

GASTRIC HISTOLOGY AND SUBTOTAL GASTRECTOMY*

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THE PRESENT CONCEPTS of the gross and histologic features of "banal" gastritis are based almost completely upon data acquired from the study of resected specimens of the stomach. These became available with the adoption of partial gastrectomy as the operation of choice for gastric carcinoma and for many cases of gastric, duodenal, and jejunal peptic ulcer. The surgeon and pathologist previously hampered by the rapid postmortem changes which occurred in the gastric mucosa were now enabled, because of well preserved material, to accurately study the histologic nature of the changes in the mucosa of the stomach. Then, too, gastroscopy subsequently increased this growing interest, for it soon became necessary to correlate the gastroscopic findings with the actual histology of the gastric mucosa. Although isolated cases of simultaneous gastroscopic and histologic analyses could be found in texts and periodicals, no systematic study had been undertaken until recently, when several investigators studied the resected stomachs of patients who had been previously gastroscoped. A few observers studied microscopically the biopsies obtained through the gastroscope. Others, influenced by the findings in experimental animals attributed the gross and microscopic gastric mucosal changes to the ligation of the blood vessels and the action of acid upon such tissue deprived of its blood supply. Their conclusions, if true, would not only negate many of the accepted basic histologic concepts of gastritis, but would naturally exclude the resected stomach and duodenum as source materials.

This study was undertaken to determine whether any histologic alterations occurred in the stomach wall during the operation of subtotal gastrectomy. The group consisted of 35 ward patients upon whom this operation was performed. Duodenal ulcer was present in 25 patients, gastric ulcer in four, jejunal ulcer in three, peptic ulcer of the esophagus in one, and gastric carcinoma in two.

The preoperative treatment in all cases was essentially the same. The patients were deprived of food for 14 to 17 hours before operation. The stomach was gently aspirated and then lavaged with warm tap water by stomach tube four to six hours prior to operation. A Levine tube was then introduced, left *in situ*, and aspirated at intervals, so that a minimal amount of gastric secretion remained. Following anesthesia, the abdomen was opened and a biopsy was obtained from the anterior wall of the stomach approximately four centimeters proximal to the pylorus and two centimeters cephalad

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to the greater curvature. In the earlier cases a rubber covered intestinal clamp was applied across the biopsy site in order to avoid contamination of the peritoneal cavity when the specimen was excised. This precaution was soon found to be unnecessary, so that in the majority of cases the anterior wall of the stomach in this region was gently elevated with forceps and a segment was excised with a minimal amount of trauma. The resulting gastric defect was then closed by an inverting continuous linen suture. Following this the vascular supply of the portions of the stomach and duodenum which were to be resected were ligated. The De Petz clamp was then applied proximal to the reentrant angle, the stomach was divided and the duodenum transected.

TABLE I

No. of Cases	Interval between Original Biopsy and Removal of Resected Specimen
10.....	10-20 minutes.
9.....	20-29 minutes.
6.....	30-39 minutes.
3.....	40-49 minutes.
4.....	50-58 minutes.
3.....	Not recorded.

TABLE II

No. of Cases.	Interval between Removal of Resected Specimen and Fixation of Postresection Biopsy
30.....	1-5 minutes.
1.....	6 minutes.
2.....	10 minutes.
1.....	15 minutes.
1.....	35 minutes.

The interval between the original biopsy and the gastric resection varied from 10 to 58 minutes. (Table I) After the removal of the surgical specimen, additional pieces of gastric wall adjacent to the original biopsy were excised. (Table III) This site was chosen because gastritis produces only focal lesions in many cases, and any changes relative to the surgical procedure might be expected to be more intense around the previously traumatized biopsy site. The entire resected specimen was then opened, described, and fixed *in toto*, usually within 15 to 30 minutes after its removal. The earlier biopsies were fixed in Zenker-formol and formalin and the later ones in Bouin and formalin. In one case (Case 3) the gastric mucosa was exposed to the air for a period of 20 minutes while the specimen was being described. This produced alterations in the surface of the mucosa (Fig. 3b).

In describing the histologic findings of the original and post-resection biopsy specimens, the classification of gastritis presented by one of us¹ was employed.

A survey of the main features of each of these forms of gastritis is briefly presented:

1. Superficial Gastritis.—The stroma of the papilla is infiltrated by plasma cells, eosinophils, Russell bodies and lymphocytes in the chronic form, and

CLASSIFICATION OF GASTRITIS

1. Superficial—focal or diffuse:
 - a. Acute—with or without erosions.
 - b. Chronic—with or without erosions.
2. Interstitial—focal or diffuse:
 - a. Acute.
 - b. Chronic.
3. Atrophic:
 - a. Productive and infiltrative—basal.
 1. Focal.
 2. Diffuse.
 - b. Infiltrative—with or without follicle formation.
 1. Focal.
 2. Diffuse.
 - c. Metaplastic.
 1. Focal.
 2. Diffuse.
 - d. With focal hyperplasia of necks or pits and occasionally polyp formation.

by polymorphonuclear leukocytes in the acute type. Edema of variable degree is present in both acute and chronic superficial gastritis; erosions may occur in either.

2. Interstitial Gastritis.—The stroma between the necks of the gastric glands is infiltrated mainly by lymphocytes, which may form large aggregates or even follicles. In severe interstitial gastritis an increase in the collagenous fibers of the stroma occurs. Simultaneous atrophic changes in the neck portions of the glands result in distortion of the architecture of this region.

3. Atrophic Gastritis.—The greatest atrophic changes and alterations are encountered in this type of gastritis. The increase in collagenous tissue of the stroma and smooth muscle fibers derived from the muscularis mucosae, usually accompanied by cellular infiltration, are always associated with an atrophic disappearance of glandular elements, whether focal or diffuse. These changes can be so extensive that the entire mucosa with the exception of the surface cells may be replaced by infiltrated collagenomuscular tissue (productive and infiltrative type) or lymphoid aggregates or follicles (infiltrative type) or both. In the latter, the production of tumorous masses or even pyloric obstruction (pseudohypertrophy) may be observed.

In the metaplastic form the surface epithelium, or that of any portion of the gastric glands, may be replaced by intestinal, goblet, and even Paneth cells. These features are associated with changes of the infiltrative, or productive and infiltrative type. The involved areas of the mucosa significantly altered and functionally atrophic may show papular or diffuse thickenings (pseudohypertrophy).

The histologic findings in the original and postresection biopsies are summarized in Table III. Five cases are recorded in detail.

TABLE III

Path.* No.	Sex	Age in Years	Diagnosis**	Interval, in Minutes, between Incision in Abdomen and Original Biopsy	Interval, in Minutes, between Original Biopsy and Removal of Resected Specimen	Interval, in Minutes, between Removal of Resected Specimen and Postresection Biopsy	Site of Biopsies, Histologic Zone	Histologic Diagnosis Type of Gastritis***	
								Original Biopsy	Postresection Biopsy
68897*	M	30	Chronic peptic ulcer of duodenum	3	27	5	Antrum	Superficial — acute and chronic. Interstitial — acute and chronic. Atrophic—basal moderate chronic infiltrative and productive. Focal metaplastic.	Superficial—chronic. Interstitial—acute and chronic. Atrophic—basal moderate chronic infiltrative and productive.
70148*	M	23	Chronic peptic ulcer of duodenum.	5	18	2	Antrum	Superficial—chronic. Interstitial — acute and chronic. Atrophic — mild basal chronic infiltrative and productive.	Superficial—chronic. Interstitial — acute and chronic. Atrophic — mild basal chronic infiltrative and productive.
70257	M	30	Chronic peptic ulcer of duodenum**	10	55	2	T. Z. †	Superficial—mild chronic. Interstitial — focal subacute. Atrophic—basal chronic infiltrative and productive.	Superficial—chronic. Interstitial—chronic. Atrophic — basal chronic infiltrative and productive.
70258*	M	52	Jejunal ulcer	10	17	2	Corpus at T. Z. Antrum	<i>Corpus at T. Z.</i> Superficial—Chronic. Interstitial—chronic and focal acute. Atrophic—basal moderate chronic infiltrative and productive. <i>Antrum</i> Superficial—chronic. Interstitial—chronic with atrophy and mild acute. Atrophic—basal chronic infiltrative and productive.	<i>Corpus at T. Z.</i> Superficial—chronic. Interstitial—chronic and focal acute. Atrophic — mild focal chronic basal infiltrative and productive. <i>Antrum</i> Superficial—chronic. Interstitial — chronic with atrophy. Atrophic—basal chronic infiltrative and productive. Lymphoid follicles.
70308*	M	51	Chronic peptic ulcer of stomach.	30	10	5	Antrum	Superficial — chronic and focal acute. Interstitial—chronic and focal acute. Atrophic—basal chronic infiltrative and productive. Lymphoid follicles. Extensive metaplastic.	Superficial—chronic and focal acute. Interstitial—chronic and focal acute. Atrophic—basal chronic infiltrative and productive. Lymphoid follicles. Moderately extensive metaplastic.

HISTOLOGY FOLLOWING GASTRECTOMY

TABLE III (Continued)

70343*	M	23	Chronic peptic ulcer of duodenum.	8	40	1	Antrum	Superficial—chronic. Interstitial—chronic and focal acute. Atrophic—basal subacute and chronic infiltrative and productive.	Superficial—chronic and focal acute with microscopic erosions.† Interstitial—chronic and focal acute. Atrophic—basal subacute and chronic infiltrative and productive. Lymphoid follicles. Small focus of acute.
70421*	F	56	Chronic N. R.## peptic ulcer of duodenum**	25		5	Antrum	Superficial—chronic. Interstitial—chronic. Atrophic—basal chronic infiltrative and productive. Focal acute.	Superficial—chronic and focal acute. Interstitial—chronic and scattered focal acute. Atrophic—basal chronic infiltrative and productive. Lymphoid follicles. Focal acute.
70457*	M	54	Chronic peptic ulcer of duodenum.	2	35	10	Antrum	Superficial—chronic. Interstitial—chronic and acute. Atrophic—basal subacute and chronic infiltrative and productive. Lymphoid follicles.	Superficial—chronic. Interstitial—chronic and mild subacute. Atrophic—basal subacute and chronic infiltrative and productive. Lymphoid follicles and aggregates.
70584*	M	43	Peptic ulcer of duodenum in healed stage.	15	32	1	Corpus near T. Z.	Superficial—chronic. Interstitial—mild chronic and focal acute. Atrophic—basal mild chronic infiltrative and productive.	Superficial—chronic. Interstitial—mild chronic. Atrophic—basal mild and focal moderate chronic infiltrative and productive. Focal lymphoid aggregates.
70771*	M	28	Chronic peptic duodenal ulcer (at line of resection). Healing erosion of duodenum proximal to ulcer.	3	N. R.	5	Antrum	Superficial—chronic. Interstitial—chronic and acute. Atrophic—basal moderate chronic infiltrative and productive. Lymphoid aggregates and follicles. (Complete replacement of glands to necks in some foci.)	Superficial—chronic. Interstitial—chronic and focal acute. Atrophic—basal chronic infiltrative and productive. Lymphoid aggregates and follicles.
70971*	M	43	Ulcerated infiltrating scirrhous adenocarcinoma of stomach with lymph node involvement.	7	N. R.	4	Corpus near T. Z.	Superficial—mild chronic. Interstitial—mild chronic and focal acute. Atrophic—basal mild chronic infiltrative and productive. Focal wedges of severe involvement. Small lymphoid aggregates.	Superficial—mild chronic Interstitial—mild chronic and focal severe chronic. Focal acute. Atrophic—basal chronic infiltrative and productive. Focal wedges of severe involvement. Small lymphoid aggregates.
71341*	M	50	Healed peptic ulcer of duodenum.**	10	30	2	T. Z.	Superficial—mild and focal moderate chronic. Interstitial—mild and focal severe chronic. Atrophic—basal mild chronic infiltrative and productive, focally more severe.	Superficial—mild chronic. Interstitial—mild and focal severe chronic. Atrophic—basal focal moderate chronic infiltrative and productive.

TABLE III (Continued)

Case No.	Sex	Age	Condition	Duration	Site	Findings	Findings
71476*	F	53	Healed ulceration of anterior wall of first portion of duodenum with stenosis.	5 23	2 T. Z.	T. Z. Superficial — moderate chronic. Interstitial — moderate chronic and acute. Atrophic—basal moderate chronic and subacute infiltrative and productive.	T. Z. Superficial — moderate chronic. Interstitial — mild to moderate chronic. Atrophic—basal moderate chronic infiltrative and productive.
					Antrum	Antrum Superficial—moderate to severe chronic. Interstitial — severe chronic and acute. Metaplastic necks. Atrophic—basal severe chronic infiltrative and productive. Lymphoid aggregates and follicles.	Antrum Superficial—moderate to severe chronic. Focal metaplasia of surface cells and pits. Interstitial — severe chronic and moderate acute. Metaplastic necks. Atrophic — basal severe chronic infiltrative and productive. Lymphoid aggregates and follicles. Focal metaplastic.
72820	M	61	Penetrating peptic gastric ulcer on lesser curvature.** Healed peptic ulcer of first portion of duodenum.**	10 40	2 Antrum	Superficial — moderate chronic. Interstitial—chronic and focal acute. Atrophic—basal chronic infiltrative and productive. Lymphoid aggregates.	Superficial—chronic. Interstitial—chronic and focal acute. Atrophic—basal chronic infiltrative and productive. Lymphoid aggregates and a few follicles.
73439	M	51	Scar of healed peptic ulcer of duodenum.**	5 25	2 Antrum	Superficial—chronic. Interstitial—chronic. Atrophic—basal moderate chronic infiltrative and productive. Lymphoid follicles.	Superficial—chronic. Interstitial—chronic and mild focal acute. Atrophic — basal mild chronic infiltrative and productive. Lymphoid follicles.
74109	M	41	Chronic penetrating and perforating peptic ulcer of duodenum.**	20 58	2 Antrum at T. Z.	Superficial—chronic. Interstitial—chronic with atrophic change. Atrophic—basal chronic infiltrative and some productive. Lymphoid aggregates and follicles.	Superficial—chronic. Interstitial—chronic with atrophic change. Atrophic—basal chronic infiltrative and productive. Lymphoid aggregates and follicles.
74421	M	49	Penetrating peptic ulcer of esophagus.**	5 30	2 Corpus near T. Z.	Superficial—chronic. Interstitial—focal chronic. Atrophic—basal chronic infiltrative and productive. Focal lymphoid follicles.	Superficial—chronic. Interstitial—focal chronic. Atrophic—basal mild focal chronic infiltrative and productive. Lymphoid aggregates and follicles.
74502	M	60	Chronic peptic ulcer of duodenum. Old gastroenterostomy.	10 30	2 T. Z. at antrum	Superficial—chronic. Interstitial—mild chronic with mild atrophy. Focal severe chronic. Atrophic—basal moderate chronic infiltrative and productive. Lymphoid aggregates.	Superficial—chronic. Interstitial — mild to moderate chronic. Atrophic—basal mild to moderate chronic infiltrative and productive. Focal metaplastic.

HISTOLOGY FOLLOWING GASTRECTOMY

TABLE III (Continued)

74659	M	41	Scar tissue involving duodenum just beyond pylorus with resultant stenosis.**	6	24	35	T. Z. near antrum	Superficial—mild to moderate chronic. Interstitial—mild to moderate chronic with atrophy. Atrophic—basal moderate chronic infiltrative and productive. Focal acute inflammation of muscularis mucosae.	Superficial—mild to moderate chronic. Interstitial—mild to focal severe chronic. Atrophic—basal mild to moderate chronic infiltrative and productive. Lymphoid aggregates.
74795	F	52	Chronic peptic ulcer of duodenum. Pyloric stenosis.	15	45	1	Antrum	Superficial — moderate chronic. Interstitial—mild acute and moderately severe chronic. Atrophic—basal moderately severe chronic infiltrative and productive. Lymphoid aggregates and small follicles	Superficial — moderate chronic. Interstitial—mild acute and moderately severe chronic. Lymphoid follicles. Atrophic—basal moderately severe chronic infiltrative and productive. Lymphoid aggregates and small follicles.
75170	M	43	Scar of healed peptic ulcer of first portion of duodenum.**	3	16	2	Antrum	Superficial — moderate chronic. Interstitial — moderate chronic and mild acute. Atrophic—basal moderate chronic infiltrative and productive. Basal mild acute. Focal metaplastic. Lymphoid follicles.	Superficial — moderate chronic. Interstitial — moderate chronic and acute. Focal atrophy. Atrophic—basal moderate chronic infiltrative and productive. Basal mild acute. Focal metaplastic. Lymphoid follicles.
75213	M	47	Penetrating peptic ulcer of duodenum.**	2	23	5	T. Z.	Superficial—mild to moderate chronic. Interstitial—focal moderate chronic. Atrophic — basal focal mild chronic infiltrative and productive. Small lymphoid follicles.	Superficial—mild to moderate chronic. Interstitial—focal moderate chronic. Atrophic — basal focal mild chronic infiltrative and productive. Small lymphoid aggregates.
75330	M	46	Penetrating peptic ulcer of duodenum.	11	16	2	Antrum	Superficial — severe chronic. Interstitial — severe chronic. Atrophic — basal severe chronic infiltrative and productive. Large lymphoid follicles with focal complete replacement of mucosa.	Superficial — severe chronic. Interstitial — severe chronic. Atrophic — basal severe chronic infiltrative and productive. Extensive infiltration with lymphoid follicles and focal complete replacement of mucosa.
75642	M	49	Chronic peptic ulcer of duodenum.	7	N. R.	3	T. Z.	Superficial—mild to moderate chronic. Interstitial—focal mild and one focus of severe chronic. Atrophic — basal focal mild to severe chronic infiltrative and productive. Small lymphoid aggregate.	Superficial — mild chronic. Interstitial—mild focal chronic. Atrophic — basal focal mild to moderate chronic infiltrative and productive. Small lymphoid aggregate.

TABLE III (Continued)

75918	M	50	Puckered stellate scar of anterior wall of duodenum.**	14	25	15	T. Z.	Superficial—mild chronic. Interstitial—mild and focal moderate chronic. Atrophic—basal focal mild chronic infiltrative and productive. Focal lymphoid aggregate.	Superficial—mild to moderate chronic. Interstitial—mild to moderate chronic. Atrophic—basal mild to moderate chronic productive and infiltrative. Large lymphoid aggregate.
76542	M	40	Scars in anterior and posterior walls of first portion of duodenum.**	5	28	2	Corpus near T. Z.	Superficial—mild chronic. Interstitial—moderate and focal severe chronic with focal atrophic change. Atrophic—basal mild and focal moderate chronic infiltrative and productive. Lymphoid follicles.	Superficial—mild chronic Interstitial—moderate and focal severe chronic with focal atrophic change. Atrophic—basal mild and moderate chronic infiltrative and productive Lymphoid follicles.
76566	M	53	Chronic peptic ulcer of duodenum.	4	16	1	Corpus near T. Z.	Superficial—focal mild chronic. Interstitial—mild to moderate and focal severe chronic with atrophic change. Atrophic—basal mild to moderate and focal severe chronic infiltrative and productive. Lymphoid aggregates and follicles.	Superficial—focal mild chronic. Interstitial—mild to moderate and focal severe chronic with atrophic change. Atrophic—basal mild to moderate and focal severe chronic infiltrative and productive. Lymphoid aggregates and follicles.
76588	M	65	Scar in superior wall of 1st portion of duodenum.**	5	16	1	Antrum	Superficial—chronic. Interstitial—chronic with atrophic change and lymphoid follicles. Atrophic—basal moderate and focal severe chronic infiltrative and productive. Lymphoid aggregates and occasional follicle.	Superficial—chronic. Interstitial—chronic with atrophic change and lymphoid follicles. Atrophic—basal moderate and focal severe chronic infiltrative and productive. Lymphoid aggregates and occasional follicle.
76778	M	41	Healed peptic ulcer of anterior wall of 2nd portion of duodenum. Penetrating jejunal ulcer.**	5	50	3	Corpus near T. Z.	Superficial—moderate chronic. Interstitial—chronic and focal acute. Atrophic—basal mild chronic focal infiltrative and productive.	Superficial—moderate chronic. Interstitial—chronic and focal acute. Atrophic—basal mild chronic focal infiltrative and productive.
76831	M	57	Perforating peptic ulcer of pylorus.**	5	23	6	Antrum	Superficial—chronic. Interstitial—chronic with atrophic change. Focal metaplastic. Atrophic—basal moderately severe chronic infiltrative and productive. Lymphoid aggregates and follicles.	Superficial—chronic. Interstitial—chronic with atrophic change. Focal metaplastic. Atrophic—basal moderately severe chronic infiltrative and productive. Lymphoid aggregates and follicles.

HISTOLOGY FOLLOWING GASTRECTOMY

TABLE III (Continued)

76865	M	53	Ulcerated infiltrating scirrhous adeno- carcinoma of stomach with in- volvement of lymph nodes.	2	31	2	Corpus at T. Z.	Superficial—none. Interstitial—none. Atrophic — basal focal chronic infiltrative and productive.	Superficial—none. Interstitial—small focus of moderate chronic. Atrophic — basal focal chronic infiltrative and productive.
76950	M	51	Chronic peptic ulcer of jejunum.	35	55	2	T. Z.	Superficial—mild to mod- erate chronic. Interstitial—focal mod- erate chronic. Atrophic—focal moderate basal chronic infiltra- tive and productive. Lymphoid aggregates. Focal extensive meta- plastic with polymor- phonuclear leukocytic infiltration and lymph- oid aggregates and follicles.	Superficial—mild to mod- erate chronic. Interstitial—focal mod- erate chronic. Atrophic — moderate basal chronic infiltra- tive and productive. More lymphoid aggre- gates. Focal meta- plastic.
77039	M	38	Several scars of anterior wall of pylorus.**	7	15	1	Antrum	Superficial — moderate chronic. Interstitial — severe chronic. Atrophic — severe basal chronic infiltrative with lymphoid follicles and moderate productive.	Superficial — moderate chronic. Interstitial — severe chronic. Atrophic — severe basal chronic infiltrative with lymphoid follicles and moderate productive.
77098	M	32	Scar of anterior duodenal wall with slight con- striction of second portion of duodenum.**	5	12	2	T. Z.	Superficial—mild chronic. Interstitial—focal acute and chronic. Atrophic — mild basal chronic infiltrative and productive. Lymphoid aggregates.	Superficial—mild chronic. Interstitial—focal acute and chronic. Atrophic — mild basal chronic infiltrative and productive. Lymphoid aggregates.
77411	M	48	Peptic ulcer of anterior wall of duodenum. Scars of superior duodenal wall just beyond pylorus.** Duodenal erosion in healing state.	10	5	10	Antrum	Superficial—chronic. Interstitial—chronic with atrophy and focal acute. Atrophic — severe basal chronic infiltrative and productive. Lymphoid aggregates and follicles.	Superficial—chronic. Interstitial—chronic with atrophy and focal acute. Atrophic — severe basal chronic infiltrative and productive. Lymphoid aggregates and follicles.

Meaning of notations on table:

* Indicates the utilization of a rubber covered intestinal clamp to obtain the original biopsy.

** Designates the surgical diagnosis in those cases in which the ulcer was left *in situ*. All the others are pathologic diagnoses.

Case 1.—Path. No. 70308: Male, age 51, admitted in April, 1940. Three years before admission the patient had epigastric pain at irregular intervals after meals for a period of three months. A gastro-intestinal series, taken in 1937, demonstrated a moderately large ulcer involving the lesser curvature and posterior wall of the stomach. During the past four months there was increasingly severe epigastric pain and occasional vomiting. Roentgenograms demonstrated that the ulcer previously noted had diminished considerably in size. Wassermann—negative. Rehfuß' test meal—maximum free acid 30; maximum total acid 54. Night Rehfuß'—free acid 0; maximum total acid 32. Vagus test meal—maximum free acid 60; maximum total acid 82.

The patient was prepared with parenteral 5% glucose in physiologic saline. Prior to operation cevitic acid, yeast tablets, vitamin B complex and nicotinic acid were administered by mouth, and seconal gr. 3 by rectum. Immediately before anesthesia, magendie minims 6 and atropine gr. 1/150 were given hypodermically.

Operation was performed, April 11, 1940, under cyclopropane anesthesia. The stomach was found to be slightly dilated. In the region of the coronary artery there was an indurated area which measured approximately four centimeters in diameter. This lesion presented a definite crater. The ulcer penetrated posteriorly and was sealed off by adherent jejunum which had found its way into the lesser sac.

The original biopsy was taken 30 minutes after incision of the abdomen, from the anterior wall of the stomach in the antral region two centimeters cephalad to the greater curvature. The resected specimen was removed ten minutes later. The post-resection biopsy was taken from the edges of the original biopsy wound five minutes after removal of the specimen. Both biopsies were cut into strips approximately one millimeter in width and fixed at once in Zenker-formol and formalin.

HISTOLOGY OF THE BIOPSIES.—*Original Biopsy—Antrum.* (See Fig. 1a): The formalin-fixed tissue consists of four strips, two of which measure 1.5 cm. in length, a third which measures 1 cm. in length, and a fourth which measures 0.7 cm. in length. The Zenker-formol-fixed tissue consists of two pieces which measure 1.5 and 2 cm. in length, respectively.

The architecture of the mucosa is considerably altered. The surface, even on gross inspection, is irregularly nodular. The nodules are separated by depressed, widened, deeper pits. In a few areas, the glandular elements have been replaced by moderately cellular, very loose, edematous fibrous tissue infiltrated by plasma cells, a moderate number of eosinophils and a small number of polymorphonuclear leukocytes. Acini of neck and antral glands are scattered within this tissue. In the deeper third of the mucosa there is loose connective tissue of finely fibrillar character that contains numerous single muscle fibers and bundles of muscle fibers continuous with the muscularis mucosae and infiltrated by lymphocytes, plasma cells and a moderate number of eosinophils. Small lymphoid aggregates and lymphoid follicles surrounded by denser collagenous tissue and muscle bundles are present. In the neighborhood of some of these follicles there are antral glands of more regular appearance, with flattened basal nuclei. These portions of the mucosa occur between the depressed pits and are often wider than those occupied by the glandular elements.

The gastric glands are replaced by glands of intestinal type in large portions of each of the biopsy strips. These glands occupy only the superficial two-thirds or one-half of the mucosa. They are lined by columnar or cuboidal cells with neutrophilic

*** Diffuse unless specifically noted to be focal.

† The isolated observation of microscopic erosions in this case, in an exquisitely focal disease like gastritis, cannot be evaluated. No active erosions were found in any of the other 34 cases of this series.

Transitional zone of the gastric mucosa between that of the corpus and that of the antrum. In this zone the peptic glands occupy a narrow portion of the mucosa just above the muscularis mucosae and antral glands, often containing acid cells, larger portions of the mucosa. In the antral region the antral glands extend to the muscularis mucosae.

Interval not recorded.

or basophilic cytoplasm and brush borders. Goblet cells occur amongst them. Many of the nuclei are pseudostratified. They vary considerably in size, shape and staining intensity. A few of the nuclei are very large, with finely granular chromatin and large eosinophilic nucleoli. There are more mitoses among the intestinal cells than among the remnants of degenerating gastric glands. Around the intestinal glands there is loose moderately cellular fibrous tissue infiltrated by plasma cells, a moderate number of eosinophils and a few polymorphonuclear leukocytes.

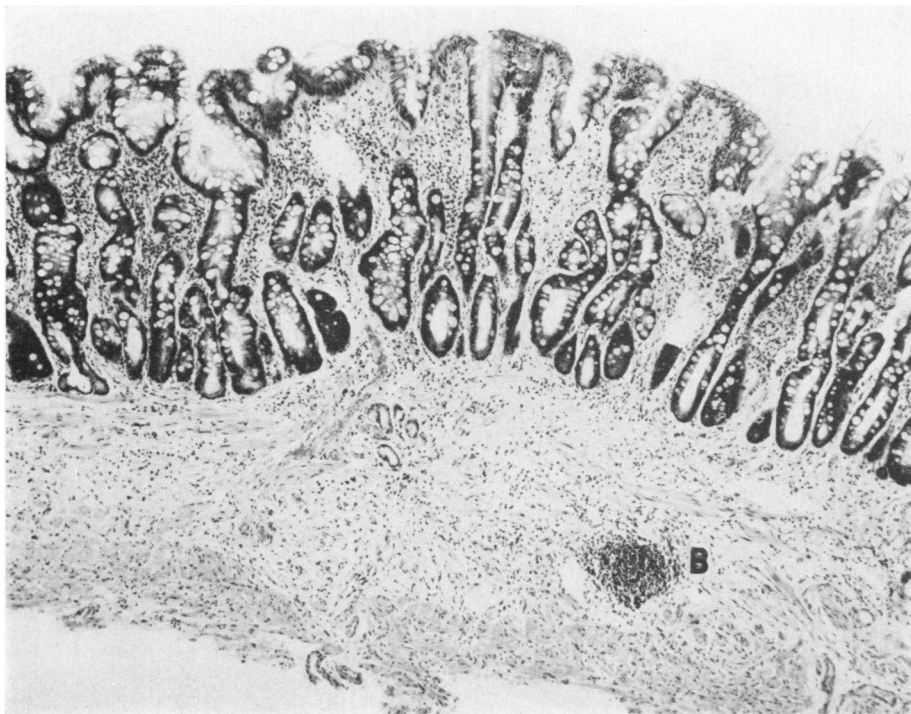


FIG. 1a.—Path. No. 70308: Original biopsy (formalin fixed, magnification 62 times). Note complete replacement of gastric glands by those of intestinal type (atrophic metaplastic gastritis). Small group of antral glands in infiltrated musculocollagenous tissue (a). Small basal lymphoid aggregate (b). Atrophic basal productive and infiltrative gastritis. The width of the mucosa is unchanged.

Most of the mucosal surface is lined by cells which are of intestinal type. Pseudostratification, which produces the appearance of budding, is present in many areas. The nuclei are elevated to the free borders of the cells. Focally, the surface lining cells are markedly flattened, widened and distorted, with vacuolated cytoplasm and pyknotic nuclei. Polymorphonuclear leukocytes, an occasional eosinophile and some lymphocytes are present in or between these cells. In a few areas the surface lining cells contain atypical nuclei which are large, swollen, hyperchromatic, and bound by poorly outlined nuclear membranes. The basement membranes beneath the cells of intestinal type vary in their demarcation. Thin mucus, in which a few desquamated epithelial cells, a small number of polymorphonuclear leukocytes and some red blood cells are found, covers the surface of the mucosa.

The papillae vary in shape, many are edematous. Some are flat and wide, others are rounded and separated by the moderately wide lumina of glands lined by intestinal epithelium. In the Zenker-formal-fixed sections many contain fine, granular, eosinophilic material (fixed edema fluid). In a moderate number the eosinophilic material is very

dense and forms a homogenous layer between the capillaries and the basement membranes of the surface lining cells. The papillae are infiltrated by many plasma cells; some contain extravasated red blood cells.

In the portions of the mucosa replaced by collageno-muscular tissue, and deep to the intestinal glands, there are remnants of neck glands and antral acini. These are of degenerative character. In many of the cells no mucus is present along the free border. The nuclei are irregularly arranged and vary in size, shape and staining intensity. The basement membranes around the acini are barely visible or absent. Some

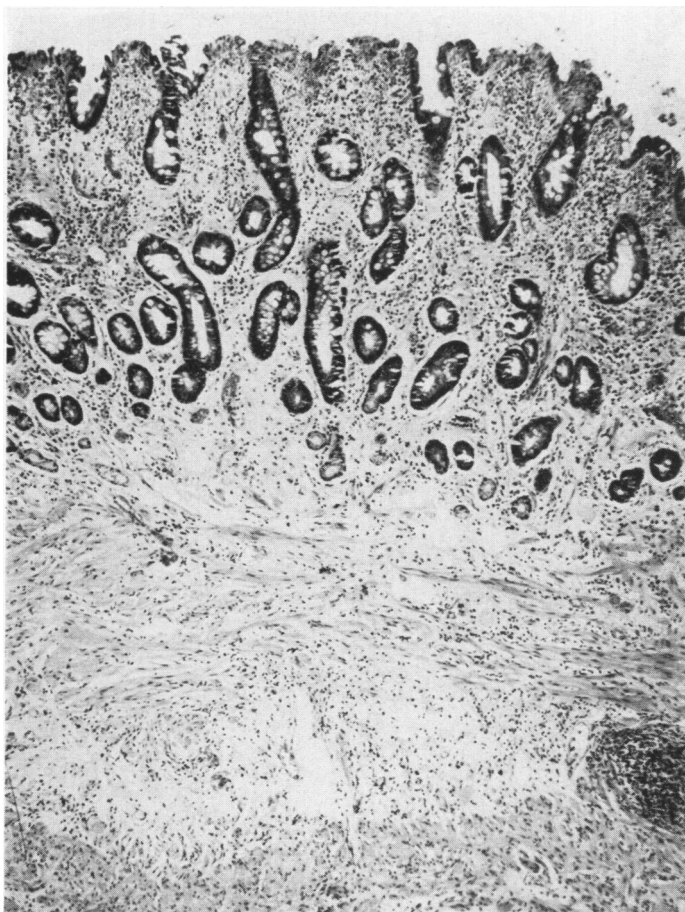


FIG. 1b.—Path. No. 70308: Post-resection biopsy (formalin fixed, magnification 62 times). The features are essentially similar to those described in Figure 1a. The surface cells in this area are slightly more distorted.

of the acini are dilated, and lined by narrow layers of cytoplasm. Scattered mitoses and a moderate number of argentaffine cells are present among these degenerating glandular acini. In the Zenker-formol-fixed section more gastric neck glands and antral glands are present. Russell bodies are found among the infiltrating cells in these regions. The junction of the muscularis mucosae with the mucosa is not clear in many places due to the proliferation of muscle fibers that extend into the upper half of the mucosa. Edema is evident throughout the mucosa but is most prominent in the papillae and just above the muscularis mucosae.

Capillaries are present within the superficial $\frac{1}{5}$ to $\frac{1}{4}$ of the mucosa. These are of uneven caliber and measure from one to eight erythrocytes in diameter. The infiltrated musculo-collagenous tissue contains scattered venules of larger caliber which are so widely spaced that the mucosa appears relatively avascular. In the deeper portions of the mucosa there are capillaries filled with eosinophilic granular material and a few dilated lymphatic channels. The walls of the capillaries both here and in the papillae are not clear.

In the Zenker-formol-fixed sections the lymphoid aggregates and small follicles are more numerous than in those fixed in formalin. From these basal foci the muscularis

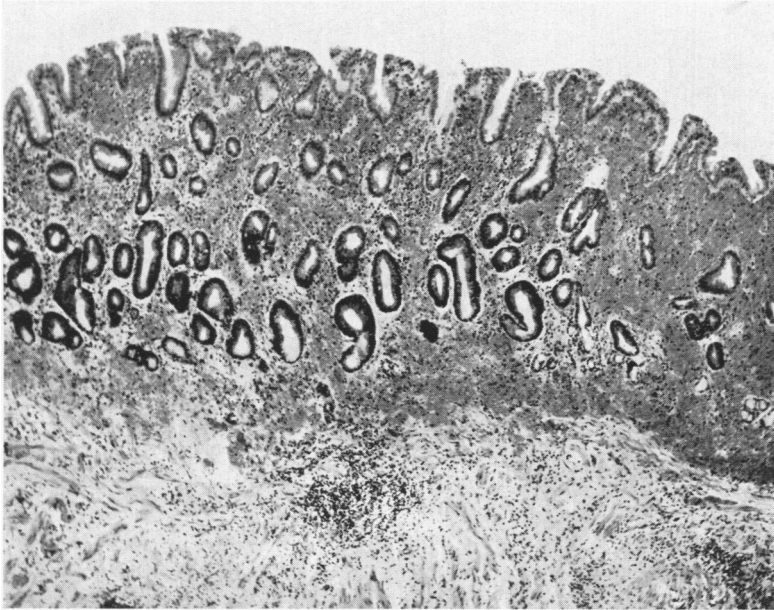


FIG. 1c.—Path. No. 70308: Post-resection biopsy (Zenker-formol fixed, magnification 62 times). Note the extensive mucosal hemorrhage. Character of the mucosa is otherwise similar to that of Figures 1a and 1b. Note the unchanged surface cells and glands.

mucosae is infiltrated by lymphocytes. In one place the lymphoid aggregates extend through the muscularis mucosae into the submucosa and focally replace the muscle fibers. The muscularis mucosae itself is edematous. The submucosa consists of loose connective tissue with dilated congested veins and arteries. Just beneath the muscularis mucosae there are some large dilated lymphatic channels. A few small islands of fat cells are present.

The septa of the muscularis propria contain extravasated red blood cells and foci of hemorrhage. The muscle cells are without significant change. The serosa contains congested capillaries and is slightly edematous.

Postresection Biopsy—Antrum (See Fig 1b): The formalin-fixed specimen consists of one strip, which measures 1 cm. in length. The Zenker-formol-fixed specimen consists of three strips, each of which measures 1 cm. in length.

The fundamental architecture of the mucosa is similar to that of the original biopsy. The surface is slightly less nodular. It is covered by mucus of slightly denser character that contains more polymorphonuclear leukocytes, some lymphocytes, and more erythrocytes.

The edema of the papillae, the congestion of the capillaries and venules in the superficial portions of the mucosa and the extravasation of erythrocytes are greater

than in the original biopsy sections. Above the muscularis mucosae the edema is slightly less intense.

One of the strips taken from the very edge of the original biopsy wound (see Fig. 1c) presents extensive hemorrhage into the mucosa. It is interesting to note that even here no greater changes are found in the surface lining cells than in the original biopsy specimens. The shape of the papillae is unaltered by the recent hemorrhage. The infiltrating cells are separated by the erythrocytes and appear less numerous, but the type of gastritis is similar.

Above the muscularis mucosae the congestion of the vessels is but slightly more prominent.

The submucosa is more edematous. Its vessels are more congested. Foci of extensive hemorrhage are present. Scattered through the submucosa are a few dilated lymphatic channels. The lumina of the dilated veins contain erythrocytes centrally, and polymorphonuclear leukocytes and some eosinophils along the endothelial lining of their walls. The septa of the muscularis propria and the serosa are without significant change.

Case 2.—Path. No. 72820: Male, age 61, was admitted to the hospital in November, 1940. He complained of aching intermittent epigastric pain of one and one-half years duration. The pain lasted for one to two hours, occurred irregularly, and subsided without treatment. During the past month the pain became more severe, lasted five to six hours, and was accompanied by anorexia and occasional vomiting. He had lost six pounds in weight and complained of increasing weakness. Wassermann—negative. Rehfuess' test meal—maximum free acid 65; maximum total acid 90. Night Rehfuess'—maximum free acid 34; maximum total acid 54. Vagus test meal—maximum free acid 60; maximum total acid 74.

The patient was prepared for operation with parenteral 5% glucose in physiologic saline. Magendie minims 6 and atropine gr. 1/150 were given hypodermically prior to anesthesia.

Operation was performed, November 14, 1940, under cyclopropane and ether anesthesia. The stomach was found to be slightly dilated. Scar tissue surrounded the first portion of the duodenum due to previous ulceration. Posteriorly, high on the lesser curvature near the esophagus, there was a penetrating ulcer whose base was formed by the pancreas. The lesion was surrounded by edema that extended to the reentrant angle. No enlarged lymph nodes were present. The ulcer was not removed, inasmuch as a Madelener procedure was performed.

The original biopsy was taken ten minutes after incision of the abdomen, from the anterior wall of the stomach in the antral region approximately two centimeters cephalad to the greater curvature. The resected specimen was removed 40 minutes later. Two minutes after its removal the post-resection biopsies were obtained from the edges of the original biopsy wound. Both biopsies were cut into narrow strips, approximately one millimeter in width, and placed in Bouin and formalin immediately.

HISTOLOGY OF THE BIOPSIES.—*Original Biopsy—Antrum* (see Fig. 2a): The formalin specimen consists of two strips, each of which measures approximately 1.3 cm. in length; the Bouin specimen consists of two strips, each of which measures 1 cm. in length.

The architecture of the mucosa is moderately distorted in the neck region and more distorted in the basal portions of the mucosa occupied by the antral glands. These alterations are greater in the formalin-fixed specimens than in those fixed in Bouin. The surface of the mucosa in all the specimens is relatively flat except where the markings of the gastric areas are faintly discernible. Small, narrow linear fragments of mucus that contain a few polymorphonuclear leukocytes are scattered over the surface.

The surface lining cells over many of the papillae are relatively unchanged. Their nuclei are oval and occupy their usual position in the cell slightly above the base. Over some of the papillae, however, the surface cells show basal vacuolization and eleva-

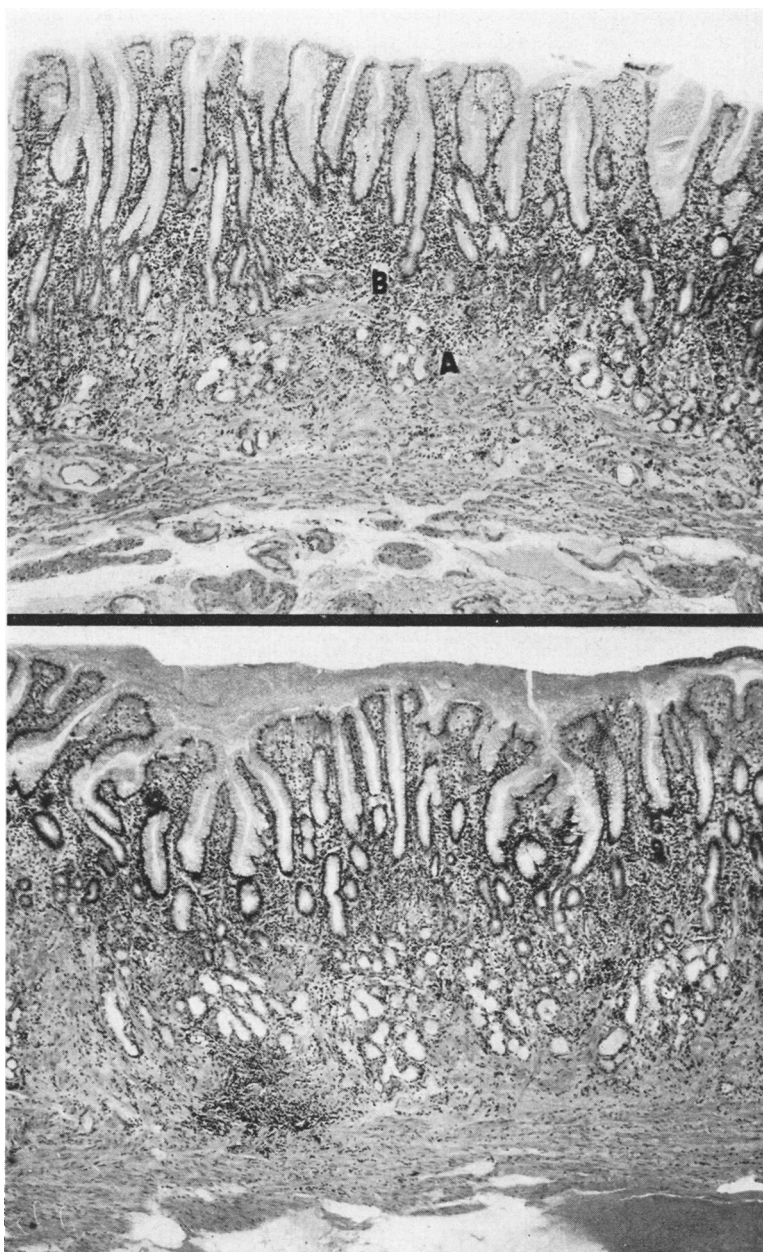


FIG. 2a.—Path. No. 72820: Original biopsy (Bouin fixed, magnification 62 times). Note the marked distortion of architecture and the bundles of muscle fibers. Islands of antral gland acini (A). Horizontal neck gland acini (B).
FIG. 2b.—Path. No. 72820: Post-resection biopsy (Bouin fixed, magnification 62 times). Note the edema of the papillae and the thick layer of mucus over the surface. The other features are essentially similar to those described in Figure 2a.

tion of the nuclei which are irregular in shape, position and staining intensity. The papillae contain a moderate number of plasma cells. Edema of the papillae varies so that some are wide and flat and others are pointed.

Some of the pits are slightly dilated and contain polymorphonuclear leukocytes; others are of average caliber. The neck glands are separated by stroma that is infiltrated with plasma cells, scattered eosinophils and some polymorphonuclear leukocytes. Around some of the necks small foci of polymorphonuclear leukocytes may be seen. Muscle bundles parallel to the surface of the mucosa penetrate to the pit-neck junctions, and form moderately large groups of fibers in some areas. The long axes of most of the neck glands are perpendicular to the surface of the mucosa; some are oblique. The basement membranes of many of the neck gland acini are no longer discernible. The lumina of some of the acini are dilated and contain polymorphonuclear leukocytes. The acini present a moderate number of mitoses and contain argentaffine cells. In some areas the neck gland acini are but shrunken remnants.

The antral glands in the basal half of the mucosa are decreased in number. They are replaced by bundles of smooth muscle fibers and by a smaller amount of collagenous tissue of finely fibrillar character. At some points continuity of the muscle bundles in the mucosa with the muscle fibers of the muscularis mucosae is evident. The fine fibrillar collagenous tissue is infiltrated by lymphocytes, occasional eosinophils and a few polymorphonuclear leukocytes. The groups of muscle fibers and the infiltrated collagenous tissue separate the antral glands from the muscularis mucosae and isolate small groups of antral acini. This produces the appearance of islands of acini in the altered stroma.

The antral gland acini are dilated, with many cells basally or superficially vacuolated. Their nuclei are irregular and vary considerably in character. These cellular changes occur in the islands of acini as well as in the closely approximated acini which lie in relatively unchanged stroma. In the latter areas, however, the nuclei are of more regular character. In the more dilated acini the lining cells are markedly flattened and contain but little or no mucus. Their nuclei are black, shrunken dots.

The portion of mucosa just above the muscularis mucosae contains lymphoid aggregates that extend into the muscularis mucosae at some points. In a few areas the lymphoid aggregates lie mainly within the muscularis mucosae. The muscle bundles of the latter are separated by edematous finely fibrillar tissue that is infiltrated by a moderate number of lymphocytes.

The capillaries of the papillae are congested and in places dilated. The walls of some of them are distinct; those of others merge with the basement membranes of the surface cells. The capillaries are of uneven caliber and are more dilated at the summits of the papillae than along the sides of the pits. These vessels range from one to two erythrocytes in width. There is a remarkable absence of visible vessels beneath the pit-neck junctions. Basally, above the muscularis mucosae dilated empty capillaries and venules are present.

The tissue of the submucosa is loose, somewhat edematous and contains moderately dilated, congested arteries and veins. Some of these vessels are filled with red blood cells and others with granular eosinophilic material. In the Bouin-fixed sections there are dilated lymphatic channels and small focal extravasations of erythrocytes.

The septa of the muscularis propria are slightly edematous. Around some of the nerves there is lymphocytic infiltration. An occasional eosinophile and lymphocyte is present around the venules of the septa. The serosa contains a few dilated congested venules and capillaries.

Postresection Biopsy—Antrum (see Fig. 2b): The formalin-fixed specimen consists of two pieces which measure 1.5 and 1.6 cm., respectively. The Bouin-fixed specimen consists of two pieces which measure 0.9 and 1 cm., respectively.

The microscopic architecture of the mucosa and its surface markings correspond to

those of the original biopsy. The surface of the mucosa is covered by a wider layer of denser mucus that contains numerous erythrocytes and small clumps of polymorphonuclear leukocytes. The entire mucosa is more edematous than that of the original biopsy. The edema is better seen in the Bouin-fixed, than in the formalin-fixed tissue. More of the surface cells show basal vacuolization than those of the original biopsy. However, even over areas of marked edema of the papillae, the vacuolization of the individual cells is not greater. The other changes of the surface cells, of the neck glands, and of the antral glands described in the original biopsy are seen here. The infiltrating cells are similar in their distribution and number.

The capillaries of the papillae are more congested but of somewhat narrower caliber. Most of them are but one erythrocyte in width. The changes in their walls are similar to those already noted in the original biopsy. Above the muscularis mucosae the degree of vascular congestion is similar to that of the original biopsy except for an occasional dilated congested vein that penetrates the muscularis mucosae from the submucosa.

The most marked differences in the gastric wall are seen in the submucosa. There is extensive edema and hemorrhage near the edges of the original biopsy wound. The arteries and veins are considerably dilated and congested. The walls of the veins are infiltrated by polymorphonuclear leukocytes. At a distance from the edges of the original biopsy the hemorrhage is focal and the edema is less prominent, but the congestion and dilatation of the vessels is similar. Erythrocytes extend into the septa of the muscularis propria from the areas of extensive hemorrhage in the submucosa. The capillaries of the muscularis propria, especially those near the serosa, are congested and surrounded by small foci of hemorrhage. Many of the capillaries and small venules are filled with polymorphonuclear leukocytes that infiltrate their walls and extend into the adjacent fibrous tissue and muscle fibers. The serosa is similar to that of the original biopsy sections.

Case 3.—Path. No. 74659: Male, age 41, entered the hospital in April, 1941. The patient was well until three years ago when he had one unheralded hematemesis. Since then he experienced epigastric pains and belching. For the past four months he complained of right upper quadrant pain and vomiting. Two months ago he had had melena. Two days prior to admission he suffered severe cramp-like pains accompanied by vomiting. Wassermann—negative. Rehfuss' test meal—maximum free acid 50; maximum total acid 70. Night Rehfuss'—maximum free acid 44; maximum total acid 52.

The patient was prepared for operation with parenteral 5% glucose in physiologic saline. Immediately before anesthesia, magendie minims 6 and atropine gr. 1/150 were given hypodermically.

Operation.—April 21, 1941: Under spinal anesthesia, with 12 cc. of Jones solution supplemented with ethylene and ether. The stomach was dilated to two and one-half times its usual size. There was increased vascularity. Scar tissue which surrounded the duodenum immediately beyond the pylorus narrowed it to a diameter of one-half inch.

The original biopsy specimen was taken six minutes after incision of the abdomen from the anterior wall of the stomach in the transitional zone near the antrum approximately two centimeters cephalad to the greater curvature of the stomach. The resected specimen was removed 24 minutes later. The original biopsy specimens were cut into strips approximately 1 mm. in width and fixed in formalin and Bouin at once. The entire specimen was then described with minimal manipulation. Thirty-five minutes after its removal it was fixed in toto in Bouin solution. Sections of the edges of the original biopsy wound were then taken from the fixed specimen.

HISTOLOGY OF THE BIOPSIES.—*Original Biopsy—Transitional Zone* (see Fig. 3a): The formalin-fixed specimen consists of three strips that measure 0.5, 0.7 and 0.8 cm., respectively. The Bouin specimen consists of two strips which measure 1.0 and 1.2 cm.

The mucosal architecture is generally unchanged. There is focal distortion in the

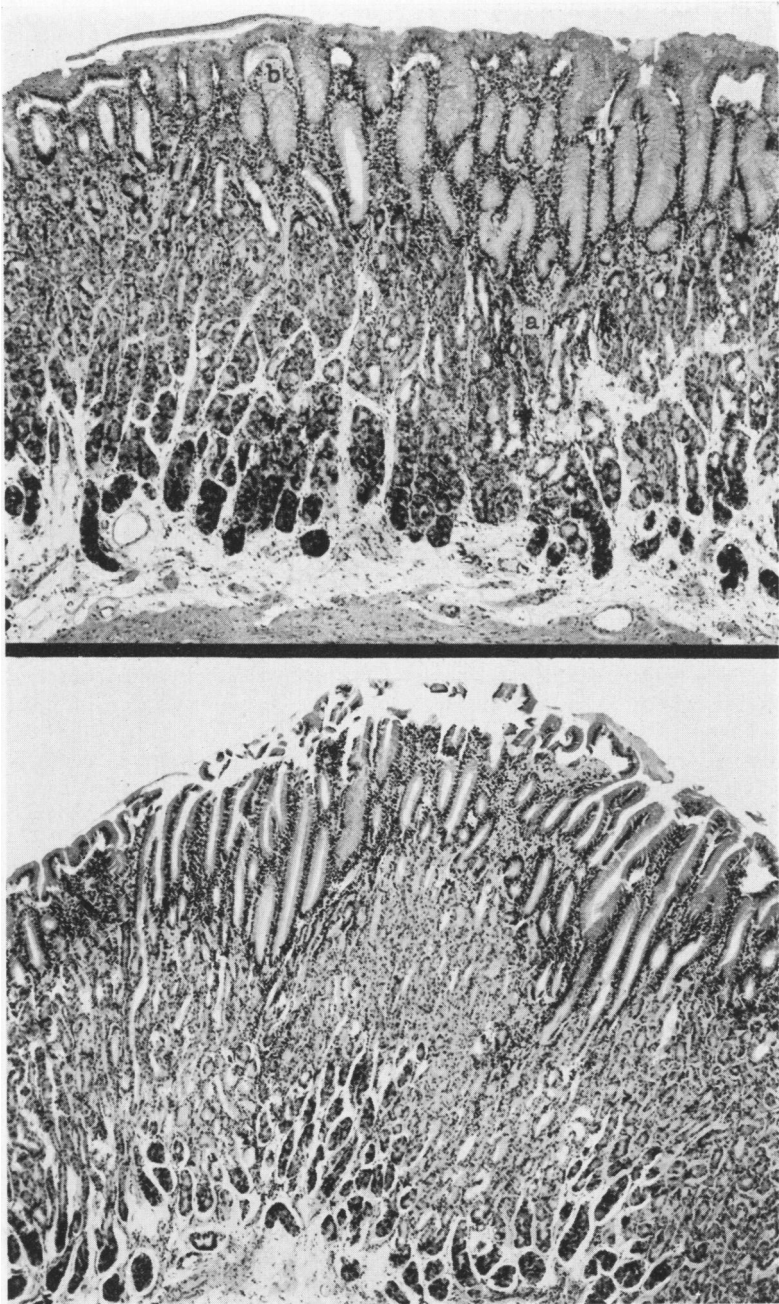


FIG. 3a.—Path. No. 74659: Original biopsy (Bouin fixed, magnification 62 times). Note the separation of the surface cells from the papillae (artefact). The latter vary in width, height, and degree of infiltration. Focal mild interstitial gastritis (a). The glands are elevated from the muscularis mucosae and separated from each other by edematous, infiltrated, finely fibrillar, connective tissue. Suprapapillary space filled with edema fluid (b).

FIG. 3b.—Path. No. 74659: Post-resection biopsy (Bouin fixed, magnification 52 times). Note the elongation of pits and necks, widening of the pits and focal villiform papillae produced by prolonged exposure to air before fixation. Basal edema is slightly greater than in the original biopsy. The summits of some of the papillae are torn (artefact). The other features are similar to those seen in Figure 3a.

neck region and above the muscularis mucosae. The surface of the mucosa is flat. The gastric areas are not discernible. A thin layer of mucus that contains a few desquamated epithelial cells, an occasional polymorphonuclear leukocyte and erythrocytes covers portions of the mucosal surface and fills the pits.

The formalin-fixed tissue differs from that fixed in Bouin. In the former the majority of the surface cells contain the usual amount of mucus. Most of their nuclei are oval or round; some are concave superficially and irregular. The surface cells over a few of the papillae contain no mucus and are shorter than the cells adjacent to them. Their cytoplasm is basophilic. Some of the nuclei occupy almost the entire cell, whereas others are at the free border. Focal pseudostratification is present in these areas. A moderate number of the cells, over both infiltrated and noninfiltrated papillae, are vacuolated basally. In the Bouin-fixed sections most of the surface cells are separated from the summits of the papillae by spaces. The major number of these spaces are empty; some contain eosinophilic granular material. The basal portions of many of the cells are no longer lined by basement membranes and are not clear. The nuclei, however, are not changed. In a few places the thin basement membranes are still visible beneath the cells. Here the basal changes in the cells are similar to those described in the formalin-fixed tissue.

The papillae vary in shape. Some are pointed; others are flat. Many are infiltrated by a moderate number of plasma cells, some lymphocytes and an occasional eosinophile or polymorphonuclear leukocyte. In these papillae there are more stromal nuclei. A small number of papillae contain extravasated red blood cells; others contain large amounts of eosinophilic, smooth material (fixed edema fluid). A few contain only edema fluid. In the Bouin-fixed sections the edema of the papillae is not as evident due to the expression of the serum into the spaces already noted between the surface cells and the summits of the papillae. The degree of infiltration is similar to that described in the formalin-fixed sections. The summits of the papillae beneath the spaces are covered by thickened, collagenous membranes of neutrophilic character.

The pits occupy one-fifth to one-quarter of the entire thickness of the mucosa. The neck glands are separated by edematous connective tissue infiltrated by small numbers of plasma cells, some lymphocytes and a few eosinophils. Their acini are surrounded by basement membranes. In a few areas no recognizable basement membranes are present. The neck cells of these acini are basally vacuolated; the acid cells are vacuolated, shrunken or deeply eosinophilic. There are small foci of denser lymphocytic infiltration between some of the neck acini. Amongst the lymphocytes a single degenerating deformed acinus is present, lined by irregular cells. In one such area the neck cells of the acinus are basophilic and granular. The cytoplasm approaches that of intestinal epithelium (dedifferentiation).

The glands in the middle third of the mucosa are separated by edematous, finely fibrillar, connective tissue that contains a small number of plasma cells and lymphocytes. There is one small aggregate of lymphocytes between the glands at this level of the mucosa. The peptic glands in the basal portions of the mucosa are separated from the muscularis mucosae by edematous finely fibrillar, infiltrated, connective tissue. At some points the peptic gland acini reach the muscularis mucosae. The glands nearest the muscularis mucosae contain peptic cells whose nuclei are near or at their free borders. The acid cells in these acini contain three to five nuclei, some of which are faintly stained and shrunken. The basement membranes of these acini may be thickened or absent. The cells of the latter merge with the edematous fibrillar connective tissue.

The mucosal glands in the formalin-fixed tissue are more closely approximated than in the Bouin-fixed specimens. This is due to less evident edema of the mucosa in the former sections.

The capillaries of the papillae in the Bouin-fixed sections are empty. They vary from one to three erythrocytes in width. At the pit-neck junctions there are venules

which vary from six to eight erythrocytes in width. Their walls are thickened. In the lower two-thirds of the mucosa there are scattered empty venules eight erythrocytes in width. Immediately above the muscularis mucosae there are dilated venules that contain eosinophilic granular material and erythrocytes. In the formalin-fixed sections the distribution of the vessels is more evident. Extravasation of red blood cells in the papillae and in small foci in the neck region are also more evident in these sections.

The demarcation of the mucosa from the muscularis mucosae is clear. The latter is edematous and contains a few lymphocytes and dilated venules which are empty or contain eosinophilic granular material. The arterioles within it are contracted. The submucosa in the Bouin-fixed tissue is edematous. The veins are dilated and contain eosinophilic granular material and some erythrocytes. The arterioles are contracted; the arteries are dilated and congested.

The septa of the muscularis propria are edematous and contain a small number of lymphocytes in some places. The serosa is moderately edematous.

Postresection Biopsy—Transitional Zone (see Fig. 3b): The specimen consists only of Bouin-fixed tissue from the edges of the biopsy wound. One strip is 1.5 cm. and the other 2.5 cm. in length.

The mucosal architecture is essentially similar to that of the original biopsy. In some areas the pits are longer and the papillae elongated and narrower. Most of the pits are empty. The surface is flat. The gastric areas are not discernible. A thick layer of denser mucus that contains desquamated epithelial cells and masses of erythrocytes covers the surface. Among the erythrocytes there are strands of fibrin and in places many polymorphonuclear leukocytes. The amount of mucus in the surface cells over some of the papillae is less than in the original biopsy. Generally, however, the amount of intracellular mucus is similar.

The cellular infiltration of the papillae and of the stroma between the neck glands is focally greater than in the original biopsy. The edema of the upper two-thirds of the mucosa is less. Basally, however, in some areas the edema is greater. The pits, neck gland acini and peptic gland acini are essentially similar. The deepest of the peptic gland acini are often completely surrounded by edematous, finely fibrillar, infiltrated, connective tissue.

The vascular distribution within the mucosa does not differ. Some of the venules near the muscularis mucosae contain polymorphonuclear leukocytes in their lumina and walls. These cells extend for a short distance into the surrounding tissue.

The muscularis mucosae is thinner. The infiltration within it and the edema are similar. The upper layers of the submucosa beneath the muscularis mucosae are occupied by large foci of hemorrhage. The veins and arteries are more dilated. They are congested and contain polymorphonuclear leukocytes which extend into the walls of some of the veins.

The septa of the muscularis propria adjacent to the submucosa are edematous. Some of the capillaries and venules within the septa contain polymorphonuclear leukocytes that extend into the walls of the vessels. Near the serosa the edema is less than in the original biopsy specimens. The serosa is less edematous.

Case 4.—Path. No. 75213: Male, age 47, was admitted to the hospital in May, 1941. He complained of sticking postprandial epigastric pain penetrating to the back, and occasional tarry stools for the past ten months. A gastro-intestinal series demonstrated a duodenal ulcer. This responded to medical therapy until two months ago when the pain became intractable. Wassermann negative. Rehfuß's test meal—maximum free acid 40; maximum total acid 60.

The patient was prepared for operation with parenteral 5% glucose in physiologic saline. Magendie minims 6 and atropine gr. 1/150 were given hypodermically before anesthesia.

Operation.—June 5, 1941: Under spinal anesthesia, with 12 cc. of Jones solution supplemented by intravenous sodium pentothal. The stomach was found to be of normal size. Distal to the pylorus there was a mass of indurated tissue that pushed the duodenum to the left. A penetrating ulcer sealed by omentum occupied the superior portion of the duodenum. A resection with post-pyloric "auschaltung" was performed.

The original biopsy was taken two minutes after incision of the abdomen, from the anterior wall of the stomach in the transitional zone near the antrum, approximately two centimeters cephalad to the greater curvature. The resected specimen was removed 23 minutes later. Sections were taken from the edges of the original biopsy wound five minutes after removal of the stomach. Both biopsies were cut into strips, approximately one millimeter in width, and placed in Bouin and formalin immediately.

HISTOLOGY OF THE BIOPSIES.—*Original Biopsy—Transitional Zone* (see Fig. 4a): The formalin specimen consists of three strips which measure 0.8, 0.7, and 1 cm., respectively. The Bouin specimen consists of three strips which measure 1.1, 1.2 and 1.5 cm., respectively.

The architecture of the mucosa is unchanged except basally above the muscularis mucosae. The junction between the muscularis mucosae and the mucosa is clear. The mucosal surface is slightly wavy, and, focally, presents gastric area markings. The surface is covered by narrow strands of mucus that contain a rare desquamated epithelial cell.

The surface cells contain an average amount of mucus. Their nuclei vary in shape, size, staining intensity and position. The long axes of many of the nuclei are parallel to the free surfaces of the cells. Focal pseudostratification of the nuclei is present. The basal portions of many of the surface cells contain moderately extensive vacuoles. A rare cell is vacuolated superficially. The vacuolization is not related to the amount of edema or infiltration of the papillae or the degree of congestion of their capillaries.

The papillae vary in character. Some are narrow and uninfiltated; others are wide. The latter contain a greater number of stromal cells than is usually seen—small numbers of plasma cells and lymphocytes, and scattered Russell bodies. Many of the papillae contain eosinophilic granular material (edema); a few contain a small number of extravasated red blood cells.

The majority of the neck glands are closely approximated and separated by their basement membranes and by the small amount of stroma usually present in this region. Focally, there is lymphocytic infiltration around acini of degenerative character, and increase in the number of stromal cells. The lining cells of the acini are vacuolated; their nuclei vary in size and position. Some of the acini of the neck glands are lined by cells with eosinophilic cytoplasm and pyknotic nuclei; others near the pit-junctions are dilated and lined by flattened eosinophilic neck cells and acid cells. Their lumina contain granular eosinophilic material.

Most of the peptic glands in the basal portions of the mucosa are closely approximated. There is the usual small amount of stroma between them. Those just above the muscularis mucosae are surrounded by thickened basement membranes which are focally widened, smooth and eosinophilic. The nuclei of the peptic cells of these acini vary in size and shape and in their position within the cell. Some of the nuclei are near or at the free borders of the cell despite the fasting state of the mucosa. Such dipolarity of the nuclei occurs less frequently in the superficial portions of the mucosa. A few of the acid cells of these acini contain two or three nuclei. The glandular acini in scattered areas are separated from the muscularis mucosae by finely fibrillar collagenous tissue infiltrated with lymphocytes, a small number of eosinophils and a few polymorphonuclear leukocytes. The stromal nuclei in these foci are increased. Single peptic gland acini with shrunken and degenerating acid and peptic cells are enclosed within this tissue, and merge indefinitely with it. There

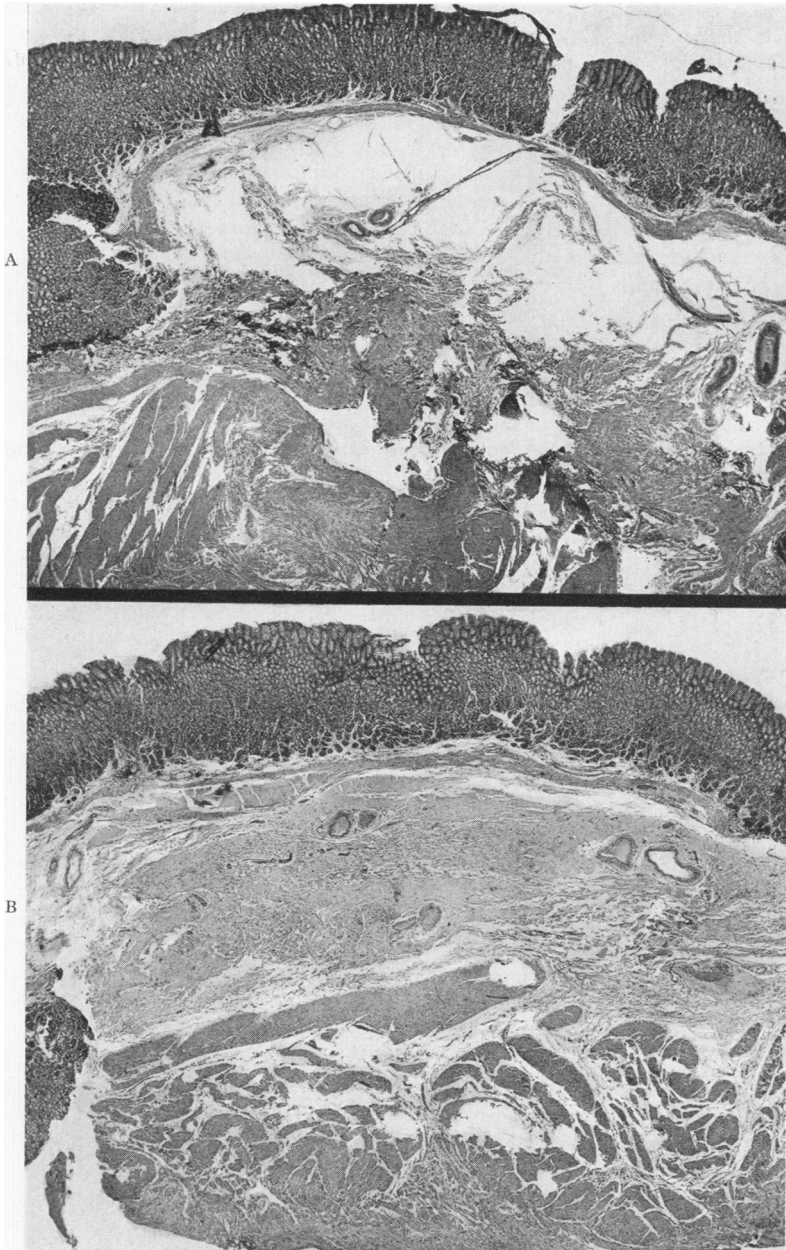


FIG. 4a.—Path. No. 75213: Original biopsy (Bouin fixed, low power). Note basal distortion in architecture (A) and edema of submucosa.

FIG. 4b.—Path. No. 75213: Post-resection biopsy (Bouin fixed, low power). Note small lymphoid aggregate above muscularis mucosae (B) and the increased edema and congestion of the submucosa. The septa of the muscularis propria are more edematous than those of Figure 4a.

are a few small aggregates of lymphocytes. The muscularis mucosae is thin and is not infiltrated by cellular elements.

The degree of congestion of the mucosa varies. Most of the capillaries of the papillae are small and of uneven caliber. They measure from one to four erythrocytes in width. Below the neck gland region only scattered capillaries, one erythrocyte in width, and a rare small venule, four erythrocytes in width, are present. Above the muscularis mucosae there are dilated congested venules, empty arterioles and small foci of hemorrhage near the lines of resection of the biopsy strips. Infiltrated collagenous tissue surrounds some of these arterioles and venules.

In the submucosa there are dilated, moderately congested arteries. The veins are more dilated and more congested. A small number of lymphocytes and an occasional eosinophil are found around some of the veins. The submucosal tissue is edematous. The septa of the muscularis propria are edematous and contain a small number of lymphocytes. The serosa is without significant change.

Postresection Biopsy.—Transitional Zone (see Fig. 4b): The formalin specimen consists of three strips that measure 0.7, 0.7, and 1 cm. in length, respectively; the Bouin specimen consists of four strips that measure 1, 1.2, 1.3, and 1.7 cm. in length, respectively.

The architecture of the mucosa corresponds to that of the original biopsy. The mucosal surface is covered by a narrow, and in places wide, layer of denser mucus which contains a few desquamated epithelial cells and many erythrocytes. The mucus is closely approximated to the surface cells, and in a few areas cannot be differentiated from the intracellular mucus. Scattered surface cells are flatter and contain less mucus than those of the original biopsy. Focally, the surface is more wavy than in the original biopsy specimen and the gastric area markings are more discernible.

The changes noted in the neck region and in the basal portions of the mucosa in the original biopsy are found here.

The state of the capillaries in the mucosa is similar. Near the muscularis mucosae there are a few more dilated veins. Most of these contain eosinophilic granular material. Some are filled with red blood cells. There are small foci of hemorrhage around the latter just above the muscularis mucosae.

The muscularis mucosae is focally wider than that of the original biopsy specimen. It presents a small amount of edema and an occasional lymphocyte.

The submucosa is more edematous. The larger, more dilated veins within it are filled with erythrocytes; the less dilated veins and the arteries contain eosinophilic granular material and a few erythrocytes. The septa of the muscularis propria are edematous and contain a few lymphocytes. The edema extends into the bundles of adjacent muscle fibers. The serosa is slightly edematous.

Case 5.—Path. 75330: Male, age 46, was admitted to the hospital in June, 1941. For the past year he was treated medically for a duodenal ulcer. One week prior to admission he experienced more severe epigastric distress, and during the past 24 hours noted hematemesis and melena. Wassermann—negative. Rehfuss' test meal—maximum free acid 60; maximum total acid 70.

The patient was prepared for operation with parenteral 5% glucose in physiologic saline. Magendie minims 6 and atropine gr. 1/150 were given hypodermically prior to anesthesia.

Operation.—June 16, 1941: Under spinal and intravenous sodium pentothal anesthesia, the stomach was found to be twice its normal size. Old and recent scar tissue and edema surrounded the first portion of the duodenum. An ulcer was found on its posterior wall penetrating into the pancreas. A small diverticulum projected from the greater curvature of the duodenum. Pathologic examination of the resected specimen disclosed a penetrating duodenal peptic ulcer.

The original biopsy specimen was taken 11 minutes after incision of the abdomen, from the anterior wall of the stomach in the antral region approximately two centimeters cephalad to the greater curvature. The resected specimen was removed 16 minutes later. Two minutes after removal of the specimen sections were taken from the edges of the original biopsy wound. Both biopsies were cut into strips one millimeter in width and placed in Bouin and formalin immediately.

HISTOLOGY OF THE BIOPSIES.—*Original Biopsy*—*Antrum* (see Fig. 5a and 5b): The formalin specimen consists of two strips which measure 0.9 and 1.5 cm. in length; the Bouin specimen consists of two strips, each of which measures two centimeters in length.

The mucosal architecture of the major portion of each of the sections is considerably distorted by the disappearance of glandular elements and their replacement by cellular infiltration, bundles of smooth muscle fibers, and a small amount of collagenous tissue. The surface of the mucosa is wavy due to depressed, irregularly distributed, widened pits. It is covered in a few areas by narrow strands of mucus which contain rare desquamated epithelial cells and a few polymorphonuclear leukocytes.

The surface lining cells generally contain an average amount of mucus. Their nuclei vary in size, shape, staining intensity and position in the cell. The basal cytoplasm of many of the cells is narrow, elongated and separated from the neighboring cells by slit-like spaces that contain a small amount of eosinophilic, granular material. Vacuoles displace the basal cytoplasm and elevate the nuclei of a moderate number of the cells. A few larger vacuoles surround the nucleus completely and narrow the layer of supranuclear mucus. The vacuolization of the surface cells is similar over edematous and nonedematous papillae. Many of the basement membranes beneath the surface cells are widened and eosinophilic. These merge with eosinophilic, smooth material in the papillae or with the walls of underlying capillaries. In the Bouin-fixed sections the basement membranes are clearer and narrower than in the formalin-fixed sections, despite the more easily discernible edema of the papillae in the former.

The majority of the papillae are edematous, moderately wide and infiltrated by numerous plasma cells; a few are nonedematous, narrow and minimally infiltrated. The pits contain degenerating polymorphonuclear leukocytes.

The neck portions of the glands are widely separated by extensive plasma cell and lymphocytic infiltration of the stroma, and in many areas are pushed aside, or replaced, by large masses of lymphocytes. The latter form diffuse aggregates or follicles in the middle third of the mucosa. Thick, hyaline collagenous fibers occur among the lymphocytes and concentrically surround portions of the periphery of the follicles. The long axes of the adjacent displaced neck glands are oblique. Many of the neck gland acini are dilated and contain polymorphonuclear leukocytes. Their lining cells are flattened, eosinophilic and contain irregular nuclei. Many of their basement membranes are indistinct and infiltrated by lymphocytes and a few polymorphonuclear leukocytes. A moderate number of argentaffin cells are found among the neck gland acini.

Large areas of the basal portions of the mucosa are completely replaced by dense masses of lymphocytes. These present a moderate number of secondary centers (follicle formation). They contain reticulum cells, dense, hyaline, collagenous fibers and groups of smooth muscle fibers. Some of the lymphoid aggregates occupy the lower third of the mucosa; others are so extensive that they reach the pit region. They enclose islands of degenerating glandular acini with vacuolated cytoplasm and deformed nuclei. Antral glands adjacent to the large lymphoid aggregates are pushed aside. Their long axes, originally perpendicular, are now almost parallel to the surface of the mucosa.

Between the masses of lymphocytes the relationship of the remaining antral glands to the muscularis mucosae and the stroma differs. The bases of a small number reach

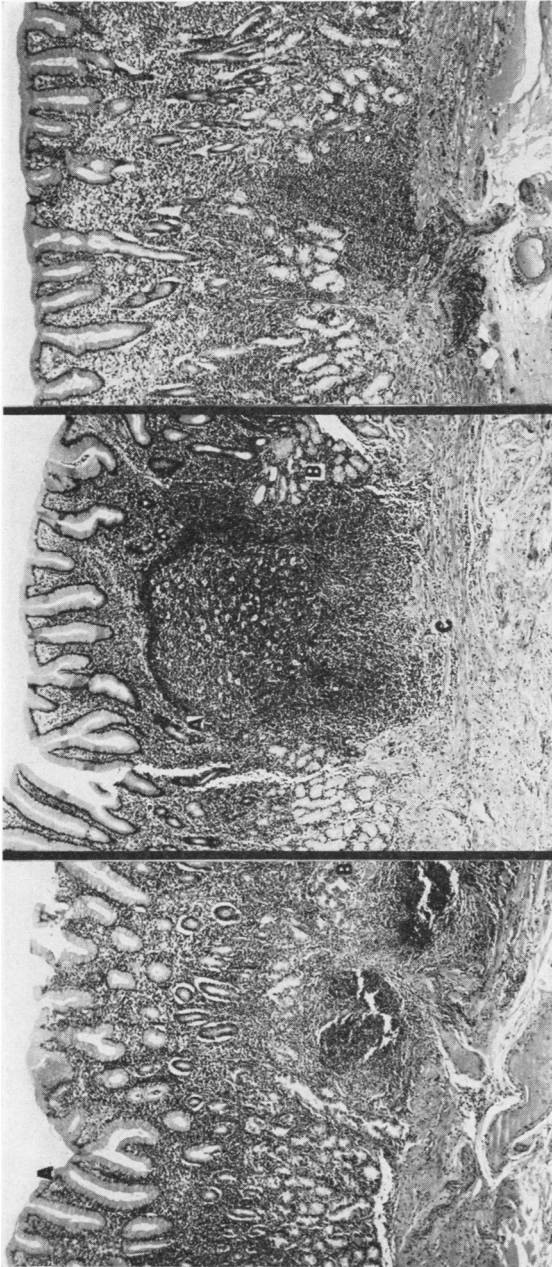


FIG. 5a.—Path. No. 75330: Original biopsy (Boviu fixed, magnification 62 times). Note the marked distortion of mucosal architecture and the basal lymphoid aggregates. Basal vacuolization of the surface cells (A). Small groups of acini (B) remain in the altered stroma.
FIG. 5b.—Path. No. 75330: Original biopsy (formalin fixed, magnification 62 times). Note complete replacement of antral and neck glands by large lymphoid follicle (atrophic infiltrative gastritis). The neck glands (A) and the antral glands (B) adjacent to the follicle are pushed aside. Their axes are changed. The muscularis mucosae (C) is infiltrated by lymphocytes.
FIG. 5c.—Path. No. 75330: Post-resection biopsy (Boviu fixed, magnification 62 times). The features are essentially similar to those described in Figure 5a. Note the greater amount of submucosal edema.

the muscularis mucosae; others are separated from the muscularis mucosae by a small amount of fine collagenous tissue infiltrated by lymphocytes, plasma cells and some eosinophils and polymorphonuclear leukocytes. Russell bodies are scattered through both this tissue and the areas of marked infiltration. In a few places above the muscularis mucosae the antral glands are replaced by dense collagenous tissue infiltrated by lymphocytes. The width of the muscularis mucosae is increased by moderate edema and lymphocytic infiltration. At some points beneath the large aggregates, lymphocytes replace the muscle fibers and destroy their continuity.

Congested capillaries, one to three erythrocytes in caliber, are noted at the summits of scattered papillae. A few capillaries, three to six erythrocytes in width, are at the level of the pit-neck junctions. The remainder of the mucosa is relatively bloodless. A rare small vein penetrates the muscularis mucosae. Within the latter there are some nondilated arterioles and venules filled with erythrocytes.

The submucosa is edematous and contains dilated arteries and veins filled with erythrocytes. A group of lymphocytes surrounds one vein. Lymphocytes from the large mucosal aggregates extend through the muscularis mucosae into the submucosa. The collagenous fibers superficial to the muscularis propria are denser than elsewhere and parallel to the mucosal surface.

The septa of the muscularis propria are slightly edematous. The serosa is without significant change.

Postresection Biopsy—Antrum (see Fig. 5c): The formalin specimen consists of four strips. Two of these each measure 0.8 cm. in length; the other two each measure 2.5 cm. in length. The Bouin specimen consists of four strips which measure 0.6, 0.8, 1.3, and 1.6 cm., respectively.

The mucosal architecture corresponds closely to that of the original biopsy.

The surface of the mucosa is covered by narrow and wide layers of denser mucus which contains desquamated epithelial cells, erythrocytes and single and clumped polymorphonuclear leukocytes. In some areas the mucus merges with the intracellular mucus of the surface cells so that but a narrow, eosinophilic zone of cytoplasm remains. This is either anuclear, or contains a deformed, shrunken or swollen, poorly demarcated nucleus. The boundaries between the surface cells in these areas are not distinguishable. Erythrocytes and lymphocytes in greater numbers are found between and within the surface cells than in the original biopsy. More of the surface cells are basally vacuolated but the degree of vacuolization is similar.

The pits are slightly longer. In the neck glands a few regular mitoses are present. The argentaffine cells are slightly more numerous.

The type and degree of infiltration and the alteration of the neck and antral glands correspond to that of the original biopsy. The eosinophils in the muscularis mucosae are slightly more numerous. The edema of an occasional papilla is greater. Focally, there is greater edema above the muscularis mucosae and between groups of its muscle fibers. The remaining coats of the gastric wall are more edematous.

Congested capillaries at the summits of the papillae are more numerous but are of the same caliber (one to three erythrocytes in width). At the pit-neck junctions, congested capillaries three to six erythrocytes in width, and congested venules eight to ten erythrocytes in width are more numerous. The deeper portions of the mucosa, as in the original biopsy, are relatively bloodless except for an occasional perpendicular congested venule (six to eight erythrocytes in width) which runs superficially from the muscularis mucosae. A few venules, three erythrocytes in width, and a few contracted arterioles are present above the muscularis mucosae. The submucosal veins and the capillaries of the septa of the muscularis propria are more congested. Focal hemorrhage occurs in the submucosa and the septa of the muscularis propria.

COMMENT

A study of Table III demonstrates quite clearly and conclusively that the fundamental histologic architecture of the biopsy specimens taken prior and subsequent to resection was not essentially altered by the operation of subtotal gastrectomy *per se* in any of the 35 cases which were analyzed. It should be remembered, however, that the number and distribution of the infiltrating cells varied in many of the biopsy strips from the same specimen, but such differences in adjacent mucosal areas have been found to be common.

However, the surgical procedure did produce changes in the surface of the mucosa, alterations in the amount of tissue fluid throughout the entire gastric wall, and congestion of the blood vessels. The amount of surface mucus increased and the volume of intracellular mucus decreased as the interval lengthened between the original biopsy and the resection of the specimen. In a few instances in which this interval exceeded 20 minutes, the intracellular mucus merged with that on the surface. However, the loss of this intracellular mucus rarely produced significant cytoplasmic or nuclear changes in the surface cells. Minor changes in the shape and height of the papillae and in the width and contour of the pits were observed. When alterations of the surface cells, including basal vacuolization, focal pseudostratification (piling), variation in the position, shape and staining intensity of the nucleus were noted in the original biopsy, they were also present in the postresection specimens. In some of these cases there were small numbers of polymorphonuclear leukocytes around the neck glands or in the papillae in the postresection biopsies.

Stromal edema and capillary congestion of the papillae, and edema of the stroma superficial to the muscularis mucosae were more evident in the postresection biopsy, except in one case (Case No. 75918), in which the basal edema was less intense. Generally, the muscularis mucosae was more edematous. It should be noted that the edema was most striking in the submucosa and in the adjacent septa of the muscularis propria when the interval between the biopsies exceeded 20 minutes.

Hemorrhage involving the entire mucosa occurred mainly near the edges of the original biopsy. This was present regardless of the time interval between the original biopsy and the resection. The glandular acini were separated by the extravasated blood but remained intact except in No. 70421, in which desquamation of the antral cells was present. In No. 76566 a small number of surface cells were destroyed over one hemorrhagic papilla. Submucosal hemorrhage was more striking and most marked when the intervals exceeded 20 minutes. The hemorrhage involved mainly those portions of the submucosa just beneath the muscularis mucosae and above the muscularis propria. In Case I, Path. No. 70308, in which but ten minutes elapsed between the original biopsy and the resection, the submucous hemorrhage was quite extensive. The veins of the submucosa, and the capillaries and venules of the septa of the muscularis propria were more congested in the postresection

biopsy. The walls of some of these vessels were infiltrated and surrounded by polymorphonuclear leukocytes.

[CONCLUSIONS

1. No histologic differences of diagnostic significance were found in this series of 35 cases in which preliminary and postresection biopsies were carefully studied and compared.

2. Postresection specimens, if fixed immediately, represent, with minor modifications, the histologic state of the gastric wall existent prior to resection.

REFERENCE

- ¹ Gitlitz, A. J., and Lerner, H. H.: Interpretation of Gastroscopic Observations in Terms of the Histology of the Gastric Mucosa. Presented before the section on Gastro-Enterology and Proctology, A. M. A. Session, June 12, 1940.