The Alvarez Lecture

ON

THE UNITY OF GASTRIC DISORDERS *

BY

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I. THE HYPERSTHENIC AND HYPOSTHENIC
GASTRIC CONSTITUTIONS

Investigations on the anatomy and physiology of the stomach of healthy young adults of both sexes show that considerable variations from the average occur under perfectly normal conditions. In about 80 per cent. these variations fall within comparatively narrow limits. This is shown, for example, in the results obtained by Bennett and Ryle (1921) with a fractional gruel test meal in a hundred healthy male students who had never suffered from any form of indigestion: the curves of free hydrochloric acid in eighty of them fell within the shaded area shown in Figs. 1, 3, and 4. The anatomy and physiology of the stomach in these 80 per cent. of healthy people

FIG. 1.—Test meal of one of the ten with hyperchlorhydria in Bennett and Ryle's 100 healthy students.

are so perfectly adjusted to the exigencies of ordinary life that they are likely to reach old age without ever suffering from any form of chronic gastric disorder. Of the remaining 20 per cent., approximately one-half are born with what I have called the hypersthenic gastric constitution, and most of the other half with a hyposthenic gastric constitution—both conditions being often familial. The former have hyperchlorhydria (Fig. 1), which is often, though not invariably, associated with a short, high, rapidly emptying stomach. The latter have hypochlorhydria, which is generally associated with a long, low, slowly emptying stomach. Both constitutions are compatible with perfect health, but in unfavourable circumstances each predisposes to the development of certain organic diseases. In addition to the hyposthenic diathesis, about 3 per cent. of normal individuals have complete achylia gastrica—an inborn error of secretion—which is even more frequently familial than hyperchlorhydria and hypochlorhydria (Fig. 2).

It has been suggested that Bennett and Ryle's group of healthy medical students cannot be regarded as an average sample of the population, as healthy people of all ages should be included. But if, as I believe, constitutional hyperchlorhydria and constitutional hypochlorhydria predispose to a variety of diseases, including gastric and duodenal ulcer, carcinoma of the stomach, and Addison's anaemia, which become more and more frequent as age advances, it is clear that the younger the group of healthy individuals examined the fairer sample they will be of the general population before it has become affected with diseases acquired as a result of constitutional predisposition. Thus very few of a hundred unselected young men with constitutional hyperchlorhydria, who may eventually develop gastric or duodenal ulcer, and none of those with constitutional hypochlorhydria who may later develop carcinoma of the stomach or Addison's anaemia, have already symptoms of these conditions; so that the hundred selected healthy young men will be fair samples

of the total male population of their age. On the other hand, if the subsequent history of the hundred could be traced, from what is known of the incidence of these diseases about 11.5 per cent. would develop one or other of them, and almost all of these would be among the constitutional hyperchlorhydrias and hypochlorhydrias. Consequently a large group comprising healthy people of all ages, such as that investigated by Vanzant, Alvarez, and their colleagues (1932), is a selected group from which many of the individuals with the hypersthenic and hyposthenic gastric constitutions are excluded, and an inaccurate picture of their incidence is obtained, quite apart from the fact that owing to the effect of long-continued gastritis the number of people with acquired low acidity makes it impossible to estimate the true incidence of constitutional hypochlorhydria.

The secretion of mucus is the normal response of every healthy mucous membrane to chemical, thermal, and mechanical irritants. The presence of mucus in the ordinary fractional test meal is, however, an indication that gastritis is present, because nothing could be less irritating than the gruel meal. But it is a matter of common experience that mucus is rarely present in much excess, except

FIG. 2.—Test meal of one of the four with achlorhydria in Bennett and Ryle's 100 healthy students.

in patients with hypochlorhydria or achlorhydria. This is due to the fact that the hypersthenic stomach is capable of secreting very little mucus compared with the hyposthenic stomach, whether in response to an irritant or as a result of inflammation (Bonis).

II. CAUSES OF GASTRIC DISORDERS

(A) MECHANICAL, CHEMICAL, AND THERMAL IRRITANTS

The mouth acts as the first line of defence in protecting the alimentary tract from damage by swallowed irritants. Food and drink are brought to the body temperature, chemical irritants are diluted, and lumps of food are broken up by chewing, and are intimately mixed with saliva; which softens hard particles and coats insoluble ones with mucus. An individual with good teeth, who takes the trouble to use them, and avoids grossly indigestible food and excess of alcohol, need not swallow anything until its thermal, chemical, and mechanical properties have been so altered that it will cause no irritation when it comes into contact with the gastric mucous membrane.

Though the majority of people are provided with a first line of defence which is potentially adequate, comparatively few make sufficiently good use of it. Food is swallowed without being properly chewed, with the result that the stomach is daily subjected to mechanical, chemical, and thermal irritants. It is also often damaged by excessive indulgence in alcohol, or by taking cocktails or spirits whilst fasting, when even a small quantity acts as a powerful irritant. Strong tea and coffee, curry and other spices, condiments, pickles, and excess of totally indigestible raw vegetable matter, taken in the mistaken idea that plenty of "roughage" is good for the health,

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may have the same effect. The stomach is frequently irritated by the unconscious swallowing of the "juice" of tobacco smoked in excess. Many people injure their gastric mucous membrane by taking drugs—often quite needlessly—for supposed constipation, rheumatism, and other self-diagnosed complaints, quite apart from those used in the treatment of definite chronic maladies, such as bromides, iodides, salicylates, mercury, digitalis, creosote, and copaiba. The contents of the duodenum and the upper end of the jejunum are gastric irritants. Gastritis is therefore a constant sequel of gastro-jejunoscopy and partial gastrectomy, and is in fact partly responsible for the success of these operations, as it is an important factor in the reduction of the free acid present. Fortunately the gastritis is often completely latent, although it is a cause of post-operative symptoms much more frequently than is generally believed.

The stomach acts as a very efficient second line of defence for protecting the small intestine from irritation. Very hot and very cold food and drink are brought to the body temperature, and the gastric juice dilutes chemical irritants, such as alcohol, and softens hard particles. Peristalsis in the distal half of the stomach conveys the food to the pyloric sphincter, which does not relax if the food is insufficiently broken up, so that a churning process results, which does its inadequate best to perform the functions which the teeth should have carried out. The stomach, and especially the pyloric half in which the mucous membrane is most exposed to friction, is thus liable to suffer in its attempt to protect the small intestine. In the 80 per cent. of people with an average type of stomach the irritation of the mucous membrane is reduced to a minimum. In the 10 per cent. with constitutional hyperchlorhydria there is ample protection against mechanical irritants, and also against chemical irritants if taken when the stomach is full. But as hyperchlorhydria is generally associated with rapid evacuation, the stomach is empty for a much longer proportion of the day and night than in the average individual, so that there is more opportunity for the mucous membrane to be damaged by alcohol, tobacco, and drugs. In the 10 per cent. with constitutional hypochlorhydria and achylia the second line of defence is deficient; they are consequently very likely to develop gastritis, and in most cases the hypochlorhydria sooner or later gives place to achlorhydria. This is in spite of the attempt made by the stomach to protect itself by the secretion of mucus; but it is a remarkable fact that the type of stomach which, on account of its deficiency in gastric juice, most often requires a protective coating of mucus is the one which, as I have already pointed out, is most capable of producing it.

(B) INFECTION

Infected material is constantly swallowed by people with pyorrhoea alveolaris, infected tonsils, chronic pharyngitis, and sinusitis, and by children with adenoids. In achlorhydria, whether due to primary achylia, or secondary to chronic gastritis in individuals with constitutional hypochlorhydria, the antiseptic acid barrier of the stomach is lost, and streptococcal infection of the inflamed, and therefore abnormally vulnerable, mucous membrane of the stomach is very likely to occur. This is especially true for the most advanced stages of gastritis, in which the atrophy involves not only the secreting tubules but also the mucin-secreting cells, so that the mucous membrane is no longer protected from invasion by bacteria by a layer of mucus. In such cases a fractional test meal shows the absence of mucus as well as gastric juice. When gastric juice is secreted in normal or excessive quantities, and even when it is deficient in hypochlorhydria, swallowed bacteria are rapidly destroyed.

(C) HAEMATOGENOUS IRRITANTS

Many acute infections are accompanied by acute gastritis, which is often followed by chronic gastritis (Faber). This must be due mainly to the direct action of bacterial toxins conveyed in the blood to the gastric mucous membrane, which perhaps makes an attempt to excrete them. Possibly the toxins produced in the body tissues themselves in acute infections may be in part responsible (Kauffmann, 1929), just as the toxins of uraemia and those produced in the skin in extensive burns may cause gastro-duodenitis and acute ulcers. The vomiting in scarlet fever and the abdominal symptoms in gastric influenza are the result of acute gastritis, and acute ulcers and erosions are often found in the stomach and duodenum in fatal cases of a great variety of infections. The development of acute haematogenous gastritis is probably quite independent of any special type of gastric constitution, though it is only likely to become chronic in individuals with hyperchlorhydria, hypochlorhydria, or achlorhydria.

The causes of gastritis are so numerous and so common that few people can pass through life without being subjected to one or more of them. Fortunately the 80 per cent. of individuals with the average normal stomach are so well protected that they rarely develop gastritis as a result of these insults, but few of those with constitutional hyperchlorhydria and constitutional hypochlorhydria escape.

Faber (1908) was the first to show how common chronic gastritis is by injecting formalin into the abdomen immediately after death, in order to prevent the post-mortem changes, which had hitherto made it impossible to carry out satisfactory investigations on the condition of the gastric mucous membrane with necropsy material. Three lines of investigation have confirmed and extended his work—biopsy, gastroscopy, and radiology. Konjetzny has examined a very large number of specimens prepared immediately after partial gastrectomy, which he performs for all kinds of gastric disorders, whether there is external evidence of disease or not. Though his work appears to be totally unjustifiable surgically, it has led to results of the greatest interest and importance from a scientific point of view, as he has found various degrees of gastritis in every case. The results have been confirmed by many others, who have performed similar operations for patients with ulcer symptoms, whether an ulcer was found or not. Further confirmation comes from Professor M. J. Stewart of Leeds, and Dr. Keith Simpson at Guy's Hospital, in the investigation of specimens obtained by partial gastrectomy performed for ulcer or carcinoma, and of fragments of mucous membrane obtained from the edge of the stoma in the performance of gastro-jejunoscopy for duodenal ulcer and pyloric ulcer. Schindler, Korbsch, Hohlweg, and Gutzeit have improved the technique of gastroscopy to such a degree that they have been able to perform several hundred examinations without any ill result. Though it is unlikely that the method will ever become widely used, it has led to the accumulation of a great deal of very valuable information about the appearance of the gastric mucous membrane in various disorders. It has been of special value when it has been possible to compare the gastroscopic and radiological appearances of the same case.

Lastly, the improved radiological technique, which we owe primarily to Forssell, and which has been specially developed by Berg, has led to the study of the folds of gastric mucous membrane and the recognition of departures from the normal associated with different varieties of gastritis.

III. EFFECT OF GASTRITIS ON GASTRIC SECRETION

The functional efficiency of an organ is always reduced when it is inflamed. In acute gastritis no gastric juice is secreted. This was admirably demonstrated by Beaumont (1833) in his observations on the effect of a drinking bout on Alexis St. Martin. In chronic gastritis the secretion is reduced to an extent which varies with the severity and the duration of the inflammation, the actual

amount of free acid present in the stomach in a test meal depending upon the constitutional type of stomach in each individual. Thus the hyperchlorhydria of individuals with the hypersthenic gastric constitution becomes less extreme, or may be replaced by a normal curve of acidity, or even, in exceptional cases, by hypochlorhydria. This is well seen in the gastritis accompanying chronic ulcer, as when medical treatment has resulted in the healing of the ulcer and the disappearance of the gastritis the acidity is almost always higher than it was before. Thus in sixteen cases of gastric ulcer and thirty-two of duodenal ulcer under my care, in which a second test meal was given at the end of treatment, the acidity had increased in all but eight, and six of these already had hyperchlorhydria and two high normal curves. The gastric cases comprised one achlorhydria which became hypochlorhydria, five high normals which became hyperchlorhydria, and one which remained unchanged, and five hyperchlorhydria, three of which became still higher, two remaining unaltered (Fig. 3). Of the duodenal cases one with hypochlorhydria became a high normal and one an extreme hyperchlorhydria, two low normals became high normals, one normal became high normal, and one

complete and permanent achylia resulted. It is clear that gastritis associated with high or normal acidity, so-called acid gastritis, is not an early stage of gastritis associated with achlorhydria, as has been suggested by Faber, Zweig, and others, nor is the former a result of prepyloric gastritis and the latter of fundus gastritis, as has been suggested by Porges and others. Both are due to the same causes, the amount of free acid depending upon the constitution of the individual concerned.

(A) GASTRITIS WITH CONSTITUTIONAL HYPERCHLORHYDRIA

I have already pointed out that hyperchlorhydria tends to protect the stomach from irritation when the first line of defence is inadequate. But the deleterious effect of friction on the mucous membrane of the distal half of the stomach when hard or large pieces of food are swallowed continues, and irritation by alcohol, tobacco, and drugs may occur during the many hours in which the stomach is empty. If even a mild degree of gastritis results from this, the mere presence of hyperchlorhydria is likely to aggravate it, as, although hyperchlorhydria is not itself a pathological condition, the excessive acidity

FIG. 3.—Duodenal ulcer with chronic gastritis. (a) July 20th, 1928; hypochlorhydria. (b) August 17th, 1928; after a month's treatment, gastritis disappeared and ulcer healed; hyperchlorhydria unmasked.

became hyperchlorhydria, seven high normals became hyperchlorhydria and one remained unaltered, and of twelve hyperchlorhydria eight became still higher, four remaining unaltered (Hurst and Venables, 1929).

The hypochlorhydria of individuals with the hyposthenic gastric constitution is almost always replaced eventually by complete achlorhydria. In most cases this can be overcome by removal of the exciting causes, an unirritating diet, and lavage every morning with dilute hydrogen peroxide. Thus in 82 per cent. of thirty-four of my cases of achlorhydria treated in this way free acid returned (Hartfall, 1932) (Fig. 4). The reduction in acidity in these cases is mainly due, as it is in hyperchlorhydria, to the effect of the inflammation on the activity of the secreting glands, but it is increased as a result of the excessive secretion of mucus which accompanies the inflammation. The mucus acts partly by its mechanical action in blocking the mouths of the secreting tubules and partly by its chemical action in combining with some of the free acid. The neutralizing effect is, however, comparatively slight, and due almost entirely to the sodium bicarbonate it contains and not to its own buffer action, as it almost completely disappears after the salt has been separated by dialysis (Bonis, 1930; Mitchell, 1931). In the 18 per cent. of cases in which the achlorhydria persisted after treatment the gastritis had presumably led to such a profound change in the gastric mucosa that recovery was impossible, and

of the gastric juice is a potential danger. The healthy mucous membrane is always bathed in gastric juice, which is neither digested by its pepsin nor irritated by its free hydrochloric acid. After death, however, the mucous membrane is rapidly digested. During life localized necrotic areas may also undergo digestion, and possibly this also occurs in areas in which the circulation is temporarily arrested or very deficient before actual necrosis has occurred. As peptic digestion is no more active with 0.3 per cent. than with 0.08 per cent. free hydrochloric acid, such digestion is not specially likely to occur in the presence of hyperchlorhydria. But although the living mucous membrane, even when abnormally vulnerable as a result of gastritis, can never undergo peptic digestion, it is very likely to be damaged by free hydrochloric acid if present in a strength greater than the average. The likelihood of this is still greater when the hyperchlorhydria is associated with hypersecretion, in which unusually strong acid continues to be secreted in the absence of food, which under ordinary conditions dilutes it and to some extent neutralizes it, owing to its alkaline reaction. According to Winkelstein (1933), the stomach secretes acid throughout the night in patients with ulcer, but never in normal people. Moreover, owing to the deficient power of secreting mucus, which is a characteristic of the hypersthenic stomach, the protection against damage afforded by a layer of mucus in the hyposthenic stomach is absent. It has been suggested that

FIG. 4.—(a) Test meal in a case of Addison's anaemia on January 9th, showing achlorhydria and excess of mucus. (b) Test meal on April 2nd, showing normal acidity, and excess of mucus in only two fractions, after treatment by gastric lavage.

the absence of mucus is due to its digestion by gastric juice, but mucus differs from other proteins in the extreme slowness with which it undergoes peptic digestion, and there is generally less organically combined hydrochloric acid with hyperchlorhydria than with the average normal acidity.

In the conditions already described, in which the failure of the first line of defence gives rise to chronic gastritis, the excessive acid in hyperchlorhydria gives the gastritis certain characteristics which are absent from that associated with hypochlorhydria and achlorhydria. It is very frequently associated with minute erosions, some of which may develop into acute ulcers, which may in turn become chronic ulcers. The condition may therefore be called ulcerative gastritis. When the hyperchlorhydria is associated with the rapidly emptying, short, high stomach which is often a feature of the hypersthenic gastric constitution, the duodenal bulb is equally involved, the condition thus being one of ulcerative gastro-duodenitis, in which a chronic ulcer is most likely to develop in the duodenum. When, on the other hand, the hyperchlorhydria is associated with a long, low, slowly emptying stomach, the main stress falls upon the stomach; the gastritis is likely to be more severe and a gastric ulcer may develop, whilst the duodenum is spared. At the same time the gastric stasis leads to more prolonged contact of the entire gastric mucous membrane with any irritants it may contain, so that although the distal half of the stomach is still the part most severely inflamed, the fundus is more affected than in duodenal ulcer. Consequently, the power of secreting acids by the fundus glands may be directly impaired, while their stimulation is reduced owing to the deficient production of the gastric hormone by the antral mucous membrane in response to chemical and reflex stimulation. In gastric ulcer the hyperchlorhydria which is at first present thus tends to be more or less reduced, and in very chronic cases hypochlorhydria, and very rarely even achlorhydria, may result. With treatment, however, the acidity always rises, though sufficient permanent damage may have taken place to prevent a return to the original hyperchlorhydria. Owing to the familial incidence of the hypersthenic gastric diathesis it is common for gastric or duodenal ulcers to occur in several members of the same family (Hurst and Stewart, 1929).

It is interesting to note that both Hart (1919) in Germany and Stewart (1929) in England found chronic gastric or duodenal ulcers or scars of such ulcers in about 10 per cent. of all necropsies, this being also approximately the number of healthy young adults with hyperchlorhydria. It would appear, therefore, that an individual with the hypersthenic gastric constitution is almost certain sooner or later to develop an ulcer, though I have seen two men and one woman over 70 years of age with an extreme degree of hyperchlorhydria who had never had a symptom or sign of ulcer or any form of indigestion. It is true that hyperchlorhydria may no longer be present when a test meal is given, especially in the case of a gastric ulcer, but it was probably present when the ulcer first formed, perhaps many years earlier, and has since been masked by the coexistent chronic gastritis.

(B) GASTRITIS WITH CONSTITUTIONAL HYPOCHLORHYDRIA AND ACHLORHYDRIA

Bennett and Ryle found that already at the age of 20 4 per cent. of one hundred healthy students had achlorhydria, which must have been due either to constitutional achylia gastrica or latent chronic gastritis. Hartfall has recently analysed the results of fractional test meals given to 2,448 of my private patients. Excluding twenty cases of achlorhydria artificially produced by gastro-jejunosomy, twenty-one cases associated with carcinoma of the stomach,

and fifty-one with Addison's anaemia, there remain 2,356 patients, of whom 242 (10.3 per cent.) had achlorhydria. From 10 to 19 the incidence was 4 per cent., which is identical with that found by Bennett and Ryle in their normal students; there was a rise of 4 per cent. to the 30-39 period, and the same rise to the 40-49 period, but in the next three decades taken together there was a rise of only about 4 per cent. It can thus be concluded that all, or very nearly all, of the individuals with the hyposthenic gastric constitution, as well as a few with normal acidity, eventually develop achlorhydria as a result of gastritis. Gastritis with achlorhydria generally gives rise to no gastric symptoms, though it may occasionally produce a mild form of chronic indigestion, and it is not an uncommon cause of nausea.

In achlorhydria the excess of mucus is a poor substitute for gastric juice, and the consequent loss of the second line of defence leads to irritation of the small intestine, so that duodenitis and enteritis develop in addition to the gastritis. The mechanical and chemical irritation of the intestines explains why chronic and recurrent diarrhoea is often caused by achlorhydria, although in the majority of patients with achlorhydria the bowels are regular.

Swallowed bacteria flourish in the alkaline contents of the stomach, and may invade the mucous membrane, producing an infective gastritis, which may ultimately lead to atrophy of the mucous membrane. They also pass into the duodenum, which is normally sterile, but now swarms with bacteria. Knott (1927) has shown that the increased alkalinity of the intestinal contents allows bacteria which are normally confined to the colon to ascend the small intestine as far as the duodenum and stomach, both of which contain colon bacilli from the large intestine even more frequently than streptococci from the mouth. Chronic cholecystitis is generally a result of an ascending *B. coli* infection of the gall-bladder, which is especially likely to occur in the presence of achlorhydria (Hurst, 1932). This explains why free hydrochloric acid is absent from the stomach in about 50 per cent. of patients with gall-stones (Bonar, 1922). Achlorhydria is also a very important predisposing cause of intestinal infections, such as typhoid and paratyphoid fever, bacillary and amoebic dysentery, and cholera—the organisms of which are rapidly destroyed by the normal gastric juice—and its presence is therefore a constant source of danger to residents in tropical countries (Camps). The toxæmia which follows the intestinal infection resulting from achlorhydria is one factor in about 25 per cent. of cases of rheumatoid arthritis (Hurst, 1925; Miller and Smith, 1927), and in some cases of asthma, skin diseases, and other conditions associated with allergy, especially in children (Bray, 1931).

IV. EFFECTS OF GASTRITIS ON HAEMATOPOIESIS AND THE NUTRITION OF THE CENTRAL NERVOUS SYSTEM

The absence of free acid from the gastric contents may interfere with the assimilation of the iron in food, so that in individuals who take a diet in which there is only just enough iron for the needs of the body under the most favourable conditions of assimilation a simple achlorhydric anaemia develops (Faber, 1908), which differs from Addisonian (pernicious) anaemia in occurring almost exclusively in women, in whom menorrhagia is often a contributory factor, and in being curable by large doses of iron, whilst liver and stomach extract are entirely without effect (Witts, 1930).

Achlorhydria is found in about 99 per cent. of cases of the Addison's anaemia-subacute combined degeneration of the spinal cord syndrome, though it is now known that it is not the actual cause of it, the

absence of hydrochloric acid from the gastric secretion being associated with the absence of a substance, Castle's "intrinsic factor," required for the production of the natural stimulant of haematopoiesis and of another required for the normal nutrition of the central nervous system. The gastritis is the primary condition; there is, consequently, often a history of chronic diarrhoea or other symptoms to which it has given rise, dating from months or years before the onset of anaemic or nervous symptoms, and in several cases the achlorhydria has been known to exist during this time. The frequent occurrence of Addison's anaemia and subacute combined degeneration of the cord in more than one member of a family is due to the familial occurrence of constitutional achylia gastrica and hypochlorhydria, which predispose to severe gastritis. Moreover, achylia is often present without any abnormality of the blood or central nervous system in relatives of patients with these diseases (Hurst, 1927; Conner, 1930; Wilkinson and Brockbank, 1930).

The first function of the gastric mucous membrane to suffer in gastritis is the secretion of hydrochloric acid. Consequently, in the majority of cases of achlorhydria pepsin is still secreted in normal quantity, the secretion of mucus is actually increased, and the production of the haematopoietic intrinsic factor is unimpaired. If the exciting cause of the gastritis continues to be at work when complete achlorhydria has developed, the gastritis becomes progressively more severe, especially if large numbers of virulent streptococci are swallowed from the mouth or throat. After a time the damage to the secreting tubules is so profound that they can never recover their power of secreting acid, even if all active inflammation ceases, and at the same time the secretion of pepsin becomes more or less impaired. The mucus-secreting cells take part in the general atrophic changes of the mucous membrane, so that mucus disappears from the test meal, its absence being a sign of the severity of the process, and not an indication that no gastritis is present. In this advanced stage of gastritis the intrinsic factors required for the normal activity of the bone marrow and nutrition of the central nervous system may cease to be formed, and Addison's anaemia and subacute combined degeneration of the cord develop. In a small number of cases this function of the mucous membrane is impaired at an earlier stage; thus in three of my cases of Addison's anaemia the secretion of free acid returned as a result of treatment of the gastritis, and six other similar cases have now been recorded. Moreover, in about 1 per cent. of cases of Addison's anaemia and subacute combined degeneration of the cord free hydrochloric acid is secreted. The haematopoietic and neurotrophic functions of the gastric mucous membrane are occasionally destroyed suddenly by an exceptionally severe attack of acute gastritis, the symptoms dating from an attack of food or corrosive poisoning, or from an acute infection (Hurst, 1926).

V. CARCINOMA OF THE STOMACH

I believe that carcinoma never develops in a normal stomach (1929). There is much evidence to show that in most of the 35 per cent. of cases in which free hydrochloric acid is present the carcinoma is secondary to chronic gastric ulcer. On the other hand, in the 65 per cent. of cases with achlorhydria the latter is a result of the associated gastritis and not of the carcinoma, and the carcinoma is probably a result of malignant degeneration of the chronically inflamed mucous membrane. Thus I have never seen a case—and I know of very few—in which achlorhydria has developed in a patient with carcinoma of the stomach, who was known to have free acid present at an earlier stage of the disease, although the secondary gastritis which must result from large

ulcerated growths and the progressive destruction of the mucous membrane in extensive carcinoma would make it natural that such a change should occasionally be observed. There was no diminution in acidity in the three cases of gastric ulcer I have seen in which a test meal was given both before and after the onset of malignant degeneration. In one patient with ulcer-cancer who was kept comfortable by occasional lavage and an unirritating diet, the acidity actually rose in the course of six months. Pollard and Bloomfield (1931) have recorded two similar cases. On the other hand, I have seen one case, and at least twenty others have been recorded, in which achlorhydria was known to be present from three to fifteen years before the development of cancer associated with achlorhydria.

Free hydrochloric acid is present in nearly all cases of carcinoma in which examination of the specimen obtained at operation shows unmistakable signs of originating in ulcer, whereas it is absent, and more extensive chronic gastritis is found, where no such signs are present. When a long history suggestive of ulcer is obtained free acid is generally present, but when the history is short and the carcinoma appears to be "primary" achlorhydria is found. The prospects of long survival after gastrectomy are better in cases with achlorhydria than with free acid (Hartman, 1921), though the reverse would be the case did those with achlorhydria represent a later stage of the same condition as those with free acid. Moreover, there is no relation between the size of a growth and the presence of achlorhydria, free acid being occasionally present with large inoperable growths and achlorhydria with very small, early, and removable ones (Pollard and Bloomfield). I have seen a number of cases in which carcinoma of the stomach was preceded or accompanied by the development of Addison's anaemia or subacute combined degeneration of the cord, the gastritis having led to lack of the "intrinsic factor," and so caused the anaemia quite independently of undergoing malignant degeneration. It seems likely, indeed, that the incidence of carcinoma of the stomach in patients with Addison's anaemia, who are kept free from symptoms as a result of modern methods of treatment, will be abnormally high unless the associated gastritis is treated in spite of the absence of digestive symptoms.

CONCLUSIONS

I have brought forward evidence to show that the main organic disorders of the stomach ultimately depend upon the same exciting causes, which are so widespread in their incidence that very few people can reach old age without coming under the influence of one or more of them at some time in their lives. Fortunately, however, four-fifths of the population have stomachs which are endowed with sufficient resistance to escape damage, and it is only the remaining 20 per cent. who are likely, sooner or later, to develop some organic gastric disease.

If these views are correct, gastritis, gastric and duodenal ulcer, and carcinoma of the stomach could be prevented by the adoption of the simple hygienic measures required to avoid the exciting causes I have enumerated. It is, perhaps, too much a counsel of perfection to expect universal prophylaxis of this kind, but it might at any rate be provided for those people who can be recognized from their physical characteristics, or from their family histories, as being constitutionally liable to develop organic disease of the stomach.

Lastly, gastritis and gastric ulcer should be recognized much more frequently and at an earlier stage than in the past, and instead of simply dealing with the results of the former, such as achlorhydria or anaemia, the primary disease itself should also be treated, and steps taken to prevent its recurrence. We may thus hope that the

frequent failure of the physician to recognize cancer of the stomach sufficiently early for the surgeon to effect a cure will in the future be immaterial, owing to the success of the practitioner in preventing its development.

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TREATMENT OF CHRONIC INFLAMMATORY DISEASES OF THE MOUTH, PHARYNX, AND LARYNX BY LOCAL APPLICATION OF ULTRA-VIOLET RAYS

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The object of this paper is to record some results following the treatment of inflammatory diseases of the mucous membrane of the mouth, pharynx, and larynx by means of the local application of ultra-violet rays emitted by a specially designed "throat lamp."

During the past fifteen years Strandberg, working at the Finsen Light Institute at Copenhagen, has recorded successful results in the treatment of tuberculous disease of the larynx, following the exposure of the skin of the whole body by general irradiation to the ultra-violet rays of the carbon arc. Cemach and de Wesselow have designed special quartz rod applicators attached to the water-cooled Kromayer lamp or to the carbon arc of the Finsen type, for the local application of ultra-violet rays to the larynx. Similar quartz silvered mirrors for the reflection of rays and other apparatus have been designed. All these apparatuses are cumbersome, and necessitate long exposures to the source of light, and this makes treatment tedious and tiresome for the sick patient.

In 1926 I designed a small water-cooled quartz mercury vapour lamp for the direct application of ultra-violet rays to the buccal cavity, the tongue, pharynx, and larynx. This apparatus was demonstrated in 1929 to the Section of Laryngology of the Royal Society of Medicine. Since then I have treated over sixty patients. The technique which is described is based upon my results and observations made during the treatment of these selected cases. The pathological conditions which have been treated may be classified under the following groups:

1. Chronic tuberculous ulcers of the tongue and palate.
2. Chronic tuberculous disease of the larynx.
3. Chronic glossitis and inflammatory ulcers of the tongue (leucoplakia).
4. Chronic inflammatory lesions of the pharynx and nasopharynx.

The value and scope of the treatment of many diseases of the mouth, pharynx, and throat by local ultra-violet irradiation is as yet little known to many oral surgeons and laryngologists. It is hoped that the extended clinical trial of this technique of treatment will confirm my results, and help to establish a valuable additional method of treatment for lesions which often resist other established methods.

TECHNIQUE OF METHOD

THE APPARATUS

This throat lamp was designed so that it could be easily inserted into the mouth, and could be brought by direct application to the pillars of the fauces, the post-nasal space, the pharynx, or the larynx. The lamp is essentially a small water-cooled "vacuum type" quartz mercury vapour lamp, and consists of three parts: (1) a quartz mercury vapour vacuum high-pressure burner; (2) a quartz water-jacket; and (3) a metal jacket, to which the burner is cemented, and which contains water-cooling apparatus, and also insulated leads carrying the electric current. The quartz burner is U-shaped and bent at its horizontal axis to an angle of 160 degrees. It is made of a thick-walled quartz tubing about

QUARTZ MERCURY VAPOUR THROAT LAMP
 A, Burner and metal holder; B, quartz water-jacket; C, metal jacket;
 D, water-tubes; E, insulated leads. (The diagram is not drawn to scale.)

1.5 mm. in diameter. The internal diameter of the quartz tubing is 0.5 cm. One of the limbs of the U-tube is dilated at its terminal end. The burner is constructed on the same principle as the high-pressure-vacuum mercury vapour lamp, and operates on an electric current of 1 to 1.5 amperes and 80 to 120 volts between the electrodes (direct current only). The water-jacket is made of quartz, and is the shape and size of the adult thumb. It fits over the quartz burner and is oval in shape, measuring 6 x 3 x 2 cm., leaving a space of 0.5 cm. surrounding the quartz burner in every direction. The jacket is made to taper gradually as its closed extremity; the open end is widened and made circular, so that it can fit tightly to the metal holder by means of a rubber washer and a circular screw cap. The jacket can easily be removed, and in this way the quartz burner can be thoroughly cleaned and a differently shaped jacket can be attached when necessary. The metal holder is made of nickel-plated metal and is circular in shape, roughly 3 cm. in diameter and 15 cm. in length. The quartz burner is soldered and cemented into this holder, and the electrodes are carried through it, being well insulated with rubber and non-conducting composition, and fused to two copper electric wires, also well insulated, so