XLI. THE DISTRIBUTION OF ESTERASES IN THE ANIMAL BODY.

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It is to the organs more directly concerned with digestion that one naturally looks for fat-splitting ferments. Yet, as a matter of fact, the body appears to be permeated with ferments which are entrusted with the delicate mechanism of equilibrium for which their peculiar reversible action is fitted, and upon which nutrition, metabolism, and life itself depend. It may be boldly presumed that wherever any constituent of an organ is found in a constant proportion, a ferment will be found preserving that proportion. A well-known illustration of this relation may be seen in the action of the glycogen-sugar ferment of the liver and blood. Going upon this assumption, one would expect to find lipase in organs containing glycerol esters, lecithase in organs containing lecithin, wax-splitting ferments in organs containing higher alcohol esters. On the other hand, it does not follow that the presence of ferments indicates also the presence of their substrates; the ferment may be elaborated, as in the case of pancreatic steapsin, for use in another sphere of action than the site of its origin.

Fat-splitting ferments have been described in many different tissues by a number of authors, among others Loewenhardt [1902] and Rona [1911, 1, 2]. Other esterases such as cholesteryl esterases and wax-splitting ferments, that is ferments which are able to split the esters of higher alcohols, also occur, as I have recorded in a former paper.

A parallel has been drawn between lypolytic power and resistance to tuberculosis. Winternitz and Meloy [1910] who have described lipase (decomposing ethyl butyrate) in a number of human organs, find a diminution

of this ferment in the kidneys, liver, lungs and blood in tuberculosis. Achard and Clerc [1902, 1904] have also noticed a diminution in Hanriot's serum lipase in tuberculous conditions which were not improving.

In order to investigate the distribution of different esterases in the animal body, and incidentally to compare lipolytic activity with the known divergence as regards resistance to tuberculosis of certain species and organs, extracts were made of the following organs and examined:

	Human	Ox	Sheep	Pig	Cat	Rabbit	Guineapig
Pancreas	+	+	+	+			
Liver	+	+	+	+	+	+	+
Lung	+	+	+	+	+	+	+
Spleen	+	+	+	+	+	+	+
Kidney	+	+	+	+	+	+	+
Brain	+	+	+	+			
Suprarenals	+	+	+	+			
Thyroid	+	+	+	+			
Thymus		+	+	+			
Lymphatic glands	+	+	+	+			
Haemolymph glands		+					
Pituitaries		+	+				
Bonemarrow		+					
Salivary glands				+			
Skin	+						

In some cases, especially with human organs, which were more or less pathological, and usually less active than the normal organs obtained from the other species, material from more than one individual was examined. In the case of human lymphatic glands seven samples of tuberculous glands in addition to non-tuberculous were under investigation.

The best medium known for extracting lipase from tissues is glycerol. Lipase is soluble in pure glycerol, as also are salts. Fatty acids, alcohols and esters are only very slightly soluble, but enough to aid lipolysis and also the titration of these usually difficult soluble substances. Glycerol also preserves the lipase by abstracting water, which injures the ferment. Glycerol is indeed well known as a preservative and anti-putrefactive, being used in commerce, for example in rennet preparations, etc., for that purpose. Although ferment solutions extracted from organs are usually difficult to preserve from putrefaction, the glycerol extracts made from organs in this investigation all became sterile within a few days. That this did not depend on the direct action of the glycerol on the organisms, but rather on its preservative influence on bacteriolytic substances present, was proved by the varying rate at which the organs became sterile. Liver became sterile at

once; lung was perhaps the slowest of all. This sterility allowed of certainty in ascribing lipolytic action to the organ from which the extract was made.

The method of extraction adopted was that recommended by Kanitz [1905], and is very simple. Glands were minced down, and pure glycerol added, in the proportion of one-third gland and two-thirds glycerol. After two days in contact, the extract was filtered through gauze, as lipases are easily injured by filtration. A small amount of fat may come through mechanically, but this is of no consequence if the autolytic activity of the extract itself is always measured in the presence of activating calcium chloride.

The following esters were used:

- (1) Glycerol esters: butyryl, tripalmitin, tristearin, olive oil, castor oil, cod liver oil, and lecithin.
- (2) Cholesterol esters: lanolin, cholesteryl propionate, cholesteryl palmitate, cholesteryl stearate (made according to Mair's [1914] directions).
- (3) Beeswax, containing myricyl palmitate.
- (4) Spermaceti, containing cetyl palmitate.
- (5) Chinese wax, containing ceryl cerotate.
- (6) Carnauba wax, containing myricyl cerotate.

The glycerol esters, with the exception of butyryl, were made up in 20 % solutions or emulsions. Butyryl was used undiluted, water being added in proportionate amount. Olive, castor, and cod liver oil were neutralised and diluted to approximately 20 %, 10 % of alcohol being present. Ovolecithin, obtained from Merck, was dissolved to 20 % in cold alcohol. Its acidity was deducted. Tristearin, tripalmitin, and the higher alcohol esters were dissolved in 40 % benzene, or xylene, and were warmed before use to allow of measurement, these substances being very insoluble. They were either neutralised in boiling methyl alcohol with methyl alcoholic potash, the alcohol being removed by evaporation, or, more often, as this first method appeared somewhat to increase insolubility, they were dissolved and used in an acid state, the initial acidity being deducted. It should be mentioned that when the fats were first obtained they were boiled in order to destroy any ferment present, as commercial preparations of fats are not always free from traces of lipases. Lecithin, although boiled, decomposes slowly in the presence of water. This process is, however, much hastened by the presence of gland extract, which contains lecithase.

The gland extracts added to fat alone, are quite inactive and require an activating agent. Activation is believed to depend upon a removal of

the inhibitory products of ferment action. Thus CaCl_2 , recommended by Kanitz [1905], has been shewn by Pekelharing [1912] to act by forming insoluble soaps of calcium, and so by precipitation, to remove the products which are hindering further action. The action of bile salts is quite opposite to this, by promoting solubility, especially in the duodenum, they promote the removal of the end products of lipolysis by their absorption through the membrane.

In testing for esterases, in each tube were placed 1 cc. of ester solution, 1 cc. of glycerol gland extract, 0.5 cc. of 5 % CaCl_2 , and 0.5 cc. of alcohol. Controls were made containing 1 cc. of gland extract, with a similar amount of benzene, alcohol, and CaCl_2 , but no ester. Esters were also tested alone with CaCl_2 and alcohol, in order to deduct their end acidity from the total acidity found after lipolysis. The mixtures were kept at room temperature and were neutralised with N/10 NaOH repeatedly during 24 hours. It is difficult to set a time limit, as, especially in the case of glycerides emulsified in water, neutralisation often restarts ferment action which had ceased, yet some mixtures act as quickly as they can be neutralised, while others may be exceedingly slow, but are never quite finished. This was especially the case with butyryn. Most mixtures could not be carried beyond a certain definite limit, which was quickly reached. This was especially the case with the higher alcohol esters and was no doubt largely due to the fact that in benzene they were mainly in a dissolved condition, which certainly aids hydrolysis.

RESULTS.

In the different glands examined fat- and wax-splitting ferments were found, which appeared to be quite independent of each other. The gland extracts differed greatly in lipolytic properties, both in strength and kind. Butyrynase was always present, although varying greatly in strength. As lecithin is so essential a constituent of cells, it is not surprising that lecithinase should appear quite as constantly. Lecithin is, however, decomposed by water and CaCl_2 ; the presence of lecithase is only determined by increased rate of decomposition so that the demonstration of small quantities of the ferment is not very satisfactory. Action on unsaturated glycerides such as olein was also rather commonly found, but often very slight. Many organs had no effect on tristearin; those which had the most influence on this rather insoluble fat were also able to deal with the higher alcohol esters, suggesting,

once again, a connection between solubility and lipolytic power. Ferments hydrolysing the esters of the higher alcohols were found in one sample of human skin in quite remarkable strength. In pancreas extract they were also strong, and were present in a lesser degree in the liver, thymus, suprarenal, lymphatic, and other glands. On comparing the lipolytic power of the different species examined, some interesting facts are apparent. The pig has been regarded as possessing more lipolytic power than the other species, but this superiority is practically entirely limited to the pancreas. Lipases are widely distributed in the organs of the pig, but in no greater measure than in the organs of other animals. Certain organs of the sheep, especially pancreas, liver and spleen, are considerably less lipolytic than in the pig, so that these organs certainly afford no explanation of the greater susceptibility of the pig to tuberculosis. If, however, the lymphatic glands of these two species are compared, a very different relationship will be found. While sheeps' lymphatic glands were found remarkably active, being the most active lymphatic gland extracts examined, pigs' glands were decidedly the weakest. The pig is susceptible to glandular tuberculosis. As ingested tubercle is believed to enter the body by filtration through lymphoid tissue (tonsils and ileo-caecal region), and then via the lymphatic glands, this lipolytic activity in the sheeps' lymphatic glands may well explain the resistance of the sheep to this disease. With the exception of one sample of human skin, human organ extracts were found disappointingly weak on the whole. On account of their source, and more or less pathological condition, they cannot be fairly compared with normal organs from other species. Nevertheless, although the results given by them are not striking, they indicate a widespread, decided and fairly even lipolytic activity over the very different varieties of fats used. Except for lecithase in the brain, the only superiority which human glands displayed was seen in a kidney shewing fatty degeneration, where there was unusual lipolytic activity, especially in the form of butyrylase. The guineapig, which is so susceptible to tuberculosis, proved decidedly weak in lipolytic power, except with regard to butyryl. The cat, on the other hand, resistant to tuberculosis, yielded stronger ferments, more especially against the higher alcohol esters. It is interesting that the brain, which contains cholesterol, but no cholesteryl ester [Lorrain Smith and Mair, 1912], possesses no cholesteryl esterases. On the other hand, those organs which are known to contain cholesteryl esters, *i.e.*, skin and suprarenals, contain also higher alcohol esterases.

In the following tables, shewing esterase activity, any primary fat acidity has been deducted, but not gland acidity. The acidity of the gland alone is, however, always given below. The gland acidity, and low or negative esterase figures close to it, are printed in *italics*, so that positive results are more conspicuous. The numbers throughout represent cc. of N/10 NaOH required to neutralise the mixtures within 24 hours.

ESTERASE ACTIVITY.

Pancreas.

Substrate	Maximum acidity*	Human	Ox	Sheep	Pig
1. Butyrin	19.9	11.7	16.0	16.0	16.0
2. Palmitin	7.2	0.6	1.0	—	5.6
3. Stearin	6.7	0.4	0.7	0.75	5.6
4. Cod-liver oil	6.7	3.6	1.9	1.75	5.0
5. Castor oil	6.6	3.0	2.0	2.0	4.4
6. Olive oil	7.0	4.4	2.7	2.0	5.0
7. Lecithin	—	—	7.0	7.0	7.0
8. Lanolin	7.0	7.0	1.0	1.6	5.1
9. Beeswax	6.7	0.4	0.9	1.1	5.1
10. Cholesteryl stearate ...	6.2	0.7	1.0	1.0	3.0
11. Cholesteryl palmitate ...	6.4	0.3	1.0	1.0	3.5
12. Cholesteryl propionate ...	9.0	0.4	1.6	1.2	5.0
13. Carnauba wax	6.6-6.8	0.4	0.6	0.6	3.2
14. Chinese wax	—	—	0.6	0.6	3.3
15. Spermaceti	8.8-9.6	—	0.8	1.25	4.5
Gland control	—	0.3	0.2	0.35	0.9

* The maximum acidity is calculated from the saponification value.

Lung.

Substrate	Human	Ox	Sheep	Pig I	Pig II	Cat	Rabbit	Guinea-pig
1. Butyrin	1.0	0.6	1.8	—	0.4	2.2	0.5	1.2
2. Palmitin	0.3	0.15	0.1	—	0.1	0.35	0.3	0.2
3. Stearin	0.3	0.15	0.35	—	0.1	0.35	0.3	0.2
4. Cod-liver oil	0.3	0.1	0.25	—	0.2	0.35	0.3	0.2
5. Castor oil	0.3	0.15	0.3	—	0.2	0.35	0.2	0.2
6. Olive oil	0.4	0.2	0.6	0.8	0.2	0.45	0.3	0.2
7. Lecithin	0.7	1.8	1.9	1.4	1.5	1.5	0.6	0.7
8. Lanolin	0.5	0.15	0.3	—	0.2	0.25	0.2	0.15
9. Beeswax	0.3	0.15	0.45	—	0.2	0.2	0.3	0.2
10. Cholesteryl stearate	0.4	—	—	—	—	0.2	0.3	0.2
11. Cholesteryl palmitate	0.4	—	—	—	—	0.3	0.3	0.2
12. Cholesteryl propionate	0.5	—	—	—	—	0.3	0.3	0.2
13. Carnauba wax	0.3	—	—	—	—	0.2	—	—
14. Chinese wax	0.3	—	—	—	—	0.25	—	—
15. Spermaceti	0.6	—	—	—	—	0.4	—	—
Gland control	0.4	0.15	0.3	0.2	0.2	0.25	0.4	0.2

Lymphatic glands.

Substrate	Human		Ox	Sheep	Pig
	Tub.	Normal			
1. Butyrin	0.6	0.7	2.2	12.5	1.0
2. Palmitin	0.4	0.15	1.0	1.0	0.2
3. Stearin	0.3	0.15	1.0	1.0	0.25
4. Cod-liver oil	0.25	0.15	1.1	3.5	0.5
5. Castor oil	0.3	0.15	1.1	3.7	0.3
6. Olive oil	0.35	0.15	1.1	3.5	0.5
7. Lecithin	1.4	0.8	2.25	2.5	1.0
8. Lanolin	0.35	0.15	0.9	0.8	0.25
9. Beeswax	0.35	0.15	1.2	1.4	0.25
10. Cholesteryl stearate ...	0.25	0.15	1.0	1.0	0.35
11. Cholesteryl palmitate ...	0.4	0.15	1.0	1.0	0.3
12. Cholesteryl propionate ...	0.4	0.15	0.8	0.7	0.3
13. Carnauba wax	0.35	0.15	—	—	0.2
14. Chinese wax	0.35	0.15	—	—	0.25
15. Spermaceti	0.45	0.25	—	—	0.4
Gland control	0.25	0.15	0.4	0.5	0.2

*Brain.**Haemolymph glands.*

Substrate	Human	Ox	Sheep	Pig	Ox
1. Butyrin	1.2	0.55	0.7	0.7	1.2
2. Palmitin	0.2	0.2	0.4	0.2	0.5
3. Stearin	0.2	0.2	0.4	0.2	0.5
4. Cod-liver oil	0.3	0.2	0.4	0.3	0.45
5. Castor oil	0.3	0.25	0.4	0.3	0.45
6. Olive oil	0.3	0.3	0.4	0.3	0.6
7. Lecithin	7.0	2.3	2.3	2.0	1.3
8. Lanolin	0.2	0.2	0.4	0.15	0.5
9. Beeswax	0.25	0.2	0.5	0.2	0.5
10. Cholesteryl stearate ...	0.2	0.2	0.9	0.2	0.5
11. Cholesteryl palmitate ...	0.2	0.2	0.4	0.2	0.4
12. Cholesteryl propionate ...	0.3	0.2	0.4	0.2	0.4
13. Carnauba wax	0.2	—	—	—	0.8
14. Chinese wax	0.2	—	—	—	0.5
15. Spermaceti	0.3	—	—	—	0.5
Gland control	0.2	0.2	0.4	0.2	0.35

Suprarenals.

Substrate	Human	Ox	Sheep	Pig I	Pig II
1. Butyrin	0.65	1.7	1.9	1.25	1.4
2. Palmitin	0.65	1.1	0.65	0.6	0.75
3. Stearin	0.65	1.1	0.6	0.6	0.65
4. Cod-liver oil	0.65	1.0	0.6	0.6	0.55
5. Castor oil	0.65	0.7	0.7	0.55	0.6
6. Olive oil	0.65	1.0	0.7	0.6	0.6
7. Lecithin	1.45	1.8	1.3	1.5	1.75
8. Lanolin	0.75	1.0	0.6	0.65	0.7
9. Beeswax	0.75	1.5	0.55	0.55	0.5
10. Cholesteryl stearate ...	0.7	1.1	0.45	0.4	0.6
11. Cholesteryl palmitate ...	0.7	1.1	0.55	0.35	0.6
12. Cholesteryl propionate ...	0.7	1.1	0.55	0.4	0.6
13. Carnauba wax	0.75	—	0.55	0.55	0.65
14. Chinese wax	0.8	—	0.65	0.55	0.65
15. Spermaceti	1.0	—	0.65	0.75	0.75
Gland control	0.65	0.6	0.5	0.35	0.45

Thymus.

Substrate				Ox	Sheep	Pig
1.	Butyrin	...	...	3.6	5.1	2.1
2.	Palmitin	...	...	1.2	1.0	1.4
3.	Stearin	...	...	1.0	1.0	1.0
4.	Cod-liver oil	...	...	1.4	1.1	1.1
5.	Castor oil	...	...	1.4	1.1	0.9
6.	Olive oil	...	...	1.7	1.2	1.1
7.	Lecithin	...	...	2.7	2.7	3.0
8.	Lanolin	...	...	2.0	1.1	1.0
9.	Beeswax	...	...	1.7	1.3	1.0
10.	Cholesteryl stearate	...	...	1.8	1.2	0.9
11.	Cholesteryl palmitate	...	...	1.4	1.2	0.8
12.	Cholesteryl propionate	...	...	1.0	1.2	1.0
13.	Carnauba wax	...	...	0.9	0.9	0.8
14.	Chinese wax	...	...	0.8	1.0	0.8
15.	Spermaceti	...	...	1.5	1.0	0.8
	Gland control	...	...	0.3	0.5	0.5

Liver.

Substrate				Maximum acidity	Human	Ox	Sheep	Pig	Cat	Rabbit	Guinea-pig
1.	Butyrin	...	...	19.9	4.0	12.4	8.5	16.0	14.0	16.0	16.0
2.	Palmitin	...	...	7.2	2.0	1.6	0.2	0.5	1.3	2.0	0.9
3.	Stearin	...	...	6.2	1.8	1.6	0.3	0.4	1.0	2.0	0.4
4.	Cod-liver oil	...	...	6.7	2.0	2.8	0.4	0.8	1.0	2.0	1.15
5.	Castor oil	...	...	6.6	2.0	2.9	0.4	1.0	1.0	2.0	1.0
6.	Olive oil	...	...	7.0	2.0	2.9	0.5	1.0	1.0	1.7	1.9
7.	Lecithin	...	...	—	6.9	5.5	5.5	6.8	4.8	6.0	3.3
8.	Lanolin	...	...	7.0	1.2	2.4	0.4	1.4	1.2	2.0	0.4
9.	Beeswax	...	...	6.7	2.1	2.0	0.3	1.2	0.9	2.0	0.8
10.	Cholesteryl stearate	...	...	6.2	1.8	2.4	0.3	1.2	1.1	2.0	0.5
11.	Cholesteryl palmitate	...	...	9.0	1.8	2.2	0.4	1.0	0.8	2.0	0.5
12.	Cholesteryl propionate	...	...	9.0	1.8	2.4	0.5	1.2	1.0	2.0	0.5
13.	Carnauba wax	...	...	5.6-6.8	1.2	1.4	0.4	0.8	0.8	—	0.5
14.	Chinese wax	...	...	—	1.2	1.4	0.3	0.7	1.1	—	0.5
15.	Spermaceti	...	...	8.8-9.6	1.4	2.6	0.5	1.2	1.3	—	0.6
	Gland control	...	...	—	1.3	0.3	0.3	0.4	0.6	1.5	0.5

Spleen.

Substrate				Human	Ox	Sheep	Pig	Cat
1.	Butyrin	...	...	1.0	0.8	0.5	1.8	1.5
2.	Palmitin	...	...	0.3	0.6	0.3	0.8	0.8
3.	Stearin	...	...	0.25	0.6	0.3	0.75	0.8
4.	Cod-liver oil	...	...	0.35	0.5	0.3	1.25	0.8
5.	Castor oil	...	...	0.35	0.4	0.3	1.25	0.8
6.	Olive oil	...	...	0.35	0.7	0.5	1.7	0.8
7.	Lecithin	...	...	4.3	2.4	2.3	7.0	5.0
8.	Lanolin	...	...	0.3	0.4	0.4	0.6	0.7
9.	Beeswax	...	...	0.3	0.8	0.7	0.8	0.8
10.	Cholesteryl stearate	...	...	0.3	0.4	0.3	0.7	0.6
11.	Cholesteryl palmitate	...	...	0.3	0.4	0.3	0.7	0.6
12.	Cholesteryl propionate	...	...	0.3	0.4	0.4	0.7	0.6
13.	Carnauba wax	...	...	0.3	—	—	—	0.5
14.	Chinese wax	...	...	0.3	—	—	—	0.6
15.	Spermaceti	...	...	0.3	—	—	—	0.9
	Gland control	...	...	0.3	0.4	0.3	0.7	0.6

Kidney.

Substrate	Human	Ox	Sheep	Pig	Cat
1. Butyrin ... (fatty) ...	6.65	0.8	0.9	—	4.0
2. Palmitin ...	2.2	0.3	0.4	—	0.65
3. Stearin ...	2.2	0.3	0.4	—	0.55
4. Cod-liver oil ...	2.5	0.4	0.4	—	0.6
5. Castor oil ...	2.4	0.4	0.4	—	0.6
6. Olive oil ...	1.8	0.4	0.4	—	0.7
7. Lecithin ...	2.5	1.05	1.2	—	1.35
8. Lanolin ...	2.2	0.4	0.4	—	0.4
9. Beeswax ...	2.0	0.6	0.5	—	0.45
10. Cholesteryl stearate ...	3.0	0.3	0.4	—	0.45
11. Cholesteryl palmitate ...	2.4	0.3	0.4	—	0.45
12. Cholesteryl propionate ...	2.2	0.4	0.4	—	0.45
13. Carnauba wax ...	—	—	—	—	0.35
14. Chinese wax ...	—	—	—	—	0.55
15. Spermaceti ...	—	—	—	—	0.6
Gland control ...	1.8	0.3	0.4	—	0.25

Thyroid.

Substrate	Ox	Sheep	Pig
1. Butyrin ...	1.6	4.3	0.4
2. Stearin ...	0.9	0.1	0.1
3. Cod-liver oil ...	0.7	0.4	0.15
4. Castor oil ...	0.8	0.2	0.1
5. Olive oil ...	0.8	0.3	0.1
6. Lecithin ...	3.3	2.3	0.85
7. Lanolin ...	1.0	0.4	0.1
8. Beeswax ...	0.9	0.4	0.1
Gland control ...	0.4	0.1	0.1

Skins. Bile. Salivary glands.

Substrate	Skins, human			Bile, Ox	Salivary glands, Pig
	1	2	3		
1. Butyrin ...	6.5	2.1	—	3.5	0.55
2. Palmitin ...	4.2	0.7	—	0.5	0.25
3. Stearin ...	4.0	1.1	—	0.5	0.2
4. Cod-liver oil ...	3.5	0.65	—	0.5	0.25
5. Castor oil ...	3.0	0.65	—	0.5	0.3
6. Olive oil ...	0.2	0.65	—	0.8	0.3
7. Lecithin ...	1.6	1.0	—	0.5	1.3
8. Lanolin ...	3.8	0.9	0.35	0.5	0.2
9. Beeswax ...	4.5	1.0	0.35	0.5	0.2
10. Cholesteryl stearate ...	4.7	1.0	0.4	0.5	0.2
11. Cholesteryl palmitate ...	5.0	0.85	0.35	0.5	0.25
12. Cholesteryl propionate ...	4.2	0.75	0.35	—	0.2
13. Carnauba wax ...	—	0.75	0.45	—	0.2
14. Chinese wax ...	—	0.7	0.4	—	0.2
15. Spermaceti ...	—	0.75	0.45	—	0.25
Tissue control ...	0.2	0.15	0.05	0.5	0.2

Substrate	<i>Pituitary.</i>		<i>Bone marrow.</i>
	Ox	Sheep	Ox
1. Butyrin	0.8	0.4	3.4
2. Palmitin	0.65	0.1	0.8
3. Stearin	0.55	0.1	0.8
4. Cod-liver oil	0.75	0.1	0.8
5. Castor oil	0.5	0.1	0.7
6. Olive oil	0.7	0.1	0.7
7. Lecithin	1.2	0.85	1.8
8. Lanolin	0.5	0.2	0.7
9. Beeswax	0.55	0.15	0.8
10. Cholesteryl stearate...	0.45	0.2	—
11. Cholesteryl palmitate	0.55	0.25	—
12. Cholesteryl propionate	0.5	0.25	—
13. Carnauba wax	0.5	0.1	—
14. Chinese wax	0.65	0.1	—
15. Spermaceti	0.5	0.15	—
Gland control	0.3	0.1	0.6

CONCLUSIONS.

Fat- and wax-splitting ferments are widely distributed among the organs of man, ox, sheep, pig, cat, rabbit, and guineapig.

Butyrylase and lecithase were present in all of the 58 organs examined, and were often very strong.

Olein lipase was also commonly present, but often as a mere trace. It was strongest in pigs' pancreas, but also active in the pancreas of other species, in the liver, and in the thymus, and to a lesser degree in lymphatic glands, ox suprarenals and thyroid, cat kidney, and pig lung.

Tristearin ferment was less frequently found, but was active in the ox, sheep and pig pancreas, the human, ox, cat and rabbit liver, the thymus, ox and sheep lymphatic glands, the human skin, human and cat kidney, ox suprarenals, and ox thyroid.

Wax-splitting ferments were found in a variety of organs, ox, sheep and pig pancreas, human, ox, pig, cat and rabbit liver, thymus, lymphatic glands, ox and sheep thyroid, ox suprarenals, human skin, and cat and human kidney.

The distribution of esterases in the body appears to have some relation to resistance to tubercle. The cat, which is very little susceptible to tubercle, is well provided with esterases throughout its organs. The sheep, although less well provided for than the susceptible pig in other regions, possesses very active lymphatic glands. The susceptible guineapig has the chief part of its

lipase in the form of butyrylase and olein-lipase, and is deficient in higher esterases. The lungs in all species were found very poor in these ferments. The more resistant liver shewed active lipolytic properties.

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