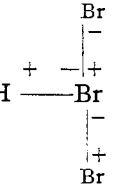
atoms in benzyl chloride, benzal chloride, and benzotrichloride (or bromides) are negative, since they are readily exchanged (without oxidation or reduction) for negative hydroxyl. It is true, however, that positive halogen atoms are the active substituting agents in side-chain substitution, but only by virtue of their oxidizing action and consequent reduction to negative halogen (photochemical action) as previously described.

Finally, Holleman has stated[1] "Il est démontrè, que l'hypothèse, suivant laquelle le noyau est attaqué par des molécules HBr_n, tandis que la cháine latérale l'est par les molécules de brome, a quelque vraisemblance; cependant un nombre de difficultés devoint encore être levées, avant qu'elle puisse servir à expliquer les phénomènas observés." The very plausible interpretation of the nucleus bromination of toluene through the action of the intermediately formed HBr_n may be readily correlated with the interpretation of nucleus substitution and the action of halogen carriers' as presented in this paper, provided HBr_n be regarded as



. But Holleman's idea of side-chain substitution is subject to the criticism that it also fails to recognize the side-chain substitution process as an oxidation and reduction phenomenon depending upon the reaction, $X^+ \longrightarrow X^- + 2\oplus$, previously considered.

CINCINNATI, OHIO.

[CONTRIBUTION FROM THE HARRIMAN RESEARCH LABORATORY, ROOSEVELT HOSPITAL, NEW YORK.]

STUDIES ON ENZYME ACTION. X. THE LIPOLYTIC PROPERTIES OF HUMAN DUODENAL CONTENTS.

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The enzymes of the digestive tract play an essential part in the changes which foodstuffs must undergo before they can be utilized in the animal body. Within recent years it has become possible to remove the contents of the upper part of the intestinal tract of human beings directly and to study their properties. Much valuable information with regard to the enzymes present has already been obtained in this way. The results to be described in this paper deal with the lipolytic properties of duodenal contents obtained under varying conditions and tested in different ways. It is believed that a detailed study of the behavior of one enzyme may at the present time be more useful than the routine examination for the ordinary digestive enzymes.

[1] *Loc. cit.*

The technique developed by Einhorn[1] and by Gross[2] and recently improved by Palefski,[3] which consists essentially in the swallowing of a soft rubber tube provided at its lower end with a perforated metallic capsule, allowing this to reach the duodenum, and subsequent aspiration of the duodenal contents by means of a suitable pump, has been used in a number of investigations. The enzymes of the duodenal contents have been studied by Einhorn and Rosenbloom,[4] Hess,[5] Crohn[6] and Chase and Myers.[7]

The results which were obtained in this investigation may be divided into several groups. Although they were not obtained in this order in the actual experimental work, for convenience of presentation they will be given in the simplest form. The general grouping comprizes: first, the results which, so far as present evidence extends, may be looked upon as the normal action on fats; second, under somewhat altered conditions, lipolytic activity differing markedly from that given in the first group; third, some evidently abnormal, or preferably, unexpected lipolytic behaviors of duodenal contents; fourth, the action of duodenal lipases in the presence of dilute solutions of the chloride, bromide, iodide, and fluoride of sodium; and fifth, the effect of a number of neutral inorganic and organic substances upon the duodenal lipases.

The method of obtaining the duodenal contents has frequently been described and will not be given here in detail. The Einhorn tube was used in every case except with Patient P and was allowed to remain over night. Whether or not food was taken before removing the contents will be stated in the appropriate places. With Patient P, the Palefski tube was used in the manner described by him. Toluol was added to the contents as soon as possible after these were obtained, generally within fifteen minutes, and the solutions for the tests made up at once. On a few occasions the tests were repeated after an interval of several days, during which the specimens remained in the ice-chest; but the results showed only inconsiderable differences from those obtained in the immediate tests on the same samples.

In the course of a study of the lipolytic properties of the castor bean, two lipases, which showed distinct differences in their action, were found to be present.[8] Under comparable conditions of testing, one of these set

[1] *Med. Rec.*, **77**, 98 (1910).

[2] *New York Med. J.*, **91**, 77 (1910).

[3] *Ibid.*, Oct. 18, 1913.

[4] *Arch. Intern. Med.*, 6, 666 (1910); *Intern. Beitr. z. Path. u. Ther. d. Ernährungsstöro.* **2**, No. 2 (1910).

[5] *Am. J. Dis. Child.*, **3**, 304; **4**, 205 (1912); **5**, 268 (1913); *Arch. Intern. Med.*, **10**, 37 (1912).

[6] *Am. J. Med. Sci.*, **145**, 393 (1913).

[7] *Arch. Intern. Med.*, **12**, 628 (1913).

[8] THIS JOURNAL, **35**, 1904 (1913).

free more acid from ethyl butyrate than from triacetin (glyceryl triacetate) while the other set free more acid from triacetin than from ethyl butyrate. Moreover, since Loevenhart[1] had found a difference in the action of extracts of various animal organs on these same esters, it was decided to test the lipolytic activity of every sample of duodenal contents with the two esters.

The experimental methods were essentially the same as those used in the castor bean work. 0.5 cc. of the duodenal contents were diluted to 25 cc. with water or the solution to be tested in a 100–150 cc. Erlenmeyer flask. Six of these solutions were made up for each set of tests, 1.0 cc. neutral ethyl butyrate was added to each of two, 0.5 cc. neutral triacetin to each of two, 0.5–1.0 cc. toluol to all, and all shaken thoroughly and placed in an incubator kept at 38–40° for 24 hours. At the end of this time they were titrated with standard sodium hydroxide solution, very nearly 0.1 normal, with five to ten drops of a 1% phenolphthalein solution in 95% ethyl alcohol as indicator. Ethyl butyrate and triacetin in similar amounts were allowed to act for the same length of time with 25 cc. water, or solution, and the acid produced without the presence of duodenal contents determined in the same way. The difference between the mean of the titrated values of the duodenal contents–solution-ester mixtures and the sum of the means of the titrated values of the duodenal contents–solution mixtures and of the ester-solution mixtures, expressed as cc. of 0.1 *N* solution, is a measure of the amount of acid set free by the action of the duodenal contents upon the esters. The figures in the following tables are all strictly comparable, except for a few in Tables IV and V as indicated in the footnotes.

In Table I are given the results obtained with duodenal contents diluted with water. The first ten specimens were withdrawn between one and three hours after the patient had been given a glass of milk. The eleventh specimen (A) was obtained an hour after three lumps of sugar and a glass of water had been taken, and the last three, a few minutes after taking a glass of 0.2% hydrochloric acid. In the table, Column 1 signifies the patient and the treatment prior to the aspiration of the duodenal contents; Column 2, the amount of duodenal contents obtained; Column 3, their color; Columns 4 and 5, the actions obtained in terms of 0.1 *N* acid (corrected for the blanks) produced from 1.0 cc. ethyl butyrate and 0.5 cc. triacetin, respectively, in 24 hours at 38–40°, by 0.5 cc. contents in 25 cc. water; and the last column, the ratios obtained by dividing the number of cc. of 0.1 *N* acid set free from triacetin by the number of cc. set free from ethyl butyrate. The contents were themselves either neutral or slightly acid toward phenolphthalein. As a rule, after milk

[1] *J. Biol. Chem.*, **2**, 429 (1907).

had been taken, they contained a considerable amount of white coagulated material. In the other cases they were only slightly turbid.

TABLE I.—THE LIPOLYTIC ACTIONS OF DUODENAL CONTENTS OBTAINED AFTER TAKING FOOD.

Case.	Amount. Cc.	Color.	Cc. 0.1 *N* acid set free from Ethyl butyrate.	Cc. 0.1 *N* acid set free from Triacetin.	Ratio. Acid from Triac. / Acid from Et. Bu.
A (milk).....	25.0	Yellow	7.46	12.21	1.64
A (milk).....	19.2	Yellow	5.09	8.32	1.63
C (milk).....	9.5	Colorless (Green tinge)	2.33	7.07	3.03
J (milk).....	15.0	Yellow	4.56	11.20	2.46
K (milk).....	13.0	Colorless	2.35	7.71	3.28
P (milk).....	34.0	Yellow	0.73	1.59	2.17
I (milk).....	35.0	Colorless	2.39	8.03	3.36
D (milk).....	24.0	Yellow-brown	0.45	1.05	2.33
M (milk).....	10.5	Yellow	0.80	1.26	1.58
O (milk).....	17.0	Yellow-green	2.45	6.36	2.60
A (sugar).....	11.0	Colorless (Green tinge)	1.40	3.82	2.73
E (HCl).....	3.0	Yellow	1.26	2.05	1.63
F (HCl).....	3.0	Colorless	1.41	3.65	2.59
H (HCl).....	30.0	Colorless	1.59	5.61	3.53

The volume of juice and the lipolytic activity per unit volume varied greatly, nor was there any regularity in the relation between the two. It is, however, evident that duodenal contents obtained under these conditions contained an enzyme or enzymes which set free much more acid (58–250%) from triacetin than from ethyl butyrate.

In marked contrast to these results are the figures presented in Table II. The specimens, the actions of which are here recorded, were obtained after at least twelve hours abstinence from food. Some of the patients drank a little water a few minutes before the duodenal contents were aspirated.

TABLE II.—THE LIPOLYTIC ACTIONS OF DUODENAL CONTENTS OBTAINED WITHOUT TAKING FOOD.

Case.	Amount. Cc.	Color.	Cc. 0.1 *N* acid set free from Ethyl butyrate.	Cc. 0.1 *N* acid set free from Triacetin.	Ratio. Acid from Triac. / Acid from Et. Bu.
C.....	10.5	Yellow	3.59	1.88	0.52
P.....	4.0	Yellow	1.32	1.06	0.80
L.....	3.0	Yellow	0.36	0.37	1.03
B.....	10.5	Yellow	0.28	0.27	0.96
A.....	8.2	Yellow	0.25	0.15	0.60

The significant fact which appears from these results is that the actions toward ethyl butyrate are distinctly greater than those toward triacetin when compared with the results of Table I. In every case, at least as much acid was liberated from ethyl butyrate as from triacetin, and in one case almost twice as much. As regards volume and action per unit

volume, the same irregularities appear as in the first group. As compared with each other, apparently more duodenal juice may be aspirated than in inanition. However, the results are too few in number to permit definite conclusions with regard to these questions to be drawn.

In Table III are presented some apparently exceptional results.

TABLE III.—SOME UNUSUAL OR ABNORMAL LIPOLYTIC ACTIONS OF DUODENAL CONTENTS.

Case.	Amount. Cc.	Color.	Cc. 0.1 *N* acid set free from Ethyl butyrate.	Cc. 0.1 *N* acid set free from Triacetin.	Ratio. Acid from Triac. / Acid from Et. Bu.
C (milk).....	11.0	Yellow	2.19	1.68	0.77
G (milk).....	20.0	Yellow	1.73	1.38	0.80
H (HCl).....	8.2	Yellow-green	1.75	1.41	0.80
I (water).....	3.7	Light brown	1.50	6.22	4.15

The first three cases of Table III might be included in Table I, but the results obtained are typical of the duodenal contents from fasting individuals, although these patients had taken milk or hydrochloric acid. Again, the fourth specimen, although obtained after water had been taken, behaved very much like the specimens obtained after taking food.

A few words, with regard to the pathological conditions under which some of the specimens were obtained, may be of interest. Patients E, F and H, Table I, were convalescing from typhoid fever. The duodenal contents of Patient G, also a typhoid convalescent, displayed a different type of lipolytic behavior, shown in Table III, from those of E, F, and H, under similar conditions with hydrochloric acid. The duodenal contents of G were therefore tested again a week later after drinking milk, but the same unusual results were obtained as before (Table III). Patients J and K, Table I, suffered from duodenal ulcer at the time the specimens were obtained, but no unusual results were found for the lipolytic actions. The diagnosis for Patient C was nervous dyspepsia. When he was admitted to the hospital the results given in Tables II and III were obtained. With milk, or after fasting, the type of action was the same and different from the action generally obtained after taking food. One week later, his condition had improved, and the lipolytic action of his duodenal contents, aspirated after drinking milk, showed the usual relations (given in Table I). The duodenal contents of Patient I, obtained either after taking milk or water, showed no difference in behavior (Tables I and III). An operation for nephrolithotomy was performed later. As for the remaining patients and others who furnished duodenal contents, there was no evidence of digestive disturbance to call for further remark or description.

It is evident, therefore, that abnormal results may be obtained from time to time even if all the conditions for obtaining the desired secretions are apparently satisfactory. For diagnostic purposes, the possibility of these exceptional behaviors must be kept in mind.

The results so far presented show two types of lipolytic activity in the duodenal contents, or in other words, two lipases. One of these, more active toward triacetin, is most in evidence when food is taken, the other, which acts chiefly upon ethyl butyrate, appears to predominate in the absence of food. There is no reason to suppose that each lipase acts only on one ester. On the contrary, it is more probable that each lipase acts on both esters, but that one exerts greater action on one ester and the other greater action on the other ester. It is extremely suggestive that the lipase most active upon triacetin, which like the fats is a triglyceride, is the one found after the ingestion of food. It seems probable that this lipase predominates in the pancreatic secretion. Support is given to this view by the work of Loevenhart,[1] already referred to, in which extracts of the pancreas of animals were found to be more active toward triacetin than toward ethyl butyrate.

It may be of interest to compare these results with those obtained by others. So far as the writer is aware, no comparative study of the action of human duodenal contents, obtained with the duodenal pump, on two or more esters has been made. Most of the published investigations have taken up the enzymic activities more from the point of view of practical diagnosis. The investigation of Einhorn and Rosenbloom[1] treated of the different methods for causing the flow of pancreatic juice by various foods and drugs and presented much valuable information. The study by Bradley[2] of human pancreatic juice obtained from a fistula is of interest in this connection. Very much more action was observed with olive oil than with ethyl butyrate. As the result of a number of experiments with added substance, it was concluded that only one lipase was present and acted on the two esters.

The results presented in this paper with duodenal contents obtained after food had been taken (Table I) showed strong action toward triacetin and much less toward ethyl butyrate. Here, evidently, pancreatic juice (and bile) exerted an action similar to that observed in ordinary fat digestion. Triacetin was used in place of a fat or oil since it is readily soluble in water and comparable conditions could be obtained in different experiments. The use of fat or oil would have involved the preparation of an emulsion for every set of experiments with the possibility of varying conditions at different times. Furthermore, it was realized that it would be extremely difficult to approach *in vitro* the conditions of lipolysis *in vivo*, such as constant stirring and mixing of the reacting mass, continual addition of fresh enzyme, continual removal of the products of the reaction, etc. It was therefore decided to use comparable conditions, as simple as possible, for testing the activities.

[1] *Loc. cit.*

[2] *J. Biol. Chem.*, 6, 141 (1909).

The lipolytic activities observed when no food had been taken, and any considerable quantity of pancreatic juice and bile, therefore, probably absent, indicated the presence of a different lipase in these specimens. It may be suggested that this lipase is present in intestinal juice, which as is known is secreted in some quantity when the intestinal walls are mechanically irritated.[1] This may well be caused by the capsule and tubing of the duodenal pump. That intestinal juice contains lipase has been shown among others by Boldyreff[2] and by Jansen[3] in experiments with dogs in which fistulas had been established. Unfortunately no experiments with different esters are presented which might throw light on the possibility of the lipase of intestinal juice acting as indicated here.

In considering the results obtained with the two esters, ethyl butyrate and triacetin, it must be remembered that the experimental conditions used were chosen rather arbitrarily. It is probable that a more complete study of these, and also of other esters, would give more satisfactory conditions for comparing and studying the activity of the two lipases in duodenal contents.

In many cases it has been found that neutral substances, organic as well as inorganic, modify profoundly the actions of various enzymes. Since the present paper is concerned only with lipases and their actions, it may suffice to mention a few of the investigations which have concerned themselves with the actions of neutral substances on the activities of lipases before presenting the results obtained with human duodenal contents. Loevenhart and Pierce[4] observed a very marked inhibiting action of sodium fluoride and hydrofluoric acid on the lipolytic activities of extracts of various animal organs on different esters and oils for all except the most dilute solutions of fluoride. These had an accelerating action. Terroine[5] showed, with pancreatic juice obtained from dogs with fistulas, that this inhibition was not limited to the fluoride of sodium but was also shown by the chloride, bromide, and iodide, but to a much less extent both on simple esters and on olive oil. In a previous paper of this series,[6] the action of a number of neutral salts on the lipolytic activity of a castor bean preparation toward ethyl butyrate was described. The results paralleled very closely those obtained by Terroine with an animal lipase on the same ester. In particular, the inhibiting action of equivalent solutions of the sodium salts, chloride, bromide, iodide, fluoride, increased in the order named, and for any one salt with increasing concentration. The other results reported there will not be given in detail and other work

[1] E. H. Starling, *Principles of Human Physiology*, p. 788 (1912).
[2] *Z. physiol. Chem.*, **50**, 394 (1907).
[3] *Ibid.*, **68**, 400 (1910).
[4] *J. Biol. Chem.*, **2**, 397 (1907).
[5] *Biochem. Z.*, **23**, 429 (1910).
[6] THIS JOURNAL, **35**, 601 (1913).

will not be described further. It may be mentioned, however, that the apparently contradictory results obtained in many investigations of the action of neutral substances particularly, on lipases and probably on enzymes in general, will be found, in most cases to be due to the different experimental conditions which were used. For instance, the ester used may have been different and may account for the different results obtained; the amount of water plays a part; the formation of insoluble substances such as insoluble soaps if a salt of a metal, such as calcium, and an oil are used; the neutralization of the lipase solution initially, involving the addition of an indicator generally dissolved in alcohol and alkali, in this way forming a salt, etc.; each action small, perhaps, but unquestionably affecting the lipolytic behavior observed.

The figures presented in Table IV were obtained in the same way as those in the previous tables. The results are given for water and for the four halides of sodium for 0.1 molar concentration. As before, the actions are expressed as the number of cc. of 0.1 *N* acid liberated in 24 hours at 38–40° by 0.5 cc. duodenal contents in 25 cc. water or solution from 1.0 cc. ethyl butyrate or 0.5 cc. triacetin.

TABLE IV.—THE LIPOLYTIC ACTIONS OF DUODENAL CONTENTS IN 0.1 MOLAR SODIUM HALIDE SOLUTIONS.

Patient.	H_2O.	0.1 M NaCl.	0.1 M NaBr.	0.1 M NaI.	0.1 M NaF.
Results with ethyl butyrate.					
J.....	4.56	3.60	3.36	0.40	0.72
K.....	2.35	2.13	..	0.26	0.37
P.....	1.58	1.24	..	..	0.54
I[1].....	3.66	2.88	1.66	0.45	0.70
P.....	0.73	0.57	0.59	0.61	0.19
G.....	1.75	1.31	0.86	0.46	0.46
Results with triacetin.					
J.....	11.20	10.85	10.33	1.42	0.68
K.....	7.71	8.17	..	1.15	0.21
P.....	3.07	3.77	..	2.94	0.67
I[1].....	12.02	12.10	9.08	0.77	0.71
P.....	1.59	1.62	1.48	0.89	0.33
G.....	1.41	1.27	1.03	0.38	0.77

A different behavior was found for the actions of these salt solutions with the two esters, and therefore, presumably, the two lipases were affected differently. With ethyl butyrate, the sodium chloride retarded the actions distinctly, the bromide somewhat more markedly as a rule, while the iodide and fluoride showed the greatest retardations. The iodide exerted greater inhibiting action than the fluoride in the greater number of cases. Terroine found the retardation to increase in the order, chloride, bromide, iodide, fluoride, with an animal lipase; while the same order was found with the castor bean lipase.

[1] 0.2 cc. duodenal contents, 48 hours action.

With triacetin, sodium chloride (of the concentration indicated) had practically no effect or a distinct accelerating action, while the bromide, iodide, and fluoride exerted greater inhibition in the order named (one result for fluoride showed less inhibition than for iodide, but against this must be placed the five showing the opposite). These actions correspond very closely to the results of Terroine with animal pancreatic juice on triacetin and also with unpublished work with castor bean and soy bean lipases. In all these cases, 0.1 molar sodium chloride solution either had no action or increased the hydrolytic action on triacetin; while with the other halides, distinct inhibition, which increased in the order bromide, iodide, fluoride, was observed.

TABLE V.— THE LIPOLYTIC ACTIONS OF DUODENAL CONTENTS IN SOME NEUTRAL SALT AND ALCOHOL SOLUTIONS.

Results with ethyl butyrate.

Patient.	H_2O.	1 M KCl.	1 M KBr.	1 M KI.	1 M KF.	0.1 M NaF.	1 M NaCl.
A.....	7.46	..	..	..	..	0.88	4.66
A.....	5.09	2.69	2.45	0.08	0.41	..	..
		0.05 M $MgSO_4$.	0.005 M $MnSO_4$.				
I[1].....	3.66	1.90	1.60	..	..	..	..
				1 M CH_3OH.			
D[2].....	0.90	0.73	..	0.59	..	0.23	0.75
		0.1 M CH_3OH.	0.1 M C_2H_5OH.				
M.....	0.80	1.93	2.09	..	..	0.25	..
					1 M C_2H_5OH.		
O.....	2.45	2.62	2.11	1.70	1.52	..	..
P.....	0.73	0.60	0.50	..	..	..	..
						1 M NaI.	
G.....	1.75	..	..	..	..	0.04	0.64

Results with triacetin.

	H_2O.	1 M KCl.	1 M KBr.	1 M KI.	1 M KF.	0.1 M NaF.	1 M NaCl.
A.....	12.21	..	..	..	..	1.57	8.15
A.....	8.32	5.42	3.75	0.06	0.48	..	..
		0.05 M $MgSO_4$.	0.005 M $MnSO_4$.				
I[1].....	12.02	7.03	7.40	..	..	..	..
				1 M CH_3OH.			
D[2].....	1.56	1.29	..	1.21	..	0.20	2.32
		0.1 M CH_3OH.	0.1 M C_2H_5OH.				
M.....	1.26	3.15	2.56	..	..	0.30	..
					1 M C_2H_5OH.		
O.....	6.36	0.76	0.65	0.86	0.99	..	..
P.....	1.59	1.37	1.13	..	..	..	..
						1 M NaI.	
G.....	1.41	..	..	..	..	0.08	0.41

[1] 0.2 cc. duodenal contents; 48 hours action.

[2] 48 hours action.

Table V summarizes the results of a number of miscellaneous experiments with different salt and alcohol solutions of the indicated concentrations under the same conditions as before.

The results of Table V will be discussed together for the two esters since essentially the same relations appear. The molar solutions of the potassium and sodium halides all showed very marked inhibiting actions, the inhibition increasing in the order chloride, bromide, fluoride, iodide for both esters. The order fluoride, iodide is interesting again in comparison with the results discussed in connection with Table IV where the more dilute solutions of the same salts were considered.

Several experiments were made using magnesium and manganous sulfates. The concentrations chosen were those which had given the most marked and most readily measured accelerations with the lipolytic activity of the castor bean preparation. The duodenal contents, however, did not show any acceleration either in the action on ethyl butyrate or on triacetin, but on the other hand showed very marked retardations in both cases.

A number of results are presented with 0.1 molar and 1.0 molar solutions of methyl alcohol and ethyl alcohol. In one case, Patient M, very strong accelerations toward both esters were observed with the 0.1 molar solutions of the two alcohols; in the other cases the retardations were very marked, except for the 0.1 molar methyl alcohol solution with ethyl butyrate for Patient O where a small acceleration was observed. The results with Patient M appear to be exceptional and due to unknown causes. The general action of the alcohols may, for the present, be looked upon as retarding the lipolysis, in agreement with the results with castor bean lipase.[1]

The results summarized in Tables IV and V are of interest from the purely scientific point of view in connection with the study of the chemical properties and reactions of lipases. At the same time, these accelerations and retardations of the enzymic activity due to the neutral salts suggest some questions and problems of more direct practical importance. The bromides and iodides of sodium and potassium have extensive therapeutic use, and it may be asked whether the continued administration of these, even in small quantities, will not exert a deleterious influence on digestive processes, in connection with fat digestion. Especially would this be true for the iodides, which *in vitro* inhibit so markedly the lipolytic activity of duodenal contents. The action of alcohol may possibly be harmful in a similar way. The study of the enzymic activities of the duodenal contents of a large number of suitable cases might throw some light on these questions.

The writer wishes to take this opportunity to thank Dr. William G.

[1] THIS JOURNAL, 35, 616 (1913).

Lyle, Director of this laboratory, Dr. Mortimer Warren, Pathologist of Roosevelt Hospital, and the different members of the House Staff of the hospital, for obtaining the specimens used in this investigation. Thanks are due Dr. I. Greenwald of this laboratory for helping to prepare the results of this investigation for publication.

Summary.

The lipolytic activity of human duodenal contents was tested in a number of cases under varying conditions.

Two lipases were present in the duodenal contents. One of these, found as a rule after ingestion of food, was, under certain definite experimental conditions, more active toward triacetin than toward ethyl butyrate; the other, present when no food had been taken, was more active toward ethyl butyrate than toward triacetin. The importance of these two lipases in diagnostic work was pointed out.

Lipases, showing similar differences in their actions on the two esters, have been shown to be present in castor beans, and also by Loevenhart in extracts of the pancreas and liver of various animals.

The effect of a number of neutral salts and alcohols in different concentrations on the activity of the duodenal contents on the two esters was studied.

CORRECTION.

In referring to Mr. A. F. McLeod's paper as abstracted in the *Chemical Abstracts* in my paper on "Some Organic Preparations" (THIS JOURNAL, **36**, 532), I find that I have not interpreted correctly the statement "calcium or sodium hydroxide solution of 0.1 %." This percentage, I find, refers to an aqueous solution; whereas my percentages were referred to the aldehyde used. It follows, therefore, that the experimental conditions in each case were different. I take this opportunity of correcting my statement in my paper alluded to above, and expressing my regrets to Mr. McLeod.

L. P. KYRIAKIDES.

NEW BOOKS.

The Scientific Work of Morris Loeb, edited by THEODORE W. RICHARDS, Professor of Chemistry and Director of the Wolcott Gibbs Memorial Laboratory at Harvard University. pp. 360, Cambridge, Mass. Harvard University Press. Price, $2.00.

This volume contains, first, as frontispiece, a pleasing and characteristic portrait of Morris Loeb; second, a brief but excellent account of his life and character, by the editor; third, a collection of lectures and addresses by Loeb on scientific subjects, some of which have not been published before; and finally, a complete collection of Loeb's experimental researches. The book is very well done. The material has evidently been