STUDIES FROM THE PATHOLOGICAL DEPARTMENT
OF THE UNIVERSITY OF EDINBURGH.

INTRODUCTION.

In the course of pathology the student encounters difficulty in correlating the clinical facts of disease with the changes in the organs observed on post-mortem examination, or with the results of microscopic investigation: the same problem arises also in the study of tissues removed by operation.

To overcome this difficulty a teaching collection of specimens has been formed, arranged, and described on the principle that each case is to be considered as a whole. The development of the case, which is described in the clinical account of the patient's history and symptoms, reveals the extent to which the various systems have been involved in the progress of the disease. The post-mortem examination and the subsequent microscopical study of the affected organs give an account of the sequence of events as it is portrayed in the pathological lesions grouped together in the case. Finally, in a review of the whole case these two accounts are compared, with the purpose of bringing out clearly the relation of clinical symptoms with pathological changes.

In order to bring this method of study within reasonable compass a number of outstanding and typical cases have been selected and worked out in full detail, and the student is directed to give to these special attention. He is also required to prepare reports of this type on cases as they occur in the post-mortem room, and this forms a large part of his work in practical pathology.

By this method pathology becomes an introduction to clinical work to an extent which is impossible where the student is restricted to the more abstract questions of morbid anatomy, and his general interest in pathology as a branch of medicine becomes the more living.

The working of this method can be explained more easily by giving examples. It is proposed to publish a number of cases, the reports of which have been drawn up on the lines described, and the following case of carcinoma of the pylorus is the first of these.

J. LORRAIN SMITH.
CASE I.

Day Book, 400.

Museum Book, 508, 508a, 509, 510.

CASE OF CARCINOMA OF THE PYLORUS, OLD OBSTRUCTION IN LEFT CORONARY ARTERY, WITH ORGANISED INfarct OF Heart WALL AND Aneurysm FORMATION. RECENT PULMONARY THROMBOSIS.

The patient was a man, aged 69, who was admitted to Chalmers Hospital on 24th October 1913 and died on 2nd November 1913.

The history was that in August 1913 he noticed that his bowels were becoming constipated and he was losing weight. In September, six weeks before admission, he commenced to vomit his food daily and had repeated "bilious" attacks. He had no pain and no flatulence. In the six weeks before admission he lost 1\(\frac{1}{2}\) stone in weight.

Previous History.—Forty-five years ago he had malaria in India. Four years ago he had a sudden fainting attack at a meeting, but was not laid up by this. There was no history of rheumatism or syphilis.

On admission the patient was a spare, anxious-looking man. The abdomen was flabby, but on palpation there was slight resistance above the umbilicus. The lower border of the stomach was one inch below the umbilicus. Nothing was felt per rectum.

Nothing abnormal was noticed clinically in the other systems beyond slight rapidity of the pulse, but its impulse was strong.

A test meal was given, and examination of the stomach contents showed residual food, no free hydrochloric acid, no free lactic acid, no sarcinæ, but a few red blood corpuscles.

An X-ray examination after a bismuth meal showed the stomach dilated and hanging low down, and to right of mid-line.

On 31st October 1913 Mr. Stiles performed laparotomy. A tumour at the pylorus was found, with small nodules of growth studded over the omentum. The wall of the jejunum appeared to be thickened and the lymphatics were dilated and filled with chyle. A posterior gastro-enterostomy was done. Shortly after the operation the patient vomited a little blood but otherwise felt fairly well.

On 2nd November 1913 at 7 a.m. the patient was weak. The pulse was 120, but its impulse was strong. The stomach was washed out and this gave much relief. He remained well till 6.30 p.m., when he suddenly collapsed. There was pallor with slight dyspnæa, and soon the respiration ceased. There was no cyanosis.
NOTES ON THE POST-MORTEM EXAMINATION.

The specimens are:—Stomach, Liver, Spleen, Kidney, Heart and Aorta (M. B., 508); Coil of Intestine (M. B., 509); Lung (M. B., 510).

In the abdomen the peritoneum showed a number of small white or yellow nodules on both parietal and visceral layers. See specimen (M. B., 509) (Plate I., Fig. 2) which shows these nodules scattered over a coil of small intestine.

There was a large mass at the pyloric end of the stomach, and over it appeared yellowish nodules which extended into the subjacent omentum. There were also beaded lines of tumour deposit over the serous coat of the pyloric end of the stomach. The stomach was not now dilated.

The mucous membrane was much congested, and in it were many small petechial hæmorrhages. At the pyloric end was a mass of new growth, with ulcerated areas on its inner surface. This tumour extended through the stomach wall to the serous coat, forming the nodules noticed above. There was no narrowing of the lumen.

The specimen (M. B., 508) (Plate I., Fig. 1) illustrates these points. Towards the left side of the stomach is the tumour involving the pylorus. The ulceration on its inner surface is obvious and the white masses of tumour extending through the muscle coat, which is in places quite destroyed. On the serous surface at this part the tumour appears as larger or smaller nodules. Note how the tumour does not extend into the duodenum.

The rest of the stomach wall is congested, and at the cardiac end little red areas of hæmorrhage are visible. At the lower border of the specimen, on the greater curvature, is the gastro-enterostomy opening. In the omentum are some tumour nodules.

On the posterior aspect of the specimen are a number of enlarged glands of a uniform white colour, from infiltration with tumour. These glands lay around the celiac axis and head of the pancreas.

Microscopically (Plate II., Figs. 1, 2, 3).—A section has been taken from the margin of the growth in the stomach wall. At the surface there is a mass of tumour which has pushed up the mucous membrane and largely destroyed it. The submucous and muscular coats subjacent are extensively infiltrated with tumour; and in the muscular wall further away are small collections of tumour cells (Plate II., Figs. 1, 3).

With a higher power the mucous membrane is seen to be in a state of acute catarrh, the epithelium is granular and broken up—part of this change is autolytic, after death—the glands are dilated, and
amongst the gland tubules are many polymorph and large mononuclear cells. The muscle coat is atrophied, the fibres are separated by oedema, and there is distinct fibrosis extending from around the tumour deposit.

The tumour consists of masses of cubical and columnar cells, in some parts definitely arranged in irregular acini. Some of the smaller deposits are in dilated lymph spaces, the walls of which can be distinguished. The larger deposits lie amongst the muscle fibres and have a delicate supporting fibrous stroma in which run the blood-vessels. In the large surface mass, and, to a varying degree, in the deeper deposits, there is a marked infiltration of polymorph leucocytes, which separate up the tumour cells in many instances (Plate II., Fig. 3).

A section of the duodenum close to the pylorus shows an infiltration with similar tumour masses. The greatest deposit is in the subperitoneal and outer muscular layers. In the submucous and mucous coats the deposits are much smaller and are scattered.

It was noted that macroscopically the tumour did not extend on to the mucous surface of the duodenum, and this infiltration, seen microscopically, is obviously due to a spread in from the affected omentum adjacent. In the duodenal deposits there is the same leucocyte infiltration of the tumour (Plate II., Fig. 2).

In sections from nodules in the omentum adjacent to the stomach the tumour cells have the same character but the acinar arrangement is hardly to be found. The individual tumour cells, or small clumps of them, are separated by great numbers of polymorph leucocytes.

In this section, as in those from stomach, there is seen phagocytosis of polymorph leucocytes by the tumour cells. Around the nodule is a zone of fibrous tissue, the inner layers of which are infiltrated with polymorphs, while the outer layers and the tissue around contain a moderate number of lymphocytes and a few eosinophile cells.

The liver was small and there were no secondary deposits of tumour in it. The mounted portion shows the centres of the lobules dark brown in colour while the peripheral areas are pale yellow.

Microscopically.—The central veins are slightly dilated, but there is little engorgement of the capillaries. The liver cells around the central vein contain granules of yellow pigment and are atrophied and faintly staining. Those towards the periphery of the lobule are better stained and more normal in size and many contain fat spaces. It is an example of pigmentary atrophy and slight fatty degeneration.

The spleen was small and atrophied. The specimen shows some congestion of the pulp and small Malpighian bodies.

A microscopic section shows the Malpighian bodies small in size, and in many the central arteriole shows hyaline degeneration of its intima. In the section stained by "van Gieson" the hyaline material is a homo-
Fig. 1.—Stomach with anterior half removed. (a) Pylorus; (b) large mass of cancer at pyloric end of stomach (note extension through wall); (c) nodule of tumour in omentum; (d) gastro-enterostomy opening.

Fig. 2.—Coil of small intestine with attached mesentery, to show (a) small nodules of tumour on peritoneum.

Fig. 3.—Heart. (a) Aneurysm at apex (note thin fibrous wall); (b) cavity of aneurysm filled with thrombus; (c) wall of left ventricle showing white strands of fibrous tissue; (d) obstructed left coronary artery (note minute lumen near centre); (e) wall of right ventricle showing fatty infiltration.
Fig. 1.—Very low power view (x 10) of edge of tumour mass in stomach. (a, a, a) Deposits of tumour in mucous and muscular coats. The large deposit in the mucous coat has pushed up and destroyed the mucous membrane (b); (c) is muscular coat.

Fig. 2.—Very low power view (x 10) of duodenum just beyond pylorus. (a) is a large deposit of tumour in the subperitoneal and outer muscular layers. (b, b, b, b) are small deposits in the submucous and mucous coats; (c) indicates Brunner's glands.

Fig. 3.—High power (x 200) of same deposit. (a) Indicates the tumour in the form of acini lined by columnar or cubical cells. Some acini contain free tumour cells and leucocytes. In the stroma are many leucocytes; (b) is the muscle layers around showing atrophy of the fibres and slight fibrosis.

Fig. 4.—Very low power view (x 10) of left ventricle near apex. (a) Dense fibrous area under endocardium; (b) loosened fibrous tissue extending amongst muscle bundles (d, d); (c) small vessels, with thickened walls, in fibrous tissue.

Fig. 5.—Low power (x 50) of portion of same. (a, a, a) Muscle bundles with strands of fibrous tissue running amongst them; (b) area of loose fibrous tissue; (c) small blood-vessels with thickened walls.

Fig. 6.—Very low power (x 10) of transverse section of left coronary artery near its origin. (a) Narrowed lumen; (b) greatly thickened fibrous intima; (c) atrophied fibrous media.
geneous yellow colour. The pulp is engorged with blood but the pulp cells are scanty.

The kidneys were of usual size. The capsule stripped off readily and the surface was smooth. A portion of one is mounted to show the venous congestion, especially marked in the straight vessels of the pyramids, and some cloudy swelling of the tubules of the cortex. In the largest pyramid shown there is a pearly-white nodule which is a small fibroma. The larger renal vessels are not thickened.

Microscopically.—The tubules are dilated and the secreting cells are atrophied and of a low cuboidal type; their cytoplasm is granular. The glomeruli are engorged. A few of the intertubular cortical capillaries are congested, and all the straight vessels of the pyramid. There is no increase of interstitial tissue. The renal vessels show no thickening.

The heart was slightly enlarged transversely. The coronary arteries were tortuous, and at the apex there was an old fibrous adhesion to the pericardium. The right side was moderately dilated and the chambers filled with post-mortem clot. The tricuspid valve was slightly dilated, and the pulmonary valve healthy. In the pulmonary artery was a stringy thrombus, pale in colour and tough on surface, but more friable and dark in colour in its interior. This thrombus extended along the branches of the artery into the lungs (q.v.). The left auricle and ventricle were dilated and filled with post-mortem clot.

The specimen (M. B., 508) (Plate I., Fig. 3) shows the further points, viz.:

The muscle of the right ventricle is infiltrated with fat. The left ventricle is dilated, especially at the apex. On the septum, near the apex, is a white patch of subendocardial fibrous thickening. The cut edge at the apex shows the wall greatly thinned and composed of white strands of fibrous tissue, with practically no muscle tissue remaining between them. This area has yielded and so formed an aneurysm of the heart wall. In the muscle above this white fibrous strands are seen extending through it. In this dilatation there is a reddish mass of thrombus with a pale periphery; here it was adherent, but the centre was softened and friable. The mitral and aortic cusps show patches of chronic degenerative thickening. The aortic valve was competent. The left coronary artery, about \( \frac{1}{2} \) inch from its origin, was greatly narrowed by fibrous thickening, in the centre of which there appeared to be a minute lumen. The cut surface of this obstructed vessel is seen in the specimen, just to the inner side of the tip of the left auricular appendix. The right coronary artery was very atheromatous. The aorta shows little patches of atheroma throughout it.

Microscopically (Plate II., Figs. 4, 5).—The thinned portion of the left ventricle near the apex consists very largely of fibrous tissue. This is in the form either of thick, almost hyaline, strands, quite free
from muscle fibres, or of a more open network of fibres, amongst which are scattered groups of, or individual, muscle cells. In the ventricle higher up sections show much more muscle but also bands of fibrous tissue running amongst the muscle bundles. The small vessels are thickened and lie in the midst of the fibrous strands.

A section of the coronary artery where it was seen almost obliterated (Plate II., Fig. 6) shows only a small lumen eccentrically placed. Around this is a thick laminated deposit of fibrous tissue, in the outer layers of which are spaces due to degeneration of some of the tissue. The elastic lamina—seen in the section stained by Weigert's method—is in many parts absent, in others it is stretched, irregularly thickened, and fragmented, and in parts fibrillated. The elastic tissue in the media appears diminished, and there is none seen in the thickened intima.

Lungs.—Both were small and deeply pigmented, and there was some emphysema along the margins. On section there was considerable congestion. In both lungs the main branches of the pulmonary arteries were filled with firm, stringy thrombus, similar to that already described in the pulmonary artery.

The specimen (M. B., 510) consists of portions of each lung. The upper is the lower part of the right lung; the lower is the inferior border of the left lung. In the upper portion—right lung—the thrombus is seen lying in the pulmonary artery, but adherent to the wall at one side only. In this lung there was no infarcted area. In the other lung there was similar thrombus in the corresponding artery, and, in addition, a small area of recent infarction at the lower and posterior border. The vessel leading to it is seen filled with dark thrombus.

A microscopic section taken from the margin of the lung shows emphysema, the alveoli being distended and their walls thinned and broken up in parts. Other alveoli show congestion of their capillary walls. In one or two areas, seen best near a larger pulmonary artery, there is collapse of the alveoli. In some alveoli coagulated oedematous fluid is seen. In the centre of the section this artery is seen plugged with a recent thrombus composed of fibrin, leucocytes, and red corpuscles. A section of the thrombus from the main pulmonary artery has a similar structure. The bronchi are contracted but show no other change.

**Summary and Discussion.**

This case is of much interest on account of two separate and distinct pathological conditions—the tumour of the stomach and the aneurysm of the heart wall.

The patient only began to experience trouble from the stomach condition four months before his death. The first symptoms were the
constipation and the loss in weight unaccompanied by any definite dyspepsia. As the disease progressed vomiting began, and he had "bilious attacks," and these are to be correlated with the erosion of the mucous membrane by the tumour and the resultant gastric catarrh set up. Pain, a frequent symptom of gastric carcinoma, was absent. Although the tumour began in the pyloric region, it had not caused much obstruction to the passage of food and so no dilatation resulted. The clinical examination showed distension of the stomach, but, as noted, no dilatation was evident post mortem.

When admitted to hospital the patient was wasted, but nothing definite could be felt in the abdomen. A test meal revealed the absence of free hydrochloric acid, lactic acid, and sarcine, but some red blood corpuscles were present. The last had come from small hæmorrhages from the eroded mucous membrane. The absence of free hydrochloric acid is a fairly constant feature of gastric carcinoma, but it has also been observed in malignant tumours in other situations. The acid may also be absent in chronic gastric catarrh with atrophy of the mucous membrane, and in some nervous conditions. Its significance is not yet settled. It may be due to direct damage to the glandular epithelium of the stomach, or it may be due to a general alteration in metabolism, which makes it difficult for the cells of the gastric mucosa to separate out the acid.

Where there is obstruction at the pylorus with resultant retention of food and dilatation of the stomach fermentation takes place, and acids such as lactic and butyric are formed, and sarcine and certain other organisms grow in the retained contents. It is to be noted that none of these were found in this case.

The wasting is usually explained as being due to the mechanical interference with the function of the gastric glands, but the growth of the tumour and the secondary catarrhal processes resulting from it also play a large part. In cases of tumour elsewhere than the alimentary tract similar wasting occurs, and as in such cases the hydrochloric acid of the stomach may be diminished, it has been suggested that as the normal acid stimulus to the production of secretin in the duodenum is thus absent, there is a deficiency in the ferments of the small intestine, and so the food is not properly or sufficiently digested there.

Spread.—The mode of extension of a carcinoma of the stomach is usually by the lymphatic paths to the glands, along the lesser curvature, and up to the liver, but it may also extend locally through the stomach wall, and that is the chief method in this case. Here the tumour has originated from the glands of the mucosa in the pyloric region, and has spread inwards towards the lumen and outwards through the muscle. Having penetrated the latter, it has extended directly into the omentum where the nodular masses can be demonstrated. There
is relatively little involvement of lymphatic glands in this case, only a few round the coeliac axis showing deposits. And although the omentum has numerous secondary nodules, few have extended from it over the surface of the peritoneum. It is to be noted also that there are no secondary growths in the liver. The duodenum shows no naked-eye evidence of extension to it along the mucous membrane, although there was a large mass in the pylorus immediately adjacent. This absence of extension to the duodenum is a feature frequently to be observed. But, as shown microscopically, there had occurred infiltration of the duodenum, the largest deposit being subperitoneal, and probably by way of the adjacent affected omentum, and small secondary deposits spreading into the muscular, submucous, and mucous coats.

**Tissue Reaction.**—It has been noted in the sections how the tumour deposits, not only in the mucous coat of the stomach but also in the muscular coats and in the omentum, all show marked invasion by polymorph leucocytes. There is therefore evidence of a distinct inflammatory reaction of the tissues to the tumour, and it is possible that the relatively restricted growth and the absence of much lymphatic gland involvement are to be ascribed to the resistance offered by the tissues.

**Types of Carcinoma.**—The histological type of growth in this case is the columnar-celled carcinoma, and shows the formation of irregular acini. Other types found in the stomach are the spheroidal-celled, either in the form of "scirrhus," which may spread widely along the stomach coats and give rise to one form of "leather bottle" stomach, or of "encephaloid," which usually forms a large fungating mass. The columnar-celled carcinoma is indistinguishable from the encephaloid except histologically, and its mode of spread is very similar, viz. through the stomach wall and thence by lymphatic paths. Colloid degeneration is a common feature of all the types, but was not in evidence in this case.

This case is to be compared with *D. B., 42, M. B., 197,* which is an adeno-carcinoma causing obstruction at the pylorus, with much dilatation of the stomach; *D. B., 127, M. B., 99, 100,* which is a spheroidal-celled carcinoma of the "scirrhus" type, with general involvement of the stomach wall and great contraction, giving the "leather bottle" appearance. *D. B., 181, M. B., 447; D. B., 269, M. B., 448; D. B., 555, M. B., 449,* are also examples of the "leather bottle" stomach.

**Site of Tumour.**—As regards site, the pyloric end is affected in more than half of the cases. Less common sites are the curvatures and the cardiac end; and occasionally the wall is diffusely infiltrated.

* These figures refer to relevant specimens in the teaching collection which the student is expected to study for purposes of comparison.
It should be remembered that gastric carcinomas may be superimposed on a chronic gastric ulcer, and this is to be correlated with the observed relationship between old-standing gall-stones and carcinoma of the gall-bladder; also chronic ulcers of the tongue, lips, leg, etc., may become malignant, illustrating the fact that there is a relationship between chronic irritation and the onset of cancer. (Vide D. B., 311, M. B., 548, squamous epithelioma of jaw in a betel-nut chewer. D. B., 413, M. B., 321, squamous epithelioma of leg following chronic ulcer of leg. D. B., 58, M. B., 136, carcinoma of gall-bladder in case of old-standing gall-stones.)

Secondary Effects.—The secondary effects of the tumour are degenerations, especially fatty degeneration, in the various organs, most prominent in the liver and kidney; and the general wasting and malnutrition of the tissues have already been referred to. In this case atrophy of the organs was the chief change; fatty degeneration, although present in the liver, was slight. The age of the patient (69) would also account to some extent for the atrophy seen.

At the operation the tumour was considered to be too extensive to admit of satisfactory removal, and also the age of the patient was against his being able to stand a radical operation. Accordingly a gastro-enterostomy was performed with the object of giving a freer passage of food from the stomach and to relieve the catarrh therein.

For a day after the operation the patient seemed to be getting on satisfactorily, but on the 2nd of November he was weak, and that night he suddenly collapsed. This leads to the consideration of his heart condition.

Heart Lesion.—Ordinary clinical examination of the heart had not shown evidence of serious cardiac disease, and the pulse, although rapid, was strong. It was only later that the fact of his having a “fainting attack” four years previously was elicited.

In the light of the pathological examination the sequence of events has been as follows:—

This man had evidently had a slowly developing arteriosclerosis, affecting chiefly his coronary arteries. Four years ago thrombosis had occurred in the descending branch of the thickened left coronary artery and caused an infarct of the heart wall towards the apex. This accounted for the “sudden fainting.” Had a larger area been involved sudden death would have then resulted, but the patient survived the infarction. The damaged tissue was gradually absorbed and replaced by fibrous tissue, and, owing to the thickened coronary, the muscle for some distance around had suffered from inefficient nutrition and had undergone atrophy with secondary fibrous replacement. The apex of the heart being thus replaced by non-contractile tissue yielded to the intra-cardiac pressure and so the aneurysm formed. This being a rigid
rough-walled sac, the blood did not so readily circulate there and consequently thrombosis occurred. Such a heart was sufficient for the ordinary functions of an old man, but the fact of it having to stand the strain of an operation proved too much for it. With the gradually failing cardiac action thrombosis had occurred in the pulmonary artery, and this would further embarrass the heart and precipitate the sudden failure which occurred.

The vascular degeneration in this case has been very localised, as there is practically no change, other than what an old subject would show, in the renal or splenic vessels, or in the aorta; the coronaries appear to have been the only arteries markedly affected.

This case shows the usual site of infarct of the heart wall. It is to be compared with D. B., 463, M. B., 363, which is a recent one in the same situation, and which resulted in immediate sudden death.

Obstruction usually occurs in a descending branch of the left coronary, and is less frequently found in the corresponding branch of the right, in which case the infarct occurs in the septum. It is a well-recognised cause of sudden death, but, as seen in this case, recovery from the primary damage may occur, to be followed by absorption of the infarct, fibrosis, and aneurysm.

The immediate cause of death in this case was heart failure complicated by pulmonary thrombosis.

From this Case Note:—1. The Carcinoma of the Stomach—(a) its site; (b) its naked-eye and histological characters; (c) its mode of spread; (d) the effects produced.

2. The Aneurysm of the Heart Wall—(a) its cause; (b) the sequence of events; (c) the effect of this lesion on the progress of the case.

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