

NOTE.—In addition to the references already cited, the following may be consulted:

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 1135 West Franklin Street.

ABSTRACT OF DISCUSSION

DR. GEORGE F. BUTLER, Wilmette, Ill.: I believe that much can be done to prevent arteriosclerosis. Eliminating syphilis as a factor, I believe that autotoxemia, or acidemia, is the principal cause of arteriosclerosis. If we test the urine early in these cases we will find that almost invariably there is evidence of intestinal fermentation or decomposition. There will be shown also, by an examination of the urine, that there is, in the majority of cases, a high degree of urinary acidity, indicating acidemia. These conditions favor degeneration of the blood vessels. Whenever the urinary acidity of any man exceeds 40, that man is on the borderline of danger. If the acidemia and intestinal decomposition can be overcome, much can be done to retard the degeneration of the blood-vessels. I think that the good success we have had with potassium iodid and sodium bicarbonate in the treatment of arteriosclerosis is due to the rapid elimination of waste products occasioned by the potassium iodid and the changing of the acid condition—not the acid condition exactly, but the acidemia—by the sodium bicarbonate. The daily use of sodium bicarbonate will lessen the urinary acidity and overcome the acidemia, while the daily use of potassium iodid serves as a powerful eliminant of toxic products. As a purely symptomatic remedy the nitrites are very valuable. I think sodium nitrite is better than any of the others; that is, I like it better, but the trouble with all of them is that their effects subside too quickly and unless the administration is kept up at frequent intervals so as to maintain a uniform dilatation of the arterioles, there is not much use in giving them. If we could get a drug which would produce dilatation of the blood-vessels and if that dilatation could be maintained for five or six hours before we should need to give another dose, I think we would have the ideal vasodilator. Now it may be that some remedy like aconite or veratrum would do this, but I cannot say, as I have never used these drugs. I wish to endorse especially the dietetic treatment. Eliminate the proteids, give plenty of water. Psychic treatment should be employed for it is necessary to relieve all anxiety and worry which have a deleterious influence on the blood-vessels and heart. And, by all means, correct the acidemia and favor elimination by alkalies and potassium iodid, and overcome, if possible, gastric and intestinal indigestion and fermentation.

DR. JOHN N. UPSHUR, Richmond, Va.: After an experience of many years, I am not very hopeful along the line of cure. The difficulty is to convince a man that he is in need of treatment, the trouble is so insidious. The cause is along nutritive lines. The blood-vessels suffer from this cause—impairment of nutrition from gastrointestinal digestive disturbance, abuse of alcohol, tobacco and too rich a diet. Nervous

strain is often back of the digestive disturbance, gastric motility being interfered with fermentation results and toxins are absorbed. When people are warned against these things—too rich diet, alcohol and tobacco—they simply will not believe the physician and elect to take the chances. I do not approve of the alkaline treatment, especially iodid of potassium; it is too apt to impair digestion and is not well-borne by the stomach in many cases. I prefer to treat these patients by a simple but nutritive diet—milk, buttermilk, skim milk. The irritation of the kidneys by alkaline drugs may lay the foundation for the development of nephritis. The condition comes on in the decline of life—it is a process of decay. Therefore, be cautious about drugs. In the weak heart of this condition I would commend sulphate of spartein in doses of from $\frac{1}{4}$ to $\frac{1}{2}$ grain. It may be given in even larger doses I would be glad if members of the Section would try it.

DR. ALEXANDER G. BROWN, JR., Richmond, Va.: It is not contended in the paper that we have the hope that we will remove from the human family at one fell stroke arteriosclerosis. The purpose of the paper is to awaken in the minds of the profession the early recognition of this disease, which is a potent factor in decay, early enough to ward and to keep off decay and to prolong life. And it is with that idea in view that I recommend the administration of iodid of potassium in connection with sodium bicarbonate, for instance; not to the degree of doing harm, but to the degree in which it will do good. I hope that the members of the profession will see these early signs of breaking down and prevent them.

TETANUS DEVELOPING TWELVE DAYS AFTER SHORTENING OF THE ROUND LIG- MENTS—RECOVERY*

REUBEN PETERSON, M.D.

ANN ARBOR, MICH.

In 1899 Dr. Joseph Taber Johnson reported before this section at the Newport meeting a case of tetanus following ovariectomy. The patient was operated on at his private hospital, and her death was the only one that had occurred in that institution for eighteen months. No other case of tetanus had been noted in any hospital or dispensary with which he had been connected; in fact, within his knowledge no case of tetanus had occurred throughout Washington for several years.

Twenty years have elapsed since that meeting. We have accomplished much through efforts to perfect our surgical technic. We know more about bacteriology, including the life history of the different pathogenic bacteria. The mortality and morbidity incidental to surgical work apparently has been reduced to a minimum. Even suppurative of an abdominal incision is a rare occurrence, necessitating an explanation as to causation in each individual case. Therefore, when last year tetanus developed in a patient operated on in my own institution, where the surgical technic is entirely under my control, not only was it startling, but it seemed of enough importance to warrant a thorough investigation and discussion. Let no man imagine himself so far superior to his fellow surgeons as to be exempt from complications such as this. Surely pride goeth before a fall. I am convinced now of the truth of the saying that if a man operate long enough and often enough he can illustrate in his own practice almost every surgical complication.

The case which serves as the basis of this paper is as follows:

* Read in the Section on Obstetrics and Diseases of Women of the American Medical Association, at the Sixtieth Annual Session, held at Atlantic City, June, 1909.

REPORT OF CASE

The patient was single, aged 19, a student by occupation. She had suffered severely from dysmenorrhea since the establishment of her periods at the age of 13.

Operation.—The uterus was found to be somewhat enlarged and retroverted and to overcome the dysmenorrhea, curettage and shortening of the round ligaments were advised. These operations were performed at my private hospital, Nov. 17, 1908. As the uterus was freely movable, the abdomen was not opened, but the ligaments isolated and shortened within the inguinal canals through a single suprapubic incision. The shortened ligaments were held in place by catgut rendered sterile by a modified Claudius iodine method. The same material was employed for closing the inguinal canals and bringing the deeper portions of the incision together. Michel's clamps were used to coapt the edges of the skin incision.

For twelve days the patient had an uninterrupted convalescence. The stitches were removed on the tenth day and the wound found to have healed by primary union.

Postoperative Complication.—On the twelfth day the patient laughingly said that she thought she was going to have the mumps as her face was sore at the angles of the jaw and the latter seemed stiff. Parotitis, which at times follows gynecologic operations, was suspected. Examination showed no enlargement of the glands and there was no elevation of temperature. The soreness and stiffness of the jaws continued about the same for the next few days. The patient sat up on the fifteenth day for a short time. The jaws were sore and stiff, so that she ate solid food with difficulty. There was no rise of temperature or pulse, however, and the patient did not seem ill. For the next three days the patient's condition remained about the same with possibly a slightly increasing inability to open the jaws. The real nature of the disease was not suspected until the eighth day after the first complaints of stiffness about the jaws when the muscles of the back and the neck became rigid. There were sudden spasms of the muscles of the jaw, so that the patient frequently waked from a sound sleep from having bitten her tongue. As the day progressed the patient became quite excitable and for the first time the temperature was elevated, being 100 per rectum. Thoroughly alarmed at the condition of the patient and convinced that I had to deal with a case of postoperative tetanus, I sent for my friend, Dr. W. H. Hutchings of Detroit, as he had had considerable experience with the treatment of this disease by the use of chloretone. We saw the patient together about 11 p. m. December 6, the twentieth day after the operation and the eighth day since the development of the slight soreness and stiffness of the jaws. Examination at this time revealed marked trismus, the patient being able to open her jaws only enough to admit a feeding-tube. The muscles of the neck and back were rigid so that the patient could be lifted slightly from the bed by raising the head from the pillow. The abdominal muscles were rigid and somewhat painful on palpation. The patient had no difficulty in swallowing, although nourishment had to be taken through a tube. There were slight twitchings of the muscles of the face, although there was no risus sardonius. Sudden movements about the bed, as for example the turning on of the electric light, caused contractions of the muscles of the neck and back, although opisthotonos was not present.

Treatment.—At 11:30 p. m. sixty grains of chloretone dissolved in hot olive-oil were administered per rectum. Within an hour the clonic contractions of the back muscles had ceased. The patient was much less rigid and could open her jaws decidedly more than before the administration of the antispasmodic. She expressed herself as very comfortable but very sleepy and thought she would have a good night. At 11:30 a. m. after the subcutaneous administration of 1,500 units of the antitetanic serum the patient slept until 5 o'clock when she was awakened by the spasmodic biting of the tongue. At 7 a. m. there was a return of the clonic contractions in the muscles of the back, the convulsive movements occurring from one to four minutes apart. At 9 a. m. the patient was again given sixty grains of chloretone by

the rectum and at 10 o'clock another 1,500 units of antitetanic serum. After the second dose of chloretone there was no recurrence of the convulsive seizures. There was a gradual relaxation of the rigid muscles, although it was about a week before the jaws could be opened normally. Following the two large doses of chloretone the patient continued in a drowsy condition and slept a good portion of the time. Although there were no further muscular spasms, as an additional precaution, chloretone in thirty-grain doses was given daily for three successive days. Salines per rectum were given every two hours, beginning shortly after the administration of the first dose of chloretone. These injections were continued for eight days, although of necessity, because of the intolerance of the rectum, the intervals between the injections had to be gradually lengthened. However, a large amount of saline solution was absorbed during this period. The bowels were kept open, at least one free movement being secured daily.

Course of Disease.—After the second dose of the antitetanic serum, the wound was examined. It was found to have healed by primary union with the exception of a small point at the extreme right hand corner. Here was situated a minute blister, containing clear serum. Careful bacteriologic examination of this fluid failed to demonstrate the tetanus bacillus, the cultures showing staphylococci only. The patient left the hospital in excellent condition, thirty-two days after her operation and twenty days after the first appearance of the tetanus.

Now I propose to reverse the mental processes of the operator who is unfortunate enough to have a case of postoperative tetanus in his practice. After establishing the diagnosis his first thought is to save his patient; his second consideration is to ascertain the cause of the attack, so that he may guard against such an accident in the future. Hence the questions before us are:

- I. What gives rise to postoperative tetanus?
- II. What is the treatment of such a complication?

THE CAUSE OF POSTOPERATIVE TETANUS

By postoperative tetanus is meant the unexpected development of tetanus in an operative case, when there has been no history of traumatism, or conditions favoring the introduction of the tetanus bacillus. In other words, this definition includes cases which, barring the accidental introduction of the tetanus bacillus, would have ended in the complete recovery of the patient.

In the case just reported, the only change in the ordinary surgical technic of the hospital which up to this time had yielded gratifying results, was the use of a different kind of catgut. For years in my private work I have employed a catgut prepared by a firm which deservedly has acquired a good reputation from the quality of the gut it has placed on the market. Last year, however, it was thought advisable to have the catgut prepared in quantities by my laboratory assistant, a man well trained in pathology and bacteriology. I was loath to employ a new catgut, however, until the method and results of its sterilization had been approved by the highest authority. Therefore, before using the catgut in the hospital it was prepared and tested in Prof. F. G. Novy's bacteriologic laboratory in the University of Michigan. The mode of preparation was as follows:

A saturated solution of iodine crystals in chloroform was prepared by rubbing up in a mortar and allowing to stand for forty-eight hours. This solution was then filtered and the catgut immersed in it for eight days.

The catgut, thus prepared, was then tested as follows:

Test 1.—The coils of catgut were lifted from the containing jar with sterile forceps and from each of four coils there was excised with sterile scissors a piece from 2 to 5 cm. in length. These short pieces were allowed to stand twenty-four hours in sterile distilled water and then planted in deep

bouillon tubes (20c.c. to the tube) and incubated at 37 C. for seven to fourteen days. This lot was unchanged at the end of this time save for one tube, which had been contaminated with some mould.

Test 2.—The above test was repeated with four other short pieces of catgut and after two weeks incubation only one tube was clouded. Stains and animal inoculations from this tube were negative.

From the results of these experiments I felt perfectly safe in using the catgut prepared according to this method, perhaps more so since for some years I had been using at the University Hospital practically the same catgut with the best results.

Before the development of symptoms of tetanus in the case reported the catgut had been used in quite a number of cases with the most satisfactory results, all the wounds healing by primary union and the convalescence in each case being uninterrupted.

I fear that many operators who report cases of tetanus following clean operations have fallen into the same error as did I in their attempts to absolve the catgut from any part in the causation of the disease. At first sight it seems reasonable to say it could not have been the catgut because the same material was employed in other cases with no bad results. Kuhn, however, has shown the fallacy of such an argument. He asserts that catgut is made from the intestines of sheep which exist under different conditions and vary much in health. Every catgut thread contains fibers from four or five different sheep. Just one of these fibers may contain the tetanus bacillus, while the others may be free from this particular germ. He goes on to say that the sanitary conditions in the slaughter-houses and factories from which the catgut comes are notoriously bad, exposing the raw material to all kinds of contamination. Experimentally it has been shown that it is most difficult for a sterilizing fluid to reach the interior of a catgut thread where many germs may lie. In order to insure absolute safety and do away with the possibility of postoperative tetanus, where catgut is to be used, the latter material must be taken from animals in perfect health. It must be prepared under the most hygienic conditions. Then the elementary threads should be tested for the tetanus bacillus and those found free of these organisms should be made into catgut which can be sterilized according to the most approved method.

Sterilization of catgut by boiling, while better than the use of chemical solutions, because of the possibility that the latter may not penetrate every portion of the catgut strand, has never been popular because of the difficulty of boiling the gut without destroying its integrity. It must be remembered, as pointed out by Theobald Smith, that under certain conditions, such as the formation of a pellicle or membrane over the surface of the boiled fluid, spores of anaërobic bacteria, such as the tetanus bacillus, resist repeated steamings for twenty minutes regularly, usually for forty minutes and occasionally for sixty minutes. Possibly the tests which have been employed to ascertain the asepticity of catgut, while applicable to the ordinary pathogenic bacteria, contain a source of error when used for anaërobic bacteria, like the tetanus bacillus. Are not we satisfied if the test-tubes without anaërobic conditions fail to show any growths? Implanted in the tissues, the tetanus spores, which have not been killed by the sterilization employed, develop under these anaërobic conditions and tetanic symptoms result.

Smith further on in the same article makes these statements, which are of special interest to the practical surgeon

The great resistance of tetanus spores concerns both the practicing physician and surgeon and the laboratory worker who is engaged in the preparation of biologic products for subcutaneous administration. As regards the surgeon, I do not believe that the usual disinfection by boiling or steaming at 100 C. such as may be resorted to away from the hospitals need be placed under suspicion or discarded, but whatever has come in contact with fecal matter or with material undergoing putrefaction should be autoclaved at 110 C. to 115 C. unless the disinfective action of the boiling water in which objects are immersed is increased by alkalies and other substances.

In view of the extensive use of catgut in all kinds of surgical operations, it is of the utmost importance that the question of production of postoperative tetanus through its means be thoroughly investigated and discussed. While convinced that the postoperative course of my surgical cases is much smoother since the employment of the absorbable ligature, I would give it up at once were I convinced that my patients are liable to such a deadly infection as tetanus. One experience is enough to satisfy the most callous surgeon.

Recently Richardson has reported two cases of tetanus following operations for gallstones and for strangulated omental hernia. He has collected notes of 21 such cases in which tetanus followed a surgical operation, 20 occurring during the past three and a half years. In all these 21 cases catgut was employed, and in all except 2 the peritoneal cavity was opened. The operations were performed in Great Britain and 18 of the 21 patients died. The catgut used at the operations was examined bacteriologically in 14 cases, but these examinations were incomplete and Richardson thinks that it has not been proved that the catgut was the source of the infection. We are more interested in the number of cases Richardson has collected than in his rather fantastic suggestion that the disease from which the 18 patients died was not tetanus at all, but one of the sheep diseases, the patient being the host of the bacillus at the time of the operation. Richardson seems to base his entire argument on the geographical distribution of the cases and admits that if cases of postoperative tetanus developed in the south of England, where "looping-ill," the disease in question, does not exist, then his whole argument fails. While his argument does fail, for a search through the literature shows a wide distribution of the cases, shattering the geographical explanation of the infection beyond a shadow of a doubt, we should be under great obligation to Richardson for his collection of cases and his courage in showing this complication to be so common in Great Britain.

As an aid to the study of the various aspects of the question of postoperative tetanus, I have collected from the literature some 150 cases of tetanus following operations, in the main of a gynecologic nature. A few operations, like splenectomy, appendicitis, nephrotomy and hernia, operations which the gynecologist may be called on to do, no matter how strictly he may follow the lines of his specialty, have been included in the list. Excluding traumatic tetanus, many more cases could have been added, if general surgical operations had been included.

These 150 cases have been divided into two groups; the first, Table 1, numbering 101 cases which had occurred up to and inclusive of the year 1890; the second, Table 2, comprising 49 cases reported since 1890. Richardson's two cases were included in this last group, the other 19 cases reported by Richardson being unavailable for statistical purposes because of insufficient data. The lack of references in his article implies that the records

of the 19 cases had been obtained through correspondence. If this be true, it would bring the total number of cases of postoperative tetanus since 1890 up to 70, it being remembered that these were largely abdominal and gynecologic cases, general surgical operations having been excluded.

The year 1890 has been chosen as the dividing line between the two groups, for the reasons that Phillips collected up to this date, through private correspondence and from the literature, 64 reports of cases of tetanus following ovariectomy, and because 1890 is a good date to separate the preantiseptic and antiseptic eras. For,

TABLE 1.—101 CASES OF POSTOPERATIVE TETANUS UP TO AND INCLUDING THE YEAR 1890

A. OPERATIONS INVOLVING THE OPENING OF THE PERITONEAL CAVITY			
Operation.	No. Cases.	Recovery	Death.
Herniotomy	11	0	11
Hysterectomy for fibroid	1	0	1
Myomectomy	1	0	1
Oophorectomy	2	0	2
Ovariectomy	63	5	58
Vaginal hysterectomy	1	0	1
Total	79	5	74
B. OPERATIONS IN WHICH THE PERITONEAL CAVITY WAS NOT OPENED			
Operation.	No. Cases.	Recovery	Death.
Excision of breast	11	2	9
Hydrocele	3	1	2
Operations on cervix	4	2	2
Perineorrhaphy for prolapse	1	0	1
Perineorrhaphy for complete tear	1	0	1
Prolapse of rectum	1	0	1
Uterine polyp	1	0	1
Total	22	5	17
Total number of operations 101.			
Recoveries, 10; 9.9 per cent.			
Deaths, 91; 90.09 per cent.			

TABLE 2.—FORTY-NINE CASES OF POSTOPERATIVE TETANUS OCCURRING AFTER THE YEAR 1890

A. OPERATIONS INVOLVING THE OPENING OF THE PERITONEAL CAVITY			
Operation.	No. Cases.	Recovery	Death.
Alexander	2	1	1
Alexander and perineorrhaphy	2	1	1
Appendicitis	3	1	2
Colectomy	1	0	1
Herniotomy	4	1	3
Hysterectomy	10	1	9
Myomectomy	1	0	1
Ovariectomy	2	0	2
Removal of appendages	3	0	3
Removal of gall-stones	1	0	1
Splenectomy	1	0	1
Tuberculous peritonitis	1	1	0
Vaginal fixation	1	0	1
Vaginal fixation and trachelorrhaphy	1	0	1
Vaginal hysterectomy	4	0	4
Ventral hernia	1	0	1
Ventro-fixation	2	0	2
Total	40	6	34
B. OPERATIONS IN WHICH THE PERITONEAL CAVITY WAS NOT OPENED			
Operation.	No. Cases.	Recovery	Death.
Amputation of cervix and perineorrhaphy	1	1	0
Epithelioma of vulva	1	0	1
Hemorrhoids	2	0	2
Lumbar nephrotomy	1	0	1
Nephropexy	1	0	1
Removal of uterine polyp	1	0	1
Trachelorrhaphy and perineorrhaphy	1	0	1
Varicocele	1	0	1
Total	9	1	8
Total number of operations, 49.			
Recoveries, 7; 14.28 per cent.			
Deaths, 42; 85.71 per cent.			

while antisepsis had been proved to be correct in principle years before, it certainly was not generally adopted by surgeons until about this year. Furthermore, it was in 1889 that Kitasato first isolated the tetanus bacillus in pure culture and studied its biologic characters.

Before 1890, outside of the mere preparation of suture material, there were many more chances for the introduction of the tetanus bacillus into the wound than after that date, when more rational means were employed to sterilize extraneous objects. Hence only the forty-nine cases collected since 1890 were studied with reference to the suture material. The information collected was very meager and unsatisfactory. The suture material

employed was mentioned in only nineteen cases: Bissell (2); Chavannoz, Coe (2); Dorsett (2); Hammond, Jerie, Koch, Martin, Meyer, Penrose, Richardson (2); Shaw, Thompson, Zacharias (21). From these cases I find that there was used:

Catgut alone	3 cases
Catgut and kangaroo tendon	2 cases
Catgut, silk, silkworm gut or silver wire in combination	8 cases
Silk alone	4 cases
Silkworm gut alone	1 case
Silk with silver wire	1 case

In only two or three of these cases are definite statements made as to the preparation of the catgut, so we are at a loss to determine whether a possible source of error lay in such preparation. That the infection is not

TABLE 3.—CASES SINCE 1890 IN WHICH ATTEMPTS WERE MADE TO ISOLATE THE TETANUS BACILLUS AND RESULTS *

No. of Case.	Where Found.	Attempts Made.	Failure.	Success.	Recovery.	Day of Death.
20	Silver suture.	1	Yes	...	...	2
55	Pus from stump (1); Pus from stump where mouse was inoculated (2).	2	Yes	...	...	2
83	Pus from abdominal wound.	1	...	Yes	...	25
45	Wound.	1	...	Yes	...	2
48	Pus from abscess in paravaginal wound; secretion from wound with catgut sutures; cerebrospinal fluid; piece of skin from edge of wound.	1	Yes	...	...	16
59	Pus from abscess found in pelvis.	1	...	Yes (?)	...	2
67	Serum from below sutured skin of wound.	1	Yes	...	Yes	...
12	Not stated.	1	Yes	...	...	3
130	Not stated.	1	Yes	...	...	†
52	Not stated.	1	...	Yes	...	12
89	Not stated.	1	Yes	...	...	†
82	Not stated.	1	Yes	...	...	2
102	Secretion from seat of ulcer.	1	Yes	...	...	2
27	Area of subcutaneous tissue from scab on skin under left scapula.	1	...	Yes	...	3
28	Pus from wound (1); Kangaroo tendons (2); catgut (3).	3	Yes (3)	Yes (1,2)	...	3
87	Unused catgut.	1	Yes	...	...	2
80	Serum from blister in wound.	1	Yes	...	Yes	..
31	Blood from finger (1); Arachnoid fluid (2).	1	...	Yes	...	3
36	One stitch.	1	Yes	...	...	2
22	Blood suture materials and dressings.	1	Yes	...	...	20
23	Blood and vaginal discharges; suture material and dressings.	1	Yes	...	...	2

* The number in column "No. of Case" refers to the number of the case in the appended bibliography.

† Not stated.

due to catgut in all cases is proved by postoperative tetanus in 6 cases in which silk or silkworm gut was either used alone or in combination with silver wire. A former Chairman of this Section, Dr. Dorsett, has given by far the most satisfactory report of his two cases of postoperative tetanus. His two patients died from this complication after the uterus had been sutured to the abdominal wall in each instance by kangaroo tendon sutures prepared by one of the best known manufacturing firms of this country. By inoculation into mice, the kangaroo tendon was proved to be infected with the tetanus bacillus.

Koch was able to prove that the catgut employed was the agent through which the infection arose. While he was unable to find the tetanus bacillus or its spores within the gut, mice inoculated with the gut died of

tetanus. Chavannoz, Hammond, Coe, Richardson and Zacharias made either cultures of or inoculations with the suture material with negative results.

There were only two recoveries in the 19 cases just referred to (Meyer, Zacharias). This is of no special significance, since it is about the average of recoveries (10 per cent.) after this most fatal complication of surgical operations. The difficulties of adequate bacteriologic examination of suture material after the advent of the disease will always be great. Just as in my own case, the wound may have healed by primary union and the catgut either be absorbed or difficult to get at. The tetanus is not a rapidly multiplying organism and it is exceedingly difficult to isolate it after the infection has taken place. This applies to the bacilli and the spores in the catgut as well as to the same organisms in or about the wound.

RELATION OF THE NATURE OF THE OPERATION TO POST-OPERATIVE TETANUS

A study of Tables 1 and 2 will show that the complication is more frequent after operations involving the opening of the peritoneal cavity. Up to 1890 there were 63 cases of ovariectomy followed by tetanus, with 58 deaths and 5 recoveries. Thus this accident followed ovariectomy in over one-half of the cases recorded for this period, while since 1890 only two cases of ovariectomy were followed by tetanus. There would seem to be only one explanation of this decrease, namely, improvement of technic whereby more tetanus bacilli were kept out of the abdominal cavity during the second period. One can not study the reported cases without becoming convinced that, considering the many thousand of abdominal operations, postoperative tetanus is a very rare

TABLE 4.—98 CASES OF POSTOPERATIVE TETANUS OCCURRING UP TO AND INCLUSIVE OF YEAR 1890
WITH SPECIAL REFERENCE TO THE ONSET AND ITS RELATION TO THE OUTCOME OF THE DISEASE

WITH SPECIAL REFERENCE TO THE ONSET AND ITS RELATION TO THE OUTCOME OF THE DISEASE																		
Day of onset after operation.	No. of Cases.	Recovery.	Deaths	Day of death.														
				1	2	3	4	5	6	7	8	10	11	13	20			
1	0	0	0	Not stated, 1
2	0	0	0	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	3	1	2	..	2	..	..	..	..	..	..	..	..	..	..	..	..
4	4	0	4	..	3	..	..	..	..	..	..	..	..	..	..	..	..
5	6	1	5	2	3	..	..	..	..	..	..	..	..	..	..	..	..
6	9	1	8	4	2	2	..	..	..	..	..	..	..	..	..	..	..
7	18	0	18	3	10	5	..	..	..	..	..	..	..	..	..	..	..
8	10	0	10	3	4	2	..	..	..	1	..	..	..	..	..	..	..
9	9	0	9	..	1	5	3	..	..	..	..	..	..	..	..	..	..
10	5	0	5	..	1	2	1	..	..	..	..	1	..	..	..	..	..
11	3	0	3	..	1	1	..	..	..	1	..	..	..	..	..	..	..
12	5	0	5	1	2	2	..	..	..	..	..	..	..	..	..	..	..
13	6	1	5	..	..	1	..	1	..	..	1	..	..	1	..	..	Not stated, 1
14	5	1	4	..	..	..	1	..	..	1	..	1	..	..	..	..	Not stated, 1
10-15	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
15	3	1	2	..	..	1	..	..	..	1	..	..	..	..	..	..	..
16	2	1	1	..	..	..	..	..	..	..	1	..	..	..	..	..	..
17	4	0	4	..	1	..	1	..	1	..	..	..	..	..	..	1	..
20	1	0	1	..	..	..	..	1	..	..	..	..	..	..	..	..	..
21	1	0	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..
22	2	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5th week	1	0	1	..	..	..	..	..	..	..	..	..	1	..	..	..	..
	98	10	88															

TABLE 5.—49 CASES OF POSTOPERATIVE TETANUS AFTER 1890
WITH SPECIAL REFERENCE TO THE ONSET AND ITS RELATION TO THE OUTCOME OF THE DISEASE

Day of onset after operation.	No. of Cases.	Recovery.	Deaths	Day of death.											
				1	2	3	4	5	7	8	12	16	20	25	
1	0	0	0	..	..	..	..	..	..	..	..	..	..	..
2	0	0	0	..	..	..	..	..	..	..	..	..	..	..
3	0	0	0	..	..	..	..	..	..	..	..	..	..	..
4	2	0	2	1	..	1	..	..	..	..	..	..	..	..
5	3	0	3	..	3	..	..	..	..	..	..	..	..	..
6	7	0	7	..	4	1	1	..	..	..	..	..	..	..	Not stated, 1
7	5	0	5	..	3	1	1	..	..	..	..	..	..	..
8	5	1	4	1	2	..	..	..	1	..	..	..	..	..
9	11	0	11	2	3	2	1	1	..	..	1	..	..	..	Not stated, 1
10	6	2	4	..	3	..	..	..	..	..	..	..	..	1	
11	2	0	2	..	..	1	..	..	1	..	..	..	..	..
12	3	2	1	..	..	..	..	..	..	..	..	1	..	..
13	1	0	1	..	..	..	..	..	..	1	..	..	..	..
14	1	0	1	1	..	..	..	..	..	..	..	..	..	..
16	1	0	1	..	..	..	..	..	..	..	..	..	1	..	
19	1	1	..	..	..	..	..	..	..	..	..	..	..	..
22	1	1	..	..	..	..	..	..	..	..	..	..	..	..
	49	7	42												

Certainly Richardson's cases, in all of which catgut was employed as a ligature, are very suggestive as to the possibility, at least, of infection through this source. My own case, in which with the same technic a change in the method of preparing the catgut was almost immediately followed by a case of tetanus, is also very suggestive. While the case is not proved, enough evidence has been advanced to make the surgeon more careful than ever as to the asepticity of his absorbable ligature. Certainly it is much easier to render other objects sterile than it is catgut. While it is possible for the infection to be carried to the wound or into the patient's body through some other avenue, in some other way, one has to admit that it is not so probable. Air, dust, water, carious teeth, the patient's skin and other sources of infection have been invoked as carriers by the different authors, but their theories have added little to our exact knowledge of the question.

complication. Modern abdominal surgery exacts such good results from the surgeon, however, that he finds but little consolation from the improvement of general statistics, if he be so unfortunate as to have a case of postoperative tetanus in his own practice. As will be seen by the tables, almost every gynecologic operation has been followed by tetanus. The complication more frequently followed operations involving the opening of the peritoneal cavity. But this is also true of any infection. The variety of abdominal operations followed by tetanus has naturally increased since 1890, on account of the development of new operations since that date. But the ratio between the cases of infection in the peritoneal and non-peritoneal operations is about the same before and after 1890. The natural inference is that since tetanus is a complication of nearly every kind of gynecologic operation the nature of the operation is not a determining factor in its production.

PERIOD OF INCUBATION OF POSTOPERATIVE TETANUS

Lambert, in speaking of tetanus in general, states that the prognosis is "in direct ratio to the shortness of the incubation period and to the rapidity and intensity of the symptoms." In Table 4, 98 cases have been tabulated according to the onset of the symptoms, the outcome of the cases and the day of death in relation to the day of onset. No patient in this tabulated list received antitoxin, so it serves as a basis of comparison between the value of the two modes of treatment, when antitoxin is administered after the onset of symptoms. Table 4 shows that in 64 out of 98 cases, or in practically two-thirds, the initial symptoms were within the first ten days. In the remaining 34 cases, the onset of the disease varied from the eleventh to the twenty-second day. There was one anomalous case in which there was a five weeks' incubation period, but such cases are unusual and always open to suspicion.

In Table 5, or in the 49 cases after 1890, there were 39 in which the first symptoms appeared within the ten-day period, or practically four-fifths of the cases, figures corresponding to Joseph Jones' statistics as given by Osler. In the remaining ten cases the initial symptoms are recorded as appearing from the eleventh to the twenty-second day.

RELATION OF ONSET OF SYMPTOMS TO DAY OF DEATH

This is irrespective of the treatment administered, although again it must not be forgotten that no antitoxin was administered prior to 1890. Looking at the cases starting within the first ten days, as tabulated in Table 4, we see that up to the ninth day in 50 out of the 98 cases, the patients died on or before the third day. After the tenth day there was not one patient out of the 48 who died on the first day of the disease, the deaths being scattered from the second to the twentieth day. Practically about the same showing is made in the cases occurring after 1890, Table 5. Up to the tenth day the patients died quickly, only a few living beyond the fourth day of the disease. Those with a longer incubation period lived the longest, one even living to the twenty-fifth day. Thus these tables would seem to bear out the claims of various writers, that the shorter the incubation period the more virulent and active is the disease, and, conversely, the longer the period of incubation the milder the disease, or the longer can the patient survive before a fatal issue.

Not a single case of tetanus developed during the first two days after the operation, and in Table 2 no case appeared until the fourth day. In the 98 cases occurring before the year 1890 the maximum number of cases (18) is recorded as developing on the seventh day, while in the 49 later cases the greatest number (11) developed on the ninth day.

TREATMENT

The treatment of tetanus may be summarized briefly as follows:

1. By proper disinfection and drainage at the point of entrance of the tetanus bacilli, we should prevent, as far as possible, further development of bacteria and the absorption of the elaborated toxins.

2. The toxins in the blood which have not united with the nerve cells should be neutralized and rendered inert by the administration of antitetanic serum.

3. The muscular spasms should be controlled by some antispasmodic.

4. Elimination of the poison already absorbed is best obtained by free catharsis and the administration of large quantities of physiologic salt solution.

1. *Disinfection and Drainage.*—As has been pointed out, this is much more difficult as a rule in postoperative than in traumatic tetanus. The tetanus bacilli may have been implanted on the peritoneum, or may be in the ligature with which a pedicle was tied. There may be no evidence, as far as the wound is concerned, that tetanus bacilli or their spores are present. In many instances it would be obviously jumping in the dark to open up the wound and drain. Yet when the latter suppurates or the proper indications exist, disinfection and drainage should be employed in postoperative as well as traumatic tetanus.

For example, in the case reported, it would have been foolish to reopen the wound, which practically had healed by primary union, when it was not at all certain where the infection had entered. If the wound had suppurated, however, the indications would have been for its early opening, disinfection and drainage.

TABLE 6.—49 CASES OF POSTOPERATIVE TETANUS AFTER 1890

SHOWING EFFECTS OF ADMINISTRATION OF ANTITETANIC SERUM

Day of onset after operation.	No. of cases.	No. of cases having anti-tetanic serum.	Recovery.	Death.	No. of cases not having anti-tetanic serum.	Recovery.	Death.
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	2	1	0	1	1	0	1
5	3	2	0	2	1	0	1
6	7	3	0	3	4	0	1
7	5	4	0	4	1	0	1
8	5	4	1	3	1	0	1
9	11	9	0	9	2	0	2
10	6	6	2	4	0	0	0
11	2	2	0	2	0	0	0
12	3	3	2	1	0	0	0
13	1	1	0	1	0	0	0
14	1	0	0	0	1	0	1
16	1	1	0	1	0	0	0
19	1	1	1	0	0	0	0
22	1	1	1	..	..	..	..
	49	38	7	31	11	0	11

TABLE 7.—TIME OF BEGINNING OF TREATMENT BY ANTITOXIN IN 34 CASES

SHOWING RECOVERIES AND DEATHS

Day of beginning antitoxin treatment after onset of tetanus.	No. of cases.	Recovery.	Death.
1	24	5	19
2	6	1	5
3	2	1	..
5	1	..	1
7	1	..	1

In 6 cases in which the patients recovered the tetanic symptoms appeared on the tenth day after the operation or later.

2. *Administration of Antitetanic Serum.*—It seems to be pretty well established that after the toxins have become fixed in the nerve cells, the administration of antitetanic serum has but little influence on the course of the disease. The injury has already been accomplished and the most that the serum can do is to prevent further combination with the nerve cells. For this purpose and because its proper administration is harmless, it should be given in every case, immediately on the onset of symptoms. Inasmuch as postoperative tetanus is never anticipated, the prophylactic use of the serum has no place in the class of cases under discussion. A comparison of Table 1, in which 101 patients were treated without the antitetanic serum, with Table 6, in which 38 patients out of the 49 were treated with the serum, shows a diminution of the mortality under the use of the serum from 90.09 per cent. to 81.58 per cent. This is not much of a showing; still it is a decided gain. In the 11 cases in which no serum was employed, there was not a single recovery. The good results of the serum may have been due partly to the fact (Table 7) that in 24 of the 38 cases, its administration was begun on the first day of

the appearance of the symptoms. On the other hand, in 6 cases in which the administration was begun on the second day there was only one recovery.

It must not be forgotten, however, that whenever we consider the efficacy of any particular form of treatment we must also consider the severity of the symptoms in the cases under treatment. Thus, the good results may not have been so much due to the antitoxin as to the fact that the cases were of a mild type and the patient might have recovered under any form of treatment. Hence the significance of the note at the bottom of Table 7, which states that in six of the seven patients recovering, the tetanic symptoms appeared on the tenth day after the operation or later.

3. Control of Muscular Rigidity and Spasms by the Use of Antispasmodics.—The list of drugs used for this purpose is large and has not been particularly satisfactory. Opium, chloral hydrate, the bromids, calabar bean, chloroform, etc., have each been tried with varying success. The objections to the use of many of these drugs are that, while they partially control the spasms, they prevent elimination and deprive us of a most necessary form of treatment.

The subarachnoid injections of magnesium sulphate, as first suggested by Meltzer, undoubtedly control the spasms, but respiration is so inhibited at the same time as to make it questionable whether the treatment may not prove worse than the disease.

As regards the use of chloretone, I can only say that it has proved most efficacious in the hands of Dr. Hutchings, who has absolutely controlled the spasms in six cases, while as far as could be judged no bad symptoms developed from the use of the drug. Certainly the effect of chloretone in the case reported above was most satisfactory. The muscular spasms were absolutely controlled after two sixty-grain doses and the muscular rigidity practically abolished. At least, since the drug is harmless, chloretone is worthy of an extensive trial in tetanus and other spasmodic conditions.

4. Elimination Through Free Catharsis and the Use of Salt Solution.—The elimination of the poisons in the body is especially demanded in a disease like tetanus. The tissues may interfere with the administration of cathartics, but in that case they may be introduced through the stomach-tube, after the relaxation has been accomplished through chloretone. Fortunately salt solution can always be administered, either intravenously, subcutaneously or per rectum, the method being determined by the condition of the patient.

CONCLUSIONS

1. While tetanus can not be said to be a very frequent postoperative complication, a study of the reported cases shows it does occasionally follow all kinds of gynecologic operations.

2. It most frequently is a complication of operations involving the opening of the peritoneal cavity, although in quite a percentage of cases it complicates plastic and other non-peritoneal operations.

3. The infection in all probability is introduced at the time of operation.

4. It has been proved that the tetanus bacillus and its spores are most difficult to kill, and that under certain circumstances they survive boiling for sixty minutes; hence when this organism is present more than ordinary heat, applied over a longer time, is necessary.

5. Absorbable ligatures, like catgut, may be carriers of the infection, unless the most approved methods of sterilization be employed.

6. The process of manufacture of the catgut renders it peculiarly liable to infection by the tetanus bacillus, which may not be destroyed by the ordinary methods of chemical sterilization.

7. The initial symptoms of postoperative tetanus appear within ten days in from two-thirds to four-fifths of the cases. The onset of symptoms in the remaining cases varies from the eleventh to the twenty-second day after the operation.

8. In the 150 cases tabulated no case showed symptoms of tetanus the first two days after the operations.

9. From a study of these cases it would seem that the average period of incubation for postoperative tetanus was about eight days.

10. The shorter the incubation period the more virulent and active the disease, and, conversely, the longer the incubation the milder the disease or the longer is it possible for the patient to survive before a fatal issue.

11. Whenever possible the point of entrance of the tetanus bacilli should be ascertained and the proper disinfection and drainage be instituted. This is often difficult in cases of postoperative tetanus.

12. Antitetanic serum acts on the free toxins in the blood, but has no effect on the toxins after they have become fixed in the nerve cells.

13. A study of the tables shows that the mortality of tetanus has been reduced nearly 10 per cent. through the use of the antitetanic serum.

14. The best effects of the serum will be seen when its administration is begun on the first appearance of the symptoms of the disease.

15. Chloretone is able to control the muscular spasms of tetanus and to do away with the muscular rigidity. It is harmless and does not prevent elimination.

16. In tetanus, elimination through free catharsis and the administration of salt solution is of the utmost importance.

620 Forest Avenue.

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ABSTRACT OF DISCUSSION

Dr. W. B. DORSETT, St. Louis: In the consideration of this subject, whether it is kangaroo tendon or catgut, we ought to consider the size of the material used; for any size above No. 3 is liable to have in the center of the strand the infectious material. In other words, the manufacturer of this gut will admit that it is harder to sterilize a large strand than a small strand. Experiments have been made in which the gut has been suspended in anilin dye and sections taken showed that the anilin dye does not always penetrate to the center. The unfortunate cases that I have had prove rather conclusively that the infection did not occur from the catgut that was used, but from the kangaroo tendon. This was of a large size and the postmortem showed that it contained the tetanus bacillus and the spores. At that time I had quite a supply of suture material that I had obtained from the manufacturers. Immediately after a second case occurred I telegraphed them to call in all the gut that they had sent out and that the kangaroo was probably infected. I got no response until the agent came to St. Louis for the purpose of disposing of his material and he then found that it was not wanted in the instrument houses. Chlorotone is new to me. The antitetanic serum in my opinion should be used as a prophylactic rather than as a remedy after the disease has once shown itself. So much impressed have been some of my friends who do general surgery with the use of antitetanic serum, that as soon as a punctured wound is discovered in persons working about stables or coming in close contact with street dirt, the serum is used as a prophylactic before anything else is done. In my two cases it had no effect as it was not used in time, and the chloroform was used simply to control the spasms.

Dr. RALPH WALDO, New York: I have seen four of these cases. Three followed abdominal operations. The material used as suture and ligature was catgut of rather large size for the adnexa which were removed. In one case a large ovarian tumor was removed. The more superficial portions of the wound were closed with silkworm gut. Whether the infection was due to the fact that the catgut was of rather large size I am unable to say. In two of these cases I performed several operations in the same operating-room at the same hour with the same assistants and using the same material. From the tenth to the twelfth day the first slight symptom appeared in the neck. No notice was taken of it until about the thirteenth or fourteenth day. The most exhaustive bacteriologic examinations were made of the catgut and everything else possible with a negative result. I speak now of three of the cases. I went very carefully into the serum question and became thoroughly convinced that if the serum was given after the disease had developed it was useless in a very large percentage of cases. My laboratory friends had used it in guinea-pigs and found that if it were used as a prophylactic the disease was prevented. If it were used after the symptoms developed, as much serum were required as the guinea-pig weighed in order to counteract the toxin. For this reason its use was impracticable. In another case a patient with uterine hemorrhage was given a hypodermic of ergot supposed to be sterile. She was brought to the hospital in the ambulance and later developed tetanus. We found a little bleb where the hypodermic had been given. This was opened and found to be full of the germs of tetanus, proving that the disease was caused by the hypodermic, whether the germ was on the skin or on the needle no one knows. In three other cases we were absolutely unable to determine anything concerning the entrance of the germs.

Dr. W. H. HUTCHINGS, Detroit: The question of post-operative tetanus is so large that it cannot be given full consideration in the time at our disposal. However, I desire to call attention to the fact that surgeons, when anything goes wrong, are altogether too ready to blame catgut. They forget that catgut can be sterilized, no matter how large it is, and forget that the patient's skin and their own hands are not so easily made sterile. There are undoubtedly cases in which the catgut has been the cause of tetanus and quite as many cases in which the catgut has been sterile, and cases in which catgut was not used at all. Unfortunately, Dr. Peterson had no cultures made, so we do not know whether his cases were

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those of tetanus or not. The question of treatment is a very important one. As Dr. Peterson says, the mortality is about 80 per cent. It has been lowered somewhat. For several years I have been conducting a series of experiments on sheep to study the methods of treatment that have won any recognized place. An important statement was made in a paper by Dr. Matas, at the recent meeting of the American Surgical Association, calling attention to the fact that often tetanus spores are taken into the body with salads and fruits, and eliminated in the feces, and that a large percentage of post-operative tetanus is found in cases in which the parts have been contaminated in that way; notably in the operation with clamp and cautery in hemorrhoids. I have become convinced that the best way to control the manifestations of the disease is by the use of chloretone. For the cure of the disease we must remove the source of the manufacture of the toxins. The toxins in the body are better neutralized by the antitoxin if it is used intravenously, though the antitoxin has no effect whatever if the toxins are already in contact with the nerve cells. The first problem is to keep the patient alive until the toxins can be overcome. I have treated six tetanus patients with chloretone for the control of the convulsions and have cured five of them. One was a case of abortion induced by curettement in which tetanus developed in six days. One case was a Fourth-of-July accident. Another case was that of a man who had a severe crushing injury to the hand. Several operations were done but the flaps sloughed and tetanus developed. Another case developed from fracture of the elbow. The man could not swallow. The serum was given and he was also given large doses of chloretone. He was so completely relaxed that all one night a nurse had to sit by the bed to hold his jaw forward so that he could breathe. Chloroform kills by paralysis of the center of respiration. Chloretone will control the convulsions, but that is all it will do. It is comparatively harmless. In one case a man took a large dose with suicidal intent. He slept for a week, woke up, and said he felt perfectly well.

DR. H. J. BOLDT, New York City: I have been unfortunate enough to lose two patients as the result of tetanus. An examination of the catgut gave a negative result. Then I had some catgut from the same manufactory infected with tetanus and anthrax bacilli. The catgut was untwisted and the infection made in the center of the gut, which was No. 3. The tubes were sealed in the presence of the bacteriologist. The manufacturer then put them through the same process as all the other catgut underwent, and it was then returned to our bacteriologist. A careful examination was made and it was found to be absolutely sterile. So that settles the question that my patients did not die from infection in the catgut. One case was a large ovarian tumor; the other a large fibromatous uterus.

DR. W. H. HUTCHINGS: Regarding the work of Wassermann, I should like to call attention to the fact that Villard has reported thirty-one cases of undoubted tetanus following the prophylactic use of serum.

DR. C. C. FREDERICK, Buffalo: I want to report a case of postoperative tetanus, the only one I ever had, which occurred in my hospital last September. It was a perfectly clean case of myofibroma for which I did supravaginal hysterectomy, the wound closing by primary union. The patient developed tetanus on the sixteenth day. I was doing a lot of work at the time. I have continued to use the catgut prepared by the iodine method. I operated on three patients on the same day that this woman was operated on and the others did not develop tetanus. I suppose that my catgut might have been the cause, though I doubt it very much. This patient did not develop tetanus until the sixteenth day after operation. The largest catgut used was No. 2. About five days prior to the beginning of the tetanus the woman had an attack of acute indigestion with diarrhea, furred tongue, elevation of temperature, etc. After two days with catharsis and withholding of food she recovered. The woman was very fond of fruits and vegetables. The attack occurred in September at a time when she was eating a great many of these things, and I have an idea that she was infected from the intestinal tract.

DR. REUBEN PETERSON, Ann Arbor: In the time permitted I could only read my paper in abstract. About everything

brought out in the discussion appears in the body of the paper and I would refer those interested to the paper itself. I am not trying to prove anything at all. I would much rather not have it proved that catgut is the source of infection. After a period of seven or eight years with the use of one catgut I changed to another sterilized by a different method and this case of tetanus developed. That is enough proof for me so far as my own surgical practice is concerned. It is difficult to prove that the catgut is at fault. It has been shown that only one fiber of the catgut need be infected. Such infection cannot be very common, because if it were, we would get all sorts of infections throughout the world when so much catgut is being used. If I have pointed out the possibility of tetanus following clean operative cases and shown the importance of careful supervision of the sterilization of catgut, I shall have accomplished my purpose. Of course we know the value of the serum as a prophylactic measure, but it must be remembered that we do not give all our operative patients antitetanic serum lest they have tetanus. The serum does neutralize the toxins as Dr. Hutchins has pointed out, and therefore should be used in the treatment in every case. Very seldom, I think, does tetanus develop from infection on the hands. If we look at the different methods of sterilization of hands, instruments and of all materials connected with the operation and see how few cases of tetanus develop, it must be very rarely that the source of infection is there. However, the infection is much more common than one thinks, as evidenced by the twenty cases of Richardson and the fifty cases since 1890 which I have collected. Chloretone, of course, is used merely as an antispasmodic, and is much safer and more effective than chloral or other drugs which have hitherto been employed. It acts so beautifully in relaxing the muscular spasm that I would advise any one so unfortunate as to have a case of tetanus, postoperative or otherwise, to give it a fair trial. It was extremely gratifying to note the relaxation of the muscles and the ability of the patient to open her jaws, following a dose of 50 grs. of chloretone.

CAUSES OF FAILURE IN THE TREATMENT OF CANCER OF THE LIP

EDMUND A. BABLER, M.D.

Assistant Surgeon, Deaconess Hospital
ST. LOUIS

The frequency with which recurrent and far-advanced cases of lip cancer have of late come to my notice has induced me to study the causes of failure in the treatment of lip cancer and to present the principal findings in this short paper, trusting that some fact might be brought forward which would impress on the profession the importance of early recognition and radical excision of the disease. I am confident that in many cases the patient's refusal to accept the advice of the medical attendant is responsible for the distressing results; in a few cases the disease is not recognized until a mutilating operation is necessary, while in other instances the surgeon has limited the operation to mere excision of the palpable growth. The secret of success in the treatment of lip cancer lies (1) in early recognition of the disease—recognition before the glands are palpably enlarged—and (2) in excision of the lymphatic glands and periglandular tissue of both sides of the neck, together with the primary growth.

In many of the early cases the treatment advocated will seem somewhat too radical. Experience, however, has demonstrated that the size of the ulcer can never be trusted to indicate the degree of spread in the parts beneath. It is equally true that the glands of the neck may be enlarged and yet not contain cancer cells. Wartmann found infection of the lymph glands in eighty-four