of time that has led me to confine myself to this one danger.

The history of the discovery of infections by other organisms—staphylococci, the gonococcus, pneumococci, the *Bacillus coli*, the bacillus of Welch, etc.—and the special precautions required to anticipate and thwart each one of them, are of great interest and importance. It would be folly to neglect them while concentrating on one special danger. The most complete surgical technique is essential in really safe midwifery practice. New knowledge may lead to its modification, and it may be that a future Lloyd Roberts lecturer will find this paper of mine useful in composing his own on “The Rise and Fall of the Obstetrical Face Mask.”

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A report by the Food Council to the President of the Board of Trade on its inquiry into the costs and profits of retail milk distribution in Great Britain has now been published by H.M. Stationery Office, price 9d. The main objects of the inquiry were to examine the extent and the causes of the differences between the financial results, per gallon of milk sold, of various businesses; to ascertain whether retail milk distributors are, on the whole, making an unduly high rate of net profit or rendering unnecessarily expensive services; and to consider the possibility of eliminating any such services and achieving generally a more economical retail distribution of milk. In its conclusions the Council suggests possible lines of action by which a reduction might be made in the average margin covering the expenses and profit of the distributor, in order to achieve a reduction in the retail price of milk.

THE LYMPHOID TISSUE OF THE ALIMENTARY CANAL*

BY

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(From the Division of Clinical Research, Henry Lester Institute, Shanghai)

(WITH SPECIAL PLATE)

The lymphoid tissue of the alimentary canal consists of the tonsillar and pharyngeal ring, the Peyer’s patches, the vermiform appendix, and the solitary follicles of the large intestine, but in order to come to a proper understanding of these lymphoid foci a few words about the lymphatic system as a whole are necessary.

It is the accepted belief now that in vertebrates the lymphatics form a closed tube system and do not communicate with the tissue spaces, with the serous cavities such as the peritoneal and pleural cavities, or with the ventricles of the brain or the central canal of the spinal cord. The lymphatic capillaries form dense networks in most of the tissues of the body, these unite to form larger vessels, and the largest, the right and left thoracic ducts, empty their contents into veins and contribute various-sized lymphocytes to the blood stream. Moreover, as Drinker and Field (1933) point out, care must be taken to distinguish between true lymph obtained from lymph vessels; tissue fluid, the fluid in the region outside blood and lymph capillaries in the cellular interspaces; and plasma, the unclotted fluid of the blood, which differs markedly from lymph and tissue fluid in protein content and to a less degree in salt content. As Drinker and Field say, “the three fluids should not be confused with one another or with blood serum as is frequently done—particularly by immunologists uninoculated with a physiological conscience.”

Moreover, as Maximow (1935) asserts:

“The lymphatic networks are distinguished from the blood capillaries by ending blindly in rounded or swollen ends. This is best seen in the mucous membrane of the small intestines, where a network of lymphatic capillaries or a single blindly ending vessel, the central lacteal, extends in the lamina propria up to the end of the villus. The lymphatic capillaries form expanded networks of considerable size round the solitary and aggregated lymphatic follicles of the intestine. They consist of a single layer of flat endothelial cells. The larger lymphatic vessels have valves and slightly thickened walls containing elastic fibres, smooth muscle, and interlacing collagenous fibres.”

Maximow concludes his description of lymphatic capillaries and vessels with the important statement, “As the lymphatics form a closed endothelium-lined system of tubes the tissue juice must pass through the endothelial cytoplasm to reach the lumen of the lymphatics.”

But the lymphatic system does not consist only of lymphatic vessels. These have associated with them collections of lymphoid tissue known as lymph nodes—sometimes called lymphatic glands—and also lymphoid follicles, the latter being solitary or aggregated follicles according to whether they are single or gathered into groups.

I do not propose to refer further to the lymph nodes, although their internal structure is very similar to the collections of lymphoid tissue elsewhere, but I wish to

* A lecture given at the Henry Lester Institute of Medical Research, Shanghai.

direct your attention to the follicular collections of lymphoid tissue to be found along the alimentary tract.

All lymphatic follicles are composed of a framework and free cells. The framework consists of reticular fibres and fixed cells, which may be flattened out, and correspond to the endothelial cells lining the ordinary lymphatic capillaries. In the lymphoid follicles they are sometimes called histiocytes, or fixed macrophages, because they may have phagocytic powers. As I have pointed out, the lymphatic capillaries form expanded networks round the solitary and aggregated lymphatic follicles of the alimentary tract, including the tonsils, but there is no evidence that these capillaries are continuous with the spaces in the lymphoid follicles in which the free cells are found. The free cells in the meshes of the framework consist of free macrophages and lymphocytes; the former are formed from the fixed macrophages and are highly phagocytic, while the latter are classified as small, medium, or large.

According to Maximow the primitive reticular cells give rise to the fixed and free macrophages, and also the medium-sized lymphocytes, which are the precursors of the large and small lymphocytes, the small lymphocyte being capable of development into the large, which then divides mitotically and produces small ones. Diagrammatically they may be represented thus:

The difference between the lymphoid follicles seen in the lymph nodes and those found in the lymphatic tissue of the alimentary tract is that the latter do not possess lymphatic sinuses and lymph is not filtered through them. They are provided, however, as mentioned before, with net-like plexuses of wide blindly ending lymph capillaries, which surround their outer surfaces except where the follicles come in close connexion with the epithelium of the alimentary tract.

The lymphoid follicles, both in the lymph nodes and in the lymphatic collections of the alimentary canal, consist of a superficial and a deep layer which tend to merge into one another. The superficial follicles comprise a compact mass of lymphocytes embedded in a cellular and fibrous reticulum, while the deeper layer has an outer dense mass of lymphocytes and a lighter-staining germinal centre. The latter is situated in the centre of the deeper follicle and passes through a series of cyclic changes, during which an intense new formation of lymphocytes is brought about through proliferation of pre-existing large lymphocytes and through transformation of the primitive reticular cells. The deeper follicles also include degenerating cells with a poor affinity for nuclear stains, which we have called debris cells because they appear to contain granular debris and crystals.

Another big difference between the lymphoid follicles in the alimentary canal and those in the lymph nodes appears to be this—that the stream of small lymphocytes which is the end-product of the lymphoid tissue of the alimentary canal flows in two directions, towards the lumen of the bowel (Special Plate, Figs. 1 and 2) and towards the subserous lymphatics (Fig. 3). The greater

part enter the lumen of the gut, whereas in the case of the lymph nodes it is towards the lymph sinuses and efferent lymph vessels and so on to the thoracic duct and the blood stream; and, moreover, it is a characteristic of the epithelium overlying the lymphoid follicles in the alimentary canal, no matter whether it is squamous or columnar, that it is constantly found to be infiltrated with lymphocytes. In other words, there is a definite flow of lymphocytes from the deeper follicles or germinal centres through the superficial follicles, then through the epithelium into the lumen of the alimentary canal. These lymphocytes are amoeboid but not phagocytic. Some macrophages and large lymphocytes are also discharged into the intestine, but these are few in number, for the macrophages and the large and medium lymphocytes mostly remain in the centre of the deeper follicles, forming the germinal centre.

May I request your attention to the lymphoid tissue of the alimentary tract as a whole: first, its development; secondly, its position.

Development of Lymphoid Tissue

It is an interesting fact that the development of the lymphoid tissue of the alimentary canal is associated with early life. For example, the lymphoid tissue of the tonsils first appears in the last month of foetal life, generally reaches its maximal development in childhood, and begins to atrophy about the age of 15. Digby (1919) has pointed out that the lymphoid tissue in the appendix of the rabbit is almost entirely developed just after birth.

In order to confirm this we made a series of microscopical sections of the vermiform appendix of small rabbits from the same litter at different times after birth (immediately after birth and seven days, fourteen days, and thirty days after), and the rapid development of the lymphoid tissue was clearly seen. Now the contents of the alimentary canal before birth are sterile; but soon after birth they become infected, and, as Digby says, "it would almost seem that it required the stimulus of bacteria in the alimentary canal to provoke the development of the lymphoid tissue."

I have pointed out on a previous occasion that in the lymphoid tissue of the rabbit's appendix there are normally found numbers of Gram-positive bacteria, and it seemed to be of interest to know how early in life these were present. In the section made just after birth and in seven-day specimens no organisms were seen. In the fourteen-day sections organisms were found on the epithelial surface, but none in the lymphoid tissue; but in the thirty-day sections they appeared both in the crypts and—although not numerous they were definitely present—in the lymph follicles. It would thus seem that the development of the lymphoid tissue begins slightly earlier than the appearance of the organisms, but that the two are definitely associated.

Position of the Tissue

Lymphoid tissue of the alimentary tract occurs in the following positions:

1. At the back of the mouth and nose, where there is an almost complete ring of lymphoid tissue consisting of the lingual, palatine, and pharyngeal tonsils.
2. In the lower part of the small intestine, as Peyer's patches.
3. In the caecum, as the vermiform appendix.
4. In the large intestines, as solitary follicles.

Now in all these places there appears to be a special relation to bacterial infection.

The *tonsillar lymphoid ring*, as we may call it, is at the entrance to the pharynx, where the path of the food and the path of the inspired air cross one another; in other words, the point where the maximum possible combined air-borne and food infection may occur.

The *Peyer's patches* begin where the curbing antibacterial action of the gastric juice and the bile begins to lose its power and micro-organisms begin to multiply. The Peyer's patches become more marked in the lower part of the ileum, until in some animals, such as the pig, there is to be found an enormous Peyer's patch about six feet long in the lower portion of the ileum next to the ileo-caecal valve.

The *vermiform appendix* with its lymphoid tissue is situated at the apex of the caecum at the point where there is probably the greatest stagnation of broken-down food-stuffs and where bacteria are most able to multiply. It is a fact that over 50 per cent. of the contents of the caecum of the rabbit is composed of bacteria.

The *solitary follicles* of the large intestine, again, are in the place where there is marked fermentation and bacterial action.

Thus we see that in all of these places there is apparently a special relation to bacterial infection. Of course it may be a coincidence, but it is certainly very suggestive.

The Lymphoid Ring of the Throat and Nose

Now let us consider the lymphoid ring at the back of the throat and nose. Here the bacteria are taken in by respiration and food. They are for the most part swallowed and are then destroyed by the acid gastric juice, but before entering the oesophagus they have incorporated with them the salivary corpuscles, which are the lymphocytes discharged by the lymph follicles of the tonsils. Digby suggested that the tonsils and adenoids by inviting a direct local infection possibly protected the body as a whole by conferring a general immunity, and it is true that pathogenic bacteria have been found in the lymphoid tissue of the tonsils and have been traced from this point of entry to the lymph nodes of the neck. But although I am not an immunologist I would suggest that possibly the tonsils act also in a somewhat different way, that the discharged lymphocytes or salivary corpuscles react to the bacterial toxins and supply a dose of immune bodies which are swallowed and absorbed by the alimentary canal and help to establish immunity in this manner. Associated with the tonsillar lymphoid tissue are small glands with ducts opening between the folds. During the act of deglutition the ring of lymphoid tissue is contracted, there is a discharge of mucus from the glands, while the lymphoid tissue contributes numerous lymphocytes to the food mass.

A few years ago it was the fashion for children to have their tonsils removed on the slightest pretext, and I remember that when I was a house-surgeon tonsillectomy for enlarged tonsils, not necessarily septic, was by far the most common operation in a large general hospital; but it is now coming to be realized that healthy tonsils must have some use, and that simple enlargement, so long as it is not causing obstruction to respiration, is due to the response of the body to some lack of hygiene or to some dietetic deficiency. It is now a fact that simple enlargement of the tonsils is fast disappearing in European countries, and therefore careful distinction must be made between slight tonsillar enlargements and septic tonsils which cause much ill-health. Layton (1936), surgeon in charge of the throat and ear department of Guy's Hospital,

writing in the *Lancet* in May of this year and speaking from clinical experience, says that in children under 5 to 8 years of age removal of the tonsils impairs resistance to infection—not to the specific diseases such as diphtheria or measles, but to that of general infections, leading to sore throat and colds, and the appearance of diffuse shotty glands in the neck. He further points out that later on, at 14 to 16 years of age, catarrhal deafness is distinctly more common in children who have been subjected to what he calls "flaying of the pharynx," where tonsils and adenoids are completely removed. Moreover, he points out that in the children of the poor living in less hygienic conditions the results may be very serious, and vary from a fading away of the child for no apparent reason to a chronic nasal catarrh which makes it seem as if the child is never free from a cold. He also adds that it is extremely difficult to cure an otitis media which occurs in a tonsillectomized child. All of these facts support the theory that the lymphoid tissue of the tonsillar ring is associated with the protection of the young subject from bacterial infections and that it is of value in the economy of the growing child.

Lymphoid Tissue of the Small Intestine

Turning next to the collections of lymphoid tissue in the small intestine, we must remember that these are associated with the alimentary canal on the one side and with subserous lymphatic vessels on the other. It has been argued that not only the lacteals but also the lymph follicles are associated with the absorption of fat, and that in the latter case this was largely the work of the lymphocytes; but Yoffey (1932) has reported, as the result of experimental work on dogs after feeding the animals on half a pound of lard and collecting the lymph over a period of eight hours from the thoracic duct, that although this was perfectly white and appeared to contain a large quantity of fat, in no case was the proportion of fat higher than 3 per cent., so this would account altogether for only 6 grammes absorbed via the lymph out of a total fat absorption of 226 grammes. Furthermore, even this small amount of fat was not absorbed by the lymphocytes, which in the thoracic duct are practically all (98 per cent.) small, with only the faintest suggestion of a cytoplasmic ring—and no fat could be demonstrated in the lymphocytes by histochemical methods.

I think we can therefore rule out the suggestion that the lymphoid follicles, either solitary or aggregated in Peyer's patches or the vermiform appendix, have any real function in connexion with the absorption of fats.

Relation to Bacteria

Passing on to the relation of the intestinal lymphoid tissue to bacteria, we find strong evidence of this. We have seen that there is a constant and steady discharge of lymphocytes in two directions: (1) into the alimentary canal, and (2) into the subserous lymphatics and so to the thoracic duct. It has not been possible to estimate the number of lymphocytes discharged into the bowel, but the number of those which pass into the blood stream from the lymphatic system as a whole through the thoracic duct is enormous.

Yoffey (1932) found that in a 10-kilogramme dog, on an average, 25 c.cm. of lymph could be collected hourly from the thoracic duct. This had a lymphocyte count of 10,000 to 11,000 per c.mm. The longest period over which lymph was collected was eight hours—this would give a daily lymphocyte output of 6,600,000,000. But the total lympho-

cytes in the circulation in this-sized animal averaged out at 2,000,000,000. It therefore appears, as he pointed out, that all the lymphocytes of the blood are replaced three times daily. He suggests that it is quite likely that the lymphocytes are concerned with the active growth processes of childhood, and that the lymphoid tissues act as a storehouse of primitive wandering mesenchymal cells to supply the various tissues as they are needed. He states his belief that the fundamental problem of lymphoid tissue is concerned more than anything else with the fate of the lymphocyte. What, then, is the fate of the lymphocytes manufactured in the lymphatic follicles of the alimentary canal?

In our own work one of the principal objectives was to discover whether we could confirm a definite migration of lymphocytes into the lumen of the alimentary canal. Accordingly a number of rabbits were operated upon, the vermiform appendix was separated from the apex of the caecum, which was closed with a purse-string suture, and the open base of the appendix was brought to the surface so that its secretion, if any, could be examined. In a previous lecture I reported that we had constantly found the ferment amylase present in the secretion of the appendix, so I will not refer to this again; but the point which I wish to emphasize is the fact that the secretion contained great numbers of lymphocytes, a few large macrophages, and some eosinophil cells. Thus there appears to be no doubt that there is a regular flow of cells from the lymphoid tissue into the lumen of the alimentary canal, and that these cells are almost entirely small lymphocytes. There was no evidence that the lymphocytes were acting as phagocytes, although numerous bacteria were present.

The Reaction to Pathogenic Bacteria

Our next effort was an endeavour to discover what was the reaction of the lymphoid tissue to pathogenic bacteria. For this purpose cultures of two kinds of bacteria were prepared for me by the Division of Pathological Sciences: first, bovine tubercle bacilli; and, secondly, *Staphylococcus aureus*. These organisms were chosen because we needed something which would be readily distinguished from the ordinary flora of the alimentary tract.

In a series of nine rabbits the appendix was obstructed and after a few days' interval the abdomen was reopened; part of the fluid secreted by the appendix was aspirated off and replaced by 1 c.cm. of the culture of tubercle bacilli. After a further interval, varying from five minutes to several days, the appendix was removed and examined, smears were taken, and sections cut of the appendiceal wall. It was found that the tubercle bacilli rapidly disappeared from the contents of the appendix. In one case acid-fast debris was discovered in the deeper lymphoid follicles; and, in another, acid-fast droplets were present on the surface of the epithelium, suggesting that bacteriolysis had taken place. In a third, acid-fast droplets were found both in and just beneath the epithelium of the mucous membrane. In a fourth case, where the animal was allowed to recover, death took place three months later from generalized tuberculosis. I realize that the number of animals used was too small for any definite statement to be made, but the results are suggestive, first, that bacteriolysis takes place either in the lumen of the bowel or in the lymphoid tissue, and, secondly, that bacteria may pass rapidly through the lymph follicles: they may be phagocytosed by the macrophages, or if the infection is a heavy one may pass on into the subserous lymphatics and thus into the general circulation, giving rise to a generalized infection.

Turning to the injection of staphylococci, a culture of *Staphylococcus aureus* was prepared for me by Dr. Tang. The organisms were killed, and then injected into the lumen of the vermiform appendix, the sacculus rotundus of the caecum, and the small intestine opposite to a Peyer's patch, after these had been closed off from the rest of the alimentary canal. Six rabbits were used, and at intervals of from one and a half to fifteen minutes the appendix, sacculus rotundus, and Peyer's patch were removed for histological examination. In the case of the appendix, sections showed some of the organisms on the surface of the epithelium or passing down the crypts, some just beneath, between or associated with lymphocytes within the epithelial cells, some in the superficial and deep lymph follicles, and a few in the lymph spaces.

We had previously noticed that where bacteria were particularly thick upon the surface of the epithelium there appeared to be a moving out of the lymphocytes through or between the epithelial cells as if to resist, and yet there was in that locality no active phagocytosis, thus confirming the theory that any lymphocytic action must be by bacteriolysis, with the formation and discharge of granules (Fig. 4).

At the same time some bacteria could pass through or between the epithelial cells, enter the lymph follicles, and migrate to the deeper parts, where they are met by the macrophages, a second line of defence being formed by phagocytes. The sacculus rotundus and the Peyer's patch showed similar results, but not nearly so marked as in the case of the appendix.

We have previously noted that in the rabbit the lymphoid tissue of the alimentary canal is normally associated with the presence of Gram-positive bacteria, and our next effort was to try to find where these bacteria came from and whether there were any conditions which affected the amount of lymphoid tissue or the number of organisms present, and so lead to some theories as to the function of the lymphoid tissue or the reason for the presence of the bacteria.

Effect of Vitamin A Deficiency

Accordingly several batches of rabbits were put on to a vitamin A deficient diet. It was obvious that the numbers of organisms in the lymphoid tissue were markedly increased; and not only were they present in large numbers scattered throughout the deeper follicles, but they appeared to be massed in colonies as if they were multiplying locally. Especially was this the case in the lymphoid tissue of the vermiform appendix; it was so to a less degree in the sacculus rotundus, and to a still less degree in the lymphoid tissue of the Peyer's patch, situated a few inches from the ileo-caecal valve.

It was also noted that when the animals had been deprived of vitamin A their lymphoid follicles showed signs of atrophy, and in the later stages, when they had begun to develop signs of xerophthalmia, the lymphoid follicles were represented by only a very thin layer of leucocytes (Fig. 5). This was so marked that it was decided to see whether the readministration of vitamin A would cause a regeneration of the lymphoid follicles. A rabbit was therefore chosen which had been on a vitamin A deficient diet for several months and in which xerophthalmia was well developed. The animal was given a similar diet with the addition of carotene in oil for one week and then killed, and the appendix and other lymphoid organs removed. When the lymphoid tissue was examined it was found that the deeper follicles showed the characteristics of active regeneration, with both superficial

and deep follicles present. (Fig. 6). This work requires confirmation, but if this is forthcoming it is certainly suggestive as a possible reason for the decline in the protective mechanism of the organism against infection and also for the loss of immunity against bacterial infection in vitamin A deficiency.

Professor McCoy lectured recently upon "Immunity in Helminth Infections," and he stated that an immunity is developed in some way at present unknown while the worms are in the alimentary canal. He demonstrated that the development of this immunity could not be brought about after animals had been for two weeks on a vitamin A deficient diet and before there was time for the development of epithelial changes. May it not well be due to the effect of a lack of vitamin A upon the lymphoid tissue of the alimentary tract?

Commentary

You may ask why a surgeon should venture into the sacred domain of bacteriology and dietetics; the answer is that I believe that just as you have a recognized department of medicine known as "preventive medicine," so there ought to be an endeavour to establish "preventive surgery." I visualize the time when the physician will try to prevent and even treat his typhoid cases, which after all are probably simply attacks on the lymphoid tissue of the Peyer's patches by *B. typhosus*, and the surgeon will try to prevent an attack of appendicitis, which is probably an attack of septic organisms on the lymphoid tissue of the vermiform appendix—possibly in both cases by a well-balanced diet or by vitamin therapy.

Anyhow, every advance in the science of medicine brings nearer the time when medical and surgical advice will be sought more for the prevention than for the cure of disease; for, as recently pointed out by Sir Robert McCarrison, Medicine is not simply concerned with the cure but still more with the prevention of disease, and we surgeons are quite willing and anxious to do our share in the discovery of means whereby we can beat our scalpels and forceps into forks, spoons, and chopsticks for the administration of a well-balanced diet.

I want to thank Drs. H. C. Hou, F. F. Tang, and Yu-ho for much helpful advice, Mr. Henderson for his painstaking efforts in assisting me in this piece of work, and Mr. R. V. Dent for the photomicrography.

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H. v. Heuss (*Med. Welt*, November 6, 1937) describes the effects of the "yellow-cross" poison gas, dichloroethyl sulphide. It is lipid-soluble and it impregnates the superficial layers of the skin, reaches the subpapillary blood vessels and their nervous plexuses, and since these plexuses are rich in lipoids it tends to accumulate there. The general clinical picture is somewhat similar to that of Addison's disease. The affected individuals are apathetic and adynamic; they suffer from vomiting and diarrhoea and they lose weight, and some cases may show pigmentation of the skin. The author, therefore, recommends for these cases extracts of suprarenal cortex in combination with glucose administered intravenously or intramuscularly.

THE MODERN TREATMENT OF DIABETES MELLITUS AND THE USE OF ZINC PROTAMINE INSULIN*

BY

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Until about fifteen years ago the treatment of diabetes mellitus in the young and middle-aged was generally unsatisfactory to the doctor, and often almost cruelty to the patient: carbohydrates, fats, and proteins were progressively restricted as the disease advanced, so that the unfortunate patient eventually existed in a state of semi-starvation, until coma and death released him from his sufferings, usually within two or three years from the time the diagnosis was first made. About the year 1922, however, with the introduction of insulin, the renaissance of the treatment of diabetes took place. Even then the policy was still to limit the patient's diet so that only a minimum dose of insulin was required; for it was then uncertain what the exact effect of insulin would be if given over a long period.

Modern Methods of Dieting

It has been only during the last few years that, as a result of the increasing knowledge of the effect of insulin, gradually more liberal carbohydrate diets have been allowed, and lately, unless the patient be overweight, 150 to 200 grammes or more of carbohydrate per day have been given, with a somewhat restricted amount of fat. It has not been found that the insulin has to be increased to any great extent on this account. I have a patient, a young woman, suffering from a severe toxic goitre with much wasting, together with true diabetes mellitus. On a diet of 300 grammes of carbohydrate with as much fat and protein as she likes, and with sufficient zinc protamine insulin to keep her free from glycosuria, she is improving; so much so that a subtotal thyroidectomy will be possible in the near future.

The advantages of an increased carbohydrate diet are:

1. Patients feel much fitter, both physically and psychologically, as the diet approximates to that of an ordinary healthy individual and is more correctly balanced.
2. Life is made easier for them. The modern diabetic can stay at an hotel, and with care is able to choose his food from the ordinary menu; the child can have his meals at the family table, provided he keeps within his fixed ration of carbohydrates, which is now a satisfying one.
3. The chances of hypoglycaemia occurring, which the diabetic dreads, are much lessened.
4. The occurrence of ketosis is much decreased.

5. It has been claimed that an increased carbohydrate diet with a relative decrease of fat lessens the incidence of arteriosclerosis, which is such a common complication of diabetes in later life. This, however, is too large a subject to be referred to any further here.

The simplest method of arranging the diet for a diabetic is, I find, the Lawrence line ration scheme. The number of black lines to be taken, each containing ten grammes of carbohydrate, is settled for each patient. At first this food is weighed, but later on the patient can guess the amount with sufficient accuracy. The number of the red lines containing fixed amounts of fat and

* The substance of the Presidential Address delivered before the Derbyshire Branch of the British Medical Association, June 23, 1937.

H. GORDON THOMPSON: LYMPHOID TISSUE OF THE ALIMENTARY CANAL

FIG. 1.—Vermiform appendix of rabbit (low power). Lymphocytes pouring into the alimentary canal.

FIG. 2.—Vermiform appendix of rabbit (high power). Lymphocytes pouring into the alimentary canal.

FIG. 3.—Vermiform appendix of rabbit. Lymphocytes in subserous lymphatics.

FIG. 4.—Vermiform appendix of rabbit. Groups of lymphocytes moving out to meet bacterial invasion.

FIG. 5.—Vermiform appendix of rabbit. Atrophy of lymphoid tissue as a result of vitamin A deficient diet.

FIG. 6.—Vermiform appendix of rabbit. Regeneration of lymphoid tissue after giving provitamin A (carotene).