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SURGERY AND THE NEW YORK SURGICAL SOCIETY

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DR. JOHN SPEESE, President of the Philadelphia Academy of Surgery,  
in the Chair

CALVIN M. SMYTH, JR., M.D., Recorder

SPIROCHÆTAL (TREPONEMA VINCENTI) INFECTIONS OF HAND

DR. JOHN B. FLICK (Philadelphia) said the pathogenesis of the organisms commonly identified with "Plaut-Vincent's angina" apparently is widespread. In reviewing the literature one is impressed with the many reports of various lesions from which these organisms have been isolated. Among them may be mentioned vaginitis, middle-ear and mastoid disease, pulmonary abscess, bronchiectasis and wounds, particularly those made by the teeth of human beings.

The inciting cause of Plaut-Vincent's infection is universally believed to be a spirochæte associated with a fusiform bacillus, but other organisms are usually found in the lesions.

There is a difference of opinion regarding the relationship of the spirochæte and the fusiform bacillus. While many believe that a symbiosis is responsible for the diseased condition, others are of the opinion that the spirochæte is merely a highly differentiated form of the same microörganism. Tunncliff<sup>1</sup> has carried out studies which tend to support the latter view. Topley and Wilson<sup>2</sup>, however, say that the balance of evidence is definitely against the theory that the fusiform bacilli and spirilla are different forms in the life cycle of one organism. It has been pointed out by Tunncliff and others that the spirochætæ precede the fusiform bacilli in the invasion of tissues and it is thought that they are responsible for the extensive destruction which occurs.<sup>3</sup>

Hultgen, in 1910,<sup>4</sup> reported what he believed to be the first case on record of a "gangrenous perionychia" due to the symbiosis of the fusiform bacillus and the spirochæta denticola:

The patient was a child of seven years brought to him because of an ill-smelling affection of her left hand which had existed for a week. On examination "the nail of the left index finger was found hanging to its bed by only a few shreds, covering a necrotic area which was surrounded by discolored pultaceous and extremely fetid tissue remnants. The upper half of the distal phalanx of the left index finger was destroyed, but the sphacelus was limited at the distal phalangeal joint by slightly irritated, reddish and moderately swollen tissues." There was similar but only slight involvement of the left thumb and slight left axillary adenitis. She had several carious teeth and her gums were not healthy. Microscopically, smears from the affected finger tips showed the fusiform bacillus and the spirochæta denticola as did preparations from the carious teeth. The girl was in the habit of biting her fingers and the etiological connection between her carious teeth and the gangrenous affection of the finger-nail beds, as Doctor Hultgen pointed out, is quite plain.

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Since 1910, a number of cases of Plaut-Vincent's infections of the fingers or hand have been reported in the literature, references to which are appended.<sup>5, 6, 7, 8, 9, 10, 11</sup> Almost all of them have been due to wounds by the teeth of human beings. In 1929, Flick reported a case of gangrenous infection of the hand and forearm following a human bite of the thumb which resulted fatally.<sup>12</sup> Smears of the pus in this case showed spirochætes but not fusiform bacilli. There was extensive destruction of tissue in the hand and forearm and the odor was most offensive, reminding one of that which is given off in spirochætal pulmonary gangrene. Permission for amputation of the forearm was refused and the patient died sixteen days after receiving the injury.

He purposed now to report five additional cases of Plaut-Vincent's infection of the hand and to comment briefly on the disease.

CASE I.—A Negro man, aged thirty years (Pennsylvania Hospital, Out-patient Department, History No. 39,209), applied to the Pennsylvania Hospital January 20, 1930, for treatment of a human bite of his left middle finger which he had received that day. The wound, which was over the distal phalanx, was cauterized with phenol and a dressing applied. Upon his return to the hospital four days later the wound showed evidence of infection. Microscopical examination of smears of the pus showed many spirochætes and fusiform bacilli. Hot salt-solution dressings were applied and he was instructed to soak the finger daily in hot salt solution. On February 7 there was no longer any evidence of acute inflammation, but there was a bulbous enlargement of the distal phalanx and some œdema of the entire finger. An X-ray examination made at this time showed almost complete absorption of the distal phalanx, only the thin portion of the base and the unguis process remaining. The patient failed to return for observation and could not be traced.

CASE II. A Negro man, aged forty-five years (Pennsylvania Hospital, Unit History No. 16,729), applied to the Pennsylvania Hospital June 4, 1930, for treatment of a human bite of the right third finger and thumb and the left thumb, which he had received that day. The wounds were treated with iodine and a dry dressing applied. Three days later there was soreness in the right axilla. Six days after receiving the injuries the wound over the distal phalanx of the third finger was found to be necrotic and foul-smelling. In the Receiving Ward of the hospital, under nitrous-oxide anæsthesia, the finger was incised, necrotic tissue clipped away and hot salt-solution dressings applied. The patient was then admitted to the house for further treatment. Microscopical examination of smears of the pus showed suggestive spirilla forms and a moderate number of fusiform bacilli. In spite of treatment the infection progressed, there was marked sloughing of the soft tissues and a foul stench to the wound. On June 18, fourteen days after receiving the injury, Dr. Alan Parker disarticulated the distal phalanx. For a few days the infection seemed to be under control and then puffiness and fluctuation developed on the dorsum of the same finger lower down. This area was drained under local anæsthesia on June 27. Microscopical examination of smears made from the pus at this time showed fusiform bacilli only, the suggestive spirilla forms having disappeared. Hot salt-solution dressings were continued and the patient was discharged from the hospital July 14. He continued under observation as an out-patient until September 8, when his wounds were healed.

CASE III.—An Italian man, aged seventy years (Pennsylvania Hospital, Unit History No. 20,769), applied to the Pennsylvania Hospital March 17, 1931, for treatment of an infection on the dorsum of his right hand. Two days previous he had opened a small blister on the back of the hand with a pocket-knife with which he sometimes picked his teeth. He had a temperature of 99° F. Local treatment was given, he was

instructed to soak the hand in salt solution daily and referred to the Out-patient Department. On April 4 a microscopical examination of a smear made from the pus in his wound showed many spirochætes and fusiform bacilli. After this arsphenamine dressings were applied daily. The condition became worse, the hand was incised and through-and-through drainage instituted. April 13, he was admitted to the house and examination showed a necrotic wound on the dorsum of the hand between the second and third metacarpal bones and a corresponding wound on the palm. Both wounds were discharging foul-smelling, greenish-yellow pus, the tissues about the wounds were discolored and the hand somewhat swollen. He had an evening temperature of 100.2° F. Examination of his mouth showed a marked infection of the gums and a number of infected stumps of teeth. April 17, a swelling on the dorsum of the right index finger was incised and pus obtained. April 27, the hand having become more swollen,

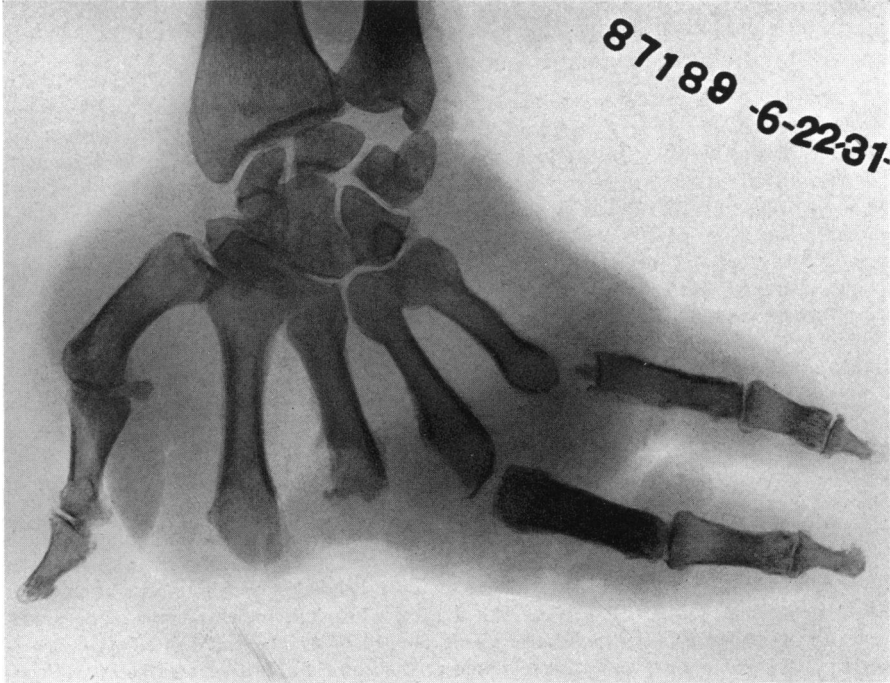


FIG. 1.—Case III. Röntgenogram of right hand which was made just prior to amputation. The destruction of bone and involvement of joints is evident.

the right index finger discolored and the proximal phalanx necrotic further surgical interference was decided upon. At operation the tendons to the index finger were found to be necrotic and the metacarpophalangeal joint of that finger destroyed. The finger was disarticulated. The incisions on the dorsum and palm of the hand were enlarged but no collection of pus was encountered. The hand was soaked daily in potassium permanganate solution and in addition continuous wet dressings were used. May 13, Dr. Adolph Walking disarticulated the right third finger. Exposure to the rays of the sun was then tried. May 21, the patient was given 0.6 grams of neoarsphenamine intravenously. Other sinuses developed in the palm and on the dorsum of the hand. The swelling increased. It was evident that the remaining metacarpophalangeal joints were involved (Fig. 1) and permission for amputation was finally secured. May 24, amputation through the forearm eight centimetres above the wrist-joint was done. The skin was closed with clips, leaving in the wound a small rubber-covered gauze

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drain. His temperature became normal the following day. The wound healed without infection and he was discharged from the hospital eight days after the amputation was done.

The pathological reports (Drs. George J. Righter and John T. Bauer) in this case are of interest and are herewith given.

“Three specimens were separately received for pathological examination, following successive operations—the index finger of the right hand (S. 16,433), the middle finger of the right hand (S. 16,495), and the remainder of the right hand amputated about

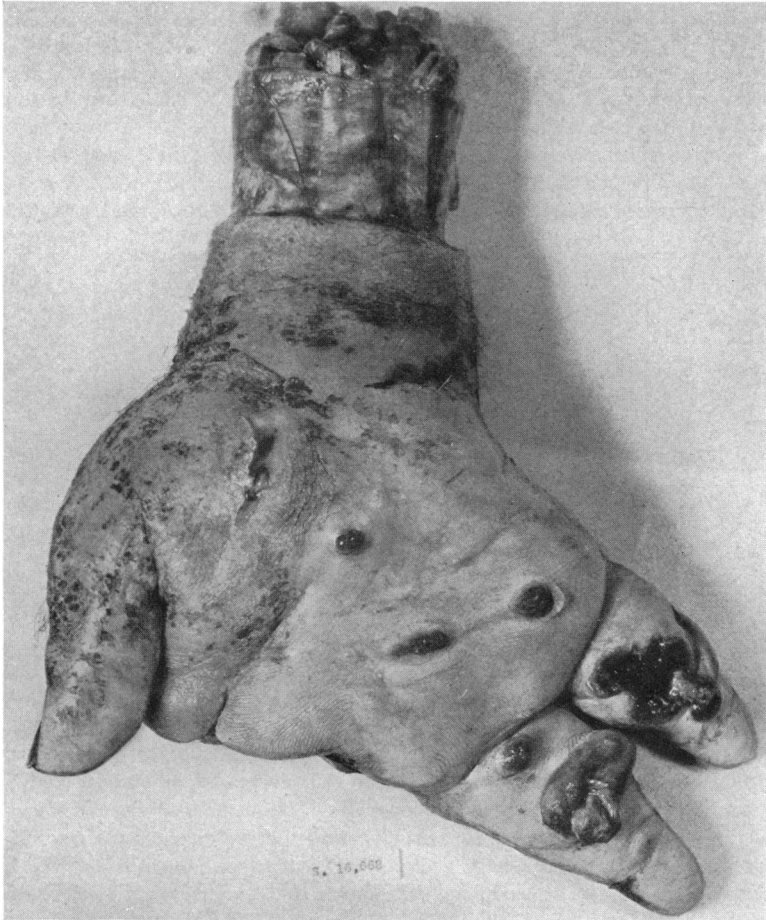


FIG. 2.—Case III. Photograph of right hand after amputation.

eight centimetres proximal to the wrist (S. 16,668). From these specimens approximately twenty-four blocks were chosen for microscopical study. As the pathological process was the same in each, differing only in extent, the combined description of the gross specimens and sections will be presented.

“On gross examination the hand and fingers were swollen greatly, the greatest fullness being in the hand and proximal portions of the fingers and tapering toward the tips. There was a sinus over the dorsum of the first phalangeal joint of the index finger. In both amputated fingers, encircling the ends of the tendons projecting beyond the line of excision, necrotic tissue which diminished in amount distally was seen. In

the middle finger necrosis had extended to the tendons. Very little pus was present. The osseous surface of the proximal phalanx of the index finger was roughened.

"In the hand three sinuses were present on the palmar aspect surrounded by exuberant granulation tissue. Over the dorsum of the hand were several sinuses. No healing had occurred at the site where the fingers had previously been removed. Instead, cavities surrounded by excessive granulation tissue and exuding pus were seen. The necrotic ends of the flexor tendons to the fourth and fifth fingers projected from granulating cavities. The external disfigurement, swelling and profuse granulations about the sinuses and sites where the fingers were removed are shown by Fig. 2.

"On dissection, in the depths of the hand the deep tendons to the two remaining fingers were sloughing, partly necrotic and bathed in pus. All of this continued throughout, extending proximally to the level of the transverse carpal ligament. The distal ends of the first and second metacarpal bones were necrotic, but the process did not extend to the distal ends of the ulna and radius.

"On microscopical examination the epithelial layer of the skin, except in the ulcerating areas, appeared normal. However, even the most superficial layer of the corium contained an increased number of polymorphonuclear neutrophiles and plasma-cells, usu-

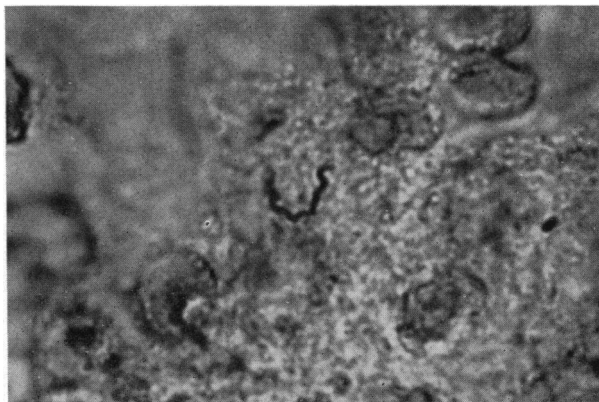


FIG. 3.—Case III. Photomicrograph of a section of tissue from right index finger under oil immersion objective, showing a typical spirochæte in the center of the field.

ally scattered about the blood-vessels and cutaneous glands. Deeper in the œdematous subcutaneous and areolar tissue the infiltrating cells increased in number and became associated with fibroblasts and a few eosinophiles. Frequent small hæmorrhages were seen. In the vicinity of sinuses or superficial ulcers, the surrounding granulations were heavily infiltrated with plasma-cells and polymorphonuclear neutrophiles, which continued through the subcutaneous tissue, fat, muscle and periosteum into the bone. In the bone the osteoblasts appeared larger than usual. Usually where the osteoblasts were missing, many giant cells were seen just beyond the outer lamellæ of bone. The superficial marrow spaces were infiltrated with cells, almost as abundant as those just outside the bone, but gradually diminishing toward the depths, where an increased number of fibroblasts suggested a barrier against the invasion. However, this barrier did not prevent a moderate number of infiltrating cells from penetrating the depths of the marrow spaces, now showing the typical loose areolar structure. In the hand where the infection had progressed over a wide area, extensive necrosis of the bones, overlying muscle and fibrous tissue, devoid of infiltrating cells, was seen. The tendinous sloughs were completely acellular and gangrenous.

"Numerous microorganisms were seen. Usually in the deeper areas, beneath the

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masses of bacilli and cocci, typical irregularly curved spirochætes were present, as illustrated by Fig. 3."

CASE IV.—A Negro man, aged thirty-two years (Pennsylvania Hospital, Unit History No. 20,902), applied to the Pennsylvania Hospital April 15, 1931, for treatment of a human bite of his right thumb received on that day. The wound was treated with iodine, a dry dressing applied and the patient instructed to attend the dispensary for further care. Apparently infection was present two days later when he first visited the Out-patient Department, as wet dressings were ordered. April 22, he was admitted to the house. At this time examination disclosed a swollen and œdematous thumb. There was a tooth wound on the dorsum of the proximal phalanx which was discharging foul-smelling pus. A moderate axillary lymphadenitis was present. Proper drainage was instituted in the Receiving Ward of the hospital and hot salt-solution dressings applied. A microscopical examination of a smear of the pus showed many spirochætes and fusiform bacilli. April 29, he was given neoarsphenamine 0.3 grams intravenously. By May 11 the wounds were healed, but some tenderness and slight œdema persisted.

CASE V.—A Negro man, aged thirty-seven years (Bryn Mawr Hospital, Unit History No. 01,054), was admitted to the Bryn Mawr Hospital June 4, 1931, with a history of having lacerated his right thumb on a piece of tin in a fall while walking through a woods. This occurred May 30. The same evening the thumb became swollen and tender. He attended the out-patient clinic of the hospital, but as the infection was not responding to treatment he was admitted to the house. Examination showed a markedly swollen and tender thumb with a laceration on the flexor surface at the base of the distal phalanx which was draining thin yellowish pus. The thumb was incised and continuous hot salt-solution dressings used. Later dressings wet with potassium-permanganate solution were tried. The wound developed a foul odor, the flexor tendons sloughed and the terminal phalanx became dislocated dorsally. Microscopical examination of smears of the pus from the wound showed a great number of typical fusiform bacilli, but no spirochætes. Dr. William P. Belk, pathologist to the hospital, made a diagnosis of Vincent's infection. The patient had a low grade fever during his stay in the hospital. June 17, eighteen days after receiving the injury, amputation of the thumb was advised. The patient, however, signed a release and left the hospital.

While spirochætes were not actually found on microscopical examination in this case we have included it as a spirochætal infection because of the clinical characteristics and the finding of large numbers of typical fusiform bacilli.

Six cases of spirochætal (*treponema vincenti*) infection of the hand have been observed by us. Of these, one died from the disease, one required amputation of the hand, one amputation of a phalanx and all but one case had bone or joint involvement of some degree. One hesitates to place confidence in inferences based upon the study of a few cases. It is our belief, however, that this infection once established permeates the tissues beneath the surface, that it is prone to attack bones and joints and that it does not respond favorably to the methods commonly employed in the treatment of infected wounds. The involvement of bones and joints is not necessarily due to deep penetration of the object which produces the wound. Thus, in Case III, the infection which resulted in destruction of all the metacarpophalangeal joints except that of the thumb was introduced by pricking a blister on the dorsum of the hand with a contaminated pocket-knife. In Hultgen's case, that of a child who had the habit of biting her fingers, bone destruction occurred within a week of the onset of the infection. Here it is fair to assume that the infection was introduced through a slight break in surface continuity.

Clinically, wounds infected with the spirochæte and fusiform bacillus are characterized by gangrene of tissues and a foul odor. The time elapsing between the reception of the injury and the development of these characteristics is brief. Swelling, œdema and tenderness of the part develop as the infection progresses and later sinus formation is not uncommon. In only one of the cases observed by us, that which was reported in 1929, was the systemic reaction alarming. Pain, although present in all of our cases, was not a conspicuous symptom nor did we note severe febrile reaction.

The treatment of this condition has not been satisfactory in our experience. This in part has been due to our failure to recognize early the seriousness of the infection and to treat it accordingly. We have erred perhaps on the side of conservatism in not opening widely the infected areas at the start. A course of intravenous injections of neoarsphenamine probably should be given in cases of established infection.

Foul-smelling gangrenous affections of the fingers and hand should be studied carefully for spirochætes and fusiform bacilli. These organisms are anaërobic and cannot be cultivated by ordinary methods, but can be detected by the examination of thin smears of pus obtained from the depths of the wound.

Wounds made by human teeth should be regarded as potentially infected and so treated. Bates<sup>13</sup> advocates cauterization with the electric cautery. He has treated over one hundred cases of human bites, some as late as the third or fourth day, by electro-cauterization and extension of the infection thereafter has occurred in only one case. He attributes his very satisfactory results to the immediate destruction of the primary focus of infection.

## BIBLIOGRAPHY

- <sup>1</sup> Tunnickliff, Ruth: Life Cycle of *Bacillus Fusiformis*. *Jour. Infect. Dis.*, vol. xxxiii, pp. 147-154, August, 1923.
- <sup>2</sup> Topley, W. W. C., and Wilson, G. S.: *The Principles of Bacteriology and Immunity*, vol. xi, p. 1179, William Wood and Company, 1929.
- <sup>3</sup> Harrell, Voss: The Present Status of Plaut-Vincent's Infection. *Arch. of Otolaryngol.*, vol. xiv, No. 1, pp. 1-8, July, 1931.
- <sup>4</sup> Hultgen, J. F.: Partial Gangrene of the Left Index Finger Caused by a Symbiosis of the Fusiform Bacillus and the Spirochæta Denticola. *Jour. Am. Med. Assn.*, vol. lv, p. 857, 1910.
- <sup>5</sup> Peters, W. H.: Hand Infection Apparently Due to *Bacillus Fusiformis*. *Jour. Infect. Dis.*, vol. viii, pp. 455-462, 1911.
- <sup>6</sup> Hennessy, P. H., Madras, C. M., and Fletcher, William: Infection with the Organisms of Vincent's Angina Following Man Bite. *Lancet*, vol. ii, pp. 127-128, July 17, 1920.
- <sup>7</sup> Hennessy, P. H.: Human Bites. *Indian Med. Gaz.*, vol. lv, p. 250, July, 1920.
- <sup>8</sup> Pilot, I., and Meyer, K. A.: Fusiform Bacilli and Spirochætes; Occurrence in Gangrenous Lesions of Fingers: Report of Case. *Arch. Dermat. and Syph.*, vol. xii, pp. 837-839, 1925.
- <sup>9</sup> Fuller, C. Rex, and Cottrell, J. C.: Infection with Organisms of Vincent's Angina Following Human Bite. *Jour. Am. Med. Assn.*, vol. xcii, p. 2017, 1929.
- <sup>10</sup> Bower, G. C., and Lang, H. B.: Case Report of Finger Infection Due to Fusi-spirochætal Organisms. *New York State Jour. Med.*, vol. xxx, p. 975, August 15, 1930.

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- <sup>11</sup> Mason, M. L., and Koch, S. L.: Human Bite Infections of Hand with Study of Routes of Extension of Infection from Dorsum of Hand. *Surg., Gynec., and Obst.*, vol. li, pp. 591-625, November, 1930.
- <sup>12</sup> Flick, J. B.: Gangrenous Infection of the Hand and Forearm Following Human Bite. *ANNALS OF SURGERY*, vol. xc, p. 450, 1929.
- <sup>13</sup> Bates, W.: Electro-cauterization in Treatment of Human Bites. *ANNALS OF SURGERY*, vol. xciii, pp. 641-644, March, 1931.

DR. FRANK L. MELENEY (New York) remarked that he could not recall having seen a case of foul gangrene following a human bite although he had always been impressed with the seriousness of other infections resulting from such an injury. The hospital's files for fifteen years failed to reveal a similar case. This type of infection is almost certainly a disease due to a mixture or symbiosis of organisms. There has been a good deal of discussion among the bacteriologists with regard to the fusiform bacillus and the spirochæte found in Vincent's infection—whether it is a symbiosis of two different organisms or whether the spirochæte is a phase in the life cycle of the bacillus. Ruth Tunnicliff claims that she was able to see spirochætes develop in the long threads which form in old cultures of the fusiform organism. Most of the other investigators say that although curved forms occur in the old cultures of the fusiform organism, they are not true spirochætes and that in Vincent's infection there is a real symbiosis between a fusiform bacillus and a real spirochæte. Knorr, who has studied Vincent's infection in many forms, believes it to be a true symbiosis and has found that in his cultures they are always associated with streptococci. He demonstrated in his cultures that first the streptococcus predominated, then the fusiform bacillus, and then the spirochæte, as if one organism prepared the ground for the next. He believes that the infection in man is usually initiated by the streptococcus. Doctor Flick said that other organisms beside the spirochæte were always present in his cases. In practically all cases streptococci are present along with the fusiform bacilli and spirochætes. Ruth Tunnicliff saw only one case of Vincent's infection in which streptococci were not present. Varney has made careful studies and believes the fusiform bacilli to be distinct from the spirochætes. Recently, Smith, at Raybrook Sanitorium, in a study of lung infections has done some interesting experimentation on the symbiosis of the organisms found in Vincent's infection. Invariably he was able to isolate at least four different species, streptococci, of the non-hæmolytic and anaërobic types, fusiform bacilli, spirilla and spirochætes. By inoculating with pure cultures, no lesion was produced. After inoculation of various combinations of these organisms into the trachea of rabbits, all of the typical lesions which are found in chronic infections of the lung were produced—bronchitis, pneumonia, bronchiectasis, abscess and gangrene. There had to be a combination of organisms to produce any of these, and the greater the number of different species used, the severer the lesion was. Gangrene was produced only when all four species were used.

Surgeons are just beginning to have an understanding of symbiotic



infections, and are just beginning to observe that certain chronic infections are due to the presence of two different species of organisms. For example, the chronic progressive gangrene of the abdominal wall, such as has been seen following drainage of certain peritoneal abscesses, is almost certainly one of these infections. Amœbic infections are probably symbiotic. Amœbæ will not grow artificially in pure culture. Why gangrene or destruction of tissue develops when certain organisms are growing together is still an unsolved problem. It needs further study. In the laboratory certain chance observations of mixed cultures indicate that with any particular symbiotic or synergistic phenomenon—for example, the formation of gas—one organism seems to initiate the process while the other continues or finishes it. This is probably true in a destructive lesion, in which one or more species of organisms are present. These cases suggest more frequent consideration of the possibility of symbiotic or synergistic infections in all regions of the body where numbers of different species of organisms are likely to be present, such as the gastro-intestinal tract, from the mouth to the anus. For example, the very severe infections following lesions in the œsophagus, such as a diverticulum which has ruptured followed by mediastinal abscess, are well known. Peritonitis following lesions of the gut is almost certainly in this group. Lesions of the respiratory tract, from the common cold to lung abscess and gangrene, must be studied from this standpoint. In all of these instances one must consider the effect of the organisms working together in the production of the disease. Until we learn more from a bacteriological standpoint about these foul infections following human bites, we shall have to content ourselves with radical surgery, both for the prophylactic and active treatment.

DR. WILLIAM BATES (Philadelphia) said that in these virulent infections of the hand, sometimes the bacterial flora in the wound corresponded with culture from the mouth, sometimes it did not. Early in his studies, he tried to prevent spread by multiple large incisions and all types of antiseptics without influencing it to any marked degree. He found that if the periosteum was injured by the tooth that osteomyelitis and resulting amputation occurred rather promptly.

The failure to control these wounds by ordinary surgical methods led to the use of the cautery. He now anæsthetizes the patient, excises the whole depth of the bite with the cautery and leaves a sterile, painless, open ulcer to heal by granulation. He had had exceptional success since starting this type of treatment. There had been necessary only two amputations; one of these was complicated by a compound fracture at the site of the infection and the other had existed forty-eight hours before applying for treatment.

In a series of cases previously reported by other writers, it was found that hospitalization in this type of wound averaged fifty-four days, whereas in a series of 130 cases now treated early by electrical cautery, they had hospitalized only the two cases referred to as exceptions.

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DR. HUBLEY R. OWEN (Philadelphia) remarked that there is no type of wound which is as dreaded by police surgeons as the lacerated wound of the hand caused by a tooth. In looking up the Philadelphia police records for the past three years, he has had twenty-eight cases of this character. He routinely has examinations made for spirochætes, and has found spirochætes (non-luetic) in nine of these cases. He had previously reported three luetic infections occurring as a result of these knuckle cuts. (Fig. 4.)

Various methods of treatment, including cauterizing with the actual cau-



FIG. 4.—Chancre of hand following a tooth wound.

tery, have been employed. No method has given uniformly good results. He now treats these wounds as one treats any primarily infected wound. No improvement in results has been seen following the use of the actual cautery. Free and open drainage with rest has given the best result.

Several years ago, at a meeting of the police and fire surgeons, this type of wound was discussed. Dr. J. J. Moorhead, of New York, stated that one reason this type of infection is so frequently followed by destruction of the metacarpal-phalangeal joint with erosion of the cartilage and subsequent ankylosis is because "an injured cartilage never forgets a bruise." The cartilage, having poor blood supply, has neither the resistive power against infection nor the power of reconstruction.

All medical students and internes should be taught the danger of this

type of wound and should be especially instructed that such lacerated wounds caused by teeth should never be sutured.

#### THE TREATMENT OF COMPOUND FRACTURES

DR. CALVIN M. SMYTH, JR. (Philadelphia), said that in spite of a voluminous literature on the subject of compound fractures and their management, there is practically no uniformity of opinion as to the best method of treatment and no standardized procedure for handling them in most hospitals. This is in spite of the fact that Lister made the treatment of compound fracture the basis of his original contribution to antiseptic surgery and that from Lister's time to the present the subject has been ever prominently before the surgical profession. In pre-Listerian surgery, the man so unfortunate as to sustain a compound fracture stood a very good chance of losing life or limb, through sepsis or amputation, and the former not infrequently followed the latter. The introduction of the Thomas splint brought about a striking reduction in the mortality and morbidity of compound fracture of the femur and the Carrel-Dakin technic materially reduced the incidence of infection with its immediate and remote complications. Nevertheless, it is still apparent that certain fundamental rules that should be invariably observed in this type of surgery are constantly violated for one reason or another. One fact that cannot be emphasized too strongly is that the ultimate result in a compound fracture is most often determined within the first hour of the existence of the condition and depends on what is done, or, more often, left undone by the one who sees it at that time. The physician called first is not infrequently tempted to do too much to these cases and hospital house officers to do too little. All compound fractures are operative emergencies and should be so considered. The surgery required is worthy of the best efforts of the senior members of a surgical staff and should not be delegated to inexperienced assistants. It is bad policy to allow these injuries to receive so-called first aid in accident and receiving wards and the interests of the patient are best served by postponing anything beyond temporary splinting and possibly flooding with iodine until formal surgery with adequate anæsthesia can be instituted. On this point probably all surgeons are in agreement. As to just what should be done at the formal operation there is perhaps a justifiable difference of opinion.

Experience with a fairly large traumatic service would seem to warrant the drawing of certain conclusions in this connection. First, all compound fractures should be thoroughly débrided and opened widely in order to provide adequate drainage and prevent subcutaneous pocketing. Second, the question of whether the fracture was compounded from without in or within out is one of purely academic interest and should not influence the type or extent of the operation. Third, in the desire to prevent infection, one must not lose sight of the fact that one is dealing not only with a contaminated wound but also with a fracture. No operation is complete unless the fracture

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is reduced and adequate provision made for its retention. In the vast majority of cases this can be done without adding to the risk of the patient and it also reduces the time of hospitalization—an economic factor of much importance especially in these times of depression. Fourth, the ideal operation is one which will accomplish these desiderata and in addition will not require frequent, painful and meddlesome dressings, which, of necessity, disturb the fracture. In a small group of cases seen early and where the contamination has been slight, Sherman's plan of reduction, plating and immediate closure has undoubtedly given good results. It most certainly affords every advantage to the fracture itself and does not require dressing. (Its applicability, however, is strictly limited.) Débridement followed by the insertion of Dakin's tubes in cases badly lacerated and contaminated has also given gratifying results where strict adherence to the Carrel-Dakin technic is insisted upon. In this method the wound receives the maximum attention and the fracture the minimum. The dressings are time-consuming, must be made daily and the patient must be disturbed for irrigation every two hours.

A method of treatment popularly known as the Orr method is at present undergoing a trial in a number of clinics. This method consists essentially of extensive débridement, reduction and fixation of the fragments, packing wide open with vaseline gauze and complete encasement in plaster. The original dressing is not disturbed for four weeks. In the hands of those who have used it, it has given great satisfaction, but a number of surgeons of large experience have expressed unwillingness to try it on account of real or implied dangers, although these same surgeons do not hesitate to employ it in cases of both acute and chronic osteomyelitis. The objections advanced against this form of treatment are based largely upon the danger of encasing a presumably infected wound in plaster, and particularly the danger of anaërobic infection. Experience has demonstrated, however, that this fear is not warranted by the results obtained by those who advocate the method. The speaker has personal knowledge of only one case in which gas infection developed following the Orr operation and this was in a patient seen by Dr. Fenwick Beekman and reported in a personal communication. In this instance the condition manifested itself on the third day and progressed to a fatal termination. Anaërobic infection is certainly to be considered in any injury the result of a street or a machinery accident and due precautions must be taken against it. While the incidence of tetanus appears to be on the decrease, in the Philadelphia area at least, we are seeing more cases of gas gangrene than formerly. A number of writers have drawn attention to this in the recent literature of gas gangrene in civil practice. Recognizing this danger in all compound-fracture cases, whether treated by the Orr method or not, a prophylactic dose of the combined tetanus and gas serum should be given. Before the introduction of the combined serum he employed the two separately, first using the perfringens and later the polyvalent serum. In no case had he had anaërobic infection develop. The justification for giving

serum to these cases has been questioned by some surgeons on the ground that it was unnecessary, although those who question it do not hesitate to give antitetanic serum in all street injuries. It is admitted that in many instances this is an unnecessary precaution but it would seem quite as logical to give the combined serum as antitetanic serum alone.

Others advance the argument that wounds such as commonly accompany compound fractures should be dressed in a manner permitting frequent inspection and dressing, in order that proper measures may be applied to the infection which so frequently appears. The answer to this objection is that cases treated by the Orr method do not become infected and that wound infection and osteomyelitis were more often the result of meddlesome dressings than of original contamination. When the first dressing is made at the end of four weeks, the wound and dressings are found soaked through with what at first glance appears to be pus, but which when wiped away leaves a clean granulating surface which heals promptly by granulation or in which healing can be hastened by skin grafting. Plaster is reapplied as at first and no further dressing made until union has taken place. When the second casing is removed the wound is usually solidly healed. This course is in striking contrast to that in which the daily dressings, irrigations, *etc.*, have been employed, and a very important factor is that the fracture has had the advantages of early and complete reduction and uninterrupted fixation.

He was not pleading for the employment of the Orr method in every compound fracture, for in certain cases, namely, those with extensive skin and muscle lacerations, stripping injury or cases not seen until infection has set in, it is clearly not indicated. He did, however, wish to state that in his experience with a small but constantly increasing series it has given greater satisfaction than any method heretofore employed and has been absolutely free from any of the objections brought forward by those who oppose its use. It is essentially a method of dressing rather than an operation and it is, of course, a well-established fact that no method of dressing can be a substitute for the good surgery which should precede it.

DR. JOHN F. CONNORS (New York) remarked that he had tried the Orr treatment and was not encouraged by the results. He said it may be that the fault was his own. For the past year he had used another line of treatment which he thought had given better results. Of 564 fractures, sixty were compound. The routine followed is this: Every case that comes into the hospital now is splinted on the spot where found. It is brought immediately to X-ray and then to the operating room, where the operation is performed. The wound is covered with iodoform gauze, the rest of the extremity cleaned with soap and water and then benzine. The wound is then cleaned with benzine and ether and débrided. If possible it is closed primarily. If it seems not suitable for closure, it is allowed to stay open. The results by this method are as good or better than by other methods of treatment. Of these sixty cases of compound fracture, twelve died. Of the sixty cases, thirty-two

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were of the tibia and fibula, and in these cases he had tried to make two series, giving sixteen cases to the man who advocates leaving the case open, and the other sixteen to the man who thinks primary closure is the best treatment. The results were very good except in four cases, and these were four with primary suture. He believed there is something in the Orr treatment but he has not been able to accomplish it. The simplest way is to put the bone in position when on the table, débride as thoroughly as possible, put the bones in position and apply traction.

The following are the figures on his mortality in compound fractures. In two cases of compound fracture of the radius and ulna, both developed gas infection. One was caused by a gunshot wound, sawed-off shot-gun. The other died from gas infection which developed three days after admission. One femur died twenty-one days after the accident, septicæmia having developed. There were three deaths in compound fractures of the tibia and fibula. One case died in three hours. Patient was run over by a subway train. Another case died in twelve hours. This patient has a severe evulsion with a severe comminution of two-thirds of both bones. The third case died following amputation of both legs; this patient had been pinned between a building and an automobile. In sixty cases of compound fractures seven had amputations. All patients who recovered left the hospital with union.

Doctor Connors uses no plaster bandage, but relies on traction and a supporting splint to maintain alignment.

DR. EDWARD T. CROSSAN (Philadelphia) said that on the Ashhurst service at the Episcopalian Hospital they are still having good results with incision, replacing of the fragments, immediate suture and immobilization—with the exception of compound fractures of the hand. In the latter type of fracture, he thinks Orr's method is the most efficient treatment; it prevents accumulation of the extravasated products that cause fibrosis, resulting in limitation of motion. Fracture of the tibia with compounding in mesial surface will always be suitable for excision and immediate closure or a sliding flap. It may be that the fact that we do not know gas-bacillus infection causes us to continue with our method of treatment. We have seen only two cases in the last twenty years.

DR. FRANK L. MELENEY (New York) said that within the past two or three years gas-gangrene sera have been made more potent than in former years. Following the suggestion of certain bacteriologists, the biological products firms have put out serum which is potent against all of the gas-gangrene organisms as well as tetanus. There seems to be definite indication for the extensive use of this serum and a prophylactic in all cases in which there is likelihood of animal or human fecal contamination, in badly lacerated wounds and in these cases of compound fracture under consideration.

DR. FENWICK BEEKMAN (New York) said that it is a mistake to say that the treatment of compound fractures should be standardized, that is,

all cases must be treated in the same manner. This is impossible because much depends upon the type of wound and the possibility of contamination. Many fractures are produced from within out by indirect violence, the skin being broken over the angle formed by the broken fragments. He did not think in many of these cases the fragments actually pierce the skin—the latter is simply broken over it. These cases can usually be handled by cleaning the skin and wound superficially and then placing the part in a molded plaster splint or plaster case, just as in a simple fracture. Then we have the severe wound in which the fracture is produced by direct violence, the soft parts have been lacerated before the bone has been broken. These are due to direct violence. Such an injury is quite a different proposition from the first type mentioned. It is the type in which one usually sees gas gangrene. The streets of Philadelphia must be cleaner than those of New York—from what Doctor Crossan says—as we see many cases of gas gangrene in Bellevue Hospital. In the speaker's service he has about six cases a year, if not more. He would be afraid to put such injuries, fractures with wounds produced from without in, up in plaster. The case about which he spoke to Doctor Smyth a year ago was an individual with a compound fracture of the thigh, treated in one of their hospitals and débrided by a man who had had much experience during the War. The wound was then partly closed, packed with vaseline gauze, and a case applied. He died in three days from a fulminating gas-gangrene infection. In the Children's Surgical Ward a child died in two days following avulsion of the skin of the leg. The Orr treatment in chronic osteomyelitis, whether due to acute hæmorrhagic osteomyelitis or to compound fracture, has been satisfactory but he does not feel that acute hæmorrhagic osteomyelitis or a fresh compound fracture should be treated by a method which hides the wound from inspection.

DR. CLAY RAY MURRAY (New York) remarked anent the question of closing compound wounds: It is more or less a matter of betting the patient's limb or convalescence against one's judgment. Regardless of what type operation is used, one of the lessons theoretically learned in the War concerning wounds is not put into practice. In a compound fracture the sutures were placed but not tied and the wound treated for four or five days, since a great many infections do not develop until after three or four days. The wound was treated in expectation of possible infection and if it did not develop, closure was practiced.

DR. WILLY MEYER (New York) recalled the early days of antiseptis, while being assistant at Professor Trendelenburg's Clinic at Bonn, Germany. Lister's principles had just been introduced. They had swung from the use of carbolic acid to bichloride. Compressed moss wrapped in sterile gauze was the favored dressing. The moss (sphagnum) was cut from large sheets according to size required and dipped once in bichloride solution 1:1000, when it became soft and swelled up like dough. Already at that time, 1882,

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gauze was sterilized by live steam. We believed that in compound fractures it was important to investigate whether dirt had gotten into the depths of the wound. Therefore the fracture line was carefully inspected. Thorough drainage with tubes was instituted by means of wide incisions and then the wound thoroughly disinfected with bichloride, 1 to 1000, not the 1-5000 solution later on in use. Antiseptic dressing with that compound and evenly compressing moss was applied and then plaster bandages on top for proper immobilization. He remembered the joy of his chief when, after three or four weeks of not touching the wound, the first dressing was changed, while the patient had had a normal temperature. The limb was saved and the fracture went on to consolidation.

Since that time the increasing traffic in large cities, the motor cars, and later the World War, caused infinitely more cases and enlarged experience. But the general principles of treatment remained the same.

It seemed to the speaker that the proper primary inspection of the wound should not be forgotten and the patient should be brought immediately after the accident to a well-equipped hospital if that is possible. The proper care by the surgeon who attends to the wound first decides the fate of the patient.

Doctor Meyer recognized Doctor Connors' experience, and the figures he gave speak for themselves, only twelve deaths in sixty serious cases.

DOCTOR SMYTH in closing discussion said that in his own service at the Methodist Hospital and in the service of Doctor Pfeiffer at the Abington Hospital, forty-two cases of compound fracture had been treated by the Orr method. In no instance did gas gangrene develop nor was it necessary to remove a single plaster case. Doctor Smyth wished to emphasize his statement that the Orr operation was employed in suitable cases only and was not applicable to every compound fracture.

## RECURRENT INFERIOR RADIOULNAR DISLOCATION

DR. ELDRIDGE L. ELIASON (Philadelphia) read a paper with the above title for which, with discussion, see page 27.

## RECURRENT CALCULI IN THE URINARY TRACT

DR. ALEXANDER RANDALL (Philadelphia) presented a preliminary report of some work which he had been doing in an effort to avoid that unpleasant surgical sequence where, after the removal of a renal calculus, a recurrence rapidly follows. Of the variety of urinary concretions which we know to occur, in but one variety are we apparently approaching some understanding of its causative factors. This is the so-called earthy, or triple phosphatic stone. It has long been recognized that certain bacteria have a very limited range of chemical reaction in which they normally thrive. Today all bacteriological media are titrated to determine their pH reaction in order to successfully cultivate the types of organisms on which one is working. Change their cultural habitat in this one factor and bacteriostatic, or bac-



teriocidal, action is obtained. Surgeons have long trusted to urotropin as an urinary antiseptic and in order to insure the generation of formaldehyde, an acid medium is necessary. For this purpose, acidifying drugs are given by mouth in order to assure an acid urine. He had long felt that possibly the acidifying drugs are of greater antiseptic value than the urotropin in the dosage ordinarily administered.

There is recognized a group of organisms which have the power of breaking down urea in the urine with the formation of ammonia; the staphylococcus, certain strains of *Bacillus coli*, *Bacillus subtilis*, *Bacillus alkaligenes* and the *corynebacterium Thompsoni* are characteristic of this group. They create an alkaline urine by their ability to split urea and having created their ideal habitat, thrive therein. With the formation of an alkaline urine, there is a resultant precipitation of the alkaline inorganic salts of calcium, magnesium and ammonium, of which the characteristic phosphatic calculi are formed. Herein we have a clear insight of this probable etiological factor. Such phosphatic calculi have three characteristics: First, they are the most rapid growing form of stone seen; secondly, once their deposition starts, it is rarely superseded by the precipitation of other urinary salts; and thirdly, it is this variety of stone which the chronic stone producers and repeaters form.

In order to control this chemical change in the urine favorable for bacterial growth and phosphatic precipitation, he had carried out the following steps in his clinical material in an effort to obtain a prevention of the infection by changing the chemistry of the urine, and in so doing creating a habitat in which bacteria responsible for the same will not grow.

The first step was in the treatment of suprapubic fistulae following cystotomy with subsequent drainage. The picture is familiar to all of the post-operative prostatic, whose wound breaks down, creating a surgical menace that is a marked detriment to normal healing and closure. These wounds appear to be essentially related to an alkalization of the urine, and at their worst present an ugly, sloughing gangrenous sore on whose walls and even on the abdominal skin there is likely to be deposited encrustations of phosphates. Some time ago we experienced the ease with which such encrustations could be removed—in fact, dissolved by the topical application of a 5 or 10 per cent. phosphoric-acid solution. The response in healing following such local treatment is marked; a healthy wound rapidly follows the separation of the ugly slough, with the complete disappearance of phosphatic encrustations. Even in the absence of such breaking down of the wound, an ammoniacal order appearing in the dressings to the initiated is a warning that trouble is in store. Since adopting this step, the handling of such cases by the topical application of this weak acid solution has become gratifyingly improved.

The second step in the clinical handling of these cases was in certain patients where, though the wound was saved from the threatened breaking down, nevertheless, the constant threat of such a possibility was evident in the persistent pool of alkaline urine draining from the bladder. No amount of acidifying drugs by mouth appears to be sufficient in these cases to change

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the reaction of such an alkaline urine to an normal acidity, while topical applications to the fistula orifice fails of sufficient penetration. It was in such a case, some time ago, that he first attempted a direct irrigation of the bladder cavity with a solution of 1 per cent. phosphoric acid. The bladder not only tolerated this solution without discomfort, but a 2 or 3 per cent. solution could likewise be used without marked irritation being experienced by the patient. Such an irrigation caused a prompt return of normal bladder urinary acidity, and this once obtained, was easily held by the administration of the acidifying drugs by mouth.

This improvement in the handling of these cases has since become a routine step in all his suprapubic cystostomies, and he felt it to be a definite step in advance in controlling the possibility of post-operative infection with the type of organism which is recognized to have the above characteristics of both alkalinizing the urine and causing a precipitation of the earthy phosphates.

This finding naturally led to the third step in attempting to accomplish the same end in cases of recurrent calculi in the upper urinary tract. As stated before these stone repeaters practically always form phosphatic stones, and with this in view, he wished to report three cases in which he had irrigated the renal pelvis post-operatively with phosphoric-acid solution in an effort and hope that by so doing the prevention of infection with the organisms which have the above-described characteristics might be avoided, and if avoided, be a means towards the prevention of recurrent calculus disease in the upper urinary tract:

Doctor Randall then threw on the screen the X-ray studies of three cases.

The first patient had had a right nephrolithotomy and left ureterolithotomy performed by the late Dr. John B. Deaver. In July, 1930, a third operation, a right ureterolithotomy, was performed by Doctor Randall. Eight months later another large stone was found and subsequently removed from the right ureter. This patient received irrigations to the renal pelvis through his post-operative drainage tube and subsequently continued to have cystoscopical lavage of this right kidney and ureter with a 1 per cent. solution of phosphoric acid. February 8, 1932, the pH of his right pelvic urine was found to be 6.1.

The second case had a stone removed from his right kidney pelvis in November, 1931, subsequent to which the renal pelvis was irrigated on alternating days with either a 1 or 2 per cent. solution of phosphoric acid over a period of ten days, and his follow-up treatment continued as in the previous case. The pH of his right pelvic urine on February 8, 1932, was 5.2.

The third case had been operated on for an acute blockage of the right ureter, in September, 1928; and a second and third operation performed on the left renal pelvis, for stone, in July and August, 1929. A fourth operation was performed upon the right ureter for an acute blockage by stone in May, 1930. An observation by X-ray study, in November, 1930, showed minute calculi in both renal pelvises; while ten months later, in September, 1931, each kidney pelvis was filled with typical coral calculi. This patient sustained a fall from horseback in November, 1931, and five days later developed an acute blockage of the right ureter, necessitating a fifth operation. X-ray studies following this fall when compared to the studies made two months prior demonstrated a fracture of the coral calculus in the right kidney pelvis, a fragment of which was

causing this acute blockage. At the last operation, a ureterolithotomy, pyelolithotomy and a nephrolithotomy were performed. For three weeks following this operation the right renal pelvis was irrigated on alternate days with a 1 per cent. phosphoric acid. The wound closed promptly on withdrawal of the drainage, and the plate taken on December 12, 1931, showed the absence of any calculi in the upper right urinary tract. It was further reported that continuation of pelvic lavage at ten- to fourteen-day intervals since the last operation has been maintained, and the pH of the right pelvic urine January 28, 1932, was 5.8, and the urine perfectly clear.

Experiments on dogs' kidneys have been performed by injecting through the ureter from a laparotomy incision a 1, 3 and 5 per cent. phosphoric acid. One kidney was removed immediately, and the second one removed at the end of forty-eight hours. He had not been able to demonstrate, on microscopical study of these experimental dogs' kidneys, any evidence of damage to the pelvic epithelial lining or the renal papillæ; nor is there any evidence in these sections of any caustic action from the use of the drug in the above strengths. He summarized his remarks as follows:

(1) Phosphoric acid 1 per cent. has an equivalent pH acidity to  $\frac{1}{N}$  HCl, or approximately a pH of 1.5. Its bacteriocidal value is based thereon.

(2) Phosphoric acid 1 per cent. is practically isotonic and is approximately equivalent to a gastric acidity of 100.

(3) In experimental dogs, renal pelves injected with 1, 3 and 5 per cent. phosphoric acid fail to show any destruction of pelvic lining epithelium, or damage to the renal papillæ.

(4) Three patients in whom renal pelvic lavage with 1 and 2 per cent. phosphoric acid solution has been used, either through post-operative drainage tube, or through ureteral catheter, have not experienced excessive renal pain or discomfort. The bladder is less tolerant than ureter or kidney pelvis, and the urethra the least tolerant of all.

(5) The renal pelvic urine in the above three recorded cases has recently been restudied and found to be pH 6.1; pH 5.2 and pH 5.8.

(6) This step in treating cases of recurrent renal calculi has a rationale in both co-related conditions in the lower urinary tract and in bacteriological findings.

CONCLUSIONS.—(1) By bladder lavage with phosphoric acid post-operatively, alkalization and phosphatic encrustations can be prevented.

(2) The treatment of staphylococcic cystitis, encrusting cystitis, leucoplakia and allied conditions by this means is indicated.

(3) The prevention of recurrent renal calculi of the phosphatic variety is being attempted with every indication of success.

(4) The possible dissolution of small phosphatic calculi, or fragments left at operation, may be expected by the recognized action of such strengths of phosphoric acid *in vitro*, and the tolerance to such topical applications *in vivo*.

DR. EDWIN BEER (New York) remarked that some years ago, the surgeon was satisfied with removal of the kidney stone or stones, and instructing the

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patient following the operation to abstain from certain dietaries. Experience has shown that the situation is not as simple as this. The more kidney-stone cases one sees (in the last ten years we have had over 1,500 kidney- and ureter-stone cases), the more difficult it becomes to evaluate the factors that make for recurrence; and the more carefully cases are studied post-operatively, the greater the number of recurrences observed.

Before analyzing the problem, however, we must distinguish between real bona fide recurrences and false recurrences due to overlooked smaller or larger fragments, which have been allowed to remain in the kidney following what appeared to be a complete surgical evacuation. About thirty years ago, a similar discussion concerning gall-stone recurrences was carried on in medical literature, when the distinction between true and false recurrences was emphasized.

With the modern development of the surgery of kidney stones controlled by X-ray of the exposed kidney in the operating room, it has been possible to empty the kidney more completely than before this procedure was introduced. Fluoroscopic control of the exposed kidney has proven less satisfactory than photography on a small film with an intensifying screen. This objective control of the exposed kidney assures the surgeon as to whether all calculous material has been removed, and if there is any doubt, or sand has been encountered in the kidney during the removal of stones, the kidney can be drained either through the pelvis or through a nephrostomy to permit of subsequent discharge of these particles which may prove to be nuclei of subsequent new stones.

In addition to this control in the operating room, before discharge from the hospital, it is customary to take a series of flat pictures to confirm the operating-room findings. Unless all stones or fragments of stone are removed, unless one is sure one has emptied the kidney, a discussion of the incidence of true recurrences is of questionable value. If, however, all stones as controlled in this manner have been removed, and the kidney in the course of a few months, or years, develops a stone, then only can we consider that we have a true recurrence. In our experience, a solitary stone in the pelvis removed by pyelotomy is much less frequently followed by recurrence than those complicated stones usually associated with sand that are more or less dendritic in their structure, filling the pelvis and one or more calices, whether single or multiple. In this our experience is at variance with some other clinics, where more recurrences have been seen after simple single stone removal by pyelotomy than after the more complicated dendritic calculi. The factors underlying stone formation are fairly well evidenced in a number of organs of the body. Apparently, even without infection, stones may crystallize out of the fluid in which the chemical salts are present, and if stagnation is present, it favors this crystallization and deposition of salts. Apparently, in both the bile and in the urine, the salts, particularly cholesterolin and uric acid, are present in a supersaturated condition, and are held in solution by colloids. If one allows such acid urine which contains an excess of uric acid

to stand in a test tube, in the course of one to three days one can see frequently the colloidal nebecula separate from the urine and coincident with this the uric-acid crystals are thrown out and are deposited on the test tube. Similarly, in phosphaturia cases, the phosphates are thrown out as a lipid colloid which collects on the top of the urine in the test tube. In prostatic obstruction with clear urine, there is frequently a tendency for urates to sediment out in the residual urine and stones apparently form as a result of this process; similarly, in the gall-bladder as a result of similar physical chemical changes, cholesterin stones develop.

If infection sets in, a totally different type of stone forms in both the urinary tract, kidney or bladder, or in the gall-bladder. In the above observations in the urinary bladder, stagnation of urine seems to be the clue to the formation of stones, and it is very likely that a similar stagnation in the kidney, both pelvis and calices, may contribute to the formation of primary uric acid, oxalate or phosphatic stones in this region. In the face of infection, stones of earthy phosphates are most likely to develop in the kidney, and it is our problem to control both the stagnation and infection in the kidney, if recurrent stones are to be avoided.

It has been my experience that in the lowest calyx, perhaps due to man's upright position, stones seem to form more frequently than in the other calices, either as primary calyceal stones or as extensions from a pelvic stone. If such a calyx becomes distorted and dilated, one can readily understand that stagnation in this calyx will persist and recurrence will probably develop even if little or no infection be present.

Dietary measures in controlling recurrence of kidney stones seems to be of very little value if deformity of the kidney and poor drainage are not controlled. Uric-acid calculi, which are present in between 6 per cent. and 10 per cent. of all cases, probably can be controlled by dietary measures. Phosphatic primary stones possibly can be controlled by making the urine highly acid. Oxalate stones cannot be prevented with any regularity by a low oxalate diet, though it is well worth while advising the patient to avoid foods rich in oxalates. Cystin stones also are hard to control, though some reports have suggested that alkalinization may prevent reformation after removal of such stones. Recurrent stones in infected kidneys are much more difficult to control; even with pelvic lavage using antiseptics one cannot with any regularity control reformation.

At operation, however, one must establish free drainage from the kidney, and if it is possible, having found a dilated calyx, for instance in the lower pole, one should obliterate this pocket, either by using mattress sutures or by resection of the lower pole if the calyx is very large. Whether nephrostomy with irrigation is of value in preventing recurrence in these infected cases is highly doubtful. It does seem more advisable to rely upon natural diuresis and forced fluids to attempt to wash out the kidney cavity than to rely upon an occasional irrigation through the cortex or through the ureter catheter.

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In some cases, however, in which much sand has been encountered, post-operative irrigation of the kidney through the nephrostomy tube with weak antiseptic, especially with hydrochloric or acetic-acid solution may dissolve some of the earthy phosphates and thus delay recurrences.

From these remarks it is evident that the problem is by no means simple and some writers have made the outlook a little more problematic by claiming that a vitamin deficiency underlies the whole process of stone formation. Whether this vitamin deficiency manifests itself in the above-mentioned colloidal instability or not has not been demonstrated, but it would not be surprising if such a colloidal instability resulted from either physico-chemical or dietetic disturbance.

In connection with Doctor Randall's experiments with phosphatic deposits following cystotomy operations, our experiences have been very much the same. These are difficult to control unless the urine is acid, and we have found that the best acidifier of the urine is ten grains of boric acid and sodium benzoate with ten grains of urotropin, to which ammonium chloride can be added as required. In addition in some of the more obstinate cases, hydrochloric acid and acetic acid up to 1-1000 or Gouley's solution or normalactol have been used with considerable success. In passing, I would call attention to the publication in the *Presse Medicale* by Meyer, in 1925, in which he calls attention to the fact that the secondary stones in the bladder can be dissolved by irrigations with the above types of acid solutions.

In the upper urinary tract, we have tried to dissolve out such stones by using a Murphy drip, double flow ureter catheter, and instilling gallons of the acid solution. No stones of any size have been dissolved in this way, though these various solutions in test tubes within one to two days usually dissolved even fair-sized calculi of the group under discussion. Small calculi and sand particles undoubtedly can be dissolved in the upper urinary tract by these methods, and, in fact, von Haberer about two years ago claimed that he regularly used normalactol, which is a lactic-acid solution with a buffer in all complicated stone cases to dissolve out residual fragments.

His experience is not quite as encouraging as Haberer's publication might suggest. On the whole, this is a new field, and he felt that with more intensive work along the lines suggested by Doctor Randall and in his remarks, eventually they will be able to do something very definite for these patients, not only in relieving stagnation and infection, but in changing the renal condition by various irrigation methods, which will dispose of stones before they get to be large recurrences.

DR. LEON HERMAN (Philadelphia) said that Doctor Randall's presentation is in the nature of a preliminary report, and, as he understands it, he does not mean that his analysis is the final word on the therapeutic value of phosphoric acid in the treatment of phosphatic urolithiasis. With this reservation, it would seem that this method of treatment, especially its prophylactic use after operation, has great advantages over prior methods. The speaker

questioned the justification for the routine use in phosphatic calculi in the kidneys. The modus of its action seems not to have been discovered, but it is well known that phosphatic stones occur only in the presence of infection, chiefly of the coccal types, and it might well be that local changes occur as the result of the action of phosphoric acid, which render the medium unsuited to bacterial life. Hexylresorcinol is extremely useful in the post-operative period, especially in the surgery of the lower urinary tract, its benefits being derived from the control of coccal infections. It will be interesting to observe the effects of phosphoric-acid irrigations of the kidney in those cases in which a nephrostomy tube is employed. Certainly the use of phosphoric acid as suggested by Doctor Randall is a decided forward step in the therapeutics of an extremely annoying condition.

#### REDUNDANT GASTRIC POLYP—GASTRIC MUCOSA PROLAPSE

DR. DAMON B. PFEIFFER reported the case of a woman, aged sixty-five years, who was admitted to the Lankenau Hospital, November 3, 1931, complaining of a lump in the right upper quadrant of her abdomen.

She was well developed, not emaciated; blood-pressure 180/26; the heart and lungs negative to examination; a lipoma, size of a lemon, in left breast; hæmoglobin, 65 per cent.; erythrocytes, 3,350,000; leucocytes, 6,800; Wassermann and Kahn, negative; icterus index, 5, Van den Bergh indirect, faintly positive direct negative; coagulation time 6.5 minutes; bleeding time, 8 minutes.

A rounded mass, the size of a large cocoanut, could be felt in the right upper quadrant of the abdomen, coming down from under the costal margin. It was smooth, symmetrical and was continuous below with the palpable edge of the liver, with which it moved on respiration. Gastro-intestinal X-ray showed the stomach displaced downwards and to the left; pyloroduodenal canal deformed and a defect in the shadow in pyloric region attributed to pressure. The cholecystogram showed a defective shadow which diminished, however, with fat meal. Barium enema showed only irritability of colon.

Under a diagnosis of hepatic tumor, cyst or abscess, she was operated upon November 11, 1931, under spinocaine anæsthesia. The mass proved to be a large, yellowish-red tumor of the liver, at first glance solitary, but on closer examination smaller nodules were found above the mass but in immediate relation to it. No other nodules were present in the left lobe or in the remainder of the right lobe. It was resilient and numerous blood-vessels coursed over its surface. It was thought to be an inoperable hæmangioma. A nodule about 1.5 inches in diameter was then observed in the gastrocolic omentum. There was no glandular enlargement in the neighborhood. On palpating the body of the stomach a movable mass was felt within the stomach, evidently a polyp. The nodule in the gastrocolic omentum was easily removed. By gastrotomy a polyp two inches long, swinging from a small soft pedicle, was seen. The stomach wall was apparently normal but the body of the polyp was friable. The polyp was excised at the base and the operation concluded with the intention of submitting the tumor of the liver to radiation. However, the patient died on the third day with symptoms of basal bronchopneumonia. No autopsy was permitted but a specimen of the tumor of the liver was removed which was pronounced metastatic carcinoma. The body of the gastric polyp was carcinomatous. The nodule in the gastrocolic omentum resembled the carcinomatous polyp in structure. The case is remarkable pathologically in that the malignant changes in the polyp did not involve the base or adjacent stomach while only two metastases were demonstrable, one in the gastrocolic omentum, evidently lymphatic-borne, while the liver metastasis must have been hæmatogenous.

## REDUNDANT GASTRIC POLYP—GASTRIC MUCOSA PROLAPSE

He presented this case because of the increased interest in polypoid growths in general and gastric polyps in particular. If one excludes fungating or simple protuberant benign or malignant tumors, it would appear that true polyps of the stomach are rare. In the Obuchon Krankenhaus there were only four cases in 7,500 autopsies. Tilger found fourteen cases in 3,500 autopsies. They occur as (1) single or several discrete pedunculated tumors, or (2) as more or less widespread areas thickly beset with polypi (generalized polyposis or polypoidosis), or (3) as coalescent papillomatous tumors surmounting hypertrophied rugæ (polyadenoma en nappe of Menetrier). The last variety is exceedingly rare. Polypoidosis is a somewhat more com-

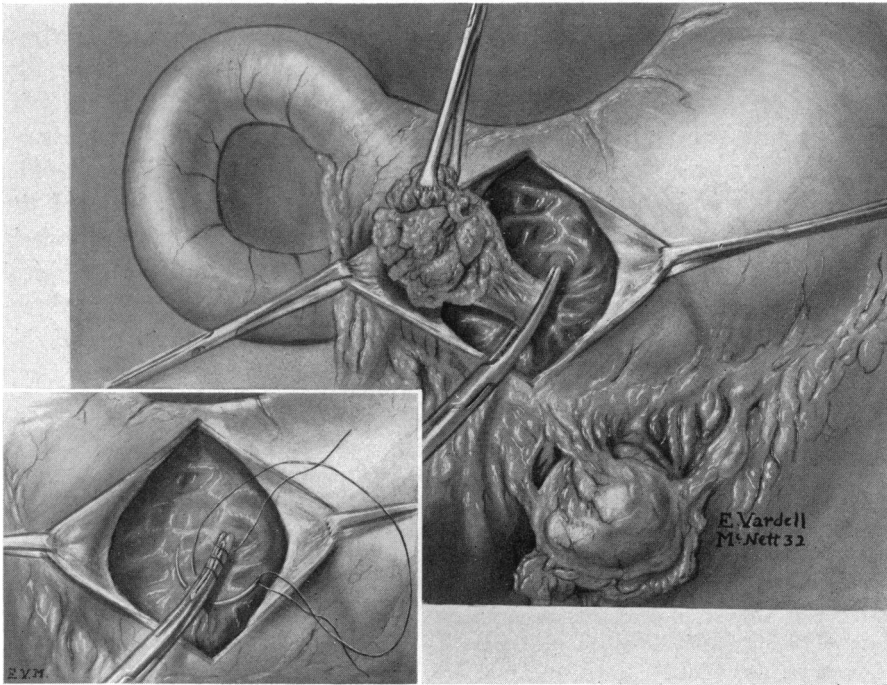


FIG. 5.—Gastric polyp and omental metastasis, overhanging mass in liver not shown.

mon condition and exhibits a strong familial tendency. Solitary polyps are more often found and may be adenomatous or simply polypoid fibroma, myoma, cyst or angioma. The chief dangers are hæmorrhage and malignant change. Bleeding is common and may be massive or small repeated losses bringing on profound anæmia. All patients with unexplained anæmias should be X-rayed with this possibility in mind.

Adenomatous polyps are prone to become carcinomatous. The symptomatology is indefinite. Tumors which prolapse through the pylorus usually cause some form of distress simulating ulcer or gall-bladder disease. Polyps of the body or fundus of the stomach are often silent. Gastric symptoms when accompanied by persistent loss of blood through the bowel may arouse



suspicion and indicate X-ray examination, upon which a clinical diagnosis of the condition depends. The speaker had a strong impression that owing to the difficulties of recognizing such growths, they are more common than at present suspected.

In 1925, Eliason, Pendergrass and Wright collected from the literature and their own experience a considerable number of pedunculated growths of the stomach in connection with an article on the Röntgen-ray diagnosis of these peculiar tumors. In this paper they presented two cases, which they believe to have been the first reported, of prolapsing mucous membrane of the stomach extending through the pylorus into the duodenum. These cases closely simulated in röntgenological signs the more frequent condition of pedunculated pyloric polyp extruded into the duodenum. In one of these cases several polyps were present on the prolapsing mucous membrane. In the other case no polyp was present. This case also had disease of the gall-bladder and a few stones as in the case here reported. It is difficult, therefore, to construct a clinical picture because of the paucity of cases and the chance that it is impossible to separate symptoms due to prolapse of the mucosa from possible gall-bladder symptoms. In any event the diagnosis is one to be made only by careful X-ray examination and equally careful surgical exploration. In a later paper in the *Journal of the American Medical Association*, February 1, 1930, Pendergrass analyzed the X-ray appearance of this lesion as follows:

*Prolapsing Mucosa.*—All of the phenomena noted in pedunculated tumors are observed in this condition, and, in addition, there is a defect in the pyloric region of the stomach which varies in direct proportion to the obliteration of the gastric canal. (1) If there is a large collar of prolapsing mucosa, there will be a wide pyloric space or filling defect. (2) If only a small collar is prolapsing, there will be a less dense opaque shadow in the pyloric region as compared to the density of the body of the stomach. (3) If the amount of prolapsing mucosa is less than 1 and more than 2, the pyloric defect will consist of longitudinal striations similar to those seen in hypertrophied rugæ of the stomach or when the stomach is only slightly filled and there is some pressure on the spine.

The condition is comparable to what the urologists describe as “floating trigone” of the urinary bladder in which the mucous membrane slides downwards and may obstruct the internal urinary meatus: and to the not infrequent condition of prolapse of the mucous membrane of the anus often seen in infants with or without true prolapse of the rectum. What its frequency or significance may be it is impossible to state, but it is in order to record cases as they occur so that conclusions may be drawn.

In regard to treatment, it seemed to be simplest to plicate the redundant mucosa and secure its adhesion to the outer coats. This is the principle employed in linear cauterization for prolapse of the mucous membrane of the anus, and it is efficient. No gastroenterostomy was done in this case. The result anatomically and clinically after this short interval is perfect.

## REDUNDANT GASTRIC POLYP—GASTRIC MUCOSA PROLAPSE

DOCTOR PFEIFFER detailed also the history of a man, aged forty-one years, who was admitted to the Lankenau Hospital December 14, 1931. Ten years previously he began having attacks which he attributed to gas, beginning usually about 2 to 4 P.M., and lasting until midnight. Soda, belching, or vomiting seemed to relieve, but a heavy dull pain in the lumbar region often persisted for two or three days. Pain was never severe and had no association with any kind of food. Attacks at first came on at intervals of about six months, but latterly were becoming more frequent. Aside from these disturbances, he was very healthy and well and a thorough diagnostic survey

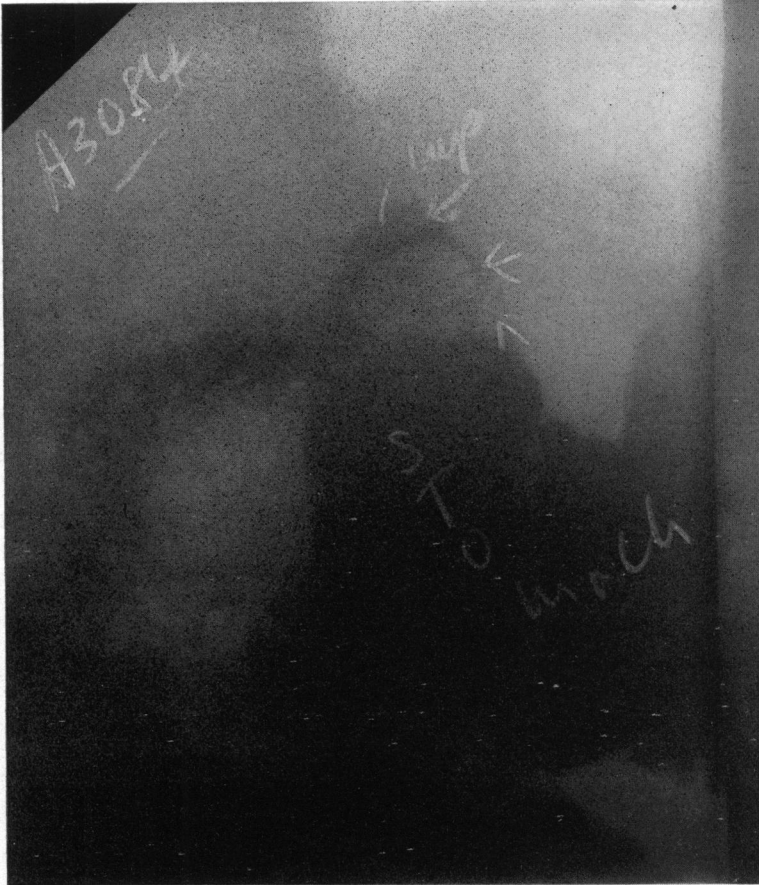


FIG. 6.—Defect in duodenal cap due to pseudo-polyp.

revealed no organic disease. X-ray films showed no gastric pathology but a constant clear defect was observed in the first portion of the duodenum exhibiting the characteristics of a polyp, and under this diagnosis he was admitted to the hospital.

At operation, December 16, 1931, the stomach, pylorus and duodenum appeared to be normal. The appendix was kinked at the base and was removed. The gall-bladder was very slightly thickened and was removed. No stones were palpated before removal but on opening the organ a few small sandlike concretions were found. The gastrocolic omentum was opened to permit more satisfactory palpation of the stomach. In this manner a curious elusive thickening could be felt about 1.5 inches proximal to the pylorus, more marked in relation to the lesser curvature. The anterior wall of the

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stomach was incised and the duodenum and stomach aspirated free of contents. The interior of the duodenum and stomach were inspected and palpated. No polyp was present. Attention was then directed to the obvious redundancy of the gastric mucosa in the pyloric region. When grasped with Allis forceps a large fold could be picked



FIG. 7.—Normal duodenal cap after operation, evidences of gastric irritability due to plastic procedure.

up and moved freely over the outer coats of the stomach wall. It could be made to glide downwards through the pyloric ring and it was concluded that this was an instance of sliding mucosa simulating polyp by extrusion into the duodenum. A considerable fold of the loose mucous membrane was picked up, oversewed with chromic catgut and attached to the underlying coats. Convalescence was uneventful. He has re-

## REDUNDANT GASTRIC POLYP—GASTRIC MUCOSA PROLAPSE

mained symptom-free and X-ray examination February 2, 1931, shows the stomach and duodenum to be normal with no trace of the previous defect.

DR. HENRY W. CAVE (New York) said that at the Roosevelt Hospital in New York, the experience with gastric polyp had been exceedingly limited. In 1902, Joseph A. Blake removed a single polyp which proved to be a benign adenoma. From 1910 to 1932, a twenty-one-year period, out of 993 operations upon the stomach, in not a single instance has there been recorded the presence of a polyp. However, recently, on the service of Dr. James I. Russell, a man of forty-five years of age presented an interesting problem.

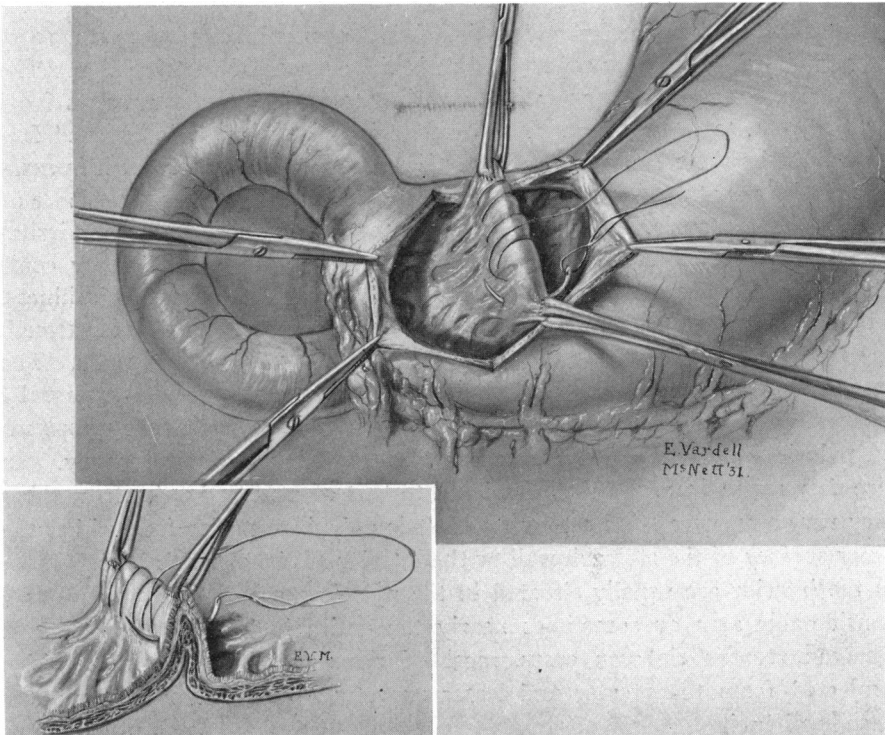


FIG. 8.—Semi-diagrammatic representation of plication of mucosa and submucosa.

This man had always been well until January 14, 1932, when he felt nauseated and vomited. Then for a period of two weeks he suffered much discomfort and cramp-like pain in the upper abdomen. He also had intermittent attacks of vomiting. X-rays showed a defect in the duodenal bulb. A diagnosis of gastric polyp was made. These intermittent attacks were thought to be due to pyloric blocking from a polyp. Twenty-four hours after admission increasing abdominal distension was noted. Flat X-ray plate of the abdomen showed a greatly distended loop of terminal ileum. The pre-operative diagnosis was new growth on ileocecal valve and possibly a gastric polyp. Immediate ileocolostomy was performed. Stomach was merely palpated, nothing abnormal

felt. Unfortunately, the man developed pneumonia and died February 9, 1932.

Considerable difference of opinion exists as to the instance of this condition. Gastric polypi and polyposis of the stomach should be clearly differentiated as they present two distinct clinical entities. Ebstein records fourteen cases of gastric polyp in 600 autopsies. Tilgen reports fourteen cases in 3,500 autopsies. Mulengracht found eleven cases in 11,475 post-mortem examinations. Stewart, of Leeds, in 11,000 autopsies found gastric polypi in forty-seven, and reported that thirteen out of 263 cases of cancer of the stomach, or 4.9 per cent., originated in polypi. Eliason and Wright, in 1925, collected 610 cases of primarily benign tumors of the stomach; fifty of these were from the University and Philadelphia General Hospitals. In 1930, these authors with Miller reported six additional cases of gastric polyp. The instance of malignant degeneration according to various authors ranges from 3.5 per cent. to 35 per cent. The etiology is unknown. It is believed frequently to be the result of chronic gastric catarrh and some think it is associated with the atrophic form of gastritis. Rokitansky, with his experience of over 30,000 autopsies, believed they were the result of inflammatory irritation, or, in some cases, congenital. Many give no symptoms; many come giving symptoms of anæmia as the most prominent feature of their illness. The polyp situated near the pylorus with a long pedicle may prolapse through the ring and cause pain, nausea and vomiting of a very severe grade. The most common symptoms are anorexia, pain, nausea and vomiting (usually intermittent), loss of weight and anæmia. There may be present symptoms of pyloric obstruction, intussusception, hæmorrhage and malignancy. In size they range from the size of a lentil to that of a foetal head. In number they vary anywhere from 1 to 300. Gastric polypi may arise from either the outer surface of the stomach wall or the interior of the stomach wall. Those in the interior are usually situated in the pyloric segment, but may cover a considerable area or sometimes nearly the entire interior of the stomach. Sherron records eighteen cases, most of them mesoblastic tumors which projected from the greater and lesser curvatures of the stomach into the peritoneal cavity.

While undoubtedly the most valuable means of diagnosis, the X-ray is not infallible. In these cases röntgenological study shows no interference with gastric peristalsis. It does show, however, usually the delay in gastric motility with retention of part of the barium meal after six hours; invariably a vacuole either in the stomach or in the duodenum is seen. Goldsmith recently reported a case where the film showed regularly a limited defect which was rounded and about as large as a walnut in the pyloric segment. A diagnosis of benign tumor, probably a polyp, was made. On opening the stomach at operation a freely movable peachstone was found, the patient having swallowed this six months previously and it could not be passed through the pyloric ring. The X-rays are of little use in cases of solitary polyp, especially

## REPAIR OF CLEFT PALATE

if they do not cause mechanical symptoms or before carcinomatous degeneration takes place.

In regard to the treatment, gastrotomy is the only sure method of determining the presence of a polyp, and a gastroscope is often a valuable aid. Because of their close relationship to malignant disease, adenomata, fibromata and myxomata offer a serious prognosis and a subtotal gastrectomy should be done. Some authors insist that subtotal gastrectomy should be the operative choice in any type of gastric polyp.

DR. RICHARD LEWISOHN (New York) said that prolapse of the mucous membrane of the pylorus and secondary obstruction is rare. The first case was reported in 1911. In recent years interest has been revived by the studies of Eliason and Wight, who have undoubtedly collected a large number of cases, and in a number have made the correct diagnosis from the X-ray. The clinical pictures of prolapse of the mucous membrane and of gastric polyp are identical. Prolapse may go on to polyp formation and in some cases to secondary malignancy. The differential diagnosis is undoubtedly difficult, but it can be made.

## REPAIR OF CLEFT PALATE

DR. GEORGE M. DORRANCE (Philadelphia) read a paper with the above title, for which see *ANNALS OF SURGERY*, May, 1932, vol. xcv, page 641.

DR. FRANK S. MATHEWS (New York) said that all operators must have felt the need of some operation which would displace the palate backward and allow the pharynx to be closed off in phonation and swallowing. In the Langenbeck operation, where tissues are approximated from side to side, the failure of the functional repair would seem to depend on lack of tissue in addition to the separation of tissues in the median line. Brophy insisted that cleft palate is simply a division of tissues and that there is no real deficiency. But this the speaker thought entirely erroneous. When in a Langenbeck operation a hole occurs at the suture line, it often heals completely by cicatrization, but this process still further draws the soft palate farther forward. Wandell, of Newcastle, has devised an operation with the intention of diminishing the gap between palate and posterior pharynx by bringing the posterior pharyngeal wall farther forward. The Dorrance operation seems a pretty severe one and requires multiple operations, and if infection with sloughing should occur, the disaster would be irremediable. The operation for cleft palate should be done only by those who have intimate knowledge of the anatomy of the parts, acquaintance with all the operative procedures, skill in operating and a kind of temperament which is chiefly characterized by self-control. Many otherwise good surgeons are not adapted to this kind of work.

DR. ROBERT H. IVY (Philadelphia) remarked that his personal experience with the Dorrance procedure has been limited to three cases, but he has had abundant opportunity to follow closely the work Doctor Dorrance has been doing from its inception and believes that this procedure is a very valuable

addition to the resources at our disposal in the treatment of certain forms of cleft palate.

There has been, and there still is, unfortunately, a tendency on the part of some surgeons to undertake cleft-palate operations with insufficient study of the problems involved in individual cases, and to look upon these cases as of minor importance when compared, for example, to major abdominal conditions. This is not as it should be, for failure of the first operation frequently ruins the case for a future good result, and there is surely not a more serious handicap to a person than to go throughout life with imperfect speech. Therefore, the surgeon who undertakes these cases should do so only after thoroughly familiarizing himself with the best technic available.

The von Langenbeck operation has been, and still is, regarded as the standard procedure in correction of cleft palate. In the past few years men especially interested in the cleft-palate problem have been taking stock, so to speak, and are becoming less and less satisfied with the von Langenbeck operation. A great drawback to this operation is that the lowering of the mucoperiosteal flaps in order to bring their edges together in the median line, and the detachment of the aponeurosis and nasal mucosa from the posterior edge of the hard palate necessarily create a dead space between the flaps and the bone above, leaving a broad, raw surface exposed to the nasal secretions. This creates a tendency toward nonunion, and even if complete union occurs, there is much scar tissue contracture which pulls forward the soft palate, creating insufficiency there, and preventing closure of the nasopharynx, so necessary for good speech. It has also been found that the von Langenbeck operation when performed early in life causes in some cases an arrested development of the upper jaw and irregularity of the teeth. For these reasons Doctor Ivy believes the von Langenbeck operation is going to be performed less and less often as time goes on. There is no time here to go into details of operative improvements that are gradually being substituted for the von Langenbeck operation, but he wished to refer especially to the recent book of Victor Veau, of Paris, in which the author describes a technic which he believes marks a great advance in this work. During the past four or five months the speaker has operated on fifteen cases by Veau's technic at various stages, and even with this short trial he is more than satisfied that the end-results are going to be vastly improved.

Doctor Dorrance's operation is especially adapted for primary cases of congenital insufficiency of the palate, with or without cleft, when neither the von Langenbeck nor any other technic will allow a shutting-off between the soft palate and the post-pharyngeal wall. It is also effective as a secondary procedure where the other operations, even though successful in closing the cleft in the median line, have not improved speech by reason of an insufficiency posteriorly.

DR. WARREN B. DAVIS said that he had used this technic at the Jefferson Hospital in six instances. Four of the six cases had short palates that had

## CHRONIC CYSTIC MASTITIS

been repaired in earlier life. In two the palate was still cleft in the posterior half. The only radical difference between his method and that described by Doctor Dorrance is that in his cases the time elapsing between the two stages of the operations varied from eight to fourteen days. All of the patients were greatly improved in speech. In one case an opening in the palate just posterior to the incisor teeth persisted. A dental plate was used to cover this opening and the speaking voice is good.

## CHRONIC CYSTIC MASTITIS

DR. J. STEWART RODMAN (Philadelphia) said that all physiologists are agreed that ovarian function plays a large part in breast function, and that in hypofunction particularly, but also in dysfunction, breast abnormalities are apt to arise. The work of Hitchmann and Adler, Rosenburg, Polano and Sedening, McFarland, Cheatle and Helen Ingleby amply supports such a point of view. In spite of all this work, however, two important factors still concerned him in deciding upon the proper advice to a given patient. First, when does aberrant physiology become pathology, and secondly, what is the real truth about any association which chronic cystic mastitis may have with carcinoma?

As to the first of these, he called attention to the work and point of view of Helen Ingleby in the pathological laboratory of the Woman's Medical College during the past five years. He, himself, had become a convert to the conservative ranks in so far as this disease is concerned in spite of having been raised in a radical school of thought in dealing with breast lesions in general.

Though others have shown the importance of ovarian function, to her belongs the credit of insisting that each breast lesion, and particularly the one under discussion, must be considered in the light of the known cycle of the mammary gland. The histological appearances differ considerably in the various phases that go to make this cycle.

In fact, the clinical findings also vary so that whatever else one may know about the patient, one must know whether one is dealing with the pre-menstrual, menstrual, post-menstrual or resting phase of the gland. To further complicate this matter, the histological appearances of the structures going to make up a benign solid tumor, for example, will often go hand in hand with those in the gland itself, so that what is often taken to be an added epithelial activity is in reality nothing more than what one would expect because of what is happening to the gland itself in the particular phase of its activity. Those interested in this most important part of the problem were referred to a paper by Helen Ingleby on the relation of fibroadenoma and chronic cystic mastitis to sexual cycle changes in the breast, about to appear in the *Journal of Cancer*.

There is, however, a time when in some of these instances of aberrant physiology one begins to deal with the pathological and, therefore, cannot



afford to any longer give conservative advice. It may be assumed that the same hormone which produces the harmless tissue aggressions and retrogressions of the menstrual cycle will in certain cases, usually associated with some type of ovarian dysfunction, produce locally a fibroadenoma, or, more generally, a chronic cystic mastitis. It seems to be the same process with these variations of the theme.

In so far as the second important problem is concerned, it does not yet seem settled as to what is the relationship, if any, between chronic cystic mastitis and carcinoma. It is agreed that the term "pre-cancerous" should no longer be used in describing chronic cystic mastitis. Certainly, most of those who have chronic cystic mastitis will not develop cancer, but some will. As yet he could find no certain way to distinguish between the two. The term "pre-cancerous" should, however, be abandoned because it accentuates something which does not happen as a rule. In agreeing to do away with it one must not forget to think always of the possibility of cancer. Cheatle, in his recent monograph with Cutler, on the breast, states that the condition which he calls "cystiferous desquamative epithelial hyperplasia" may go on to carcinoma, and he has been quoted elsewhere as stating that he believes this to happen in about 20 per cent. of the cases. This was about his own experience if by cystiferous desquamative epithelial hyperplasia he means that type of chronic cystic mastitis associated with cyst formation and epithelial activity, the papillary and adenomatous groups of Warren's original classification.

Just why the epithelial hyperplasia of chronic mastitis, in the majority of instances, stops short of carcinoma remains for future workers to show. The recent work of Hammett in Reiman's laboratory proving that at least one of the activators of epithelial growth is SH radical is interesting. There must be other factors involved, however, as continued stimulation by the SH radical leads always to higher differentiation of cells while carcinoma goes the other way and always represents a group of undifferentiated cells.

Clinicians, however, must, while waiting for these problems to be finally solved, have some sort of working rule to guide them in dealing with chronic cystic mastitis, or abnormal involution of the breast. In their newly found conservatism, they must not forget that "lumps" in the mammary gland do not normally belong there and that while the majority falling into this group of chronic cystic mastitis are harmless, some are not and should be removed either locally or with the entire breast. In a general way, one will be fairly safe if each of these patients whose age falls into the active sexual cycle of the gland is first placed definitely into the menstrual phase which she shows. Then allow one menstrual period to intervene and see the case again about ten days after the period, or in the middle of the resting phase. If the lump is smaller and less tender, further conservatism is justified. All lumps which do not change, or increase in size, particularly in woman over thirty-five, should then be removed. He did not often do the radical amputation on those with chronic cystic mastitis, but still does it in certain cases in

## CHRONIC CYSTIC MASTITIS

women over forty where there are multiple small cystic masses in the gland, as it has been his experience so far that every now and again early malignancy is found in this type. Frozen sections are not of much value, as even the pathologists themselves admit, so that one must depend largely on his own and the pathologist's opinion of the gross appearance.

DR. OTTO C. PICKHARDT (New York) remarked that a composite, clinical picture of this lesion could be described thus: The palpating fingers examining a breast in which chronic cystic mastitis has developed would feel, usually in the upper and outer quadrants, a firm, diffuse hardness, filled with numerous shotty nodules. These nodules, which have a definite edge, form larger ill-defined lumps or tumors and are often unusually sensitive. They frequently regress or disappear and are very liable to be bilateral. Intermittent retraction of the nipple may be present. Associated axillary adenitis is by no means constant and is frequently evanescent in character. When it is present the nodes are usually tender and rather soft.

Seventy-six per cent. of the cases of chronic cystic mastitis studied by the speaker grouped themselves in the third and fourth decades, while the incidence of carcinoma of the breast is more common from the fourth decade onward. In other words, chronic cystic mastitis appears earlier in life than carcinoma.

The pathological reports of the Lenox Hill Hospital in 1927-1928 would every so often add, after a minute pathological and cellular description of this lesion, the term "pre-cancerous." On further investigation it developed that there were two distinct schools of thought on this subject—that of Bloodgood, in America, and of Cheatle, in England. Bloodgood felt that chronic cystic mastitis was an essentially benign condition and remained so. Cheatle believed it to be a "pre-cancerous" condition and hence dangerous. With the aid of Doctor Rohdenburg, Director of the Lenox Hill Laboratory, Doctor Pickhardt studied this problem from the theoretical and experimental angle and from the clinical analysis angle.

The investigators received a very definite impression that the type of woman, whatever her age, suffering from this disease, was of the decidedly active kind. They are of the "hyper" rather than of the "hypo" type, and of the alert rather than the phlegmatic. From this it is but a step to the thought that their ovaries are overfunctioning. This condition has been shown by various authors, particularly E. Laquer, C. Ancel, and Leo Loeb, to have a definite effect on the mammary gland. Ancel states: "Corpus luteum induces a proliferation of the mammary gland." Loeb states: "the mammary gland under the stimulus of persisting corpus luteum secretion grows to a considerable size and resembles in character that obtained in pregnancy." These conclusions were drawn from animal experimentation.

An attempt was made to produce chronic cystic mastitis in experimental animals by (1) continuous injections of corpora lutea substance, and (2) *a.*—Ligating parts of the breasts with catgut and silk; *b.*—Injection of a

watery suspension of Kieselguhr into the breast itself. The second part of the experiment was carried out after the animals were well stimulated with the corpora lutea material. The experiments proved that chronic cystic mastitis could be artificially produced.

The animals (mice and guinea-pigs) injected with corpora lutea and without obstruction of the ducts mechanically produced, showed stimulation of the breast without cystic distension and with but slight epithelial overgrowth. Most important, from the standpoint of chronic cystic mastitis being a pre-cancerous condition, one of the mice developed at the point of ligation a definite carcinoma which, at its edges, showed typical chronic cystic mastitis. But a second series of identical experiments yielded no further carcinoma but only chronic cystic mastitis.

The end-result of the speaker's first study could be summed up as follows:

Chronic cystic mastitis can be produced experimentally in mice and guinea-pigs. There were three elements necessary in the development of this lesion: (*a*) Mechanical stasis; (*b*) inflammation; (*c*) proliferative elements due to some epithelial growth stimulation, most logically a specific hormone of the corpus luteum, or graffian follicle, or both.

One animal developed cancer at the site of production.

Chronic cystic mastitis appeared to be a pre-cancerous condition.

The clinical analysis included 117 cases of chronic cystic mastitis, all operated upon; ninety could be traced.

Pathologically, they were divided into two large groups: (*a*) Simple chronic cystic mastitis, seventy-three; (*b*) pre-cancerous, seventeen.

The difference in classification between the simple and the pre-cancerous types is based on the following:

"The suspicion of possibly early malignant change or a tendency to malignant degeneration (so-called pre-cancerous) is aroused in those instances where the acini are filled with epithelial cells. Here even serial sections may not always succeed in demonstrating or excluding penetration of the basement membrane." (Rohdenburg.) Of all these, one and one only, clinically has developed into a carcinoma. This case came from the pre-cancerous group.

This case, in which apparently a pre-cancerous chronic cystic mastitis has developed into a carcinoma. February, 1929, a radical mastectomy of the left breast was performed for a tumor the size of a hen's egg. This tumor was movable and the skin was movable over it. Small axillary nodes were present. Microscopical examination of sections obtained from many different parts of the breast showed the picture of a chronic cystic mastitis—some of the ducts and acini were dilated and either lined with multiple layers of atypical cells or completely filled with these cells. Although the lesion was suspicious, there was no definite evidence of infiltrative epithelial growth. Sections of about twelve axillary lymph-nodes showed no evidence of malignancy. By December, 1930, there were well-marked supra-clavicular nodes with lymphœdema of the arm. Clinically the case is now one of carcinoma.

## CHRONIC CYSTIC MASTITIS

The problem under discussion may be viewed from two separate but connected angles: the almost purely clinical angle, as exemplified by Bloodgood, and the almost purely histological angle, as exemplified by Cheatele. Taking the standpoint of the purely histological angle as the first station, the following observations appear to be in order. From the histological standpoint the diagnosis of malignancy is based upon certain deviations from the normal in the architecture of a given tissue. These deviations do not suddenly occur, but are gradual changes which may be traced step by step from the normal to the malignant. The exact point at which a malignant power is assumed by the cells is at all times difficult to determine, and is oftentimes utterly impossible. The histopathologist states that if this proliferation continues, then it seems logical to suppose that sooner or later the proliferation will become malignant. In support of this viewpoint he cites comparable changes in tissues other than the breast, *e.g.*, the prostate, where such changes are almost invariably followed by malignant degeneration. Against this are the facts that analogous types of proliferation when they occur in the appendix (carcinoids) are clinically but seldom malignant, and the fact that analogous types of proliferation as observed after the injection of Scharlach R in olive oil in animals do not behave in a clinically malignant manner.

In general, the theoretical conclusions would lead one to infer that chronic cystic mastitis is a pre-cancerous lesion.

The histological viewpoint, based as it is on the architectural arrangement of the tissue, must give way to the experience gathered by clinical observation, since clinical experience is the history not of what may, but of what does take place. As shown in the present analysis, clinical observation clearly confirms the standpoint of Bloodgood that the condition is not malignant, and that it does not appear to be the precursor of malignancy at a later date. The few cases associated with malignancy which we have observed much more nearly correspond to the normal cancer rate in a random sample of the same number of females of the general population. We would conclude from our analysis that the condition of chronic cystic mastitis belongs to the same group of proliferative tissue changes as the carcinoid of the appendix. While these bear certain histological resemblances to proliferative processes associated with the development of malignant neoplasms, they actually but seldom pass over the line and become malignant.

Finally, the clinical results as shown by the follow-up in this series, even where only a local excision has been done, are so excellent and so remarkably free from cancer that the speaker has been convinced against his original inclinations and must now feel that chronic cystic mastitis is a benign condition. If it is pre-cancerous it shows that removal in that stage is sufficient to eradicate the cells which tend toward malignancy.