orf strains failed to grow on passage although cytopathic change was produced initially, and a third strain failed to produce any detectable changes in tissue culture.

It should be noted that the minimum times given in Table II for a cultural diagnosis are only the earliest appearance of sufficient cytopathic change to be considered typical enough

TABLE II.—*Minimum Times Before a Provisional Diagnosis was Possible*

Virus	Electron Microscopy	Tissue Culture			
		Cells	Earliest Characteristic C.P.E. in Days		
			Mean Time	Range	No. of Specimens
Orf ..	2–3 hours	Amnion	5·3	2–20*	15
		Bovine testis	5·2	2–20	9
Vaccinia	2–3 hours	Amnion	1·3	1–3	16

* One specimen, included in Table I, is omitted from this series because the extremely slow development of C.P.E., 55 days, was so markedly out of the normal range. The vaccinia cultures are taken from a larger series which was unaccompanied by microscopy.

In each case the cells are primary cultures. Bovine testis cultures were prepared as described by Ferris and Plowright (1958).

to warrant a provisional report. This obviously requires confirmation by further observation and subculture accompanied by neutralization or other serological tests.

The application of the technique for differential diagnosis is illustrated by the warts virus specimen. The patient was a farm worker who developed a single granulomatous lesion on the right thumb which was thought to be orf by one clinician and a wart by another.

The shortest time for the examination of a specimen and a positive report was found to be two hours.

Conclusions

The disadvantages of the electron-microscopic technique are the nature of the apparatus required and the fallacies inherent in any morphological technique. The first can be overcome by sending the specimen to a laboratory where facilities are available. The advantages are its quickness, the differentiation between two distinct viruses, and the identification of virus particles in material from which they cannot be grown.

It could be a valuable extra technique for smallpox diagnosis provided that it is used in conjunction with other methods. Especial care would be necessary to prevent laboratory infections from the aerosol produced during sonication, but a safe method for handling this material should not be difficult to devise.

In view of the degree of resolution demonstrated in Fig. 3 the application of the method to viruses smaller than warts virus should be feasible provided they are present in sufficient quantity.

Summary

Confirmation of the clinical diagnosis in orf infections is often prolonged by the slow growth of the virus in tissue culture.

To overcome this difficulty a simple preparative technique has been evolved for the recognition of virus particles in the clinical material within a few hours. Crusts or biopsy specimens are broken up by ultrasonic vibration, the virus is concentrated by centrifugation and examined by electron microscopy with phosphotungstate as a contrast agent.

The examination of 20 specimens by this technique in parallel with tissue culture is described. These comprised 17 orf, 2 vaccinia, and 1 wart infection.

The results obtained suggest that the technique might be extended to some other viral skin infections to supplement existing methods.

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Arteriovenography of the Portal System

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[WITH SPECIAL PLATE]

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Splenoportography has proved extremely valuable in the investigation of patients with portal hypertension, particularly in those where surgical therapy is contemplated, for prior knowledge of the state of the portal and splenic veins enables a planned procedure to be carried out. Splenic puncture, however, always carries a certain risk from haemorrhage, and should never be done if the prothrombin time is more than two seconds prolonged. A serious disadvantage of the method is that occasionally all the contrast medium is diverted into collateral channels and the portal vein is not filled even though it may be patent. Furthermore, patients who have had a previous splenectomy may require investigation. Other techniques for showing the portal vein which can be tried in these patients are not very satisfactory. The retrograde injection of contrast medium through a wedged hepatic-vein catheter (Tori, 1953) or direct transhepatic portography (Bierman, Steinbach, White, and Kelly, 1952) requires a high injection pressure which may damage the liver parenchyma.

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Parks and Couch (1962) described one case in which they catheterized a large collateral vessel arising from the haemorrhoidal plexus, but this technique requires a surgical exposure with a general anaesthetic or a pudendal block.

Other workers have occasionally demonstrated the portal vein on serial films taken of the venous phase following contrast injection into the aorta or its visceral branches (Rigler, Olfelt, and Krumbach, 1953; Ödman, 1956, 1958; Evans, 1964). The best visualization of the portal vein is obtained when contrast medium is injected directly into the coeliac axis or superior mesenteric artery. Selective catheterization of these vessels may be difficult, and the only extensive series is that reported by Boijsen, Ekman, and Olin (1963). These workers had the benefit of image intensification with television control and an automatic rapid serial changer. In this paper we describe the results that have been obtained using only simple *x*-ray equipment. Forty-two patients have been examined. Important details of the technique which are necessary for successful catheterization and good visualization of the portal vein are described and the indications for this procedure considered.

Technique

The catheters, which are made from green radiopaque Ödman tubing, are shaped by immersion in hot water, using a specially designed wooden mould (Special Plate, Fig. 2). The type of catheter used for coeliac-axis catheterization depends on previous clinical assessment of the size of the spleen. Experience has shown that when the spleen is large, the coeliac axis and splenic artery tend to arise horizontally from the aorta, and the best type of catheter is one with a wide bend (Fig. 2B). When the spleen is normal in size or only moderately enlarged the artery arises at an acute angle and a smaller and narrower bend should be used (Fig. 2C). The size of the bend used for superior-mesenteric-artery catheterization is not so critical (Fig. 2A), but if the aorta is very tortuous a rather wider bend than that illustrated is better. In addition to the end hole the catheters have two side holes placed within 0.5 cm. of the tip.

The patient is positioned on the *x*-ray table over a wooden tunnel used for taking the serial films. Three lead skin-markers are then strapped in place in the mid-clavicular line so that the first marker is at the level of the xiphisternum and the third halfway between the xiphisternum and the umbilicus, the second marker being placed midway between the other two. The catheter is inserted into the right femoral artery, using the Seldinger (1953) technique. With the patient in the left oblique position, the catheter is advanced under fluoroscopic control to the level of the first skin marker. The tip of the catheter is then rotated anteriorly and a film taken with the undercouch tube after the rapid injection of 10 ml. of 45% hypaque. This will show the site of origin of the coeliac or superior mesenteric artery in relation to the skin-markers. The origin of the coeliac axis is most commonly found at the T 12–L 1 interspace, and usually corresponds to the level of the second marker. The superior mesenteric artery arises 1–2 cm. lower. This preliminary film is also a check that the bend of the catheter being used is the correct one for the particular patient. The catheter is then moved from above downwards at the level of the origin until it is seen to "pop" into the vessel. When the superior mesenteric artery is being catheterized, gentle manipulation and rotation enables the catheter to be advanced a further 3–4 cm. Coeliac axis catheterization is more difficult, but an attempt is always made to pass the catheter on into the splenic artery. If this fails the catheter is positioned so that the tip directly faces the origin of the splenic artery.

The patient is then returned to the supine position and instructed not to move or flex the leg. The catheter is secured by strapping in the groin. These are important precautions for preventing dislodgment of the catheter. The overcouch tube is then centred over the origin of the coeliac axis or superior mesenteric artery and, after a preliminary film to check exposure and catheter position, 20–30 ml. of 45% hypaque is injected rapidly by hand. A series of eight films are taken routinely, using a stationary grid, the changing being done by hand. The first two films which show the arterial pattern are taken during the injection and the remainder at approximately four-second intervals.

Results

The 42 patients examined are divided into two groups: 33 patients in whom portal venography was attempted by coeliac axis catheterization, and 9 patients in whom the superior mesenteric artery was catheterized, most of these having had a previous splenectomy. The majority of the patients had portal hypertension, but both groups include a number of patients being investigated for hepatomegaly or unexplained abdominal pain. In these the prime aim of the investigation was the demonstration of an abnormal arterial pattern in the liver or stenosis at the origin of the coeliac axis or superior mesenteric artery.

Splenic Arterioportography

The coeliac axis was successfully catheterized in 28 of the 33 patients (Table I). The five unsuccessful cases were encountered early in the series, and in each instance the failure, in retrospect, could be attributed to the wrong shape of catheter being employed. Adequate visualization of the portal venous system was obtained in 19 (68%) of the 28 successfully catheterized. The best results were obtained in those cases where it had been possible to pass the catheter some distance into the splenic artery. Excellent visualization was also obtained in four cases where the splenic artery was the major branch of the coeliac axis or arose directly from the aorta. In these cases the hepatic artery arose from the superior mesenteric artery.

TABLE I.—*Results of Coeliac Arterioportography*

Diagnosis	No. of Cases	No. Successfully Catheterized	No. Showing Portal Venous System
Portal hypertension :			
Cirrhosis	13	11	6
Cirrhosis before and after portacaval anastomosis	3	3	3
Cirrhosis after portacaval anastomosis	7	6	4
Portal-vein thrombosis	2	2	2
Miscellaneous :			
Hepatomegaly due to tumour	3	2	0
Abdominal pain	3	3	3
Unexplained splenomegaly	2	1	1
Total	33	28	19

Failure of visualization was basically due to too little contrast medium reaching the spleen. The causes for this were various and included backflow of contrast into the aorta, predominant flow into the dilated hepatic artery (two patients with hepatic metastases), and stenosis at the origin of the coeliac axis (one patient).

In a number of cases the portal vein could be followed into its terminal ramification in the liver, but in general the portal radicles were not as well seen as on a splenic venogram. In two cases in which the splenic vein only was visualized the presence of a portal-vein thrombosis was confirmed at

laparotomy. Large collateral channels were seen in these two patients and in five of the nine patients with cirrhosis successfully examined. In two of the four in whom collaterals were not shown, a barium-swallow examination was negative and there was no clinical evidence of a collateral circulation. The other two, however, had definite varices, and it seems likely that the collaterals were missed on the arteriovenogram.

We have also used the method to demonstrate the patency of a portacaval shunt. The examination was successful in all seven patients, and in each of these the shunt appeared patent with contrast medium flowing freely into the inferior vena cava. In these cases no collaterals were visible. There was also other evidence that the shunt was patent, the splenic pressure being within normal limits and no varices being visible on barium-swallow examination. Three of the patients had had a splenic arterioportogram done previously as part of the pre-operative assessment. Clinical details of one of these are given, the relevant films being shown in Fig. 1 (Special Plate).

Case Report

A storekeeper aged 41 was known to have had pulmonary sarcoidosis since 1944. In 1962 he had a haematemesis, and on examination was found to have marked hepatosplenomegaly. A barium-swallow examination showed gross varices, and the presence of portal hypertension was confirmed by the finding of a raised intrasplenic pressure of 28 mm./Hg (normal <15 mm./Hg). A liver biopsy showed fibrosis and granulomata in the portal tracts, but no evidence of cirrhosis. The wedged hepatic-vein pressure was normal, and this together with the histological appearances indicated that the portal hypertension was due to pre-sinusoidal obstruction. A splenic arterioportogram showed a patent dilated portal vein (Fig. 1b), and following a further haematemesis in 1963 a portacaval ananstomosis was performed. After the operation he did well and a repeat arterioportogram done six months later showed a patent anastomosis (Fig. 1c).

TABLE II.—*Results of Superior Mesenteric Arterioportography*

Diagnosis	No. of Cases	No. Successfully Catheterized	No. Showing Portal Venous System
Portal hypertension :			
Cirrhosis	3	3	3
Portal-vein thrombosis	3	2	1
Miscellaneous :			
Blood dyscrasia	1	1	1
Abdominal tumour	2	2	2
Total	9	8	7

Superior Mesenteric Arterioportography

Catheterization of the superior mesenteric artery was successful in eight of the nine patients examined (Table II). In retrospect, the one failure was due to a poor preliminary film with inadequate localization of the origin of the vessel. Serial films of the venous phase showed the portal vein in seven patients. The contrast was often excellent, and in some the whole course of the superior mesenteric vein could be seen from its origin in small venous radicles in the intestinal wall to its junction with the portal vein. In portal hypertension the venous radicles were markedly dilated. The investigation was of particular value in two patients who had been thought to have extrahepatic portal hypertension due to a portal-vein thrombosis. In both cases the portal vein was shown to be patent (Special Plate, Fig. 3), and one has now had a successful portacaval anastomosis. Details of this case are given.

Case Report

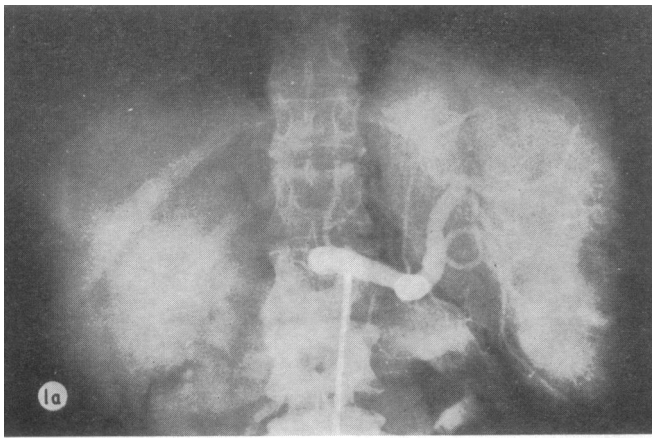
A housewife aged 40 had her first haematemesis at the age of 20. Further severe bleeds occurred which required blood transfusion. Two years later splenectomy was performed. Since then haematemeses and melaena of varying severity have recurred at intervals of approximately three to four years. Investigations in 1958 revealed no clinical evidence of liver disease and normal liver-function tests. A liver biopsy was not very helpful. Only small fragments of liver were obtained, and these appeared normal histologically. A diagnosis of extrahepatic portal hypertension due to a portal-vein thrombosis was made. She was readmitted in 1963 for a superior mesenteric arterioportogram which showed that the portal vein was patent. This was subsequently confirmed at operation when a portacaval anastomosis was performed. An operative liver biopsy showed a well-compensated cirrhosis with definite regeneration nodules and fibrosis but with some areas of relatively normal lobular structure.

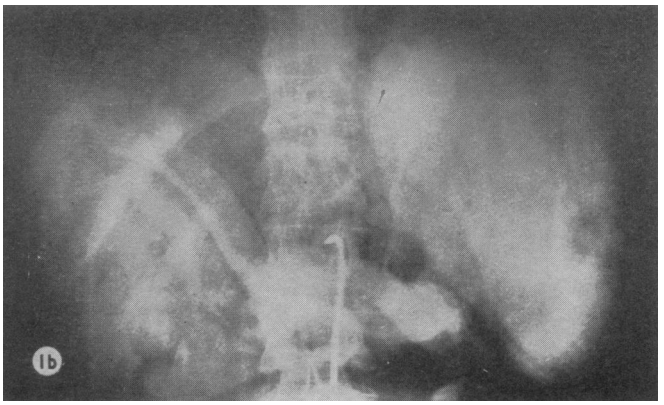
Discussion

The results of the present study show that arterioportography can be successfully performed using only standard *x*-ray equipment. Including both groups of patients together, the respective artery was catheterized in 36 (86%) out of 42 cases, and in 26 (72%) of those catheterized good visualization of the portal venous system was obtained. The most important single factor determining success was the use of a correctly shaped catheter, and most of our failures occurred early in the series before this was realized. To obtain the highest concentration of contrast in the splenic and portal veins after coeliac axis angiography, the catheter should be passed on into the splenic artery. This was not always possible. The coeliac axis, however, is known to show individual variation (Michels, 1942) and further work using different shapes of catheter and models of the anatomical variants are in progress. In cases where visualization of the portal vein is poor, subtraction radiography (Ziedses Des Plantes, 1961) may be of considerable help in obtaining better definition. The catheters are difficult to see in obese patients and in those with marked hepatosplenomegaly, but this was never a cause for failure. Since the portal circulation is slow in cirrhosis (Ekman, 1957), timing of the films by hand changing is not so difficult as might be thought. Dislodgment of the catheter is always a problem, but with two side holes and a hand injection the catheter is unlikely to be blown out of the vessel.

The greatest value of this procedure is in patients in whom the spleen has been removed. Boijsen *et al.* (1963) describe similar cases to ours in which a patent portal vein was shown by arterioportography and in which a successful portacaval anastomosis has subsequently been performed. After splenectomy many patients do, however, have an extensive thrombosis of the portal vein and the prospect of a successful shunt is slight. In three such cases Boijsen *et al.* (1963) were able to demonstrate a collateral channel in the hepatoduodenal ligament which was large enough for anastomosis. In one of these a post-operative follow-up showed that the shunt was working. Superior mesenteric arterioportography is also the only method available for checking the patency of a spleno-renal anastomosis. Serial films in these patients show retrograde passage of the contrast medium from the superior mesenteric vein into the splenic vein and then into the inferior vena cava via the anastomosis (Boijsen *et al.*, 1963).

In patients in whom the spleen is still present splenoportography remains the procedure of choice, for it affords a higher concentration of contrast medium in the portal vein and collateral circulation. There are, however, certain definite indications for coeliac arterioportography ; for instance, when the prothrombin time is more than two seconds prolonged or when the platelet count is very low. It is also indicated when a previous splenoportogram has shown filling of collateral channels only and occlusion of the portal vein is suspected. Coeliac arterioportography provides information





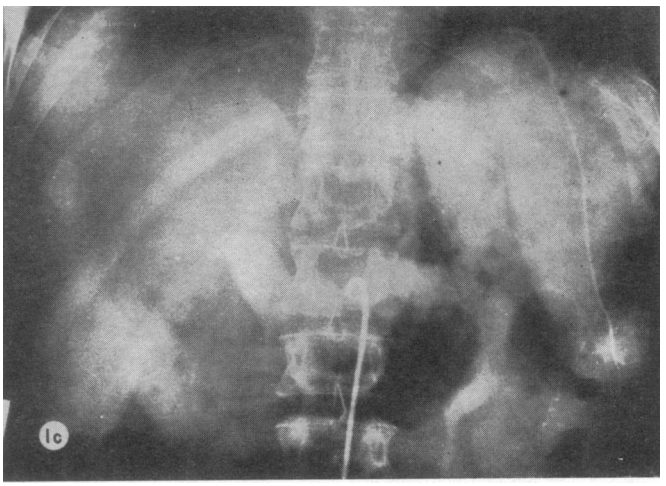


FIG. 1.—Splenic arterioportogram showing the arterial pattern (*a*) and the venous phase (*b*). A film of the venous phase taken in a repeat examination done after a portacaval anastomosis is shown in (*c*). Note that the splenic artery is the major branch of the coeliac axis. The hepatic artery arises from the superior mesenteric artery.

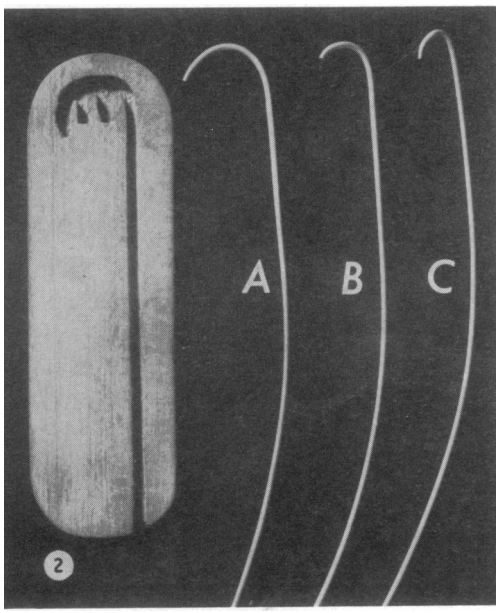
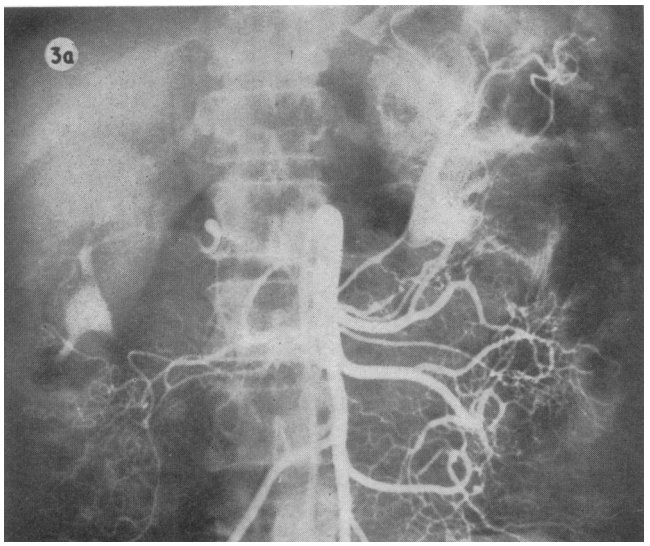


FIG. 2.—Wooden mould designed for shaping the catheter. Two variations of coeliac axis catheter are shown, one being used when the spleen is large (B) and the other when it is normal or only moderately enlarged (C). The catheter with the very wide curve (A) is used for superior mesenteric artery catheterization.



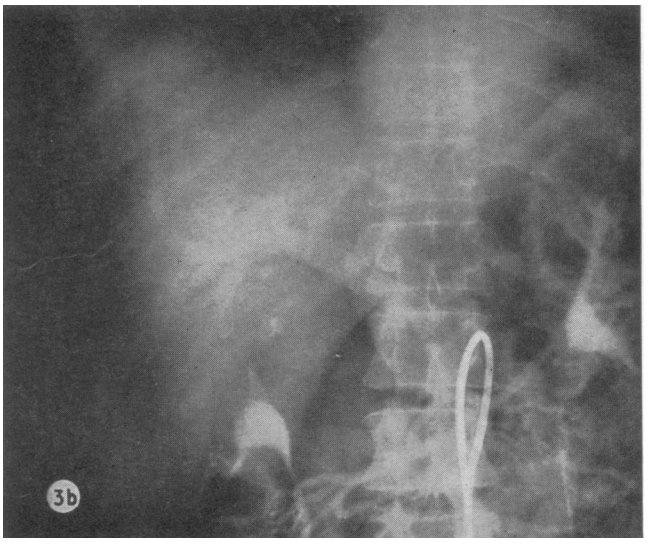


FIG. 3.—Superior mesenteric arterioportogram showing arterial pattern (*a*) and venous phase (*b*). The portal vein is patent and its terminal branches in the liver are clearly shown. This patient, whose spleen had been removed, had previously been thought to have a portal-vein thrombosis.

regarding the arterial supply as well as the venous phase. If a hepatoma with secondary portal-vein thrombosis is suspected then it is the procedure of choice, for hepatoma and secondary neoplasm in the liver are supplied exclusively by the hepatic artery (Breedis and Young, 1954). The question will arise of which of the arteries should be catheterized. This has to be decided individually. If the only information required is whether the portal vein is patent, then the superior mesenteric artery is the one to choose, since this is generally easier than coeliac-axis catheterization and consistently affords a high concentration of contrast in the portal vein.

On the other hand, coeliac arterioportography shows the splenic as well as the portal vein and is the better procedure if an arterial lesion such as hepatoma or the very rare splenic arteriovenous aneursym (Murray, Thal, and Greenspan, 1960) is suspected. We have not tried the technique described by Boijsen *et al.* (1963) in which both vessels are catheterized and contrast is injected simultaneously. This results in passage of contrast medium into all branches of the portal system and should provide maximal contrast in the portal vein, but the use of two catheters must undoubtedly lengthen the procedure and does not appear to be justified routinely.

Finally, it is necessary to emphasize that arterioportography is a safe procedure, the only risk being that of a percutaneous femoral puncture. The wider availability of this procedure means that no patients with portal hypertension need now be operated on in whom the portal venous system has not been completely visualized pre-operatively.

Summary

A technique of arterioportography is described for use with standard *x*-ray equipment. In 36 (86%) of the 42 patients examined the artery was successfully catheterized and in 26 (72%) of them good visualization of the portal venous system was obtained. Superior mesenteric arterioportography is of particular value in the pre-operative assessment of patients with portal hypertension in whom the spleen has been removed. Coeliac arterioportography is technically more difficult and the indications for its use are considered.

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Dissecting Microscope Appearances of the Gastric Mucosa

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[WITH SPECIAL PLATE]

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Since the introduction by Wood *et al.* (1949) of a simple and safe instrument for peroral gastric biopsy, this method or some modification of it has been widely used to study the pathology of the gastric mucosa. Although many histological studies of gastric biopsy specimens have been made, we have been unable to find any account of the changes visible in such biopsy specimens when they are examined under a dissecting microscope.

In the course of a study of the gastric and small-intestinal changes in ulcerative colitis (Salem *et al.*, 1964a, 1964b) we took the opportunity to study some of the gastric biopsy specimens under the dissecting microscope and to compare the appearances with the results of subsequent histological examination.

Results

The gastric biopsy specimens were obtained by means of a Crosby-Kugler capsule, which was introduced for small-intestinal biopsy (Crosby and Kugler, 1957) but has also been found convenient for gastric biopsy (Floch and Sheehy, 1962 ; Salem *et al.*, 1964a). The specimens from 48 patients have been examined under the dissecting microscope ; in some patients separate specimens were obtained from the cardia, the body, and the pyloric end of the stomach under fluoroscopic control using an image intensifier and television monitor.

We found that the appearances of the fundic mucosa under the dissecting microscope varied from specimen to specimen and that three main categories could be recognized which corresponded to various histological appearances. The three categories are as follows:

Category I (corresponding to normal histological appearances).—Under the dissecting microscope there is a uniformly regular pattern of papillae, each one of which has a round hole in its centre, representing the mouth of a gastric gland. The papillae are packed close together. The colour varies from a pale pink to a faint red. The general appearance can be compared to that of a honeycomb, or Morocco leather (Special Plate, Fig. 1).

Category II (corresponding to superficial gastritis on histological examination).—The papillae are swollen, congested, and reduced in number. The gastric-gland openings are slit-like and look deep, owing to surrounding swelling (Special Plate, Fig. 2). Hyperaemia is often obvious. (Sometimes patches of mucosa with these characteristics are interspersed with normal areas, just as histologically the appearances of superficial gastritis may be patchy.)

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