40. *The Quantitative Estimation of Pancreatic Secretion.*

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The value of quantitative estimation of the pancreatic function is apparent. The interest in the estimation of pancreatic function really goes back to the time when Einhorn first introduced the duodenal tube.¹⁾ A series of methods have been devised using this tube and estimating the three ferments of the duodenal contents aspirated. Objections were made that the duodenal contents in fasting often show very low enzymatic activity or the amount is too scanty to make an analysis satisfactorily although the pancreas is not involved. Several stimulants for pancreatic secretion were thus applied by various workers such as bouillon, hydrochloric acid, ether, cream, peptone etc. It was pointed out however, that the presence of a considerable amount of saliva, gastric juice and biliary secretion so diluted the duodenal contents that no quantitative study of the pancreatic ferments was possible. We have given much consideration to this point and have devised a method which allows a reliable and very accurate estimation which may be regarded, for the first time, as a quantitative estimation of the pancreatic function. The method in short is as follows: On an empty stomach, early in the morning, the metallic capsule of the duodenal tube is introduced into the duodenum. After verifying that the tip stays in the duodenum, the contents of the duodenum are constantly aspirated for three hours with or without stimulants (as stimulants 3 cc. of ether, 30 cc. of 10% alcohol, water or 0.2% hydrochloric acid are introduced into the duodenum). For the estimation of enzymatic activity we applied *Gross's* casein method for trypsin, *Okada's* colorimetric method for amylase and *Rona-Michaelis's* tributyrin method for lipase with some modifications. The degree of the enzymatic activity is multiplied by the amount of juice aspirated, and the result is called the total enzymatic efficiency. It is proved that the liquid introduced into the duodenum could be quantitatively recovered by constant suction. The result thus obtained in 50 cases of normal subjects is as follows.

1) Einhorn, Max, Ueber Gewinnung von Duodenalinhalt beim Menschen. Berl. kl. Wochenschr., 522, 1910.

	Below 30 kilounits *	1 case	2%
Trypsin	From 30 to 120 kilounits	48 cases	96%
	Over 120 kilounits	1 case	2%
	Below 50 kilounits	1 case	2%
Amylase	From 50 to 300 kilounits	48 cases	96%
	Over 300 kilounits	1 case	2%
	Below 50 kilounits	5 cases	10%
Lipase	From 50 to 300 kilounits	41 cases	82%
	Over 300 kilounits	4 cases	8%

* One kilounit of trypsin means an enzymatic activity when one gm. of casein is completely digested in 30 minutes, and one kilounit of amylase that when one gm. of sugar is produced from soluble starch in 15 minutes. One kilounit of lipase means 1000 times of an enzymatic activity when the decrease of the number of drops is 20 in 50 minutes, i.e., about the half of the difference of saturated tributyrlic solution and pure water.

From the result of the foregoing it may be regarded that the normal figures of total enzymatic efficiency in three hours' collection are 30 to 120 kilounits for trypsin, 50 to 300 kilounits for amylase and for lipase. The enzymatic efficiency in three hours' collection shows but little difference whether any stimulants as above mentioned are used or not, showing only somewhat higher figures when hydrochloric acid is used. The total efficiency seems somewhat less for subjects of over 40 years of age. Female cases show on an average a low efficiency. The amount of the duodenal return is not apparently influenced by age between 16 and 62 years. The sex, on the contrary, shows a distinct influence, being much less in female cases. The bile pigment elimination is also estimated after the procedure of *Meulengracht* and is checked by pure bilirubin. The amount of bile-pigment showed marked fluctuation. Female cases showed distinctly less average value. It seems the bile pigment elimination increases with age.

The degree of the enzymatic activity in short periode gives but little information on the pancreatic activity. If on the other hand one estimates the enzymatic activity of every half-hour or one hour collection in three separate hours and finds out the highest value, the result is fairly consistent and may be used for judging the pancreatic activity. The result thus obtained in 50 cases is as follows :

Trypsin	Below 500 units	2 cases	4%
	Over 500 units	48 cases	96%
Amylase	Below 600 units	0	0%
	Over 600 units	50 cases	100%
Lipase	Below 600 units	4 cases	8%
	Over 600 units	46 cases	92%

From the result of the foregoing it may be regarded that the normal figures are over 500 units for trypsin and over 600 units for amylase and for lipase.