William Henry Thompson (1860–1918)

President of the Ulster Medical Society 1900–01

Presidential Opening Address
Ulster Medical Society
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PHYSIOLOGY AND THE HEALING ART.

Ladies and Gentlemen, I have in the first place to thank you for the honour you have conferred upon me in electing me to be your President for the ensuing year. It is an honour which I highly prize, but I wish I could say with equal sincerity that I feel qualified in any commensurate degree to discharge the duties you have so confidingly entrusted me with. Physiology too often in the present day, of necessity, pursues its course far distant from the haunts of men in practice, and he who makes it his speciality, loses touch, more or less, with the immediate concernments of those who devote their lives to the treatment of disease. This, I have always felt, is a circumstance to be struggled against, and indeed I hope to be able to convince you before finishing this evening that it often results in a loss to both sides. Nevertheless it is from such a standpoint, and with these facts in view, that I feel myself somewhat out of place in essaying to fulfil the duties which necessarily devolve upon the President of your Society. Mingled with this, I am glad to admit, however, is a certain amount of hope that with your assistance, and forbearance the discharge of those duties may afford opportunities for strengthening the cords which ought to bind our respective subjects – yours and mine – together.

Before proceeding to the business proper of the evening I have to express on your behalf and my own our deep regret at the great loss which the Society has sustained in the death of our esteemed friend and colleague, Dr. Strafford Smith. A man of marked ability, of genuine kindliness of nature, and whose success in our profession had already attained a high pitch, could ill be spared from any community, and we, his brethren, join with his many friends and relatives outside our profession in deeply deploring his early and sudden death.

PHYSIOLOGY AND THE HEALING ART.

Physiology formerly was said to be the basis of rational medicine. It is a saying which has grown, somewhat worn and old, but I fear the amount of conviction which it carries to the breast of the average medical man has not increased with its age. These are sentiments which perhaps I ought not to re-echo, but no real harm is ever done by fairly looking at facts in the face. All the less likely is this to happen in the present instance, because I believe the saying is in reality more true to-day than when it was first uttered. The intimate connection has only been obscured by other developments; the dissociation is more apparent than real.

ASSOCIATION NOT SUFFICIENTLY INTIMATE:
PROBABLE CAUSES.

In seeking to trace the origin of this feeling to its cause it seems to me that first and foremost should be placed the great and rapid development of the subject of physiology which carries its devotees far into fields where none but the specialist can be expected to follow them. This minute research is necessary if truths of moment are to be wrung from the secrets of nature. Nevertheless it is a process with which the man of practice cannot always sympathise. It is only when those truths are brought back and take their place in the guidance of treatment that his interest is specially awakened.

Another circumstance to which I would assign a place in obscuring the link of connection between pure physiology and practical medicine is connected with the study and treatment of acute infectious disorders. These in themselves, always of great interest to the medical man, have been rendered doubly so by the great achievements of the science of bacteriology. The diagnosis of such maladies by the discovery of the microorganisms, which give origin to them, and the study of the life history of these germs themselves have filled a gap that could not have been filled by any other means. In this way the science of germs has come to occupy an engrossing position in men's minds, and to a similar extent has it overshadowed, and in a sense crowded out, the older subject of physiology. But even here, where most obscured, the knowledge yielded by the latter must come in when the process of diagnosis is complete, and the curative treatment, if it is, to be rational, is undertaken.

I should, however, be very sorry to convey to your minds that I do not fully appreciate the great good which has been done by the study of bacteriology. I only wish to recall your attention to the fact that there is still a solid substratum of physiological basis to the healing art, whose culture it is unwise to neglect, if we are, as I hope it is the aim of all of us, to build up a stable, well proportioned, and durable scientific structure.

One other cause I would like to indicate, as a factor, which I think in some measure accounts for the rather small degree of sympathy which too often exists between physiology and the practice of the healing art. I will do so by asking you a question. Do clinicians sufficiently avail themselves, or are they placed in a position in this country to sufficiently avail themselves of the resources brought within their reach by the application of physiological methods to the discovery and treatment of disease?

This question I will leave with you for the present, and will ask you to follow me while I endeavour to bring before you a few of the advances which have recently been made in a physiological field intimately associated with the every-day practice of your profession.

RECENT ADVANCES IN PHYSIOLOGY OF GASTRIC DIGESTION.

Somewhat more than ten years ago an elaborate institute for the experimental study of medicine was established in St. Petersburg. This institute consists of numerous departments, is in short the Pasteur Institute of the capital of Russia. Two of these are devoted to the prosecution of physiological research, one in the field of chemical, the other, more strictly in the field of experimental physiology. The director of the former is the distinguished Professor Nencki, of the latter the no less celebrated Professor J. P. Pawlow. It is to some of the work which has emanated from Pawlow's laboratory that I wish more especially to draw your attention.

During the whole of the ten or more years which have elapsed since its foundation, the laboratory, consisting of the director with a staff of assistants, and numerous workers, has devoted itself exclusively to a systematic study of the process of digestion. The first results of this combined work were given out in collected form, about three years ago, as a series of lectures to Russian, physicians, and soon after published in the Russian language. The book was translated into German by one of the assistants of the laboratory about a year later, and thus was made more available to the scientific world generally. It is quite a small work, less than 200 pages, but it literally teems with results of the most valuable kind to the practitioner of medicine. The volume was supplemented a few weeks ago by a further fasciculus of less than 50 pages.

From the chapters of the first of these publications, which deal with the subject of gastric digestion, I purpose to draw a few facts, which will serve to exemplify the nature of the work accomplished in Pawlow's laboratory. You can then judge of its practical bearing upon the science of medicine.

OLD METHODS FAULTY.

For long past nobody had been very satisfied with the usual methods by which gastric juice was obtained, in order to study its properties. This as you will remember was by means of simple fistulae leading through the abdominal wall into the stomach. The chief fault of this method consisted in the fact that gastric juice could never be obtained in any quantity unmixed with food. In order to make real progress it was necessary to possess a means by which the juice could be collected (1) at all times, (2) in pure condition, (3) in exact quantity (4) while the stomach functioned normally, (5) and from an animal in perfect health.

PAWLOW'S IMPROVEMENTS.

Pawlow achieved these desirable ends by an improvement of the old method in which a partially isolated portion of the fundus of the stomach was converted into a little pouch which retained its nervous and vascular connections, and whose mouth was led to an aperture in the abdominal wall. The deeper end of the pouch, as well as the opening into the main portion of the stomach, were securely closed. By the application of rigid aseptic principles of surgery no trouble was experienced in securing rapid and complete recovery of the animals. By means of a glass tube, perforated with numerous small apertures, and led into the pouch, gastric juice of the purest quality could then be collected in almost any desired quantity. Figures 1 and 2 give diagrammatic representations of the way in which this pouch is formed.

The first interesting fact confirmed by this method was that no secretion whatever occurred when the animal was fasting, but that a copious flow of juice could be set up by the mere act of chewing and swallowing food. This flow commenced after a latent period of about 5 minutes had elapsed, never less than 4½ minutes, and was not due to the entry of food into the larger stomach. The latter was proved in an ingenious way, viz. – by making an opening into the oesophagus in the neck, dividing the tube, and causing both ends to heal to the edges of the surface wound. After recovery, the animal could be made to chew and swallow food as before, but the food came out at the opening in the neck, and unless specially led into the lower segment of the oesophagus, did not enter the stomach.

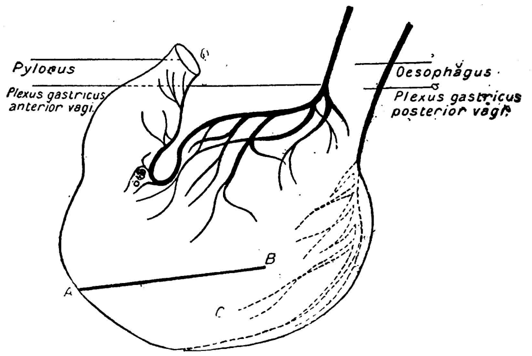

Fig. 1.—METHOD OF FORMING PAWLOW'S POUCH.
A B, Line of Incision. C, Flap for Forming Pouch.

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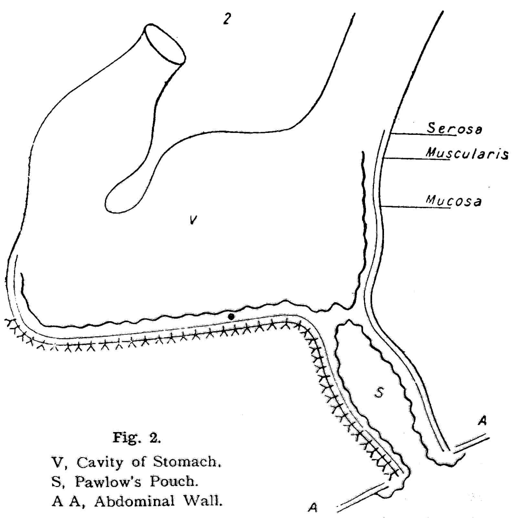

Fig. 2.
V, Cavity of Stomach.
S, Pawlow's Pouch.
A A, Abdominal Wall.

It was then seen that this "make-believe" feeding caused precisely the same secretion of gastric juice, and that the flow could be kept up as long as the animal continued to chew and swallow. Another modification of the method consisted in performing the oesophagotomy as described, together with an ordinary fistula leading into the stomach. The juice excited by make-believe" feeding could thus be collected from the whole organ and not alone from a shut-off segment.

QUERIES WHICH PAWLOW SET OUT TO ANSWER.

Having secured an admirable means of studying the work of the gastric glands, Pawlow set out answer the following amongst numerous other interesting questions relative to their functional activity.

(1) Is the amount of juice secreted by the stomach in any way proportioned to the quantity of food eaten.

(2) What is the way in which the juice is poured out. Is all or most of it discharged in one gush at the beginning of digestion, as soon as the meal is partaken of, or on the contrary by degrees, and in declining quantities suitable to the gradual digestion and removal of dissolved food from the organ.

(3) Does the digestive power of the juice – the amount or pepsin which it contains – vary in any way with the different phases of digestion, or is it constant throughout.

(4) Has the nature of the food any influence on the quality of the juice; or are the gastric glands in any way able to adapt themselves to the kind of food presented them for digestion.

The answers to these questions, with some of the evidence, I shall endeavour to present to you seriatim, and in as few words as possible.

RELATION BETWEEN AMOUNT OF FOOD AND QUANTITY OF JUICE.

And now we may take up the answer to the first question as to whether there is any quantitative relation between the juice secreted and the amount of food partaken of. The facts on which the answer is based are shown, you in the following table.

TABLE 1. – RELATION BETWEEN THE AMOUNT OF FOOD TAKEN AND THE QUANTITY OF GASTRIC JUICE SECRETED		
Flesh Diet.	100 grm.	26 cc. Juice
	200 grm.	40 cc. Juice
	400 grm.	106 cc. Juice
Mixed Diet.	300 cc. Milk 50 grm. Flesh 50 grm. Bread	42 cc. Juice
Mixed Diet.	Double the above quantities	83.2 cc. Juice

The figures are taken from experiments in which a dog was "make-believe" fed with varying quantities, in the first instance, of a flesh diet, and in the second of a mixed one, the juice being collected from the whole stomach. On looking at these, you will see that the chewing of 100 grms. flesh caused a flow of 26 c.c. of juice, of four hundred grms. almost exactly four times that amount. Again a given quantity of mixed diet produced a secretion of 42 c.c., double that amount gave rise to almost precisely double the quantity of juice. The gastric glands therefore work in health with the greatest precision, apportioning their labour with beautiful exactness to the magnitude of the task before them. Increase the unit mass of any food by a given multiple, and within ordinary limits, the glands will respond with a like increase of gastric juice.

CURVE OF SECRETION OF GASTRIC JUICE.

Next comes the answer to the question relating to the manner in which the secretion of juice is spread out over the whole period of digestion.

The reply is taken from figures yielded by two experiments in which a dog was twice fed with 100 grms. of flesh each time, the amount of juice poured out by the stomach pouch being measured hour by hour.

TABLE 2.—HOURLY RATE OF SECRETION OF GASTRIC JUICE.		
Two Experiments. – Dog fed 100 grm. Flesh in each.		
	Exp. 1.	Exp. 2.
Hour 1	11.2 cc.	12.6 cc.
Hour 2	8.2 cc.	8.0 cc.
Hour 3	4.0 cc.	2.2 cc.
Hour 4	1.9 cc.	1.1 cc.
Hour 5	0.1 cc.	1 drop
Total	25.4 cc.	23.9 cc.

Here you will see that the greatest secretion occurs during the early periods of digestion, but that the juice continues to be discharged in declining quantity as long as any food remains to be dealt with. The glands therefore do not pour out all their fluid at once, and leave matters to themselves, but "stand by," paying out more and more with strict economy as long as the needs of the case demand, and the same result repeats itself with stereotyped exactness, as often as the same conditions are fulfilled. The course therefore which gastric secretion runs, follows definite and purposive laws and is by no means a matter of blind chance. Fig. 3 represents in curve form the facts given in table 2.

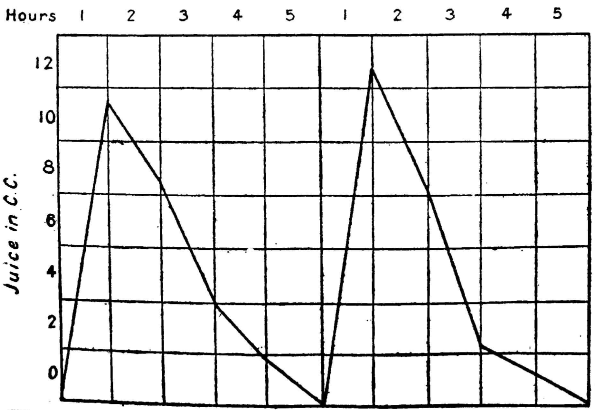

Fig. 3. Curve of Secretion of Gastric Juice after a Meal of Flesh. (Two Experiments.)

DIGESTIVE POWER VARIES WITH STAGE OF DIGESTION.

And now comes the reply to the third query. If the glands are thus capable of varying their rate of secretion in so remarkable a manner, according to the needs of digestion, are they not likewise able to extend similar variations to the digestive power – the pepsin content – of the juice which they secrete? I speak only of pepsin content because Pawlow has shown that the acidity of the juice, as it pours from the glands, is always constant and varies only because it comes into contact with more or less of an alkaline mucus, which latter in health should not be present.

The digestive power of the juice was determined by causing it to act on short columns of coagulated eggwhite, contained in capillary glass tubes broken into small pieces. The length of column dissolved gives a reliable means of measuring the activity of the juice. The results obtained from two experiments on a dog fed each time with 400 grm. of flesh are given below:–

Table 3. – digestive power of gastric juice (quantity of pepsin) at different stages of digestion.		
Two Experiments. – Dog fed 400 grm. Flesh in each.		
	Exp. 1.	Exp. 2.
Hour 1	6.0 mm.	5.8 mm.
Hour 2	4.5 mm.	4.1 mm.
Hour 3	3.4 mm.	3.4 mm.
Hour 4	3.5 mm.	3.0 mm.
Hour 5	3.8 mm.	3.8 mm.
Hour 6	3.0 mm.	3.1 mm.
Hour 7	3.6 mm.	3.5 mm.
Hour 8	3.9 mm.	4.5 mm.

You will see from these figures that the juice secreted at the beginning of the meal has, in the case before us, the greatest digestive power – i.e., contains the most pepsin – when presumably it is most required, and that the proportion gradually declines as the need for it likewise decreases during the following stages. The glands then have also the power of varying the quantity of pepsin which they discharge in the juice according to the same laws by which they vary the total amount of secretion poured out. Fig. 4 illustrates the same in curve form.

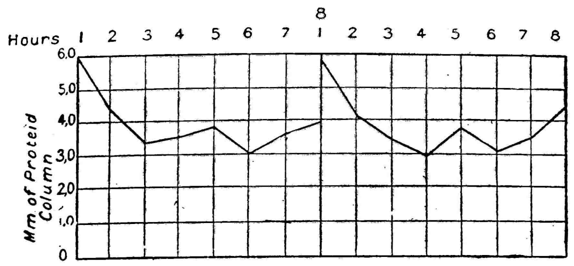

Fig. 4.—Curve showing Digestive Power of Gastric Juice, hour by hour. Food 400 grms. of Flesh. (Two Experiments.)

So far then we find ourselves dealing with a mechanism whose adaptation to its work could not be more perfect nor more beautifully conceived.

REGULATION OF THE JUICE TO THE NATURE OF THE FOOD.

But the fourth question is perhaps the most interesting of the whole in the series which I have selected. Has the nature of the food any influence on the quality or quantity of the juice? Are the glands capable of adapting their secretion to the kind of food presented them for digestion, and if so how is this met?

The answer to the first part of the question is undoubtedly in the affirmative, the variations applying not only to the quality and quantity of the fluid, but likewise to the course and duration of its outflow. It would occupy too much time to quote all the experiments on which the facts are based, but these are the chief facts themselves.

Weight for weight the greatest amount of juice is poured out on flesh diet, the least on milk, bread being intermediate.

The total acidity is greatest with a flesh and lowest with a bread diet.

The digestive power – the pepsin content – is greatest with the juice poured out on bread, least on milk, the proportion being as follows: bread formed juice 44, flesh-formed 16, and milk-formed 11. Milk, therefore, in agreement with what is known from everyday experience makes least demands on the activity of the glands for its digestion.

Nor do the peculiarities end here. The manner in which the juice is secreted and the period at which it attains its maximum digestive power are likewise different for each class of foodstuff. This is exemplified in the following table [next column].

The time of maximum flow occurs therefore with a flesh diet either in the first or second hour, and both are nearly equal, with a bread diet in the first and with a milk diet in the second hour. The period of maximum strength is reached in the first hour with flesh, in the second or third with bread, and towards the end of digestion with milk diet. Fig. 5 represents the curve of secretion of gastric juice on different diets, and Fig. 6 that of its digestive power at different stages, under the same conditions.

TABLE 4. – INFLUENCE OF THE KIND OF FOOD ON THE QUANTITY AND QUALITY OF THE GASTRIC JUICE.

	Quantity of Juice (cc.)			Digestive Power (mm.)		
Hour	Flesh.	Bread.	Milk.	Flesh.	Bread.	Milk.
1	11.22	10.6	4.0	4.94	6.10	4.21
2	11.3	5.4	8.6	3.03	7.97	2.35
3	7·6	4.0	9.2	3.01	7.51	2.35
4	5.1	3.4	7.7	2.87	6.19	2.65
5	2.8	3.3	4.0	3.20	5.29	4.63
6	2.2	2.2	0.5	3.58	5.72	6.12
7	1.2	2.6	–	2.25	5.48	–
8	0.6	2.2	–	3.87	5.50	–

Quantities of Food:–
Flesh, 200 grm.; Bread, 200 grm.; Milk, 600 cc.

FIXED MODIFICATIONS OF THE DIGESTIVE FLUIDS TO SUIT PARTICULAR DIETS.

Intimately connected with the foregoing is a further Important question, viz.: – whether the digestive system is capable of permanently adapting itself to a special form of diet or not Thus given a continued preponderance, say of proteid in the diet, with a paucity of fat and carbohydrate, or on the other hand a more than usual proportion of! carbohydrate, with a scarcity of fat or proteid, or lastly an undue amount of fat; what power have the digestive organs of meeting these possibilities? The answer is that a condition is gradually established whereby a steady increase takes place in the amount of special ferment which is necessary to meet the requirements of the particular diet, while at the same time a decrease in those which are superfluous sets in. Such adaptation is, however, not accomplished through the gastric glands but by means of the pancreas. The main importance of the matter lies in the fact that once having established a dietetic adaptation of secretion, it cannot be undone in a day. Great alterations in a dietary therefore, even when urgently demanded, can only be advantageously

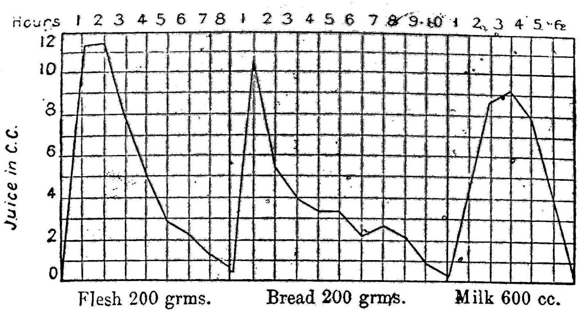

Fig. 5.—Curves of Secretion of Gastric Juice, with different diets.

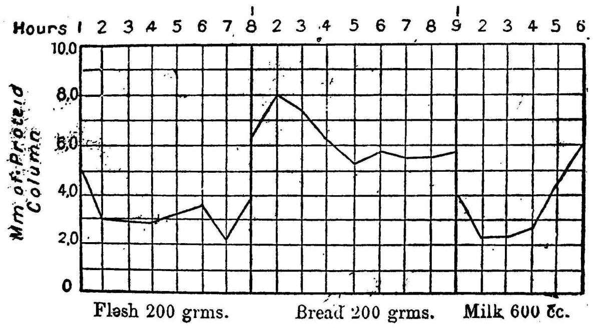

Fig. 6.—Digestive Power of Gastric Juice, hour by hour, on different diets.

introduced by degrees.

FLOW OF JUICE FROM "MAKE-BELIEVE" FEEDING.

And now one point more, before I leave the results which I have selected from this admirable series of researches. It is I think perhaps the neatest determination made in the whole set of experiments. This is no other than an actual estimation of the value of the combined act of chewing and swallowing in terms of gastric juice.

In establishing the fixed rate of secretion, for the whole act of digesting a particular meal (which as a matter of fact under like conditions has been found to be always the same) we have determined the value of chewing and swallowing, plus the further exciting effect of the food after it enters the stomach. But we can estimate the value of these two factors separately, that of chewing and swallowing in the way I have explained to you, by receiving the food from an opening in the oesophagus and not allowing it to enter the stomach. The other factor is known if we bring the same meal directly into the main stomach of the animal through an ordinary gastric fistula, and observe its effects on the secretion as shown by the stomach pouch. Food introduced in this manner, is not nearly so powerful an excitant of juice flow as when it enters in the usual way. But the curious fact comes out that the sum total of the "make-believe" or swallowing juice, plus that caused by the direct introduction of food is exactly equal to that of the whole meal swallowed and digested in the ordinary way. This is strikingly illustrated in Fig. 7, where the similarity between curves A and D is very remarkable.

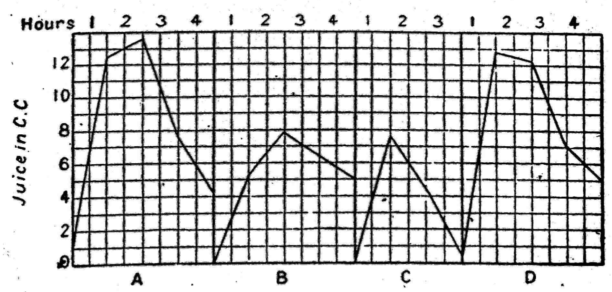

Fig. 7 – A, Ordinary curve of gastric secretion, 200 grms. flesh. B, Curve from direct introduction of food, 150 grms. flesh. C, Curve from "make-believe" feeding with same, D. Curve formed by the summation of B and C.

Thus by having any two of the foregoing factors, we can readily determine the third, and in this way we learn that the whole of the earlier part of the secretion is an accompaniment of the act of chewing and swallowing, and not at all dependent on the mere entry of food into the stomach.

Now this "make-believe" juice, if we may so call it for shortness, is not only copious in amount but of a very active character. It constitutes therefore a most important part of the whole. But although an accompaniment, and apparently caused by these combined events it is not really so.

VALUE OF APPETITE IN CAUSING SECRETION.

The same secretion can be excited by the mere sight of food, accompanied by an eager desire on the part of a hungry animal to have it. This implies that the food is such as will excite this keen desire and, without it, the chewing and swallowing are wholly ineffective.

Everything therefore which aids in creating the desire for food and in augmenting the satisfaction of having it, has its material value in an increased flow of the best and most active gastric juice.

Hence the importance of set preliminaries to the chief meal of the day. The customary ablutions, the change of raiment, the dismissal from the mind of business anxieties, the table decorations, the plan of the meal, the savoury odours and last but not least the expectation of finding an appetising repast, these are all matters of moment and have their fixed values in terms of active gastric juice.

NEED FOR CHEMICAL WORK IN CLINICAL RESEARCH.

I may now return to the query with which I left off regarding the application of physiological methods to the study of disease.

It would be ungracious of me to find fault in any way with the excellent clinical work done in this country even if I possessed the authority or had the wish to do so. That is not my purpose. I wish rather to indicate a line of work which might I think be more cultivated and which I believe has great possibilities connected with it. It is work which will necessitate a considerable expenditure of time and trouble, but these considerations must not stand as serious obstacles in the path when the end in view is an important one. The line of work to which I refer consists in the fuller application of the methods of chemical physiology to clinical work.

Some years ago, a method of examining the contents of the human stomach was perfected by Ewald. This consists in the introduction of a soft tube at a given time after a test meal, whereby the contents can be syphoned off or expressed out of the organ. The method necessitates a careful chemical

examination of the juice obtained, and when this is done I am told it yields information of the most valuable kind regarding disease, which cannot be obtained in any other way. But is this method, which I think I may call a physiological one, adopted with sufficient frequency in our country? Are the chemical examinations which it entails carried out with sufficient thoroughness?

Again, in the majority of the departures from health, the importance of quantitative variations in the composition of the chief excreta of the body outweighs in value the qualitative. And yet, are quantitative chemical determinations of these ingredients carried out to the extent, and with the degree of precision their importance demands? Nay more are the means for such examinations adequately supplied by the numerous great institutions devoted to the treatment of disease throughout our country?

Further, it must often be almost imperative in such perverted conditions of body metabolism, as one meets with in the various kinds of diabetes, of leucocythaemia, of Addison's, disease, in obscure fevers, aye, even in ordinary fevers, to possess a complete picture of the whole metabolism from beginning to end, from the ingesta to the egesta. It is only by thus seriously grappling with such problems that real progress can be achieved.

NEED FOR CHEMICAL LABORATORIES AS HOSPITAL DEPARTMENTS.

And yet what clinical hospital in our land is adequately equipped to afford its staff the necessary amenities for carrying out such a series of investigations. I do not imply that there are no facilities for such work, but they are all too few, and the laboratories are not as they should be, integral parts of every large hospital, just as much as well equipped operating theatres are at the present time. That it is by no means impossible to carry out such a scheme, is shown by the fact that it is adopted for example in the Johns Hopkins Hospital in Baltimore and in many of the clinics in Germany.

CHEMISTRY IN THE MEDICAL CURRICULUM.

And now I think I come to the kernel of the whole matter. Is the training which our medical students for the most part receive in the subject of chemistry carried out along lines that will enable them to meet such conditions in the later stages of the curriculum and in after life as I have indicated? Are our young medical men afforded sufficient opportunity and encouragement to draw them into fields of enquiry?

The education of our students in this branch of science, I say it with all humility, has not, to my mind, received the attention which it deserves. Till very recently it was quite the exception for examining bodies, university or otherwise, to require any knowledge, however elementary, of quantitative chemical analysis, and even now there are, so far as I know, only two which insist upon it.

Our students are well versed in the detection of the ingredients of simple and complex chemical mixtures, many of which contain metallic elements never normally found in the human body nor likely to occur in it as poisons. But the important practical matter of quantitative estimation has been wholly omitted, and with it the invaluable training in experimental methods of precision which even a short course of this work entails. Nor has it been found impossible by those who have tried it to graft such a course of instruction on to the old scheme, by omitting here a little and there a little of unnecessary or less useful work, without prolonging the time which a student ordinarily devotes to practical chemistry.

As an indication of the necessity for alteration in the direction I suggest, I have often mentioned the fact that quite a small number of students, when they come to work at physiological chemistry, know the meaning of the simple word "titration," and curiously enough I have found my remarks very forcibly borne out by discovering not long since, in an otherwise excellent translation of an important German medical work, that this same word is all through the book rendered by the English word "trituration."

But I do not wish to lay the blame entirely at the door of the chemists. The same accusation till comparatively recently held good against the physiologists, with this difference as I think, that these latter have more quickly appreciated the requirements of the case, and have striven as far as possible under present conditions to meet them. Behind both sets of teachers however lies the council of general medical education, which has not awakened to its responsibilities in this matter.

NEED FOR POST GRADUATE RESEARCH SCHOLARSHIPS.

Such arrangements and possible legislation as I have foreshadowed can however only be designed to meet the needs of the average student. For specialisation and also for research, the young medical man must obtain a fuller training. How is this to be acquired when as a rule he is under the necessity of toiling hard to earn a living? Well a good deal can always be done by an earnest worker in the unoccupied hours with which the young practitioner is usually blessed.

But the progress of medicine should not be left to take chance in this haphazard fashion. Hitherto money prizes and scholarships have been almost exclusively applied to other and perhaps very desirable objects. It cannot however be too quickly recognised by those able and willing to promote the advancement of medical knowledge that here is a field most deserving of support and from which an urgent appeal for assistance is now issuing, throughout the length and breadth of the land.

NEED FOR MORE WELL-EQUIPPED LABORATORIES.

But even these provisions will not fully meet the needs of the case. Achievements such as I have exemplified in the case of one department of the St. Petersburg Institute are only possible by the aid of combined work. For this purpose well-equipped and fully manned laboratories must be provided by some means or other. And all honour be to such men as Lord Iveagh, Mr. Thompson Yeates, Mr. R. G. Dunville, and others who have nobly come forward with their wealth to aid in this work. Philanthropists of this type are however far too. few. Nor should the cause be left entirely in their hands. The Government of our Great Empire – which has hitherto shown too little sympathy with such aspirations – must awaken to its duties in this respect, if our country is to take the place which its responsibilities impose upon it, in. the advancement of a great, noble, and humane science.

Meanwhile we must each and all of us do what little we can, and “be satisfied with success in even the smallest matter, and think that even such a result is no trifle.”