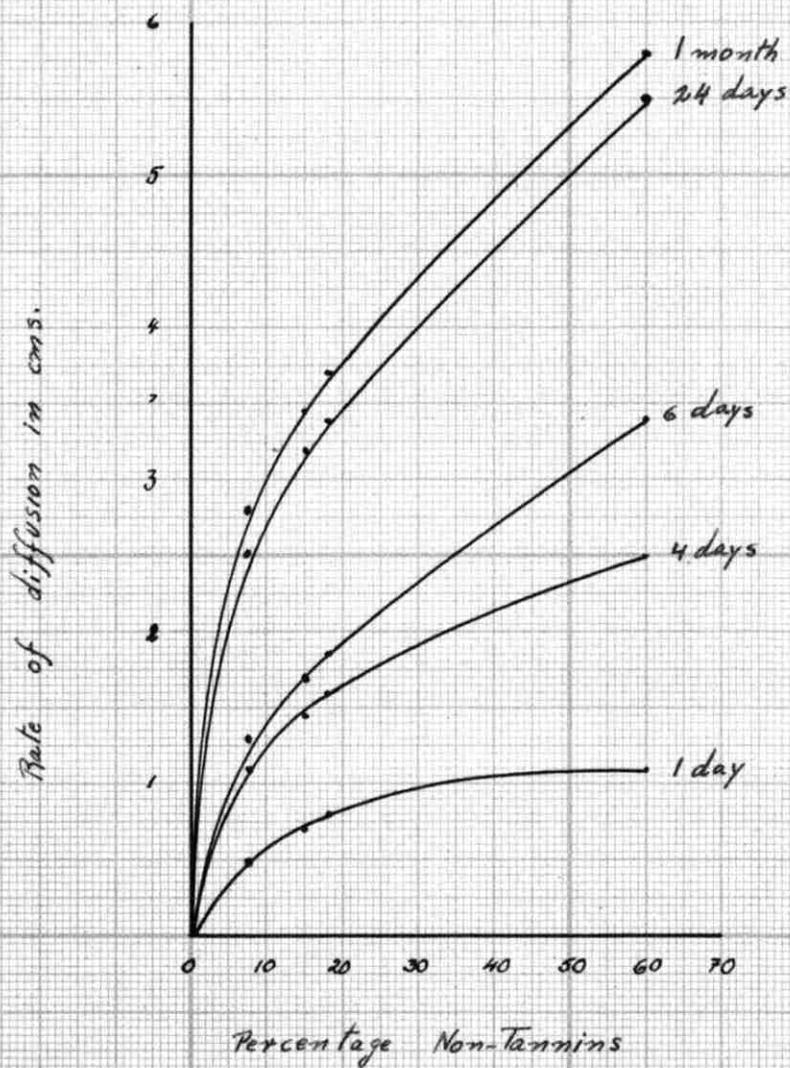


Fig. 8

III. Rate Of Diffusion Of Aleppo Galls Extract Into 4% Gelatin-  
Jelly With Increase Of Tannin Concentration.

Kind of Tannin	Gms. of Galls in 100 cc.	Rate of diffusion in cms.				
		1 day	2 days	1 week	2 weeks	1 month
Alep. Galls I	0.5	0.45	0.7	1.2	1.8	2.2
"	1.5	0.55	0.8	1.45	2.2	2.6
"	3.0	0.7	0.95	1.7	2.6	3.0
"	5.0	0.7	1.0	1.85	2.7	3.2
"	7.0	0.85	1.2	2.2	3.2	3.8

Tannin extracts of Aleppo Galls ( quality I ) were prepared containing different amounts of the galls per 100 cc. water.

10 cc. from each solution were poured over 4% gelatin-jelly containing 0.1 % Ferric chloride and the rates of diffusion in each test-tube determined after the specified times. ( Fig. 9 ).

It is found that the rate of diffusion increases with increase in the percentage of non-tannins, but the proportionality factor of diffusion is not a constant.

Substance :- Aleppo Galls I  
pH :- 3.95

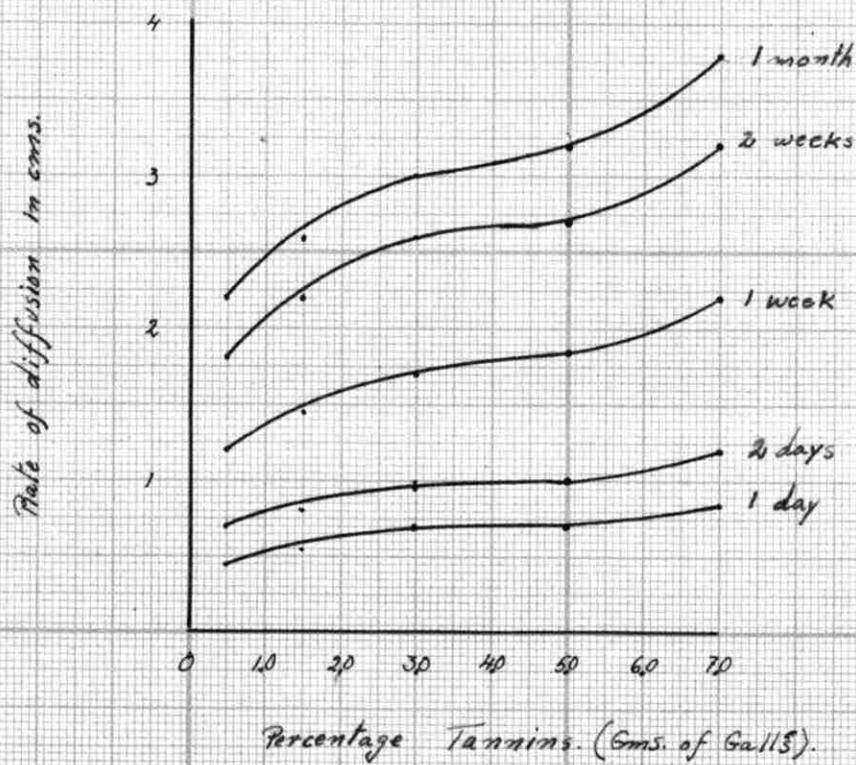


Fig. 9

IV. Rate Of Diffusion Of Aleppo Galls Extract Into 4% Gelatin-Jelly With Increase Of Sodium Chloride Concentration In Gelatin - Jelly.

4 gms. Gel. in 100 cc. water.	Mols NaCl	Rate of diffusion in cms.					
		1 day	2 days	1 week	2 weeks	1 month	1 1/2 mon.
Gelatin +	0.0	0.7	0.95	1.7	2.6	3.0	3.7
" +	0.1	0.7	0.95	1.75	2.65	3.0	3.8
" +	0.25	0.7	1.1	1.9	2.75	3.2	4.1
" +	0.5	0.65	1.2	2.00	2.9	3.6	4.5
" +	0.75	0.6	1.1	1.8	2.7	3.2	4.0

15 cc. solutions of 4% gelatin containing 0.1 % Ferric chloride were made 0.1 M, 0.25 M, 0.5 M, and 0.75 M. with respect to Sodium chloride. They were set in test-tubes of 1.6 cms. diameter and 10 cc. of Aleppo Galls extract ( quality I ) containing 3 gms. galls per 100 cc. water were poured into each test-tube above the gel and the rates of diffusion in each test-tube determined after the specified times. The results are shown in the chart above ( Fig. 10 ) .

It was found impossible to prepare gelatin-jellies with concentrations higher than 0.75 M. with respect to sodium chloride in the presence of Ferric chloride due to the conglutination of the gelatin.

The maximum rate of diffusion was found to be around 0.5 M.

Substance: Aleppo Galls I

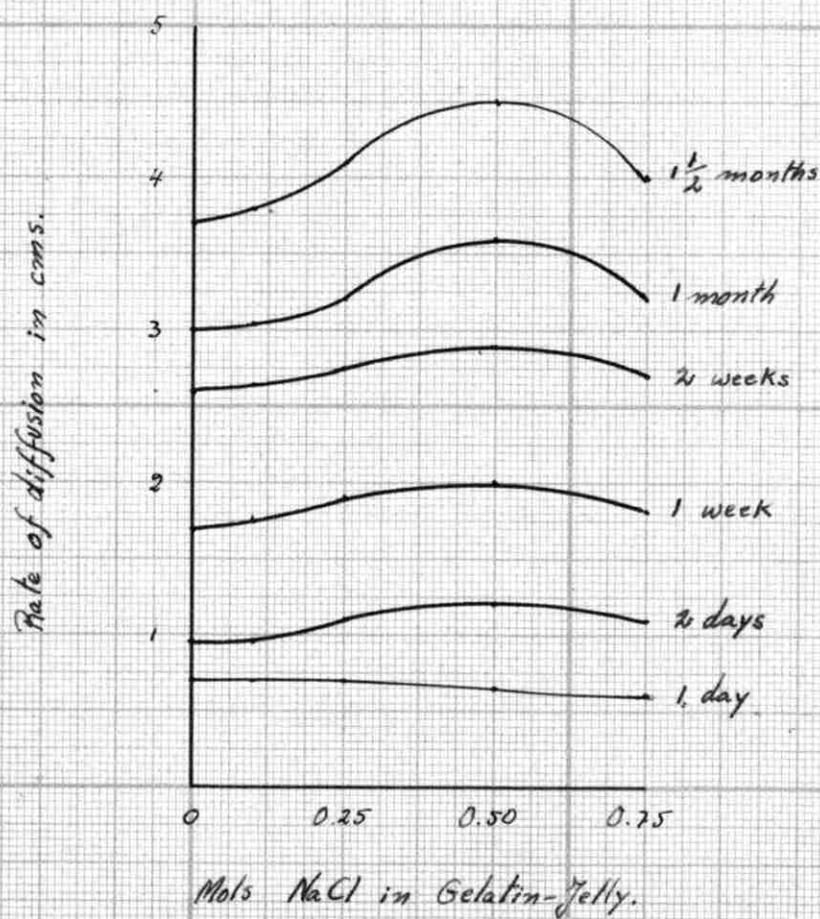


Fig 10

The rate of diffusion of tannins in gelatin-jellies containing Sodium sulfate, Magnesium chloride and Sucrose were not determined due to their great power of hydration.

V. Rate Of Diffusion Of Aleppo Galls Extract Into 4 % Gelatin-Jelly With Increase Of Sodium Chloride Concentration In Galls Extract.

No results were obtained due to the coagulation of the tannins by the Sodium chloride and the gelatin which was partly dissolved. Thus part of the tannins were precipitated and therefore the rates of diffusion could not be determined.

VI. Rate Of Diffusion Of Aleppo Galls Extract Into 4 % Gelatin-Jelly With Change In pH Of The Extract.

Gms. in 100 cc. of water	pH	Rate of diffusion in cms.					
		1 day	2 days	1 week	2 weeks	3 weekd	1 month
5 gms.	1.22	0.7	0.9	1.5	2.1	2.5	3.1
"	3.00	0.7	1.0	1.75	2.4	2.9	3.5
"	3.95	0.7	1.0	1.85	2.7	3.2	3.8
"	5.50	0.4	0.7	1.0	1.3	1.7	2.0
"	6.45	0.3	0.55	0.9	1.4	1.8	2.1
"	8.00	0.3	0.6	1.0	1.8	2.3	3.1
"	8.65	0.3	0.6	1.0	1.7	2.2	2.9

Aleppo Galls extract ( quality I ) were prepared with different pHs. and containing 5 gms. of the galls per 100 cc. water.

10 cc. of each solution were poured over gelatin-jelly containing 0.1 % Ferric chloride and the rates of diffusion determined after the specified times. The results are shown in the above chart ( Fig. // ) .

Two maximum rates of diffusion were found, one at a pH of 3.95 and the other at a pH of 8. The rates of diffusion were found to increase as the pH increased from 1.5 to 3.95, Further increase in pH caused an decrease in the rate of diffusion until pH 5.5 was reached when it started to increase again. The reason

Concn - 5gms. Aleppo Galls I / 100c.c. water

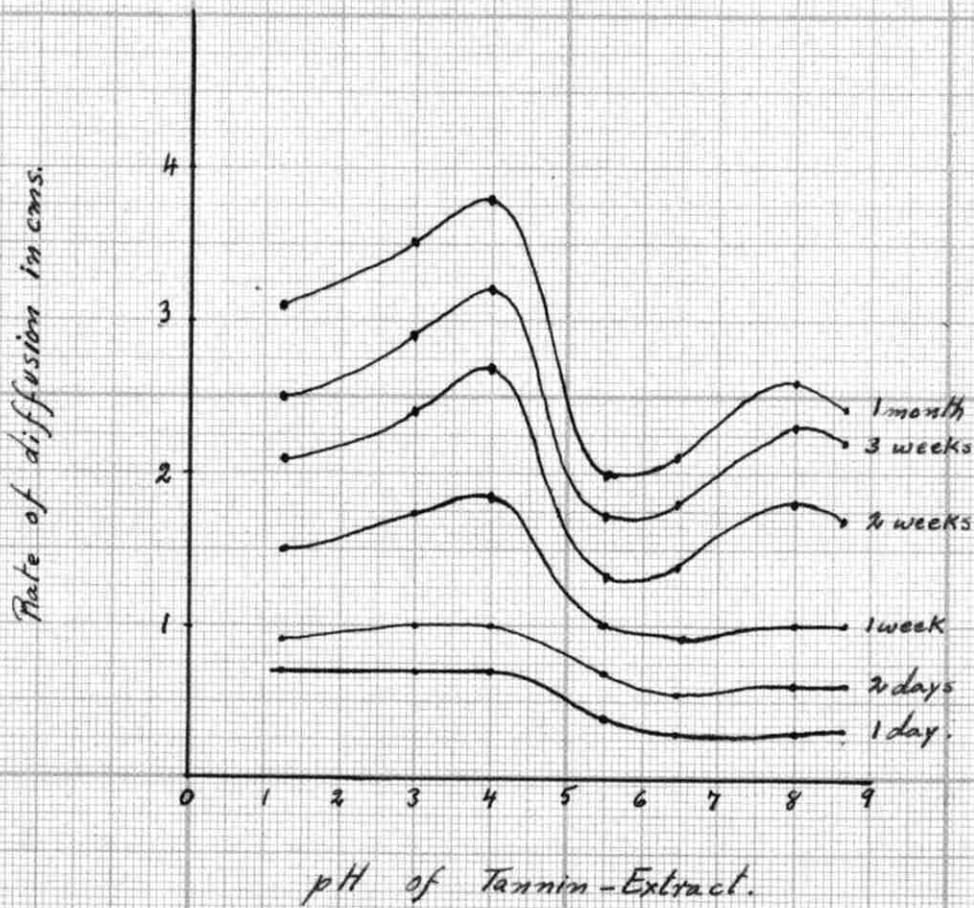


Fig. 11

( according to Wilson ) being that tannin particles below pH 5 are positively charged, while between pH 5 and pH 8, and below pH 2 they are negatively charged.

Since tannin particles are negatively charged in this region and since the rate of combination increases, one may suppose that collagen may become increasingly positive with rise in pH from 5 to 8, thus increasing amount of combination.

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## I. PREPARATION OF HIDE POWDER.

The adipose tissue was carefully cut away from the fresh skin and the skin thoroughly washed. It was then extracted with several changes of 10 % Sodium chloride solution, in order to remove the soluble protein matter. It was then treated with a Sodium sulfide ( 0.1 % ) saturated lime solution for several days until the hair was quite loose.

The hair and epidermal matters were removed by scrapping the grain surface with a knife blade and the entire grain surface was cut away on a splitting machine. The skin was then washed thoroughly to remove most of the lime. It was then digested for 5 hrs. at 40° C. with a solution containing one gm. of pancreatin, 2.8 gms. Sodium dihydrogen phosphate and 18 cc. of 1 M. solution of Sodium *hydroxide* per liter. This removed all the elastin fibers. The skin was then cut into small pieces and put into a jar of water equipped with a stirring device. Dilute Hydrochloric acid solution was then added at such a rate as to maintain the solution just faintly acid to methyl orange. When no more acid was required, the pieces were left to wash in running tap water over night. Next day they were soaked in several changes of alcohol to remove the water and then in xylene, after which they were exposed to air until the xylene had evaporated. They were then grained in a mill to a fibrous powder.

Percentage ash in the Hide-powder = 0.5 %.

pH of pure Hide-powder according to Porter = 4.8

Porter observed that a point of minimum swelling of hide powder occurs at a pH value of 4.8, indicating this as its isoelectric point. Porter also found points of maximum swelling of hide powder at pH values of 2.4 in acid solution and about 12.3 in alkaline solution.

## II. AMOUNT OF TANNIN ABSORBED BY HIDE POWDER FROM TANNIN

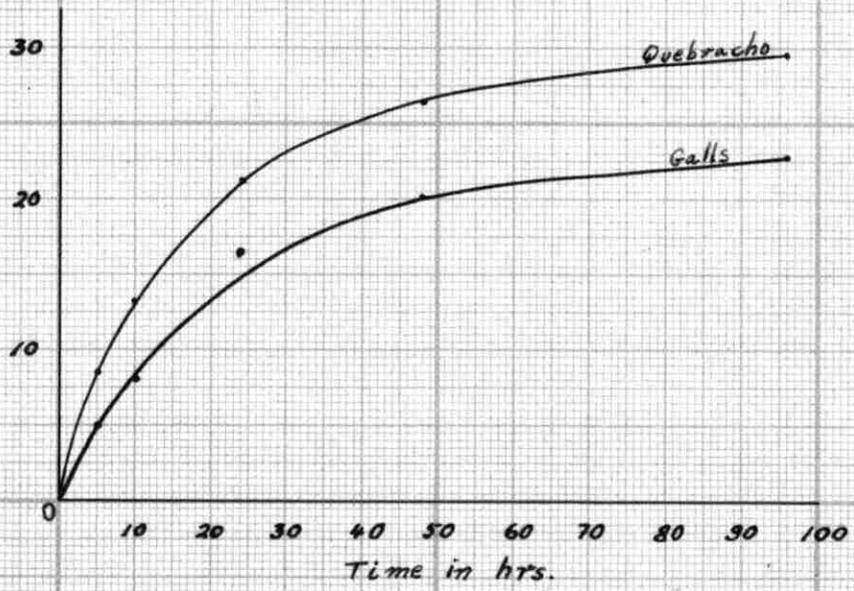
### EXTRACT WITH LIME.

Gms. Extract per 100 cc.	Vegetable Tannin	Gms. Tannin fixed by 100 gms. Hide-powder				
		5 hrs.	10 hrs.	24 hrs.	48 hrs.	96 hrs.
3 gms.	Alep. Galls	5.0	8.1	16.5	20.04	22.53
3 gms.	Quebracho	8.5	13.45	21.2	26.5	29.25

3 gms. of Aleppo Galls extract ( 56.16 % tannins and 3.84 % non-tannins ) and Quebracho extract ( 52.4 % tannin and 7.6 % non-tannins ) . The amounts of tannin fixed by 100 gms. of hide-powder determined after 5, 10, 24, 48, and 96 hrs. respectively.

Portions of purified powder equal to 2 gm. of anhydrous substance were shaken with 50 cc. of the extracts and each determined after the specified times. After the specified time the powder was washed until the wash water no longer gave a dark color upon the addition of a drop of Ferric chloride solution. The powders, freed from soluble matter were dried in a current of warm air and then completely dried in the oven. The increase

*gms. tannins combined with 100 gms.  
Hide-Substance.*



*Fig. 12*

in weight of the absolutely dry material was taken as the amount of tannin fixed by 2 gm. of hide-powder. The results are given in the chart above ( Fig. 12 ).

The rate of fixation of the tannin increases as the time increases but the proportionality factor of fixation is not a constant. The reason being that as the time of fixation is increased the amount of combination is also increased, which decreases the rate of diffusion of the tannin and therefore the rate of combination is decreased.

III. AMOUNT OF TANNIN ABSORBED BY HIDE- POWDER FROM TANNIN-EXTRACT AFTER TWENTY FOUR HOURS WITH INCREASE OF TANNIN CONCENTRATION.

Kind of Veg. Tannin	pH	Gms. Tannin Fixed by 100 gms. Hide-powd.				
		0.5 gms Tannin	2 gms. Tannin	4 gms. Tannin	6 gms. Tannin	8 gms. Tannin
Aleppo Galls III	4.0	7.0	20	13	9	7.5
Quebracho	4.3	9.0	27.5	15	10	9.0

Two kinds of vegetable tannins were used, one of Quebracho extract containing 52.4 % tannins and 7.6 % non-tannins and Aleppo Galls III extract containing 56.16 % tannins and 3.84 % non-tannins.

Portions of purified powder equal to 1 gm. of anhydrous substance were shaken with 50 cc. of the tan liquor containing 0.5 gm., 2 gms., 6 gms., and 8 gms. respectively of Quebracho and Galls.

The results show how the rate of tanning varies with increasing concentration of solutions of Quebracho and Aleppo Galls extracts. Both extracts give curves of similar shape and having maximum points at the same concentration ( Fig. 13 )

There are two explanations given for the appearance of maximum points in the curves:

1. The rate of combination of tannin and hide substance increases so rapidly, with increasing concentration of tan liquor, that it soon reaches a point where the surfaces of the hide fibers quickly become so heavily tanned that they are rendered less permeable to the tannin remaining in solution. The interior of the fibers are thus prevented from tanning so rapidly, which accounts for the smaller amount of tannin fixed by the hide powder in the stronger solutions.

2. The second explanation is furnished by the work of Thomas and Foster, who observed that the electrical difference of potential at the surface of tannin particles decreases with increasing concentration of tan liquor. This would lessen the attraction between the tannin particles and the protein jelly and thus cause a decrease in the rate of combination.

Gms. Tannins combined with 100 gms.  
Hide - Substance.

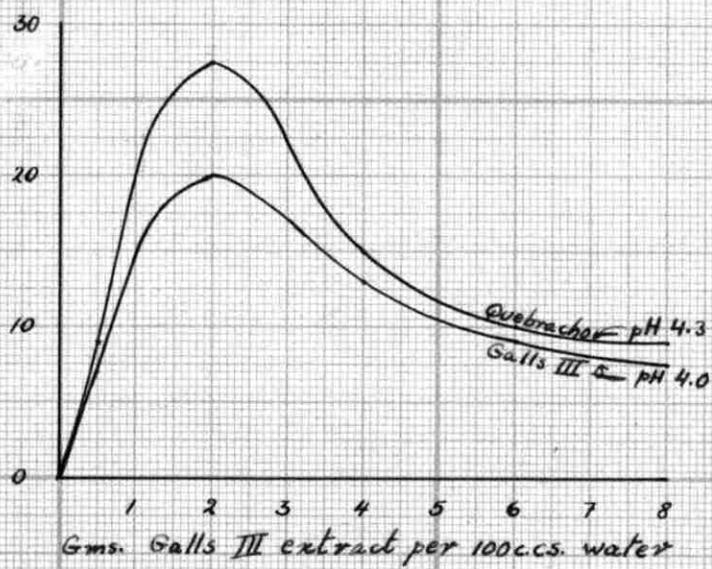


Fig. 13

I believe that the second explanation is the more plausible, because a greater rate of diffusion of tan liquor into gelatin, as was shown in part VI experiment 1 and 2, is obtained when using more concentrated solutions. This means that according to the first explanation the rate of diffusion increases to a maximum and then decreases with increase of tannin concentration, which is not true, because according to experiment 1 and 2 part VI the rate of diffusion increases with an increase in the tannin concentration. Increasing the concentration increases the rate of diffusion but not the rate of combination, which supplements the second explanation.

IV. AMOUNT OF TANNIN ABSORBED BY HIDE POWDER FROM VEGETABLE TANNIN WITH CHANGE IN pH OF TANNIN EXTRACT.

Gms. of Galls extract per 100 cc. of water.	Gms. tannin combined with 100 gms.					
	pH 1.2	pH 2.02	pH 4.05	pH 7.2	pH 9.0	pH 11.55
35 gms.	30.2	30.15	11.5	17.53	17.2	9.25
80 gms.	40.5	42.02	7.5	20.4	20.0	11.5

Aleppo Galls III extract was used. Portions of purified powder equal to 1 gm. of anhydrous substance were shaken with 50 cc. of tan liquor of pHs 1.2, 2.02, 4.05, 7.2, 9.0 and 11.55 respectively of the extract.

In the concentration experiments ( Exp. III ), a tan liquor containing 2 gms. of solid matter per 100cc. gave a much greater rate of tanning than one containing 8 gms. per 100 cc., but the results of this experiment show that this is dependent upon the pH value; at pH 4, the more dilute solution tans at the greater rate, while at 2 and at 8, the more concentrated solution tans at the greater rate ( Fig. 14 and 15 )

Looking at the curves one observes a steep rise in both curves to the left of pH 4.5, which is exactly what one would expect, knowing that the positive electrical charge on collagen increases as the pH value falls from the isoelectric point ( pH 4.8 ) and that the tannins are negatively charged at pH values higher than 2.

+++++

Gms. Tannins Combined with 100gms. Hide-Substance.

Time:- 24 hrs.  
Conc:- 8gms./100 c.c.s. water  
Tannins:- 60%

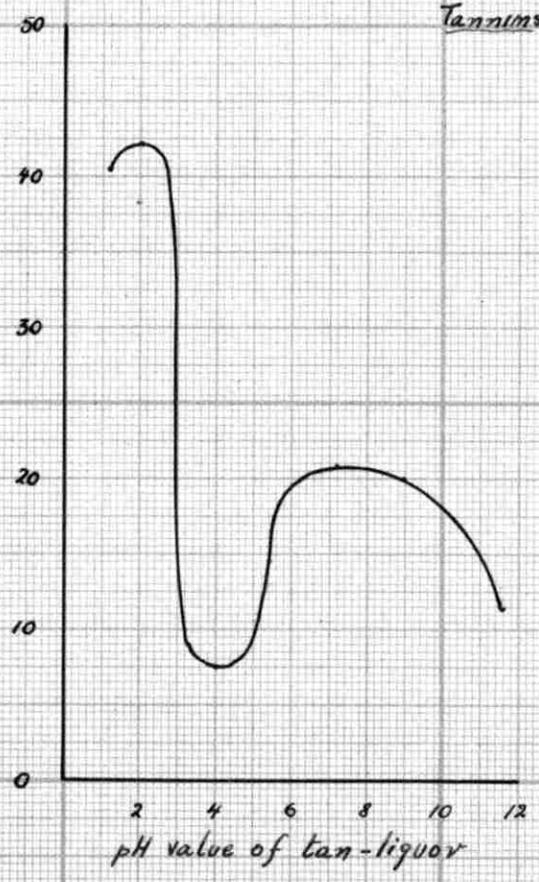


Fig. 14

Time:- 24 hrs.  
Conc:- 3.5 gms. / 100 c.c.s. water  
Tannins:- 60%

Gms. Tannins Combined with 100 gms. Hide-Substance.



Fig 15

RESULTS  
OF THE  
INVESTIGATIONS  
CARRIED  
ON  
BASIC CHROME LIQUOR

CHROMITE ORE

OCCURENCE:- In the region of Ladikiyyah.

Qualitative Analysis:- The metals found in the chromite-ore besides chromium are the following:- 1. Iron, 2. Aluminium, 3. Magnisium, 4. Calcium and 5. Silica.

Quantitative Analysis:- Three grams of the chromite-ore were treated with 8 grams of Sodium peroxide for one hour in a porcelain crucible. The crucible while hot was put in a large beaker containing 200 cc. distilled water and boiled until the mixture was completly disintegrated. The resulting mixture was filtered and the solution made up to 250 cc.

The filtrate contained Chromium and Aluminium in the form of Sodium chromate and sodium aluminate respectively, while the precipitate contained Ferric hydroxide, Calcium hydroxide, Magnisium hydroxide and Silica.

Procedure for the Analysis of the filtrate:-

1. Chromium:- 50 cc. of the filtrate were taken and the Sodium chromate determined volumetrically by the Ferrous-permanganate method.

2. Aluminium:- 50 cc. of the filtrate were taken, acidified with sulfuric acid and the Aluminium precipitated

as Aluminium hydroxide with dilute ammonium hydroxide. The Aluminium hydroxide was then determined gravimetrically.

Procedure for the Analysis of the Precipitate:- To separate the Ferric hydroxide, Calcium hydroxide and Magnesium hydroxide from the broken pieces of the crucible and the silica, was treated with hot dilute hydrochloric acid until all the precipitate dissolved and the soln. made up to 250 cc.

1. Iron:- 500 cc. of the filtrate were taken and made alkaline with dilute ammonium hydroxide. The Ferric hydroxide precipitated was determined gravimetrically.

2. Calcium oxide and Magnesium oxide:- To the filtrate after precipitating the iron as Ferric hydroxide, ammonium chloride and disodium hydrogen phosphate were added until there was no more precipitate. The CaO and MgO were then determined as Calcium phosphate and Magnesium pyrophosphate, ( gravimetrically ).

3. Silica:- The silica was determined separately.

Result Of The Complete Quantitative Analysis Of The Ore

	Percentage
Chromic Oxide .....	46.4
Aluminium Oxide .....	7.9
Ferrous Oxide .....	35.3
Calcium ,Magnesium Oxides	6.4
Silica .....	4.05
Moisture .....	0.08
Total	101.05

PREPARATION OF SODIUM DICHROMATE FROM THE CHROMITE - ORE

120 parts of powdered chromite-ore were mixed together with 100 parts of sodium carbonate powder and 50 parts of powder lime, was added in order to prevent the materials from fusion, but remain in a pulverise form, in order to make it easy to leach.

The construction of the furnace is as follows: ( Fig. 16 )  
The whole furnace is made of fire-bricks, except the inside part which is made of refractory-bricks. The mixture is put into the chamber D through the door A. B is a mazout burner and C is a tube made of fire-bricks which is being heated by the mazout burner and which conducts air into the chamber D in order to oxidise the chromite-ore to the chromate. The air enters by the draft caused by the escaping gases from chamber C through the outlet E. The air coming in can be regulated so as to have sufficient oxygen in chamber D. F is an outlet for the escaping gases from the mazout burner.

The temperature of the furnace should be around 1200 C. in order that the air will be able to oxidise the chromium to the chromate in the presence of the sodium carbonate. The approximate time required for the chromite-ore to be oxidized to the chromate is between 5 and 8 hours.

The resulting material now consists of sodium carbonate some calcium chromate, sodium oxide, lime, ferric oxide and other unimportant materials. The whole material is leached in

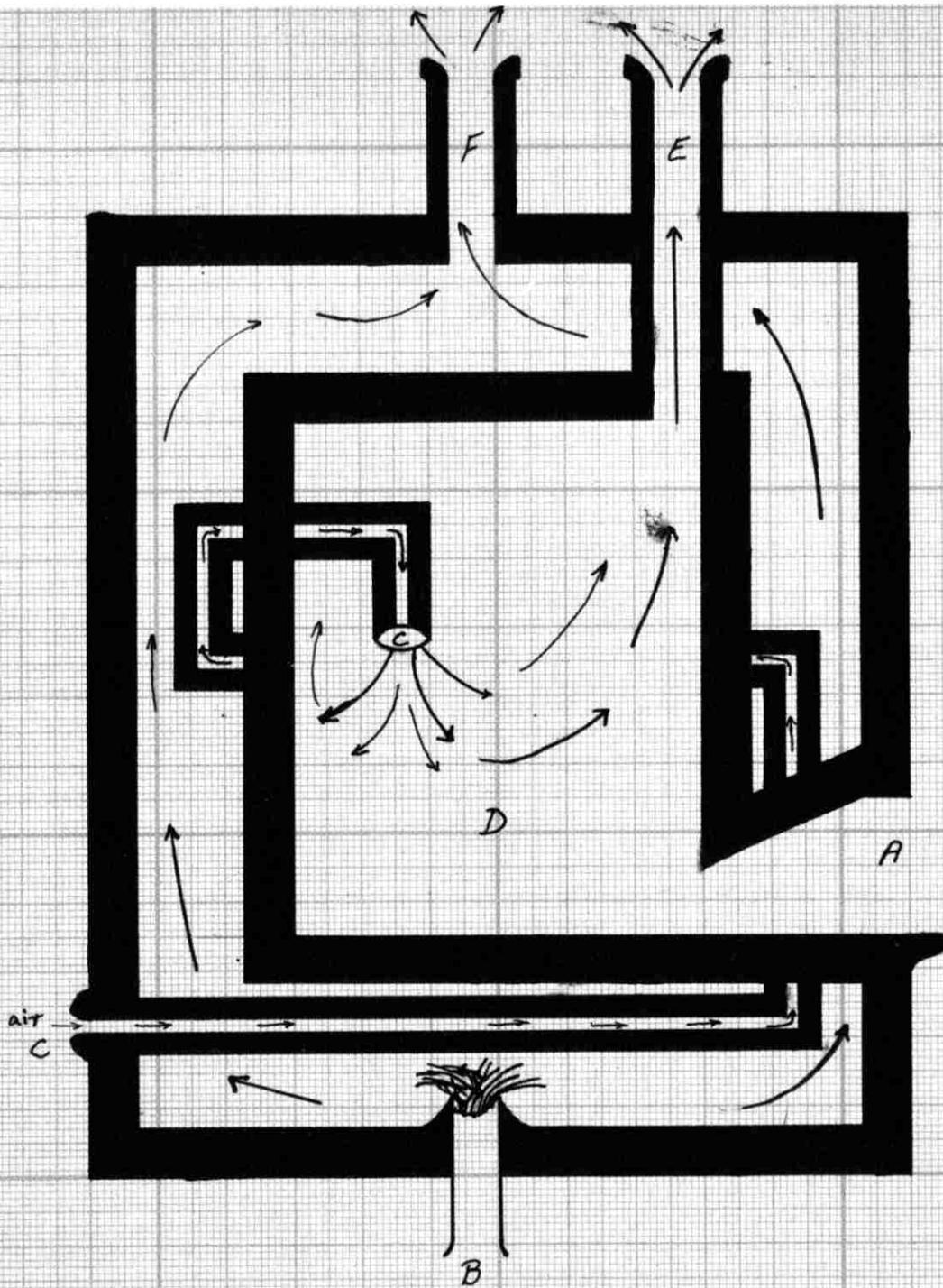


Fig. 16

boiling water and then enough sulfuric acid is added to produce a weak reaction, the calcium being changed to the insoluble calcium sulfate and the solution now contains sodium chromate, ferric sulfate and sodium sulfate. The resulting solution is allowed to settle and decanted from the calcium sulfate, silica and other impurities. The ferric sulfate present in solution is now precipitated by means of chalk. The whole thing is allowed to settle and the solution decanted from the ferric hydroxide and the excess calcium carbonate. The solution now containing the sodium chromate is acidified with sulfuric acid to the dichromate and concentrated to the required concentration.

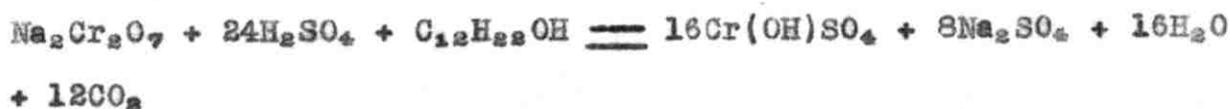
PREPARATION OF ONE - CHROME BATH

There are two methods by which basic chrome-liquor can be prepared by the reduction of sodium dichromate as:-

1. Reduction with sugar:-

122 grams of commercial sodium dichromate ( 82 % pure ) were dissolved in 800 cc. of water. To the dichromate soln. were added very slowly 115 grams of conc. sulfuric acid ( 95 % ). Afterwards a conc. <sup>soln</sup> of sugar ( actually Dibs was used ) were added very slowly until a green soln was obtained, when the whole soln was made up to one liter. The resulting soln contained 12.6 % of basic chrome-sulfate.

The resulting soln is 0.38 M with respect to sodium sulfate.

2. Reduction with sulfur dioxide:-

122 grams of commercial sodium dichromate (82 % pure) were dissolved in 800 cc. water. Sulfur dioxide was then passed through the soln until complete reduction was effected, shown by the change in color from orange-yellow to green. The resulting soln contained approximately 12.6 % basic chrome-sulf..

The resulting soln is 0.38 M with respect to sodium sulfate.



PREPARATION OF GLUE FROM CHROME SHAVINGS

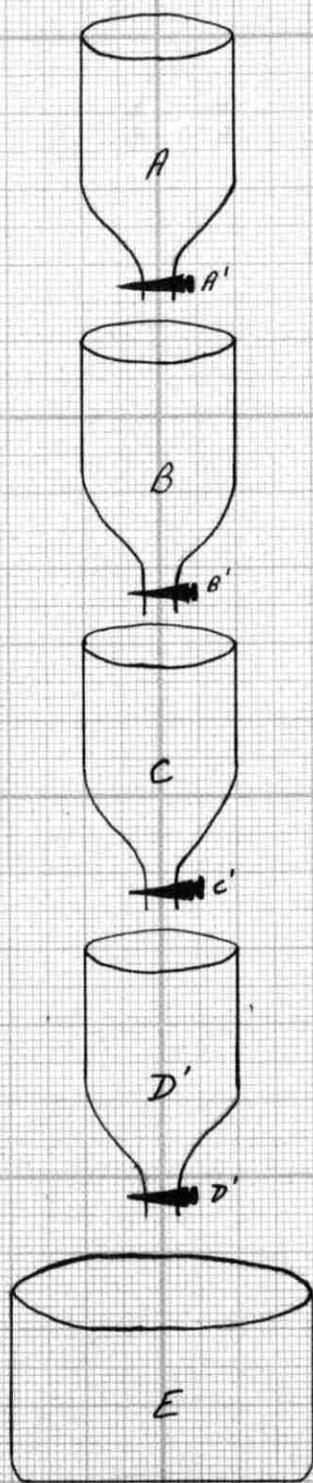
The shavings were put in extractors as shown in fig. 17. Extractor A is covered with 5 % Sulfuric acid at temperatures ranging between 50 and 70 C<sub>o</sub>. After a day tap A' was opened and solution poured over B, and left there for another day afterwards poured over C then D and finally poured into vessel E. The process was repeated until A was nearly free (required five extractions ) from any green color. Then B was put in place of A, C in place of B and D in place of C and extractor A containing a new sample was put in place of D and the whole process could be continued indefinitely.

The liquor in vessel E containing chromium sulfate and excess sulfuric acid was concentrated to the required concentration and the solution treated with calcium carbonate and filtered until the right acidity was obtained, so that it will be used again for chrome tanning.

The shavings were first washed to remove the remaining acid and then dissolved in boiling water and the solution treated with sufficient lime powder to precipitate the remaining chromium sulfate as chromium hydroxide. The solution was then filtered, the excess lime was just neutralised with dilute sulfuric acid and the excess acid neutralised with calcium carbonate. The soln was then filtered from the calcium sulfate and the excess calcium carbonate.

The resulting glue solution was concentrated and then left

Fig. 17



to be dried under the sun.

The treatment with lime hydrolysed part of the glue and degelled it.

RESULTS OF THE EXTRACTION OF BASIC CHROME - LIQUOR FROM CHROME SHEVINGS=-

WITH SULFURIC ACID

Sample No.1

Wt. of sample.	No. of Extractions	Conc. and volume of solvent.		Solution after extraction.					% Chromic Oxide for every
		Vol. in liters	Sp.Gr.	Vol. in liters	Sp.Gr.	% $\text{CrOHSO}_4$ in Soln	% $\text{CrOHSO}_4$ in Ch.Sh.	% $\text{Cr}_2\text{O}_3$ in Ch.Sh.	
440 g.	1	2.0	1.03	1.90	1.0500	1.02	4.40	2.00	0.50
"	2	1.8	1.03	1.75	1.035	0.26	1.04	0.47	0.47
"	3	1.5	1.03	1.50	1.035	0.308	1.050	0.48	0.48
"	4	1.5	1.03	1.50	1.032	0.13	0.44	0.20	0.50
"	5	1.5	1.03	1.50	1.032	0.13	0.44	0.20	0.50
Total							7.42	3.37	Av. 0.49

RESULTS OF THE EXTRACTION OF BASIC CHROME - LIQUOR FROM CHROME SEAVINGS WITH

SULFURIC ACID

Sample No. 2

Wt. of sample	No. of extractions	Conc. and volume of solvent		Solution after extraction.					% chromic oxide for every 0.005 deg. in Sp.Gr.
		Vol. in liters	Sp.Gr.	Vol. in liters	Sp.Gr.	% $\text{CrOHSO}_4$ in solution	% $\text{CrOHSO}_4$ in Ch.Sh.	% $\text{Cr}_2\text{O}_3$ in Ch.Sh.	
400 g.	1	1.9	1.05	1.25	1.06	0.76	2.37	1.08	0.54
"	2	1.75	1.035	1.45	1.040	0.57	2.07	0.94	0.49
"	3	1.45	1.032	1.25	1.037	0.335	1.05	0.48	0.48
"	4	1.5	1.03	1.5	1.035	0.29	1.1	0.50	0.50
"	5	1.6	1.03	1.5	1.032	0.12	0.45	0.20	0.50
<b>Total</b>							<b>7.13</b>	<b>5.22</b>	<b>Av. 0.502</b>

Every 0.005 degree of ruse in Sp.Gr. represents approximately 0.5 gms. chromic oxide in solution. The amount of chromic oxide removed from 100 gms. of chrome shavings in first sample is equal to 3.37 gms. and 3.22 gms. from second sample. Originally the chrome shavings contained 3.55 gms. chromic oxide per 100 gms. and therefore the amount of chromic oxide remaining in the chrome shavings after extraction is equal to 0.18 gms. in the first sample and 0.33 gms. in the second sample.

I. CHANGE IN THE pH OF BASIC CHROME - LIQUOR WITH DILUTION

Solution	Grams $Cr_2O_3$ per 100 cc. solution							
	pH	14%	10%	8%	5%	2.5%	1%	0.5%
Solution I	pH	--	--	2.26	2.38	2.6	2.58	--
Solution IIA	pH	2.5	2.7	2.85	3.13	3.45	3.75	--
Solution IIB	pH	--	2.75	2.90	3.18	3.50	3.80	--
Solution of Chromium sulf.	pH	--	--	2.03	2.13	2.30	2.52	2.7

Two kinds of basic chrome-liquor were used:-

1. The first solution ( sol.I ) containing 8 gms. of chromic oxide per 100 cc. of solution was used for experiments on the diffusion into the gelatin-jelly.

2. The second solution ( sol.IIA ) containing 14 gms. of chromic oxide per 100 cc. of solution was used for the experiments on the combination between it and the hide powder ( collagen ).

One kind of chromium sulfate solution was used, which consisted of 20.6 gms. of chromic sulfate per 100 cc. solution

For solution IIB the pH of the solutions were determined two weeks after being diluted, in order to give time for the establishment of equilibrium. The curves show that the Hydrogen-ion concentration decreases with dilution. Being a salt of a weak base and a strong acid, chromium sulfate ( or basic chromium sulfate ) hydrolyses to a very considerable

- (1) = Soln II A
- (2) = Soln II B
- (3) = Soln I
- (4) = Soln of  $Cr_2(SO_4)_3$

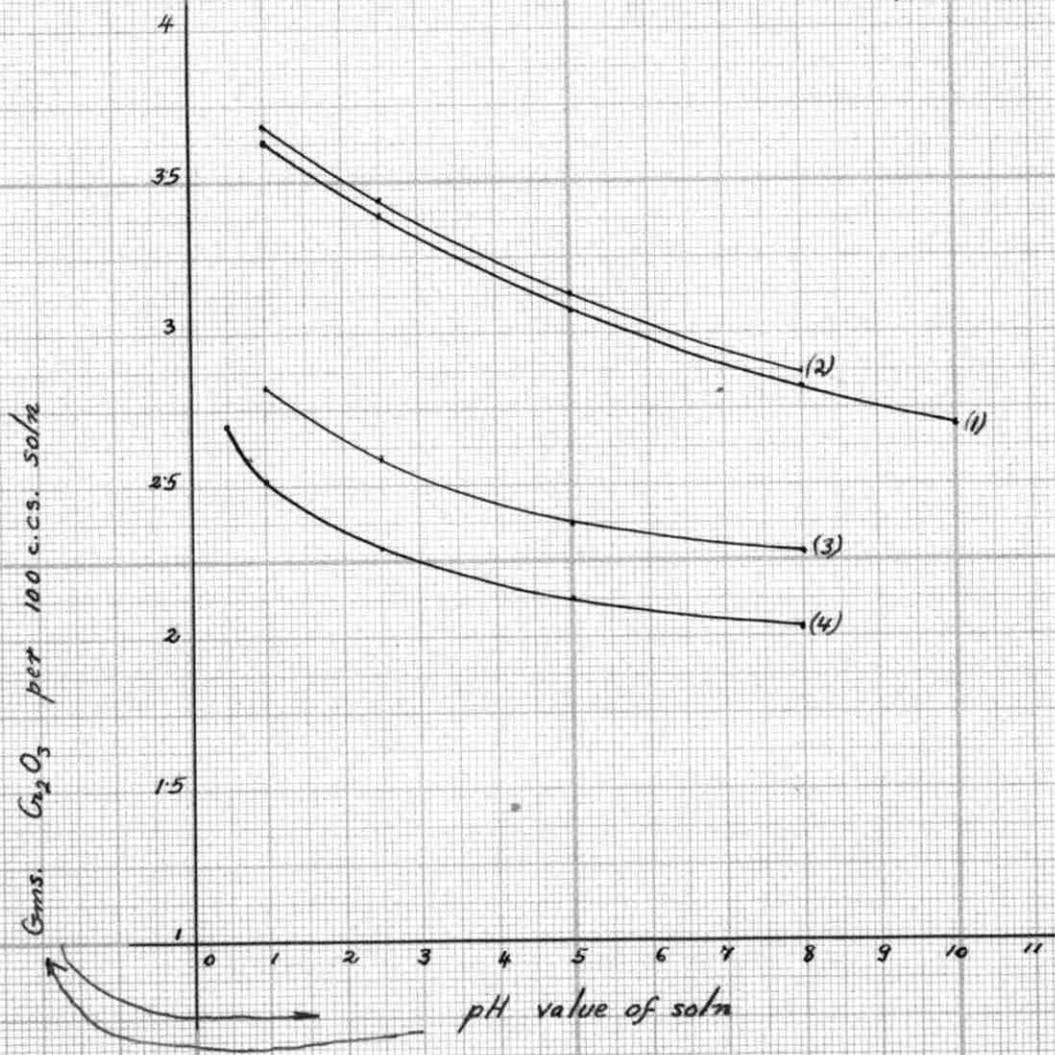


Fig. 18

extent in aqueous solutions, yielding free sulfuric acid and a series of basic chromium sulfates ( a series of higher basic chromium, e.g.  $\text{Cr}_2(\text{OH})_4\text{SO}_4$  ), (Fig. 18 ).

Thus the total Hydrogen-ion concentration is increased, but the hydrogen-ion concentration per unit volume decreases on dilution, so that the resulting pH of the solution becomes higher.

## II. EFFECT OF NEUTRAL SALTS ON THE pH OF THE BASIC CHROME - LIQUOR.

Grams Chromic oxide per 100 cc. soln	Time	pH						
		Mols 0	Mols 0.25	Mols 0.5	Mols 0.75	Mols 1.0	Mols 2	Mols 3
<u><math>\text{Na}_2\text{SO}_4</math> solution</u>	After 1 month	2.58	2.85	2.93	2.88	2.85	2.78	--
NaCl solution	Immedia- tely	2.58	2.57	2.53	2.51	2.48	2.38	2.28
NaCl solution	After 1 month	2.58	--	2.38	--	2.23	1.78	1.38

Solutions containing 3 gms. of chromic oxide per 100 cc. were made 0.25 M, 1.0 M, 2 M and 3 M, with respect to NaCl and  $\text{Na}_2\text{SO}_4$  and the pH of the resulting solutions determined. The results are shown above ( Fig. 19 ). For the case of the Sodium sulfate there were no appreciable immediate changes in pH, so the pH of the solutions were determined

(1) =  $\text{Na}_2\text{SO}_4$

(2) =  $\text{NaCl}$  (Immediately).

(3) =  $\text{NaCl}$  (after one month).

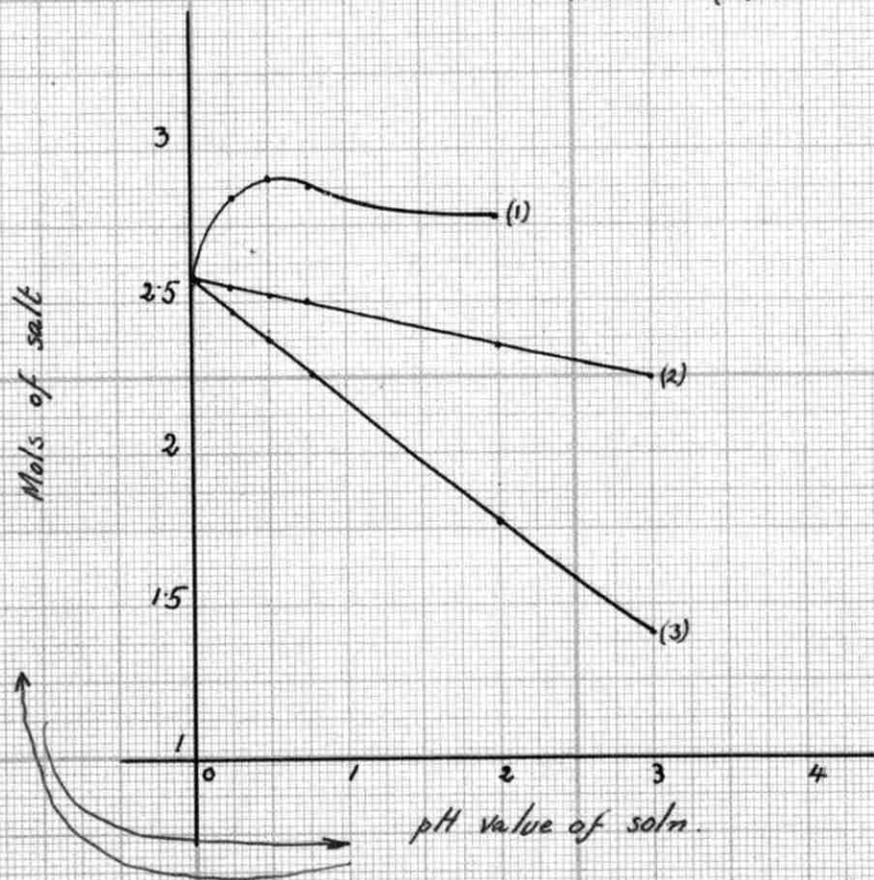


Fig. 19

after one month of the addition of the sodium sulfate, while those of the sodium chloride were determined immediately, and also after one month of the addition of the sodium chloride to the basic chrome-liquor containing 3 gms. of chromic oxide per 100 cc. of water.

The pH of the acid chrome liquors were found to decrease with addition of sodium chloride and increased by the addition of sodium sulfate.

Thomas and Baldwin found that neutral chlorides lower the pH of acid solutions, while neutral sulfates higher the pH. This was found to be the case by the above experiments conducted on the basic chrome liquor. It was found by Thomas and Baldwin that chrome liquors containing more sodium sulfate required more alkali to precipitate the chromium. They suggested that this may be due to the fact that sulfates increase the stability of chrome-liquors, by forming addition compounds with the chromium salts which are less easily precipitated than the simpler salt.

III. RATE OF DIFFUSION OF BASIC CHROME - LIQUOR INTO  
GELLATIN - JELLY WITH CHANGE IN pH OF CHROME - LIQUOR

Grams chromic oxide per 100 cc. solution	pH	Rate of diffusion in cms.				
		1 day	2 days	1 week	2 weeks	3 wks.
3 grams	1.25	1.35	2.00	3.30	4.80	---
3 grams	2.00	1.50	2.05	3.35	4.95	---
3 grams	2.58	1.50	2.10	3.50	5.10	---
3 grams	3.80	1.40	1.90	3.20	4.50	---
3 grams	5.25	1.20	1.40	2.60	3.60	---

Basic chrome-liquors of pHs 1.25, 2.00, 2.58, 3.80, and 5.25 were prepared containing 3 grams chromic oxide per 100 cc. of solution.

10 cc. of every solution were taken and poured over 4 % gelatin gels in test-tubes of 1.6 cms. diameter and the rate of diffusion in each determined after the specified times. ( Fig. 20 )

Maximum diffusion took place around pH 2.5 and an increase in the pH above 2.5 diminished tremendously the rate of diffusion of the basic chrome-liquor into the gelatin gel, while a decrease in the pH below 2.5 only diminished slightly the rate of diffusion. For example, the slope of the curve above pH 2.5 is much greater than below pH 2.5 after two weeks diffusion. The reason being that an increasing pH value cause the molecule of chromium salt to form aggregates of increasing

Conc:- 3gms.  $Cr_2O_3$  / 100c.c. soln.

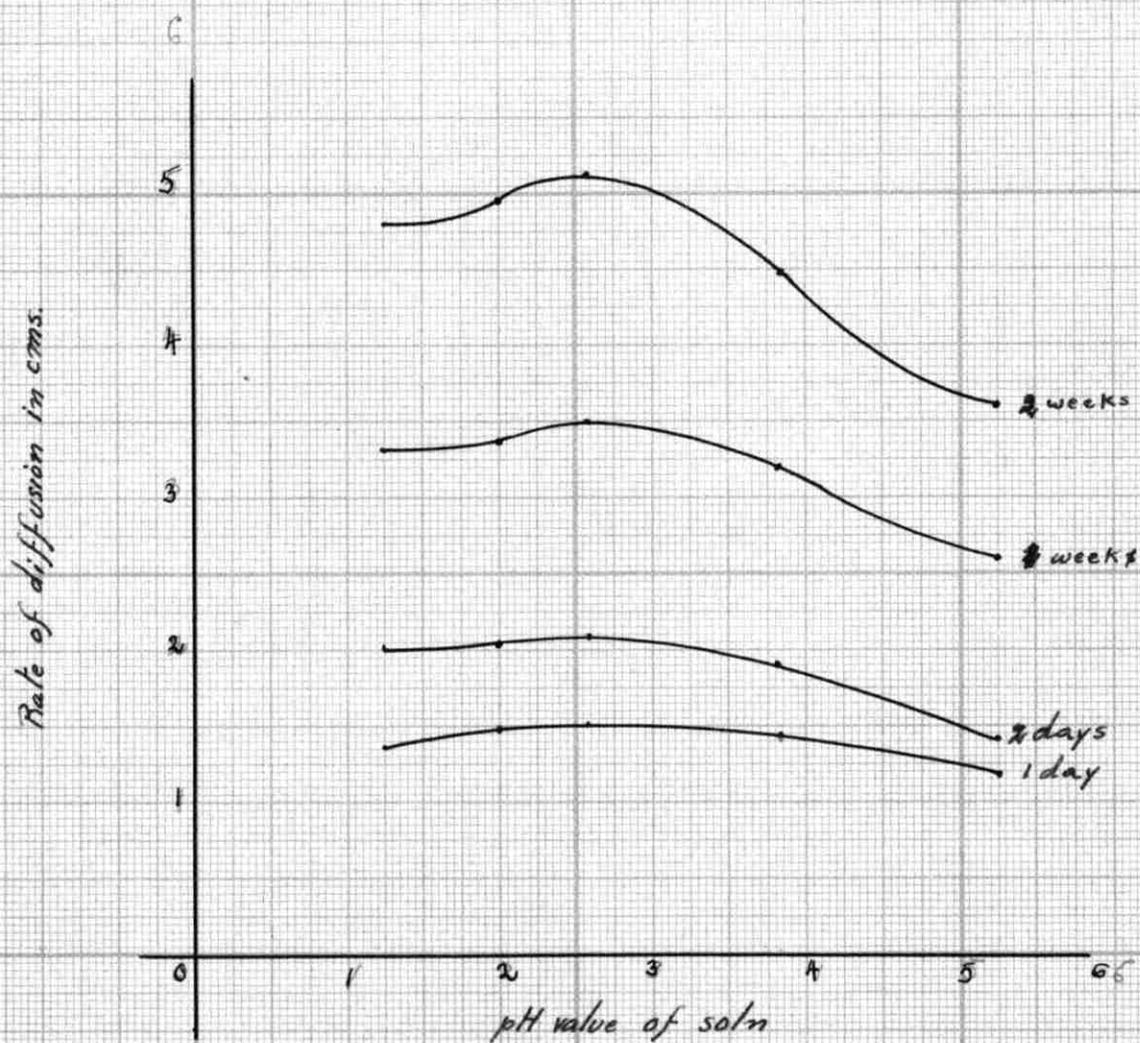


Fig. 20

size and therefore greatly reducing the rate at which they diffuse into the gelatin gel, ( Wilson ).

IV. RATE OF DIFFUSION OF BASIC CHROME - LIQUOR INTO GELATIN-  
JELLY WITH CHANGE OF CHROME LIQUOR CONCENTRATION.

Grams chromic oxide per 100 cc.	pH	Rate of diffusion in cms.					
		1 day	2 days	1 week	2 weeks	1 month	2 months
1 gram	2.65	0.70	1.00	1.70	2.40	3.20	3.50
2.5 gms.	2.63	0.85	1.20	2.05	3.00	3.90	4.25
5 gms.	2.40	0.90	1.40	2.50	3.60	4.60	5.10
8 gms.	2.26	0.95	1.45	2.80	3.90	4.85	5.40

A solution containing 8 gms. of chromic oxide per 100 cc. solution and the other solution containing, 2.5 gms., and 1 gm. were prepared by diluting the original solution. ( Fig. 210

It was found that the rate of diffusion increases with increase in the percentage of chromic oxides but the proportionality factor of diffusion is not constant. This is due to the following causes:-

1. As the concentration of the liquor increases the Hydrogen-ion concentration increases, and therefore the rate of diffusion diminishes. The rate of diffusion increases as the pH is lowered until a point of maximum is reached when it starts to decrease. This was shown to be true in experiment III.

2. The salt concentration increases and therefore

Substance:-  $\text{Cr}(\text{OH})\text{SO}_4$

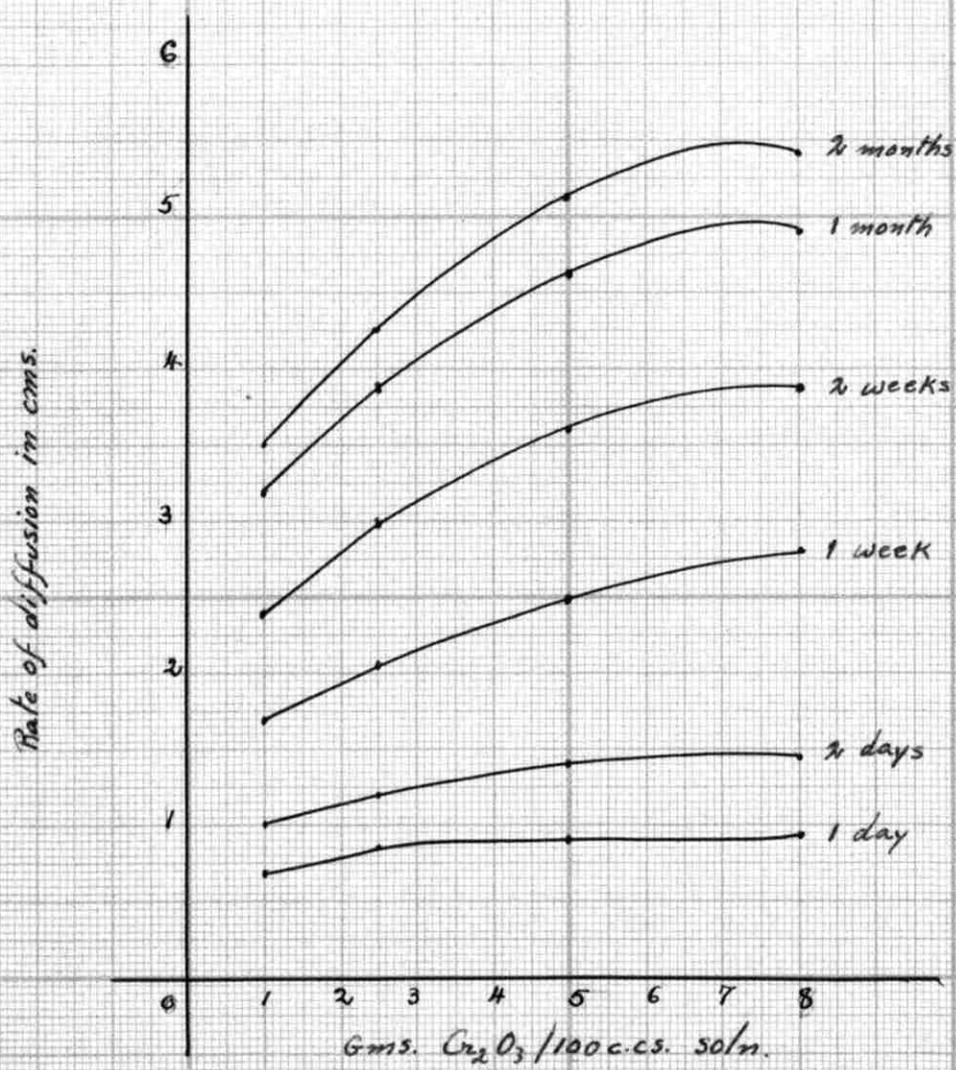


Fig. 2/1

the rate of diffusion of the liquor decreases.

3. The probability of the formation of additional compounds at high concentrations, increasing the molecular size of the chromium salt and therefore the rate of diffusion is decreased.

V. RATE OF DIFFUSION OF CHROMIUM SULFATE SOLUTION INTO GELATIN JELLY WITH CHANGE OF CHROMIUM SULFATE CONCENTRATION

Grams chromic oxide per 100 cc.	pH	Rate of diffusion in cms.				
		1 day	2 days	1 week	2 wks.	1 month
2.5 grams	2.3	0.7	1.0	1.7	2.2	3.0
5.0 grams	2.13	0.85	1.5	2.75	3.6	4.75
8.0 grams	2.03	0.9	1.7	3.3	4.2	5.5

A solution containing 8 grams of chromic oxide per 100 cc. soln was prepared. The other solutions containing 5, and 2.5 grams chromic oxide were prepared by diluting the original solution ( Fig. 22 ).

The rate of diffusion increases with increase in the percentage of the chromic oxide in the chromium sulfate soln, but the proportionality factor of diffusion is not a constant. This is due to the same causes of the chrome-liquor with the exception of one factor which is that of concentration. We know that in the preparation of basic chrome liquors from Sodium dichromate, Sodium sulfate is formed which increases the salt concentration of the basic chrome-liquor, while in the

Substance:-  $\text{Cr}_2(\text{SO}_4)_3$

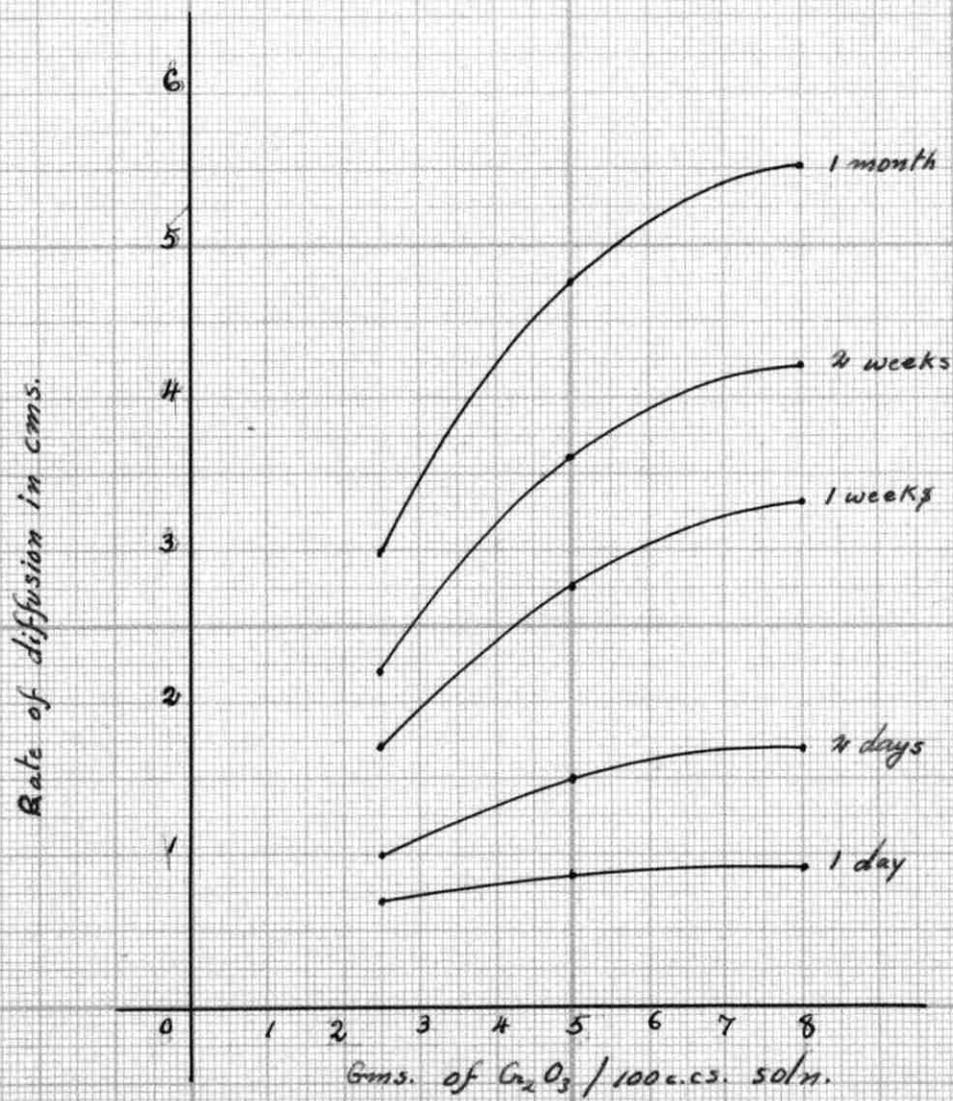


Fig. 22

case of the chromium sulfate there is no sodium sulfate so that on increasing the concentration of the chromic oxide the salt concentration is not increased as much as that of the basic chrome liquor,. Therefore the relative decrease in the rate of diffusion is not as much as that of the basic chrome-liquor, especially at high concentrations of chromic oxide. For example, a solution of chrome liquor which contains 5.6 grams of chromic oxide per 100 cc. of solution is nearly 0.4 M with respect to sodium sulfate.

VI. RATE OF DIFFUSION OF BASIC CHROME - LIQUOR INTO GELATIN-JELLY WITH INCREASE OF SODIUM CHLORIDE, SODIUM SULFATE, MAGNESIUM CHLORIDE AND SUGAR CONCENTRATIONS IN GELATIN-JELLY

4 gms. gelatin jelly per 100 cc. water	Mols of NaCl	Rate of diffusion in cms.					
		1 day	2 days	1 week	2 wks.	3 wkā.	1 mon.
Gelatin-jelly	0.0	0.95	1.40	2.20	3.90	4.85	5.40
Gelatin-jelly	0.5	1.00	1.50	2.95	4.00	4.95	5.50
Gelatin-jelly	1.0	1.00	1.55	3.30	4.30	5.30	5.90
Gelatin-jelly	1.25	1.00	1.60	3.60	4.80	5.70	6.40
Gelatin-jelly	1.5	1.00	1.55	3.40	4.50	5.60	6.30
Gelatin-jelly	2.0	0.90	1.40	3.00	3.80	4.60	5.40
Gelatin-jelly	3.0	0.85	1.30	2.50	3.40	4.20	4.80
Gelatin-jelly	4.0	0.80	1.30	2.60	---	---	---
Gelatin-jelly	5.0	0.80	1.30	2.50	---	---	---

Fifteen cc. solutions of 4 % gelatin were made 0.5 M,

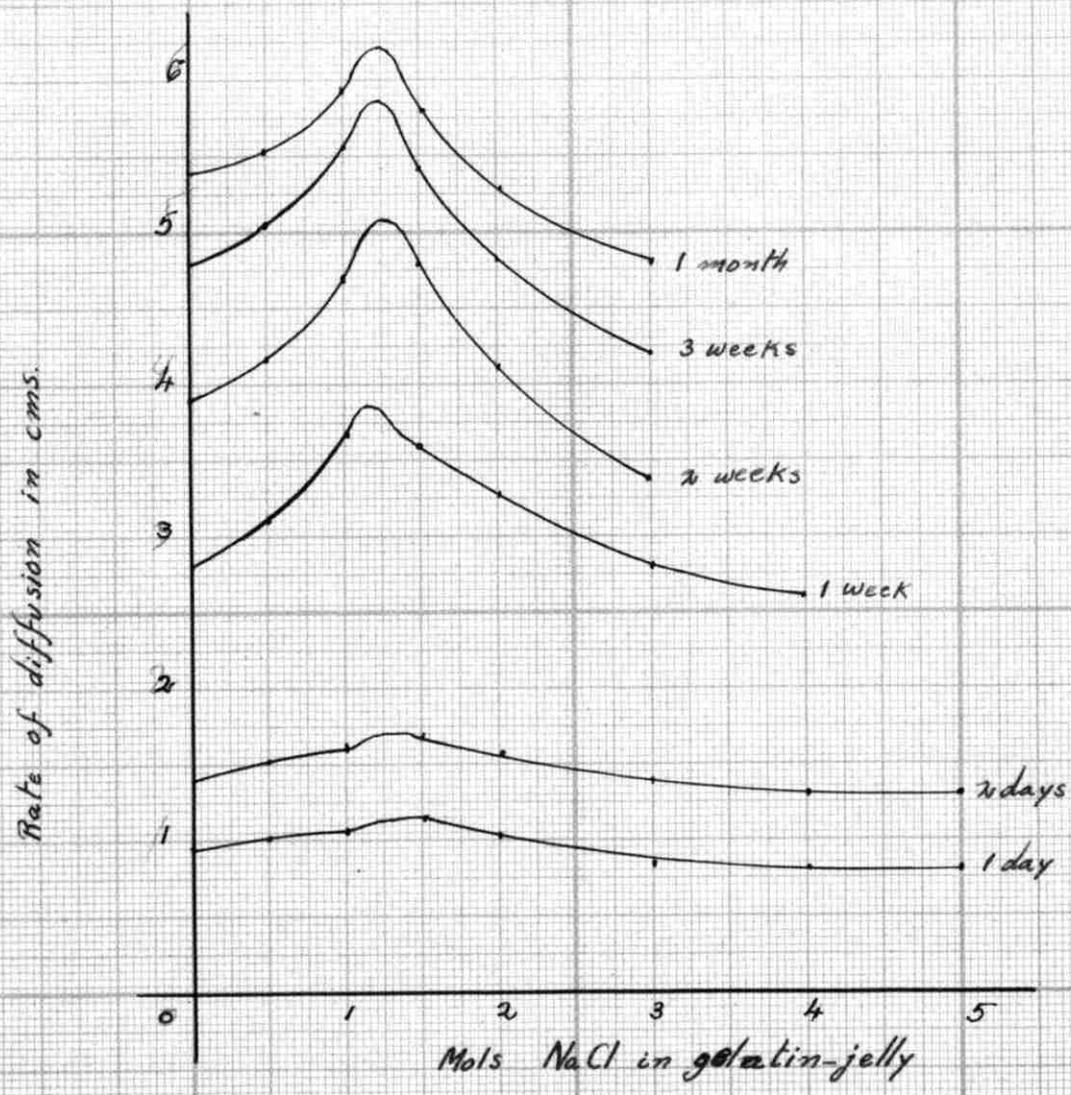


Fig. 2.3

1.0 M, 1.25 M, 1.5 M, 2.0 M, 3.0 M, 4.0 M, and 5.0 M with respect to sodium chloride. They were set in test-tubes of 1.6 cm. diameter and 100 cc. of basic chrome-lequer containing 8 gms. chromic per 100 cc. solution were poured into each test-tube above the gelatin, and the rate of diffusion in each test-tube determined after the specified times. The results of the experiment are shown above. In the test-tubes containing 4.0 M and 5.0 M sodium chloride the gelatin was found to be ruptured due to the great swelling caused by the high concentration of sodium chloride in the gelatin-jelly, ( Fig. 23 ).

4 gms. gelatin per 100 cc. of water.	Mols $\text{Na}_2\text{SO}_4$	Rate of diffusion in cms.				
		1 day	2 days	1 week	2 wks.	3 wks.
Gelatin-jelly	0.0	0.95	1.45	2.80	3.90	4.50
Gelatin-jelly	0.25	1.20	2.00	3.60	5.10	5.80
Gelatin-jelly	0.50	1.10	1.80	3.20	4.50	5.10
Gelatin-jelly	1.00	1.00	1.50	2.90	4.00	4.60

Due to the great power of hydration of sodium sulfate (  $10 \text{ H}_2\text{O}$  ) it was found impossible to prepare gelatin-jellies with a concentration higher than 1.0 M with respect to sodium sulfate.

15 cc. solutions of 4 % gelatin were made 0.25 M, 0.5 M and 1.0 M with respect to sodium sulfate. They were set in test-tubes and 10 cc. of solutions of 8 gms. chromic oxide

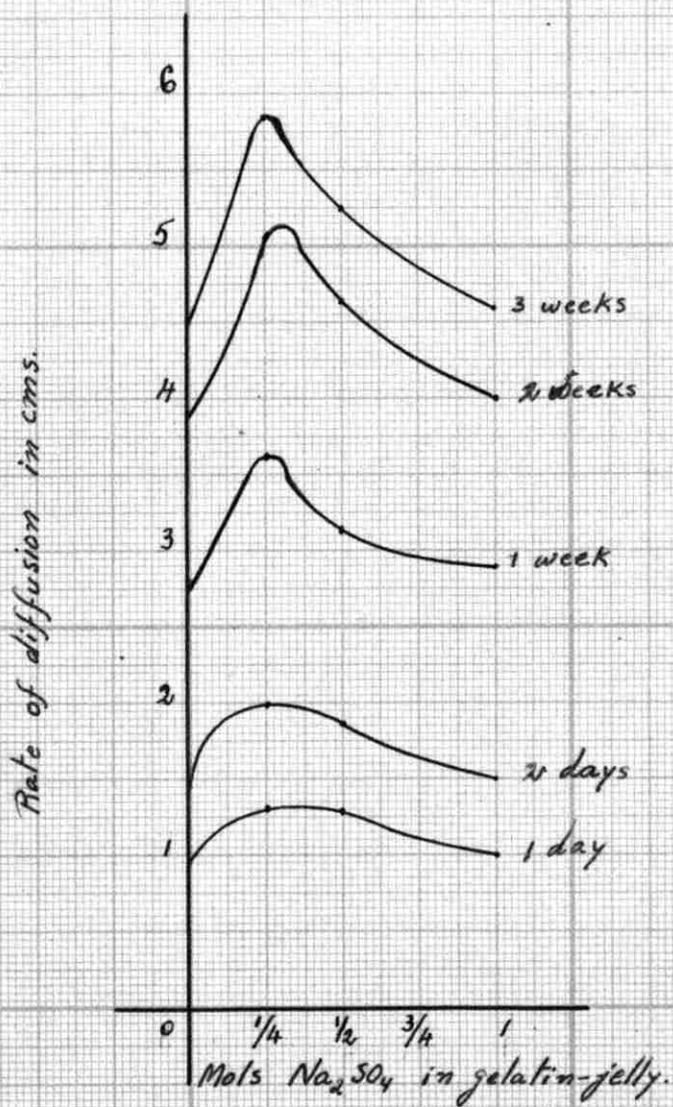


Fig. 24

were poured into each test-tube over the gel, and the rate of diffusion determined after the specified times. The results of the experiment are shown in the above chart ( Fig. 24 )

4 gms. gelatin per 100 cc. of water	Mols	Rate of diffusion in cms.				
		1 day	2 days	1 week	2 wks.	3 wks.
Gelatin-jelly	0.0	0.95	1.45	2.80	3.90	4.50
Gelatin-jelly	0.25	1.10	1.80	3.75	5.20	5.80
Gelatin-jelly	0.50	1.10	1.80	3.70	5.10	3.60
Gelatin-jelly	1.00	0.90	1.50	3.10	4.30	4.75
Gelatin-jelly	1.50	0.80	1.25	2.60	3.60	3.90

Due to the great power of hydration of magnesium chloride ( not as great as that of sodium sulfate, being  $6H_2O$  ) it was found impossible to prepare gelatin-jellyes with a higher concentration than 1.5 M with respect to magnesium chloride.

15 cc. solutions of 4 % gelatin were made 0.25 M, 0.5 M, 1.0 M and 1.50 M with respect to magnesium chloride. They were set in test-tubes of 1.6 cms. diameter and then 10 cc. of solution of 8 gms. chromic oxide were poured into each test-tube over the gel, and the rate of diffusion determined after specified time. The results of the experiment are shown in the above chart ( fig. 25 ).

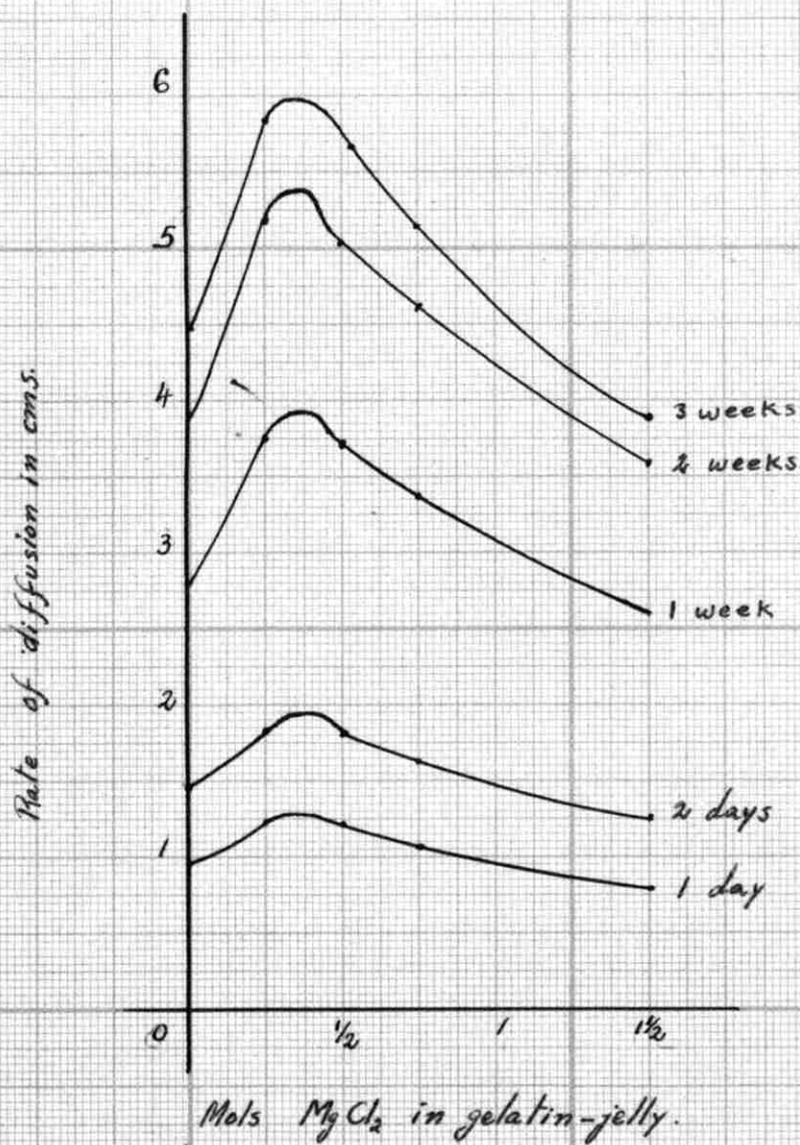


Fig. 25

4 Grms. gelatin per 100 cc. of water	Mols	Rate of diffusion in cms.				
	Sucrose	1 day	2 days	1 week	2 weeks	3 wks.
Gelatin-jelly	0.0	0.95	1.45	2.80	3.90	4.50
Gelatin-jelly	0.25	1.00	1.70	3.30	4.90	5.50
Gelatin-jelly	0.50	1.05	1.70	3.10	4.40	4.90
Gelatin-jelly	1.00	0.80	1.20	2.40	3.40	3.85
Gelatin-jelly	1.50	0.50	0.80	1.70	2.40	2.80
Gelatin-jelly	2.00	0.45	0.65	1.30	1.80	2.10

Due to the great power of hydration of sucrose, it was found impossible to prepare gelatin-jellies with a higher concentration than 2.0 M with respect to sucrose.

15 cc. solutions of 4 % gelatin were made 0.25 M, 0.5 M, 1.0 M, 1.5 M, and 2.0 with respect to sucrose. They were set in test-tubes of 1.6 cms diameter. Then 10 cc. of a solution of 8 grams of chromic oxide were poured into each test-tube over the gel and the rate of diffusion determined after the specified times. The results of the experiments are shown in the above chart ( Fig. 26 )

Explanation of the resulting charts:-

From fig. 23 it is found that the rate of diffusion of chrome-liquor into gelatin-jelly increases up to a concentration of 1.25 M, sodium chloride. Increasing the concentration diminishes the rate of diffusion of the liquor. The resistance to diffusion in gels can be considered a result of the brush-

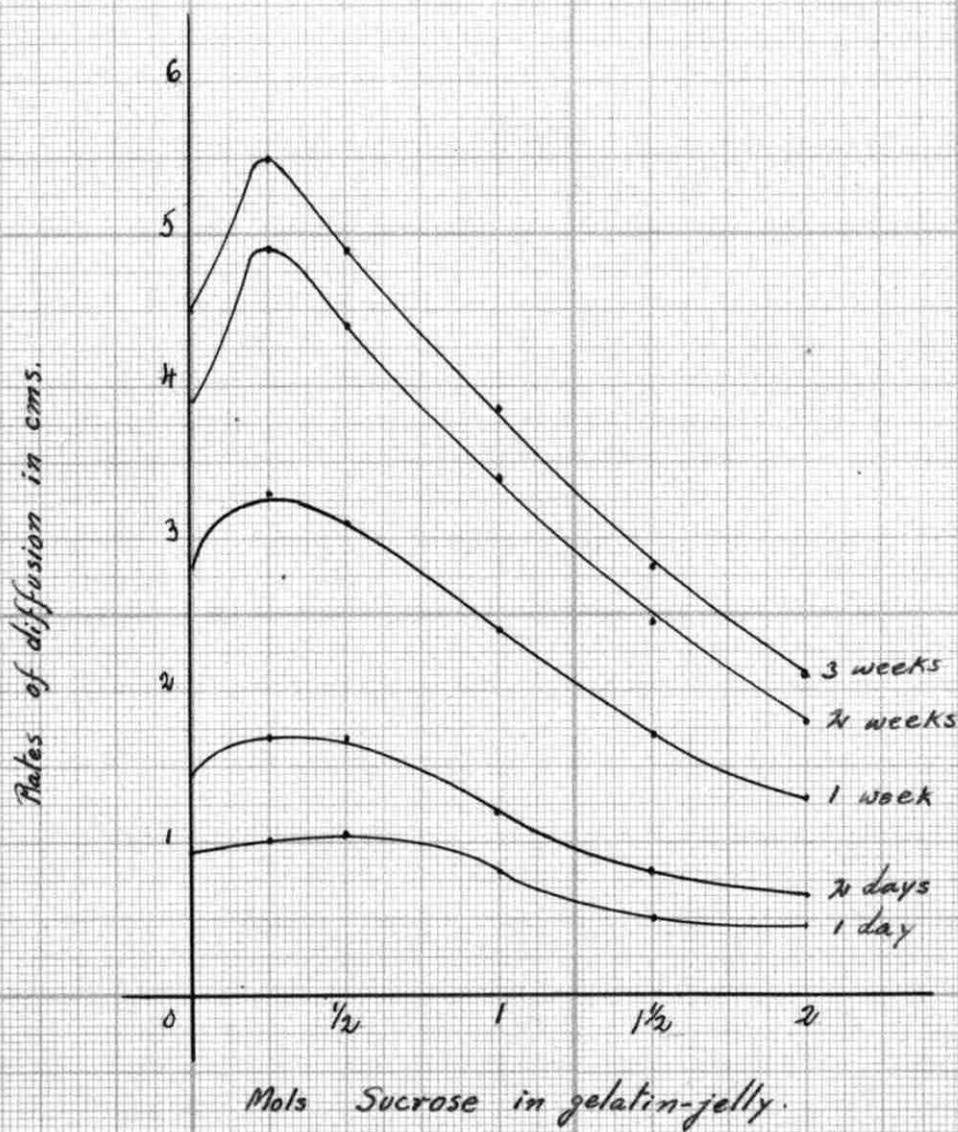


Fig. 26

heap structure of its internal phase. Thus the presence of sodium chloride which favours swelling up to a certain concentration lessens the resistance to diffusion of the chrome liquor into the gelatin-jelly; swelling being regarded as a process which enlarges the spaces in the mesh-like structure of the gelatin gel. But increasing the concentration of sodium chloride in the gel brings another factor with it which is that of hydration. Thus increasing the concentration of the sodium chloride above 1.25 moles increases the concentration of the gel, counteracting the forces that act in the direction of the enlargement of the spaces in the mesh-like structure of the gelatin in gels containing less than 1.25 moles, and as a result of the hydration of the salt, the concentration of the gel is increased and therefore the rate of diffusion of basic chrome-liquor is diminished. The same is true in the cases of gelatin gels containing sodium sulfate and magnesium chloride, except that the maxima lies at the concentration of 0.25 M for sodium sulfate and at a concentration of 0.35 M for Magnesium chloride. This is due to the greater power of hydration of sodium sulfate and magnesium chloride; thus bringing the maximum point nearer to zero concentration.

For example, looking at the curves of those of sodium chloride, sodium sulfate, and magnesium chloride after three weeks it is found that they approximately have the same maxima, i.e. around 5.75 M, gms, but not at the same concentration.

VII. RATE OF DIFFUSION OF BASIC CHROME - LIQUOR INTO GELATIN-  
JELLY WITH INCREASE OF SODIUM CHLORIDE, SODIUM SULFATE,  
MAGNEZIUM CHLORIDE AND SUCROSE CONCENTRATIONS IN CHROME-  
LIQUOR.

No results were obtained for chrome-liquors containing concentrations higher than 1 M with respect to the above salts, due to the gelatin being dissolved in the chrome-liquors.

I. AMOUNT OF CHROMIC OXIDE ABSORBED BY HIDE POWDER FROM  
CHROME LIQUOR WITH TIME .

Gms. chromic oxide per 100 cc.	pH	Gms. chromic oxide combined with 100 gms. Hide				
		5 hrs.	8 hrs	24 hrs.	48 hrs.	96 hrs.
2 gms.	3.75	9.25	10.78	12.8	13.75	15.05

Portions of purified powder equal to 1 gm. of anhydrous substance were shaken with 50 cc. of chrome-liquor containing 2 gms. chromic oxide per 100 cc. of pH 1.53 and each determined after 5, 8, 24, 48, and 96 hrs. The results are shown above (Fig. 27)

The results show that most of the combination takes place up to around 24 hr., further increase in time increases the amount of combination very slightly.

Substance:-  $\text{Cr}(\text{OH})\text{SO}_4$

Conc:- 2 gms.  $\text{Cr}_2\text{O}_3$  / 100 c.c. water.

pH:- 3.75

Gms.  $\text{Cr}_2\text{O}_3$  Combined with 100 gms.  
H<sub>2</sub>O - Substance.

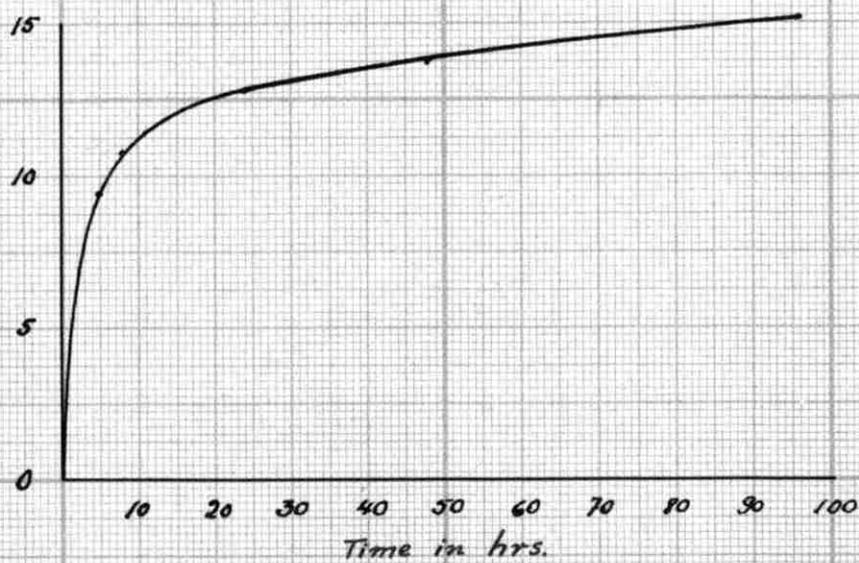


Fig. 27

II. AMOUNT OF CHROMIC OXIDE ABSORBED BY HIDE POWDER FROM  
CHROMIUM SULFATE WITH TIME.

Gms. chromic oxide per 100 cc.	pH	Gms. chromic oxide combined with 100 cc. Hide				
		5 hrs.	8 hrs.	24 hrs.	48 hrs.	96 hrs.
2 gms.	2.35	3.52	5.13	9.01	10.54	11.20

The amount of combination of hide substance with basic chrome-liquor is greater than that of chromium sulfate.

The rate of tanning in the chromic sulfate solution is very much less than that of the basic chrome-liquor, because the hydrogen ion concentration is about 25 times as great as in the chrome-liquor. It will also be noted that the amount of chromic oxide combined with 1 gm. of skin protein is greater for the chromi-liquor after 48 hrs. than the limiting value in the case of the pure chromic sulfate which has not reached a limiting value in 48 hrs. The limiting value, according to Wilson is 13.8 gms. chromic oxide per 100 gms. of hide substance ( Fig. 28 )

III. AMOUNT OF CHROMIC OXIDE ABSORBED BY HIDE POWDER FROM  
CHROME LIQUOR AFTER 48 Hrs. WITH INCREASE OF CHROME-  
LIQUOR CONCENTRATION.

Substance:-  $\text{Cr}_2(\text{SO}_4)_3$   
Conc.:- 2 gms.  $\text{Cr}_2\text{O}_3$  / 100 c.c. water  
pH:- 2.35

Gms.  $\text{Cr}_2\text{O}_3$  Combined with 100 gms.  
H<sub>2</sub>O - Substance.

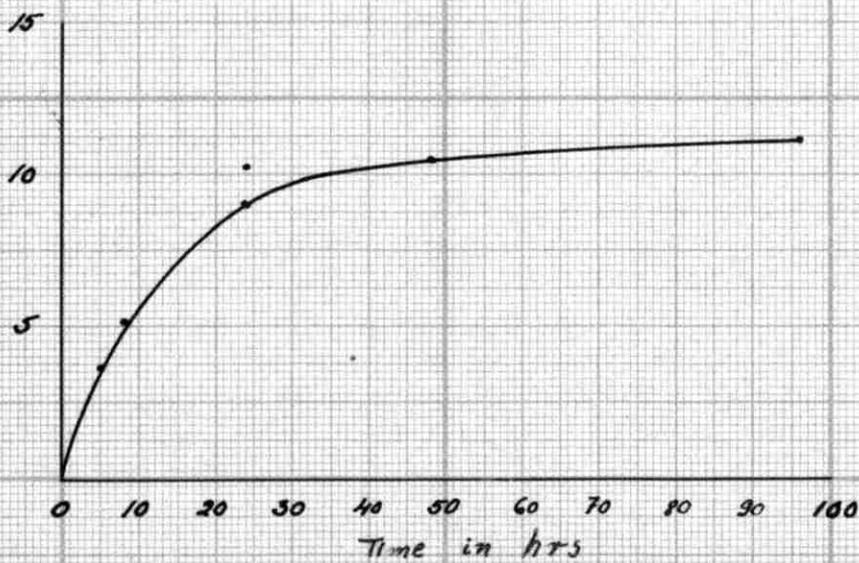


Fig. 28

Time	Gms. of chromic oxide combined with 100 gms. Hide				
	1.5 gms. CrO in 100 cc	2gms. per 100 cc.	5 gms. per 100 cc.	10 gms. per 100 cc.	14.gms. per 100 cc.
24 hrs.	13.95	13.75	11.62	7.2	4.04

The reason for the point of maximum at a concentration of 1.5 gms. of chromic oxide per 100 cc. is not entirely clear, although a number of causes may be assigned to the falling off in rate of combination at higher concentrations, among which may be mentioned the increasing hydrogen-ion concentration, the increasing salt concentration, and the probability of the formation of addition compounds,.

It is interesting to compare this curve with those of vegetable tanning as a function of concentration, where both have a maximum, the chrome-liquor at a concentration of 1.5 gms. while that of vegetable tanning at a concentration of 2 gms. per 100 cc. which shows that amount of combination is greater at such concentrations than at higher concentrations. ( Fig. 29 )

Substance:-  $\text{Co(OH)SO}_4$   
Time:- 48 hrs.

Gms.  $\text{Co}_2\text{O}_3$  Combined with 100 gms.  
H<sub>2</sub>O - Substance

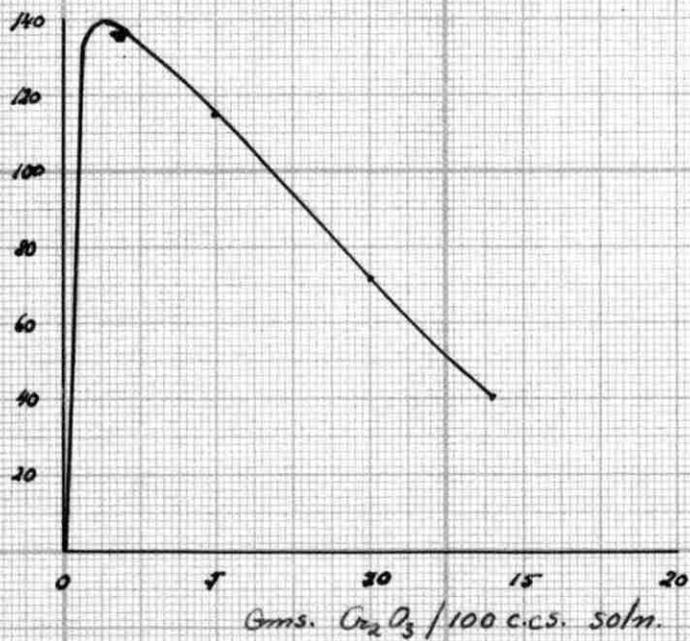


Fig. 29

IV. AMOUNT OF CHROMIC OXIDE ABSORBED BY HIDE POWDER FROM  
BASIC CHROME CHROMIUM WITH CHANGE IN pH OF BASIC CHROMIUM  
SULFATE

Gms. chromic oxide per 100 cc.	Time	Gms. chromic oxide combined with 100 gms. Hide					
		pH 1.45	pH 2.5	pH 3.05	pH 3.75	pH 4.6	pH 5.25
2 gms.	48 hrs.	3.02	8.35	12.75	13.75	11.43	10.06

Portions of purified powder equal to 2 gms. of anhydrous substance were shaken with 50 cc. of chrome liquor of pHs 1.45, 2.5, 3.05, 3.75, 4.6 and 5.25 respectively, each containing 2 gms. chromic oxide per 100 cc. soln.

The reason for the lowering in combination below pH 3.75 is that when chromium salts contain a great excess of acid they diffuse into them very rapidly, but the rate of combination of chromium and collagen is correspondingly decreased. Thus it becomes necessary to neutralize some of the acid before the skins can become completely tanned, even though completely permeated by the chromium salt. Increasing the pH above 3.75 causes the molecules of the chromium salt to form aggregates of increasing size, greatly reducing the rate at which they diffuse into the skin, thus reducing the rate of combination between the chromium and the collagen. This was shown to be the case in VII, experiment III, Fig. 30.

Substance:-  $\text{Cr}(\text{OH})\text{SO}_4$  soln

Time:- 48 hrs.

Conc:- 2 gms.  $\text{Cr}_2\text{O}_3$  / 100 c.c. soln.

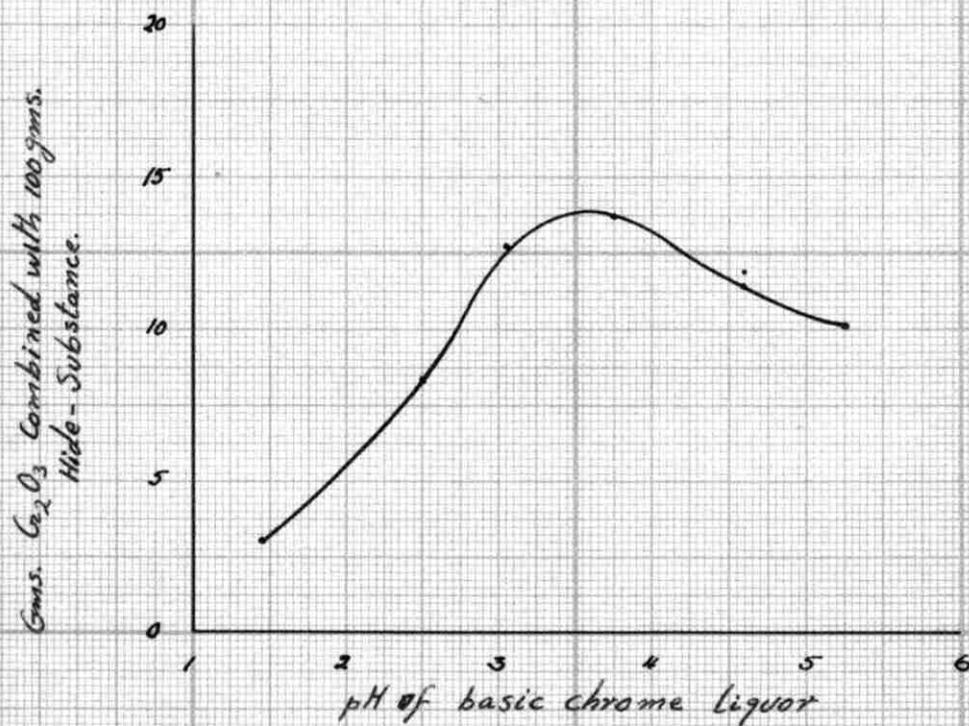


Fig. 30

V. RETARDATION OF CHROME TANNING BY NEUTRAL SALTS .

Gms. chromic oxide per 100 cc.	Mols NaCl 0.0	Mols MaCl 0.5	Mols NaCl 1.0	Mols NaCl 2.0	Mols NaCl 3.0	Mols NaCl 4.0
1.5 gms.	11.54	9.51	7.5	6.24	6.67	7.55

The reason sodium chloride retards chrome tanning is that it forms addition compounds with the basic chromium salt rendering it less dissociated and, consequently, less active in combining with the skin protein. Upon increasing the concentration of the salt still further, the hydration effects a virtual concentration of the chromium ions to such an extent that the retarding action of the addition compound formation is counterbalanced by the activity of the high concentration of chromium ions and the curve therefore begins to slope upward, ( Fig. 3/ ).

Substance:-  $\text{Ca(OH)SO}_4$

Time:- 24 hrs.

Conc:- 1.5 gms.  $\text{Cr}_2\text{O}_3$  / 100 c.c.s. soln.

Gms.  $\text{Cr}_2\text{O}_3$  Combined with 100 gms. H<sub>2</sub>O - Substance.

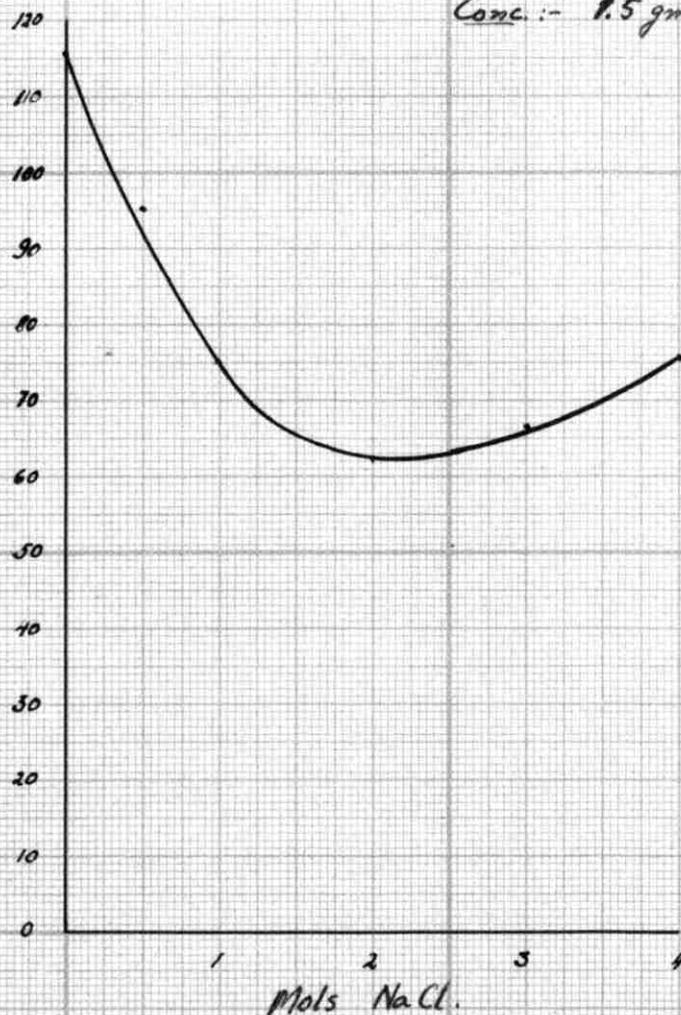


Fig. 30

SULFONATED OILS

As a constituent of fat-liquors and other preparations used in the leather trade, there is little doubt that the so-called soluble oils or sulphonated oils have assumed a place of distinct importance. Apart from the actual lubricating properties of these, they are useful as emulsifying agents for other oils and fats, and hence their widespread use in this direction.

To 100 gms. of the oil 25 gms. of concentrated sulfuric acid were added very slowly, so that it required several hours to make the total addition and the temperature kept below 10 C°. When all the sulfuric acid was added, the mixture was allowed to stand for a day, when it was ready for washing. The resulting oil was washed with a strong solution of common salt and the whole well stirred together and the mixture allowed to stand for separation. The oil comes to the top of the liquor and the salt solution separated. This washing operation was repeated several times, when finally the oil was allowed to stand for a longer time than the previous washing, so that as much water as possible would settle out. The final process was neutralisation, for which dilute ammonium hydroxide was used. Dilute ammonium hydroxide solution was added in small amounts at a time, the solution being stirred after each addition, until the oil reacted neutral to litmus paper. The actual end point of the neutralisation was when the oil suddenly went quite clear. The following oils were sulfonated :- Castor oil, Olive oil, Peanut oil and Sesame oil.

C O N C L U S I O N

The Leather Industry in the Near East has great possibilities - it was proved to be the case by this war. It shows that the Near East can prepare most of the materials required for the industry and instead of exporting large quantities of raw skins and hides, it can export them in the tanned form, consequently decreasing the amount of imports of tanned hides and leather works; Thus increasing the economical welfare of the Near East.

All experiments conducted on gelatin-jelly and on hide-powder, show that pH of chrome-liquor, <sup>(and</sup> in tannins), salt concentration in gelatin-jelly and in chrome-liquor, (in tannins) and the concentration of the chrome-liquor or tannins <sup>have great effects upon the rate of diffusion of the chrome-liquor and on</sup> extracts, <sup>and</sup> on the combination between them and collagen. tannins

Therefore any changes in these operations changes tremendously the final products.

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