The Huxley Lecture

ON

THE FUNCTION OF THE CAECUM AND APPENDIX.

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[AFTER some introductory remarks Sir William Macewen proceeded:]

What Huxley owed to the various teachers in Charing Cross Medical School may be difficult to gauge and hopeless to apportion; doubtless each had its subtle influence. Some teachers supply material which enables students to pass examinations and nothing more. Here and there one finds a teacher who not only imparts information, but who can do much more for receptive students—he can teach them to observe, and, better still, he may induce them to think. When we do happen to come in contact with one of these, we should stand by silently and watch him work. Such teachers are true fertilizers of youth.

There were two people who, Huxley acknowledged, aided in forming his early mind. The one was Professor of Physiology in Charing Cross School of Medicine, Mr. Wharton Jones, of whom Huxley says, "I don't know that I have ever felt so much respect for anybody, as a teacher, before or since"—the importance of that teaching may be gathered when it is remembered that Huxley made comparative anatomy and physiology his life-study. The other was a man with whom Huxley hardly ever came into personal contact, and whose life-work lay far removed from scientific pursuits, one who has been called many hard names, and who will live long after the libellers have been forgotten; one who wrote his works in the silence and seclusion of the lonely countryside. We may see in Huxley's whole life the immense influence exerted over him by this great teacher. He not only led him to look into German literature and to reap the fruit of the extension of that study into German science, but Huxley's life-work seems to have been framed upon Carlyle's principal motif. Huxley acknowledges his great indebtedness to *Sartor Resartus*—and perhaps I may be permitted also to acknowledge that influence. The first time I read *Sartor Resartus*, it was a sealed book to me—my mind being quite unprepared for it, it fell flat. Years after, having passed through a furnace of doubt and difficulty in the meantime, I happened to light accidentally upon *Sartor Resartus*, and opening its pages read and reread it, day and night, pursuing its discourse with restless eagerness until it was consumed and digested. Its true meaning and bearing on life was revealed—it proved a draught of deepest joy and refreshment to a thirsty soul. It is evident that *Sartor Resartus* made a deep impression upon Huxley. Look, for instance, at what Carlyle says on the pursuit of truth:

"One circumstance I note," says he, "After all the nameless woe that inquiry which for me, what it is not always, was genuine love of truth, had wrought me, I nevertheless still loved truth, and would bate no jot of my allegiance to her. Truth, I cried, though the heavens crush me for following her; no falsehood, though a whole celestial lubberland were the price of Apostasy."

That same cry has been repeated through Huxley's life. We recognize it as the guiding spirit of his work, that which made him hate shams and strike them hard when he found them.

In commenting upon the many hard names he had been called, Huxley says: "One thing people will not call me with justice, and that is 'A liar!'" He regarded truth as the apple of his eye. He would willingly own the monkey as an ancestor should facts prove it to be so, and would shun any one who used great gifts to obscure truth. It was that ruthless endeavour to reach truth and cling to it for its own sake that made Huxley what he was. His creed may be summed up in his own words: "Sit down before fact as a little child, be prepared to give up every preconceived notion, follow humbly wherever and to whatever abysses Nature leads, or you shall learn nothing."

No doubt most of you are familiar with that delightful life of Huxley written by his son, and the many glimpses into his character which one gets there. Allow me to give another.

Many years ago a paper was prepared by me on the trans-plantation of bone, and a friend suggested that it should be sent to the Royal Society. Not knowing one single person belonging to that Society, I rather hesitated about complying with the suggestion, believing that the paper might not be received. Finally, however, it was agreed to let the Royal Society have the refusal of it, so the paper was sent, addressed to "The Secretary." Shortly after, I received a letter from Huxley, who was secretary at that time, inviting me to be present for the reading of the paper, which he had taken the responsibility of placing directly before the Society, without requiring, as usual, that it be first submitted to the Council for consideration. The recollection of that first meeting with Huxley has ever since filled me with warm admiration of his kindly personality. I came before him an absolutely unknown person and a stranger, yet he took me by the hand, seated himself beside me, and soon we were oblivious to all save the matter of our conversation. He asked me many questions concerning the subject of the paper, and gave me in return information regarding the persistence of vitality in parts removed from the lower forms of organism and other kindred subjects. He further gave much useful advice on the best manner of presenting the paper to the Society. The summary read was successful in awaking the interest of the members in the subject treated, and a discussion followed the reading, in which Mr. Busk, Mr. Bowman, Emeritus Professor Allen Thomson, Professor Huxley, and others took part. But I believe it was mainly the kindly interest evinced by Huxley toward the subject which brought about its favourable reception.

Is this body of ours so very imperfect that we require to submit it to the numerous rectifications which are sometimes recommended to be carried out after it comes into the world?

The Arabs, not content with the beautiful ovoid form of the cranium, apply boards and flatten the heads of their offspring. Certain Africans and South Sea Islanders transfix their nasal cartilages and place rings and skewers through them. The Chinese produce a very high arch in the feet of their ladies by bringing the toes and heels together. We smile at these "improvements" and call them distortions. When a child is born in this country some consider it necessary that he be circumcised. A few years later the tonsils are removed; this is followed by the removal of the pharyngeal tonsil; a few years later the appendix becomes an ever-increasing terror, which is only allayed when that organ has been placed in a glass jar. Next, there is at present openly expressed discontent about the alimentary tract. Some are persuaded that there is an intestinal whorl too much, and that this extra whorl requires to be "short-circuited." It is further alleged that the stomach is an organ which the human body would be well to be rid of, and though it be the chief seat of digestion of albuminous substances, yet that the small intestine should take its place. One author goes on to say that many creatures that have found the opportunity of obtaining their nourishment in a highly-digestible condition have lost more or less completely the digestive organs; that parasites such as the tapeworm live in the human digestive tract, bathed in nutritive fluid which they absorb directly, they having no digestive tract. From the trend of this author's remarks, one would gather that he believed that man has been evolved in the wrong direction, though he does not go the length of proposing that man should receive his nutriment through the medium of his morning tub. It would not be surprising if some one, going on the same lines, were to state that he had arrived at the conclusion that the olfactory and gustatory nerves were but remnants of a bygone age when our primitive ancestors had to sniff the air to guide them to their food, and for its proper selection had to depend on their sense of taste; as these nerves were no longer of use for our protection and comfort, were in fact a source of considerable inconvenience, their devolution would add greatly to the happiness of mankind; that mastication was out of fashion, teeth a failure, deglutition a bore (especially as the tongue was now constantly occupied in a "higher sphere"), and digestion a discomfort; that eating and drinking, with all their attendant evils, being remnants of a pre-civilized age, ought to be abolished, and each human being, shortly after birth, should have an enterostomy performed (quite a simple matter—an incision, a loop of bowel,

a few stitches), and ever after that be happy. A few pellets of concentrated essences, delicately adjusted by chemical processes, might easily be dropped into this minute aperture, where they would speedily be converted into pabulum sufficient to sustain man in all his wants without any waste products remaining. Instead of the nation being burdened by the maintenance of the largest fleet in the world held for protection and transit of ships loaded with food-stuffs which pass into our markets day by day, some firms of chemists would simply enlarge their premises, and send out food supplies in the shape of tabloids, which could be delivered by the local postman. What a social revolution this would accomplish—how much time and labour would be saved—the abolition of the epicure and the diner-out, champagne and turtle soup a matter of history! No more teetotal societies or black lists, and the consequent empty gaols, to say nothing of the solution of the domestic servant problem! It is scarcely likely that in the City of London, at least, such a proposition would become popular.

Again, the large intestine is by some physiologists regarded as a useless inheritance bequeathed to us by our animal ancestors, of little importance as far as digestion goes, and mainly discharging a function similar to that of the urinary bladder. The urine, continually secreted by the kidneys, accumulates in the reservoir provided by the bladder. In like manner, after digestion, the remaining waste matter accumulates in the intestinal receptacle, the colon, where it remains for a period, but where it may stagnate, the products of putrefaction being absorbed and thereby becoming harmful to the individual. It is boldly asserted that the large intestine and its appendix are at best superfluous, generally antagonistic to health, and baneful to the life of man, and that their removal would be attended by happy results.

Some who hesitate to go so far as to advocate the removal of the colon have no scruple in condemning the caecal or vermiform appendix. All agree that this is a rudimentary and useless organ, through the incompetency of which life is constantly threatened and many times lost. Some persons have been so much impressed by this idea that they are uneasy until the appendix has been removed; and some surgeons say that, while operating for other purposes, they never miss the opportunity of relieving their patients of a possible source of danger by removing the normal appendix from the abdomen.

With all such proposals before us, one is forced to ask, Is this human body of ours so badly constructed that it contains many useless parts, and requires so much tinkering? Possibly I may be out of fashion with the times, as I cannot find such imperfections in the normal human body as are alleged. On the contrary, the more one looks into the human body and sees it work, the better one understands it, and the more one is struck with the wondrous utility, beauty, and harmony of all its parts. There are many parts of the human body whose structure is unknown, and the function of which is hidden. Have we a right to conclude that every part of the human anatomy whose structure and function we do not understand is useless? The theory of evolution does not lead us to such a conclusion. Evolution there certainly has been, and it still goes on; but it would be fallacious to conclude that every organ whose use is not clear to us must be a remnant of a past existence, and therefore of no further use.

Man, like all other animals, has undergone and is doubtless still undergoing slight modification as the thousands of years pass, but when that fact is granted, we have still to ask whether man has outlived the use of any particular part of his anatomy. Others argue on different lines, stating that they have removed the healthy appendix and that as the persons have thereafter maintained undisturbed health, it was clear to them that the appendix could perform "no function useful to man." Is this argument not equally fallacious? One has been compelled to remove the spleen and certain portions of the brain, one of the lungs and one of the kidneys, and the patients recovering were in after-life able to go about their work without detriment apparent to the ordinary observer; but it would be ridiculous to say that therefore the spleen and those portions of the brain, kidneys, and lungs were useless in normal human beings and should be removed, or that man would be as well without these organs.

One would prefer normal man as he comes into this world to the pared and mutilated animal which would be produced if the attempts at betterment which some folks propose were carried into effect. With all his alleged imperfections, normal

man is a much more perfect animal than the physiologist or the surgeon can make him. Human effort toward the repair and perfecting of normal man has hitherto been poor compared with Nature.

It is, however, seen that the appendix is often the seat of disease, sometimes arising with startling abruptness, sometimes approaching insidiously, and usually selecting the youth of both sexes, striking them down with appalling suddenness. To combat this disease thousands of operations are required, many individual surgeons performing hundreds of operations for the relief of this affection which would in the majority of instances otherwise have ended fatally. All this removal of diseased appendices, however, does not bring us one step nearer the causation of the disease or the prevention of the malady, nor does the solution of these seem probable as long as one regards the appendix as useless. If the appendix be really a useless organ, and at the same time a menace to the life of its possessor, should it not be removed at an early period of existence? Many imbued with this idea beg to have their appendices taken away.

In the midst of this serious indictment against the appendix, dare one say a word in its favour?

The great majority of mankind seems to do very well with the appendix; it gives rise to no annoyance in them, for it is, after all, a small percentage of the community that becomes the victims of appendicitis. Is the appendix really a useless organ? In endeavouring to answer this question it is seen that the appendix is so closely connected with the caecum, that it is necessary in any such inquiry to consider the structure and function of the caecum and appendix together. While physiologists have done much work on digestion in man, they have confined their attention principally to the upper portion of the alimentary canal, seldom descending further than that part of the small intestine where the bile and the pancreatic juice are poured into it. The large intestine is treated by them as a whole, the caecum is not differentiated, and the processus vermiformis is either not mentioned at all or dismissed in a few lines dealing with its histology. It is only recently that anatomical textbooks have paid attention to the structure and position of the appendix, the attention of anatomists having been directed to it by the surgical work that was being done in that region. In the same way, people learn geography by the wars that are being waged in various parts of the world. Speaking generally, the colon—including the caecum—is regarded by physiologists mainly as a receptacle for the refuse of the food-stuff from which the nutriment has been removed. The absorption of the soluble constituents, especially of water, is completed in this tube, and it is probable that cellulose may be digested by fermentive changes occurring therein.

Is it not possible that in man the caecum and appendix play an important part in the process of digestion? In considering this question let us first look briefly at the lessons which may be gained from a study of digestion in the lower animals. Comparative anatomy shows us that in the lower forms of life, such as in fish, batrachians, and reptiles, the caecal appendages do not exist, the small and large intestines forming a continuous tube. Higher in the scale of life, as in birds and mammals, one sees at the junction of the small with the large intestine one and sometimes two pouches, in which the food undergoes a certain process of digestion before it is passed into the colon. There are, however, considerable differences in the caeca among the mammals and birds, dependent on the nature of the food which they consume and on whether there is special provision for its digestion.

In the carnivorous mammals, as in dogs and cats, the caecum is rudimentary or absent, and the colon is short and uncomplicated. The gland secretion from the upper part of the alimentary tract is abundant, and so strong as to produce a powerful digestive effect, which process is carried out in the stomach and small intestine, the latter of which also absorbs the principal nutritious elements. It is quite different in the complicated digestive apparatus of the herbivora, in whose immense caeca the digestive process goes on, and in some of which it forms the most important part of the digestive apparatus.

In those of the herbivora whose food not only is poor in nutritious substances but is enclosed in resisting cellulose envelopes, the digestive apparatus is complex and often specialized. The ruminants have not only powerful masticatory apparatus and abundant saliva, but they have several pouches and stomachs in which the food is prepared, and they possess long intestinal tracts and well-developed caeca.

On the other hand, in the monogastric herbivora, as the horse and rabbit, which do not chew the cud and which often bolt their food, the stomach is small and the digestion is principally caecal, the caecum having become compensatorily enlarged. The caecum in these animals is enormously developed, being much larger than the stomach and forming an immense pocket occupying the greater portion of the abdomen. Besides having numerous folds of mucous membrane, it is abundantly endowed with gland follicles and large lymphatics. The caecum is thus a compensatory organ to the stomach. In those herbivora that feed principally on tender vegetables and fruits, capable of being easily digested, the caecum is small. In those that feed upon bulky vegetables, difficult to digest and rich in cellulose, besides having specialized organs made for digestion in the upper part of the alimentary tract, they have enlarged caeca, in which an important part of the digestion occurs; while in those herbivora whose stomach is small the principal part of their digestion occurs in the caecum. The caecum of the solipeds takes the place of the ruminant's stomach.

In birds the same facts are demonstrated. The vegetable eaters among them have greatly developed caeca, abundantly supplied with glands secreting a digestive fluid, also with villi for absorption, and the mucous membrane is thrown into folds to further multiply the surface. In flesh-eating birds the caeca are rudimentary or absent, digestion in their case being completed in the stomach and small intestine. In such birds as pigeons and geese with double crops—analogs of the ruminant's pouches—the process of grinding and mixing the food with digestive fluid is so thorough that the digestion is completed in the upper portion of the alimentary canal and the caeca are absent. The crop and gizzard fulfil the same end as the caeca. It is seen in the herbivora that a large amount of undigested food is found in the caecum, while in the colon most of the undigested matter has disappeared, showing that digestion has occurred in the caecum. Many recognize that the caecum acts as a reservoir for fluids and undigested food-stuffs coming from the small intestine, the caecal reaction and temperature favouring fermentive change. While cellulose has passed through the small intestine unacted on by the saliva, gastric juice, and pancreatic secretion, it becomes digested in the caecum, where it may be converted into marsh-gas and possibly into sugar, the latter of which is absorbed.

To summarize: one sees that the digestion in carnivorous birds and animals takes place principally in the stomach and small intestine, the caeca being rudimentary or absent; while in the herbivora the caecum is enormously developed and in the solipeds the caecum is the chief digestive organ, the stomach occupying a secondary place.

Man, if not an omnivorous animal, is at least a carnivorous and herbivorous one; therefore, by analogy, one would expect man to possess not only a stomach and small intestine, but also a caecum—just as he has. As the vegetable food which he consumes is generally of the more tender and nutritive varieties, the caecum is only of moderate size.

DATA OBTAINED FROM OBSERVATIONS ON MAN.

During practice frequent opportunities present themselves by means of openings made for the relief of pathological conditions or brought about by traumatism or disease, for observation on digestion, as carried out in the various portions of the alimentary tract. While such observations have from the very nature of things been fragmentary and incomplete, and in this respect not comparable to direct experiment practised on the lower animals, and further having the disadvantage of being seen through pathological surroundings, still they possess some compensating value from having been made upon man himself.

The effect upon the patient of the escape of food-stuffs from the alimentary canal through fistulous openings varies according to their position relatively to their distance from the stomach. The nearer the stomach the more serious the result. For our present purpose it is sufficient to look to the effects of the escape of chyme from such openings as may occur toward the distal end of the small intestine, the caecum, and the colon.

When openings have formed toward the distal extremity of the ileum, of sufficient magnitude to allow the chyme and intestinal secretions to escape freely, the patient suffers from inanition. A somewhat similar result is seen when the artificial opening has occurred in the caecum of sufficient size and patency to allow of the free escape of the contents. The strength of the patient becomes less and

is difficult to maintain, especially when ordinary food is administered.

In marked contrast to this is the condition of the patient affected with an artificial opening in the descending colon near the sigmoid. He does not lose weight; on the contrary this is often increased, his health and strength are maintained, and he is capable of carrying out his usual avocation with vigour. These facts go to prove that the entire nutriment obtainable from food is not removed during its passage through the small intestine, otherwise there would be no perceptible loss when the chyme is removed at the end of it. Whereas, it is only when the chyme is allowed to pass along the whole length of the large intestine as far as the sigmoid flexure that the patient derives the full good of the ingested matter. It is further seen that if a large opening be made in the caecum, not only permitting the contents to escape freely, but also interfering seriously with its secreting surface, troublesome diarrhoea is apt to occur, accompanied by a watery secretion from the mucous membrane. This diarrhoea, which is apt to ensue, constitutes one of the difficulties in dealing with such cases, and arises not only from the interference with the caecal function, but also probably with the influence controlling the ileo-caecal valve.

If the caecum be entirely removed, the patient recovers and maintains fair health as long as special diet be taken, but he is subject to attacks of diarrhoea, alternating with constipation, on the ingestion of ordinary food. In six cases of this kind operated on by me, two only had a tendency to diarrhoea, alternating with constipation, and they complained of frequent indigestion, while four others complained of diarrhoea as being of frequent occurrence. Though for months after the operation which relieved them of their previous pathological conditions these patients improved greatly in strength and weight, yet ultimately they appeared thin and impoverished, the diarrhoea being still apt to occur.

In one patient, whose caecum, ileo-colic valve, and a large portion of the ascending colon had to be removed, the ultimate diarrhoea was an annoying and a marked symptom, commencing, as the patient stated, "on the slightest excuse," and continuing for an indefinite period thereafter—often for weeks. This patient likewise became weak and lost flesh, and though living for many years after the operation never regained normal weight. (It has been reported that the ligation of the caeca in chickens produces diarrhoea with loss of flesh, which ultimately causes death from inanition.)

Those cases illustrate the fact that the arrest of the function of the caecum results in disturbed digestion manifested in diarrhoea and in lowering of the strength, though these results may be modified by special diet.

In observing the caecum through defects in the abdominal wall it is seen that, when in a physiological condition and undisturbed, it undergoes considerable alterations in form, sometimes being broader and sometimes elongated, and occasionally there is a churning movement. At first such movements seem to be erratic, but there are at least some of them which apparently are excited by the taking of food and by its passage through the small intestine. In some patients, immediately on taking food into the stomach there was a caecal movement commencing from below upwards, as if expulsive. In one instance this seemed to correspond to a peristaltic action of the small intestine, but in others such movement in the small intestine could not be discovered, and in them it followed the ingestion of food too quickly to permit of the peristalsis acting through the whole length of the small intestine. It was, therefore, regarded as probably due to reflex action. Once this movement was excited in the caecum it traversed the colon, and, in one instance at least, it reached as far as the sigmoid.

Some of these caecal movements originate in the appendix, the undulating movement running upward from the appendix, and causing the contraction of the caecum. There were other movements in the caecum whose point of origin was not ascertained. Observations on the interior of the caecum, seen through defects in its walls, showed that there were differences in the amount and fluidity of the secretion exuding from its mucous surface. When irritated mechanically, the flow of exudate was greater and more fluid. At a variable interval after a meal—one or two hours—peristaltic effects in the colon ensued, resulting in the extrusion of its contents, and shortly after a clear thick fluid was poured from the secreting caecal surface, and in several instances was seen to exude in considerable quantity from the appendicular orifice. As far as could be ascertained, there was no cause for this

flow other than a reflex action, possibly stimulated by the presence of food and the exudation from the upper part of the small intestine.

In a case where the anterior wall of the caecum had been removed (by an explosion), the ileo-caecal valve and the appendicular orifice being exposed, after recovery from the shock several observations were made. First it was seen that there was a considerable flow of glairy mucus from the appendix and caecal surface which did not constantly exude, or, at least, did so to a greater extent shortly after food was introduced into the stomach, and to a marked extent just before food began to pass through the ileo-caecal valve. On one occasion quite a stream of fluid poured from the appendix just before the chyme began to pass through the ileo-caecal valve. When chyme passed through this valve it did so in small quantities at a time, and there were occasional pauses in which the ileo-caecal valve seemed to close—probably by a reflex action. This fluid from the caecum and appendix was invariably alkaline.

This patient, who was very observant, took quite a philosophic interest in his condition, and was rather proud that his misfortune could be made of service. It was seen that his will power had no effect upon either the secretion or on the control of the ileo-caecal valve; but one day, when he was much disturbed by the reception of "bad news," which could not be kept from him, and after which he said he had indigestion or was "bilious," the secretion in the caecum was at first very watery, and then the surface became drier than at any previous time, and apparently the contents of the small intestine were more quickly evacuated, and overflowing gave rise to smarting and irritation on the sides of the wound. The caecal secretion, being scanty, was not sufficient to neutralize the acid chyme which was poured in. Usually the flow from the ileo-caecal valve was slow, the material passing into the caecum in small quantities, which slide over the orifice of the appendix and get smeared by the exudation therefrom, as well as mixed with the exudation from the general caecal cavity.

It seems as though there were a control over the ileo-caecal valve regulating the amount of material which passes from the small intestine into the caecum. If the valve by any means be rendered patent, the contents of the small intestine flow quickly into the caecum, and a troublesome escape of semi-digested material ensues—material which has missed the caecal digestion. One of the troubles of operation in this region consists in the arrest of the control of the ileo-caecal valve and the flow of the fluid contents from the small intestine into the caecum at a rate greater than the caecum and appendix can deal with. Is this regulation of the flow into the caecum due to reflex action, induced by the impression on the nerves of the mucous membrane of the caecum and appendix, brought about by the quantity and quality of the contents of the small intestine which are received into the caecum? Such is a probable solution.

Attempts were made to stimulate artificially the exudation from the caecum and appendix. The passage of the finger lightly over the caecal surface from the ileo-caecal valve downwards toward the base of the caecum did not succeed in increasing the exudation. A camel-hair brush, moistened in the chyme issuing from the ileo-colic valve, and drawn several times downwards over the mouth of the appendix, was followed on several occasions by an increased exudation—while oftener it had no such result.

The fold of mucous membrane about the orifice of the appendix has been seen to close and cover the orifice, and in the same patient has been seen to recede and to expose the opening. Artificial means were not successful in bringing the folds of mucous membrane over the aperture, by inducing reflex action.

You are all aware that, by a beautiful experiment performed on the upper part of the digestive tract of dogs, Pawlow has recently shown that there was, what he named an acid reflex, which controlled the pyloric extremity of the stomach and prevented the acid contents of the stomach from issuing in too great quantity at a given time, whereas, with alkaline contents, the reflex of the pyloric valve did not exist. It appears to me that at the ileo-caecal valve there is a controlling reflex agency regulating the flow of partially-digested food into the caecum. It regulates the flow of material at a rate which enables the caecum and its juices to deal with it. When this agency is interfered with caecal indigestion occurs which generally ends in diarrhoea of partially-digested matter, but which occasionally leads to masses of matter gathering in the caecum and causing constipation, with sub-

sequent fermentive action of a kind which is apt to result in irritation of the mucous membrane and appendix.

NERVOUS MECHANISM OF APPENDIX.

The appendix is regarded as a mere diverticulum of the caecum, and yet its vascular and nervous supply pertain more to that of the small intestine than that of the colon. The appendix is supplied by the terminal branches of the same group of nerves as supply the small intestine—the superior mesenteric plexus of the sympathetic. Reflex action may be easily set agoing in the appendix by stimuli from the small intestine, and each part may react on the other.

When it is recollected that the circular muscles of the caecum are continuous with those of the appendix, and that the longitudinal caecal bands end themselves on the appendix, it will be understood how easily the nervous apparatus of the appendix may initiate the larger movements of the caecum by first inducing movements in the appendix, and how inhibition of these movements may cause caecal disturbance. The same agency, by control of the vascular supply, will regulate the exudation from the appendix, and that in accordance with the impulse received from the small intestine. It is known that the mind has an influence on the small intestine through the vagi, sometimes exciting peristalsis and sometimes arresting it. The appendix is subject to the same mental effects. An instance of the result of mental disturbance on the caecal secretions having been already quoted, one can see that a concentrated brain effort or profound mental distress has the power of producing effects upon the appendix and caecum and their secretion.

Thoughts passing through the mind are well known to affect the secretion of the salivary glands. In two cases which were under my notice, in both of which the duct had formed a communication with the skin on the cheek—while the natural opening into the mouth had closed—we could produce an astonishingly free flow of saliva by mere suggestion of foods, especially of acid fruits. One of the patients had to beg of his friends not to introduce food topics into their conversation, in order that he might be relieved from mopping up the flow. While his mind was fully occupied, as when he felt cornered in chess, there was cessation of the salivary flow.

In the foregoing we have seen that there is a nervous mechanism regulating the movements of the appendix and caecum, and also controlling the ileo-caecal valve. We have also seen that the exudation of the appendix and caecum is augmented and diminished under certain circumstances. Let us look now to the character and power of this exudation emanating from the appendix and caecum.

THE SECRETING SURFACE OF THE CAECUM AND APPENDIX.

In the first part of the large intestine, and especially in the caecum and appendix, the lymphatic follicles and the glands of Lieberkühn are very numerous and well developed, the latter being larger, deeper, and broader than the corresponding cells in the small intestine, and the goblet cells which they contain are larger and more abundant. This all histologists admit. So closely are those glands packed together in the caecum, that the united surface presented by them is immensely larger than the ridges between the glands, which is all that is left at this place for absorption. So that the histological structure would point to the caecum and appendix being made for digestive purposes rather than for absorption.

The succus entericus which is exuded by these cells of Lieberkühn has hitherto received scant attention by physiologists, and it has been stated that even in the small intestine it is of little moment in digestion. But in the small intestine the succus entericus is of great assistance in digestion, possessing the capability of increasing the activity of the pancreatic ferments and "more especially the proteolytic," the latter to a marked degree. The succus entericus appears to Pawlow as a ferment of other ferments, which he names enterokinase. So powerful is this kinase that, while pancreatic juice alone took six hours to dissolve fibrin in a thermostat, and had not even attacked white of egg after ten hours, the addition of some succus entericus to the pancreatic juice dissolved the fibrin in from three to ten minutes, and the coagulated white of egg in three to six minutes.

Now, if we remember that the glands of Lieberkühn are far more numerous and better developed in the upper part of the colon, the caecum, and appendix than in the small intestine, it will be apparent what a powerful adjuvant to the completion of digestion is to be found in the caecal succus entericus, which is poured out so abundantly from those parts upon the semi-digested matter received from the small intestine.

Taking the appendix apart, though there are individual differences, one sees in most appendices that the surface is covered with glands of Lieberkühn in an active state of secretion during health. If one takes the appendix at an average of $3\frac{1}{2}$ in. and lines that space with glands of Lieberkühn encircling the interior, it is seen that a considerable amount of succus entericus may be exuded from that surface alone, more especially as it is abundantly supplied with blood; therefore, the secretion of the appendix, viewed alone in this sense, would be a valuable aid to digestion.

THE ACTIONS OF MICRO-ORGANISMS ON CAECAL DIGESTION.

There is, however, another agent at work in the final disintegration of pabulum poured into the caecum, and that is the micro-organisms. They find in the caecum and appendix abundance of alkaline medium in which they can grow and pabulum in the chyme for their development. They undoubtedly perform a part in disintegrating compounds which have resisted the action of the gastric and intestinal exudations. These organisms are found in all the recesses of the caecum and colon, and are constantly found in the cavity of the appendix, the exudation from which aids in stimulating and at the same time in controlling the action of the organisms and in preventing them from acting injuriously upon their host. The leucocytes in the solitary lymphatic follicles and the nuclein aid in maintaining this control. Bizzozero has shown that the cells of the appendix in healthy rabbits contain enormous numbers of degenerated micro-organisms, and Ruffer has counted more than 200 micro-organisms in a single field of a section of the vermiform appendix. It looks as if the cells and nuclein of the solitary follicles in the appendix have a controlling action on the organisms, and one of the functions of the appendix may be to maintain cultures of these organisms in a fit state to perform their function on the pabulum poured into the caecum. On the inhibition of this function, the germs may be capable of damaging the coats of the caecum and appendix which have been thereby lowered in vitality. When a purgative action has produced its effect and cleared out most of the germs from the caecum and colon, those in the appendix will still maintain a fresh culture for renewed action. The chyme from the ileo-caecal valve is directed toward the orifice of the appendix and receives there its portion of succus entericus and germs fitting it for the completion of digestion.

SOME ANATOMICAL RELATIONS OF THE APPENDIX AND ILEO-COLIC VALVE.

When one looks at the disposition and arrangement of the various parts in the interior of the caecum, one sees that the ileo-caecal valve, besides performing its other functions, is so formed that it sheds the chyle over the orifice of the appendix in its descent into the caecum (see schematized drawing of interior of caecum and appendix).

Scheme of caecum, ileo-caecal valve, and appendix, in section.

The appendix, while in itself having the muscular mechanism and nervous apparatus necessary for emptying its contents in any position it may normally be placed in, is in the majority of instances so situated that the action of gravity favours the escape of the contents into the caecum. The action of gravity, on the other hand, favours the retention of the chyme in the caecum until the caecal digestion is completed, when muscular movements are originated for its expulsion.

CAUSATION OF APPENDICITIS.

In the foregoing it has been shown that the caecum and appendix perform an important part in the final stages of digestion. If this be so, one would expect *a priori* that serious interference with the function of those parts would give rise to disease. This is exactly what occurs. Though the causes of appendicitis are varied, the majority are intimately associated with the digestive process and the factors controlling it. Thus Deaver, who has perhaps performed more operations for appendicitis than any one, says that the disturbances of digestion have been so pre-eminent in the etiology of appendicitis "that it is unhesitatingly asserted that appropriate inquiry will elicit a history of such disturbance in almost all cases." "Indigestion" is a very vague and loosely employed term to indicate discomforts of many kinds occurring in the alimentary tract. The differentiation of caecal indigestion from other forms requires further study before the symptoms pertaining thereto are accurately defined. This presents certain difficulties—first, because caecal digestive incompetency must have an effect upon the upper part of the intestinal canal, while indigestion, arising in the small intestine, will likewise act upon the caecum; secondly, because the irritation and inflammatory changes in the appendix produce, through the superior mesenteric plexus, pains in the abdomen generally, but especially over the region of the umbilicus. From these two reasons there is difficulty in the early stages in properly localizing the lesion, and often the patient is believed to be suffering from a form of indigestion attributable to the stomach or upper parts of the small intestine, when in reality it arises from the caecum itself. If caecal disturbance of function continue both caecum and appendix suffer. There will be want of proper exudation of succus entericus in quantity and in quality, and lowering of the activity of the solitary lymphatic glands, which will no longer control the germs which swarm in that cavity. The bacillus coli communis, which is the surgeon's terror, serves in its proper place a beneficent purpose in effecting the disintegration of some of the undigested matter, but when uncontrolled by the healthy organs and their exudations is apt to cause ravages in the tissues, and to produce toxins which are lethal.

If from inhibition of the appendicular and caecal movements, or the want of exudation of the succus entericus, or if the caecum receives material which the succus entericus cannot digest, a stasis occurs in the contents of the caecum, and the constipation which is so often a feature of the appendicitis ensues. At a later stage fermentative disintegration of the faecal contents, with absorption of toxins and damage to the wall of the parts, is apt to ensue. These are followed by diarrhoea, which is sometimes curative.

Doubtless the appendix and caecum are affected together, but, just as pyogenic organisms affecting the throat spread by continuity of structure to the middle ear and mastoid cells and produce serious damage there long after the throat has healed, so the appendicular inflammation, once started, may continue to produce serious effects within the appendix after the caecum has recovered from the primary effects.

As to prevention of appendicitis, there are some lessons to be derived from the foregoing. Primitive man had to search for his food, and sometimes he had a hard physical fight to get it. When he found it, as he had been looking forward to it, he was fit for it and enjoyed it; consequently, he had an abundant flow of all the digestive juices which were ready to receive the food and give it a warm welcome. Present-day man is said to be in an evolutionary stage. With his indoor occupations and his ever-engrossing mental pursuits, he forgets that he has to live, and that in order to do so he has to eat and digest, and that his duty to himself and to the community is to do both well in order that he continue in health. But, from the way prevalent in many places, he seems to act as if food should be thrown into the stomach, as a sandwich into a pocket, and the lid closed. Then he wonders that he has indigestion and appendicitis. Though, in a sense, digestion is independent of the direct control of the brain, yet powerful

mental impressions exert an influence over the glands concerned in digestion—from the salivary down to the glands of Lieberkühn in the caecum and appendix. The mental influence is such that when the mind is engrossed in other affairs than the taking of food, those gland secretions are apt to be scanty and indigestion is apt to follow. If a person is mentally engrossed he ought to refrain from eating, or eat very sparingly.

The standing lunch, eaten against time, while the mind is fully occupied with business or professional examinations—the food, instead of being chewed and mixed with saliva, being simply washed down as a bolus with some fluid—is one of the best ways of not only producing indigestion, but of ultimately causing caecal and appendicular mischief. Man has neither a crop like a bird nor a caecum like a horse, and, therefore, he has no provision for bolted food. One has heard of children being forced to take foods which they dislike because “it was good for them.” The digestive juices will not flow under these circumstances. The brain of children is so often burdened with “tasks” committed to memory and engrossed with educational enigmas that there is no time for digestion. Mastication is not taught in schools, digestion has no place in national education, and there are no certificates given for sound digestion, but we appoint Royal Commissions to inquire into the causes of the physical deterioration of the race.

Although the caecum aids in digestion it does so by receiving partially-digested food which contains the proper amount of secretions from other glands. It does compensate somewhat for their defects, but cannot do so entirely.

Therefore it is a matter of great moment to commence the digestive process well. A free mind, with the prospect of enjoyment of food, thorough mastication until the saliva is efficiently mixed with the food, and then the process of gastric digestion will have a good beginning, and the food thus prepared will be received in due course with abundant digestive juices in the other parts of the canal.

At a consultation on one occasion, the lady of the house (French by origin), who was not a patient, being in perfect health, twitted the local Scotch doctor with the rainy weather they kept in Scotland. He replied: “But, my lady, it seems to suit you, as you are always in good health.” “Yes,” she said, “thanks to you, doctor; you always keep me in good health.” The doctor laughed, and explained that the lady always asked for advice, but never took the medicine. The lady said that at least she always had the prescription made up. That it was the same wherever she went—London, Paris, or elsewhere; she consulted the best authorities, and had a general chat with them about her condition, and how best to maintain health, and, when they were good enough to give her a prescription, she had it made up and dated, and placed both prescription and drug in a cabinet made for the purpose. “But,” she added, “indeed, I have never been ill. I believe the greater number of maladies arise from indigestion, and that indigestion occurs mainly from too fast eating; whereas I eat slowly, and many times I am ashamed, as I am the last to put down my fork.” There was a method in that lady’s madness.

For many years I have believed that the human caecum and appendix are of value in digestion. The facts pointing in that direction have accumulated slowly, and are not all garnered; many require still to be investigated. One would have preferred to have waited until they were gone over again, re-tested, and either verified or dropped out. But “Art is so long” that I have ventured to present you with an unfinished picture, which I hope some of you will be able to correct and finish. What has been said is merely a contribution to the subject. In dealing with it in the future remember what Huxley says: “Let us sit down before fact as a little child, be prepared to give up every pre-conceived notion, and to follow humbly wherever Nature may lead.”

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ACCORDING to American medical journals, Dr. W. L. Smith, of Boston, who was travelling for pleasure, was recently detained at Ispahan during an outbreak of plague. During his detention he treated the natives with success. The Shah, who was suffering from malaria, sent for Dr. Smith and has now, it is said, appointed him his physician in ordinary.

An Address

ON

THE FUTURE RELATION OF KING'S COLLEGE TO ITS MEDICAL SCHOOL AND HOSPITAL.

Delivered at King's College at the Opening of the Medical Session on October 4th, 1904.

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BEFORE proceeding to address you on the subject of the future relation of King's College to its Medical School and Hospital I should like to say a few words on the more general topic of the medical life and practice. And first let me congratulate the students who have been winners in the competition for the highest distinctions awarded in the Medical Department, and have received to-day the welcome recognition of their industry and ability. There is no need for me to enlarge upon this theme. The legitimate satisfaction at their success which they must feel is far and away more grateful to them than would be any words of mine. But I should like to remind those of my hearers who have industriously competed without in the end finding a place in the list of the more fortunate recipients that they cannot be described as “losers.” They are simply “non-winners,” and, indeed, so far from having lost anything, it is certain that they have gained very much, for the time expended in working cannot but be attended with infinite advantage to themselves. It has been wisely said: “The reward is in the race we run, not in the prize.” Nothing can deprive them of the precious service to their own mental development rendered by their hours of industrious occupation, and the last thing they would need or desire from us would be any expression of condolence.

It would be a truism to say that the medical students of this College are on the threshold of an honourable profession. Speaking as one who has been a member of it for very many years, I should like to say, for their encouragement, that I believe they have chosen well. They will have the opportunity of living the fullest, and it will be their own fault if it is not the most useful, of lives. What better has existence to offer than this? I took my place as a first year's student in this College on the occasion of an introductory address by the late Dr. Todd, and of all the many sentences which fell from his silver tongue there is but one which I now remember (and that was a quotation): “To scorn delights and live laborious days”; and the words were applied, of course, to a medical career. The aptness of the latter part of the quotation cannot be denied. There is probably no more laborious life than that of a medical man, and, doubtless, in the sense in which the words were employed by the poet (as will be acknowledged by those who remember the context), the former half is also true. But I am ready to assert with confidence that in no walk of life can the highest forms of delight—those which belong to the acquisition of knowledge, and those which never fail to attend the faithful performance of duty—be looked for and found more certainly than in that upon which many of those before me are now entering. Did time permit, I would gladly pursue this general topic—one upon which the experience of a long and active professional life probably gives me some authority to dwell. But I will content myself with saying a few words upon a practical point which may, perhaps, prove useful to some of those whom I am addressing.

I would earnestly counsel all those who have the opportunity—and there must be very few who have not—to aim at the highest; not to be satisfied, I mean, with that qualification for practice which is most easily obtained. Addressing as I am an assembly of medical students the majority of whom are probably intending to enter family practice, I would point out to them that in these days graduation at a university is in the air. The times have passed when it was only necessary in our profession for the consulting physician to obtain a degree. In such greater numbers every day are family practitioners adopting this course that one need not be possessed of any gift of prophecy to say that in a few years those who are without a good medical degree will lag behind in the race for success, and still more so for distinction. As