CICATRICAL STENOSIS AND VALVE FORMATION AS A CAUSE OF PYLORIC OBSTRUCTION, WITH A REPORT OF FIVE CASES RELIEVED BY OPERATION.

Presented to the Section on Surgery and Anatomy, at the Forty-eighth Annual Meeting of the American Medical Association, held at Philadelphia, June 1-4, 1897.

BY W. J. MAYO, M.D.

SURGEON TO ST. MARY'S HOSPITAL,
ROCHESTER, MINN.

Non-malignant forms of pyloric obstruction are not infrequent and have, I believe, been commonly confused with cancerous disease and, with some exceptions, allowed to die without surgical intervention.

When the stenosis results from the cicatrization of an ulcer which had existed years previously the patient may be in middle life or later before the obstruction becomes marked and the cachexia of chronic starvation closely simulates that of malignant disease.

Now and then cases operated upon by such masters as Senn, Lange, Weir and others have appeared in American literature. European operators have been more advanced in this respect and have furnished many important contributions to the subject.

Stricture of the pylorus following upon the healing of gastric ulcer is the most common form of non-malignant obstruction and four out of five cases upon which I have operated have been of this variety. The site of previous ulceration in these cases was along the lesser curvature and anterior surface of the stomach, and in two the cicatrix was very extensive, a prolongation extending downward in the the pyloric region and causing great distortion of the canal. In two of the remaining cases the strictured area was narrow and circular in form, one with its origin in a cicatrix along the anterior wall and the other having no apparent cause. In these two cases the dilatation of the stomach was extreme, although the mechanical obstacles to its emptying were not so great as in the three cases in which the scar tissue was more extensive. In one of these two cases the pylorus was held up very high by a short gastrohepatic omentum, and in both cases the downward sagging of the stomach produced a well-marked kinking or valve formation at the pylorus, which evidently was obstructive in its nature.

In a case which died from chronic starvation, supposed to be due to pyloric obstruction of a cancerous form and therefore not subjected to operation, the postmortem showed a large fibrous hypertrophy, such as described by Greig Smith, with obstruction not of a malignant nature.

The pylorus was stenosed, yet not to a marked degree, the strictured portion easily admitting a lead pencil. There was no evidence of previous ulceration. Here again this valve formation was well marked.

Some observation of the two cases operated upon and experiments made with the postmortem findings just referred to leads me to believe that a pylorus somewhat rigidly held upward by a short gastrohepatic omentum, or one in which a certain amount of mechanical obstruction is present will permit sagging of the stomach and valve formation of the pylorus, with consequent obstruction.

It is possible that this condition may exist in many cases of chronic gastric catarrh and dilatation without producing sufficient trouble as to cause death or require operation.

The production of valve formation at the pylorus is similar to the valve formation of the ureter at the pelvis of the kidney as a cause of hydro- and pyonephrosis so graphically portrayed by Christian Fenger.

Enteroptosis favors such obstruction, as the greater the sagging of the intestines and the greater the downward displacement of the stomach the more perfect are the mechanical conditions which tend to valve formation.

One year ago I read a paper before this Section on a similar subject and referred to valve formation as a possible cause of the difficulty at the outlet of the stomach, and I am now still more confirmed in the belief then expressed. It certainly explains many of the changes incident to the causation of obstructive symptoms without previous local disease.

Kussmaul, on the cadaver, has been able to produce a rotation obstruction which is evidently similar in nature. A few cases of congenital stricture have been reported by Landerer and Maier.

It is altogether questionable whether movable kidney can produce mechanical pyloric obstruction, although this conclusion has been drawn as to the relief of gastric symptoms supposed to be given by nephrorrhaphy in neurasthenic women.

The diagnosis of marked pyloric obstruction and the consequent dilation of the stomach is not difficult, in fact the vomiting of large quantities of ingested material or its removal by the stomach-tube is of itself significant. After inflating the stomach with atmospheric air, by means of an ordinary valve syringe and a stomach-tube, its outline can be rendered evident to the usual methods of physical diagnosis, inspection, palpation, percussion and auscultation. The gastroscope and the gastroduodenoscope have little practical value to the surgeon. The differentiation between the malignant and the non-malignant forms of obstruction is often difficult and may be impossible without exploratory incision. The examination of the stomach contents has perhaps some value. When the test meal of Ewald and Boas shows an absence of free hydrochloric acid with Gunsburg's test and at the same develops lactic acid by Uffelmann's method of examination the indications are for cancer; yet prolonged non-malignant obstruction may cause such disease of the mucous membrane as to mislead the observer. In a considerable number of such examinations made for me by Dr. Christopher Graham the conclusions of Rosenheim have usually obtained, but these tests are far from reliable in character and at best are only confirmatory.

In two of my cases of obstruction from former ulceration the cicatricial mass could be plainly felt through the abdominal walls, so much so as to lead to a fear of malignant tumor.

After all, the chief factors in the differential diagnosis will be obtained from a careful examination into the personal history of the patient, especially as to previous ulceration and from the length of time the obstruction has existed. In this respect the occasional cases wherein the scar tissue of previous ulceration has degenerated into malignancy are of interest.

I wish to call attention to the significance of enlarged glands in the greater and lesser omenta as evidence of malignancy.

I have three times seen enlarged glands having all the appearance of malignant disease in non-malignant pyloric obstruction, evidently due to chronic sepsis

from the absorption into the lymphatics of decomposing stomach contents.

Fenger speaks of this septic glandular enlargement about the head of the pancreas in his writing on "The Floating Stone in the Common Duct," as nowise malignant. I have found it in one case in the axilla in a non-malignant tumor of the breast and in the deep lymphatics in a case of sloughing uterine fibroids.

Bull says that 50 per cent. of pyloric cancer cases die of starvation before glandular infection takes place.

Maylard, in his work on "The Surgery of the Alimentary Canal," speaks of the large fibrous stricture of the pylorus as having only fibrous structure, but says that if epithelial elements be found in the enlarged glands malignancy is established. I think that the accuracy of statements as to the absolute malignancy of any case in which the proof is enlarged glands, which have not been microscopically examined, can be questioned.

OPERATIONS FOR THE RELIEF OF PYLORIC OBSTRUCTION

The median abdominal incision between the ensiform cartilage and the umbilicus has proved to be the

FIG. 1 shows the manner in which the first two stitches are applied. The forceps serve as retractors to hold the wound apart as shown in Fig. 2. These stitches are inserted before the incision is made.

most satisfactory in giving easy access to the field of operation. This can be enlarged by a transverse cut across the rectus muscle if necessary for free exposure.

Pyloroplasty, devised by Heineke and Mikulicz, is the operation of choice and in narrow strictures is easy and certain in its results. As much of the incision as possible should be in the healthy rather than the scar tissue, as the latter is stiff and does not nicely coapt and has the disadvantage of all scar tissue that necrosis is apt to be the result of the suture pressure. If the contracted portion is very long the duodenum can be folded or knuckled upon the stomach after the *adossement* method of the French authors. This latter plan worked admirably in the second operation on my fifth case. As pyloroplasty can not be readily performed in severe cases in which the scar tissue is very extensive or the pylorus bound down by adhesions to a degree which renders the operation hazardous, the mortality should not be great—about 10 per

cent. Out of five cases I was able to do pyloroplasty in only two.

Gastrorrhaphy, introduced by Bircher, may be a good operation in valve formation, but cases which are suitable to this procedure could be relieved by pyloroplasty.

Loreta's operation of divulsion has a mortality of 40 per cent. and fails in a large proportion of the cases, making a primary recovery to yield a permanent cure. Greig Smith, however, believes that it has a field in the large fibrous form of obstruction.

Pylorotomy will seldom be done for non-malignant stricture. I can understand how a surgeon could commence a pyloroplasty and finding this method unsuitable be forced to make a pylorotomy as the only way out of the difficulty, but the mortality of 50 per cent. is too high when contrasted with other methods of relief for general adoption. Weir, Meyer and others have done the operation successfully in this class of cases.

Gastro-enterostomy for non-malignant disease is an operation of expediency and not of choice. Circumstances often compel its use, however, as extensive

FIG. 2 shows the wound drawn transversely with a few interrupted sutures in place.

contracture of the pylorus or the presence of tissue unsuitable for the security of suture union.

Inaccessibility of the field of operation, by reason of the presence of dense adhesions to important structures, is also an important indication. For one or more of these reasons, three of my five cases were relieved by gastro-enterostomy.

This operation by the suture methods, according to McGill, gives about 50 per cent. mortality and, with mechanical aids, about 23 per cent. The best mechanical device is, undoubtedly, the Murphy button. The greatest drawback to its use is the liability of the button dropping backward into the stomach upon separation. This happened in three out of eight gastro-enterostomies which I have made by its use. A year ago I suggested the tying of a string to the intestinal side of the button with the end in a double bow knot eight inches away, thinking that intestinal action at that distance from the site of the adhesions would act as a kite tail guide or tractor. In three

cases the action was admirable. In a fourth case, I regret to say, the button had not appeared when the patient left the hospital and I presume it is in the stomach.

Great care should be exercised to secure the jejunum at its origin and form a coil as close as possible to the proximal end. Rockwitz says that the union should be made so that the intestinal and gastric peristalsis will be in the same direction to prevent impaction of the unused portion of the bowel. Braun advises entero-anastomosis to empty the duodenum more perfectly, and Kocher makes a right-angled attachment of the bowel to the stomach in order that gravity may aid the downward passage of the gastric contents. In all operations in this region the omentum can be readily fastened with a few sutures in such a position as to add greatly to the security of union. The unequal thickness of the stomach and intestine is a source of weakness in this operation.

FIG. 3 shows the wound as closed by two rows of continuous Lembert sutures by means of the needles and threads used in the original sutures, the unthreaded end of the sutures having served as retractors as well as for the purpose of indicating the extent of the suturing necessary.

It should be borne in mind that a stomach with a normal capacity of three pints dilated to two or three times this extent at the time of operation, will certainly contract after relief of the obstruction, and that this contraction will effect the opening and correspondingly reduce its size to the same extent, and that such harmful contraction may not necessarily be due to the scar tissue forming the margins of the fistula. In this lies the uncertainty of gastro-enterostomy as a permanent opening.

Taking all of these facts into consideration, the suture method of Wolfier offers the fewest objections, as the opening can be of sufficient length to provide for future contraction and, with the improving technique of modern methods of suturing, the mortality will steadily diminish.

In operations on the stomach the emptying of this viscus should be carefully attended to previous to operation, to prevent contamination of the wound by escaping contents. A preliminary hypodermic of morphia with chloroform anesthesia has, in our hands, best controlled the tendency to retching so annoying in operations of this character. The after-treatment has been simple; morphia, if needed, to prevent peristalsis, and rectal feeding for three or four days, with strychnia hypodermically and stimulants per rectum as needed.

Case 1.—Stricture and valve formation. Pyloroplasty.—M. M., male, aged 46, American, admitted to St. Mary's Hospital Jan. 10, 1895, with a history of gastric symptoms extending over a period of seven years. For the past two years he has vomited large quantities of partially digested or decomposing food, once or twice in twenty-four hours. He has grown weaker and lost about one hundred pounds in weight. Early in his illness he vomited blood a few times and suffered severe pain after taking food.

Physical examination.—Patient very much emaciated, heart's action feeble, with dilatation of the right ventricle. With the stomach-tube a large quantity of gastric contents was removed. Dilating the stomach with air, it was found to extend downward and to the left, to a point on a line with the anterior superior spine of the ilium. The pylorus was plainly felt on a level with, and to the right of, the umbilicus. Free hydrochloric acid was present in the test meal.

Operation.—Jan. 13, 1895. A small cicatrix was found on the anterior wall of the pylorus and from this a band encircled the pylorus producing a stenosis of about the caliber of a goose-quill. The sagging of the stomach was very marked, producing a kinking or valve formation just at the stenosed area. Enlarged glands were found in the mesentery, having the usual appearance of malignant disease. Pyloroplasty was done and the patient discharged February 15, cured. When seen six months later he had gained seventy pounds in weight and was doing his work on a farm.

Case 2.—Cicatricial stenosis. Gastro-enterostomy.—W. G., male, aged 53, German, admitted to St. Mary's Hospital May 26, 1896, with a history of ulcer of the stomach which had caused severe trouble for nine years. During this time he had been unable to work and was more or less constantly under treatment. For three years he had been unable to take solid food and at intervals of from eighteen to thirty hours vomited up great quantities of material from his stomach.

Physical examination.—Patient extremely emaciated and so weak as to be unable to walk without assistance. On dilating the stomach with air, it filled almost the whole of the left side of the abdomen. Examinations of stomach contents were contradictory and uncertain. To the right of the umbilicus a thickened area amounting almost to a tumor, could be felt.

Operation.—May 29. A very extensive board-like cicatrix was found on the lesser curvature of the stomach and extending into the pyloric region. The strictured area was extensive, bound down by dense adhesions, and showed practically no tissue which would be safe to suture. Gastro-enterostomy was done with a Murphy button and string guide. Button passed on the thirteenth day; patient discharged June 19. When seen two months later he had gained thirty pounds in weight and was completely relieved of his trouble. When seen last (ten months after the operation) patient looked fat and well, but exhibited some symptoms of possible contraction of the opening. Should these symptoms become sufficiently marked I shall enlarge the gastro-enterostomy opening, by an operation similar to pyloroplasty.

Case 3.—Cicatricial stenosis. Gastro-enterostomy.—Mrs. J. E., aged 55, Irish, admitted to St. Mary's Hospital July 6, 1896, with a history of chronic stomach trouble extending over a period of fifteen years. She had been unable to eat solid food for several years, and vomited large quantities once or twice in twenty-four hours.

Physical examination.—An enlargement felt to the right of the umbilicus. The abdomen protuberant and distended with gas. On examination this distention found to be due to an enormously dilated stomach. Examination of stomach contents shows free hydrochloric acid, but the tests were not very satisfactory. Patient very much emaciated.

Operation.—July 10, 1896. An extensive cicatrix found on the lesser curvature and in the pyloric region. The pylorus was contracted extensively and felt like cartilage. Enlarged glands were found in the omentum. Extensive adhesions rendered the field inaccessible, and the stiffness and extent of the

stenosis made gastro-enterostomy expedient. This was readily done with the Murphy button. Imperfect preliminary removal of gastric contents made the operation difficult on account of escaping fluids after the stomach was opened. Uneventful recovery with rapid gain in both strength and weight.

Case 4.—Cicatricial stricture. Pyloroplasty.—(Three months after *adossement* for recontraction.) M. St. G., aged 50, Irish, admitted to St. Mary's Hospital Jan. 18, 1897, with a history of chronic gastric disease for twenty years. At times there would be complete relief of symptoms for some months, until about three years ago, since which time he has been in constant distress. He is unable to eat solid food and for a year has vomited a large percentage of the food taken. *Examination.* An emaciated man with a greatly dilated stomach which contained much of the food taken twenty-four hours before. Test meals show free hydrochloric acid. *Operation.* Jan. 21, 1897. A pyloric obstruction due to stricture, having its origin in an ulcer. Adhesions to the liver and gall bladder rendered elevation into the wound difficult. Pyloroplasty was done, some of the sutures being necessarily placed in the scar tissue. Patient discharged in good condition February 15. When seen April 1 he had gained twenty-five pounds in weight and said he could eat anything.

April 15. Was readmitted to hospital suffering from frequent vomiting and symptoms of acute obstruction at the pylorus, which had come on suddenly ten days previously.

April 16. The abdomen was opened in the middle line and as the pyloric mass lay to the right, the rectus muscle on this side was cut across just above the umbilicus, giving free exposure. Adhesions to the gall bladder and liver rendered inspection of the strictured area a matter of great difficulty and during the separation the pylorus at the seat of the stricture was opened widely, one wall being composed of the liver. It could now be seen that the sutures in the scar tissue had given way and adhesions to the liver had prevented leakage at the time, but these adhesions had been largely responsible for the recontraction. A long incision was made with its center at the opening in pylorus and the stomach folded over the nearly immovable duodenum after the fashion of *adossement* as described by Pilcher in his able article on "Fecal Fistula" in the Dennis System of Surgery. Over this the neighboring tissues were carefully drawn. The patient made an uninterrupted recovery.

Case 5.—Stricture and valve formation. Gastro-enterostomy.—B. K., male, aged 44, German, admitted to St. Mary's Hospital March 22, 1897, with a history of stomach trouble for five years during which time he had lost eighty pounds in weight. He does not vomit but for three years has used a stomach tube and removes by this means a large quantity of partially digested food from the stomach once or twice a day. *Examination.* On distending the stomach with air it fills the whole left side of the abdomen and extends across into the right hypochondrium. Test meals show free hydrochloric acid. *Operation.* March 22, 1897. Pylorus held high by a short gastro-hepatic omentum. A circular stricture and marked valve formation was made out. Enlarged glands were found in the omentum. The field of operation lay well under the liver, in a situation which precluded a safe suture operation. Gastro-enterostomy was done with a Murphy button and string guide. Button had not passed when patient left the hospital April 20, otherwise he had made an uninterrupted recovery with entire relief of symptoms and steady gain in weight and strength.

DISCUSSION.

Dr. J. M. BARTON of Philadelphia—Undoubtedly many patients are perishing from unrecognized pyloric obstruction. As recently as March of this year there was an article in the *Medical Record* mentioning the death of a patient from this condition. One reason for this is that the symptoms and history are misleading. The history should be a history of distinct gastric ulcer or a healed ulcer and then a history of obstruction, but such a history is quite rare. In hunting among the histories of reported cases but few of them have a distinct history of gastric ulcer, but symptoms are usually those of an ordinary dyspepsia. The headache, nausea, acid eructations after the taking of ordinary articles of food, and the sleeplessness and vomiting, which vomiting first occurs after meals and does not call attention to any obstructive symptoms. Ultimately these symptoms glide into symptoms of obstruction. We would expect, where there has been a long history of chronic catarrh, that the symptoms should be divided into two portions, those of obstruction and those associated with dyspepsia. If we operate, the symptoms of obstruction would be relieved, but the other symptoms would continue. I have been surprised to find that immediately after operation the symptoms would disappear. Where the patient is run

down and continues to run down we should operate, but there are certain cases in which we should operate at all times. I agree with the reader of the paper as to technique. Owing to the contraction of the stomach the operation may not be of service. The cases in which I have performed dilatation have remained all right for many months, but I do not regard this operation as favorably as I used to. I found that some of my patients had been doing well before I operated on this case, but I have reason to believe that there is a latent obstruction in many cases. In cases where the patients are exhausted I think an operation will do very well. Where the whole ulcer is on one side of the pylorus and the folds of the mucous membrane have come together, if they be separated there is quite a possibility of the case getting well. I remember two cases, one eight years and the other two years ago. These patients had suffered many years, had lavage performed ten years ago and had symptoms of dyspepsia. After operation they made rapid recoveries and were able to eat and digest everything. One patient had no stomach symptoms for seventeen months after operation, but from that time he began to vomit and since then has vomited about ten times. He gained many pounds of flesh after operation but is now losing. His condition is such that if another operation is necessary I shall do pyloroplasty. With regard to the other case on which I operated the patient remained well without further symptoms and gained twenty-two pounds. She was able to act as station agent for four years, but recontraction has now occurred and she is losing weight. I intended to perform another operation but she declined to have it done.

Dr. DONALD MACLEAN of Detroit—Dr. Mayo spoke of the diagnostic value of the microscope as deciding between benign and malignant growths. So far as my experience goes I have come to endorse the opinion, which I heard my old teacher express many years ago, that if you have a tumor you should cut it out, and if it does not come back it is benign, while if it does return it is malignant. I have submitted many tumors to histologists and I have had this sort of experience: "The tumor that you sent me is a round-celled sarcoma, exceedingly malignant and will soon kill your patient." The patient is still alive. On the other hand I have had just the opposite experience. I wish to ask whether there is a microscopic or a histologic standard established now by which we can judge whether a growth is malignant or benign; if so, I would like to know it. I have watched with the intense and critical observation of a father watching his son the work of my former pupil, Dr. Mayo, and I admire it very much indeed.

Dr. JOHN B. MURPHY of Chicago—Just because there is a tumor and some vomiting we are not justified in concluding that the case is one of carcinoma. Even if it kills the patient we are not justified. In a large percentage of cases occurring in people under 40 we find that this induration which is called a malignant tumor is not a carcinoma, and Dr. Mayo's paper brings this point out very well. In the class of cases where malignancy is suspected we must endeavor to make a positive diagnosis by an examination of the contents of the stomach, although even that is not sufficient to justify the diagnosis of carcinoma. The method of operating by Dr. Mayo is the best. Where a pyloroplasty is possible that is the operation to do. If a cicatrix is produced and this operation be rendered impossible we must do a gastro-enterostomy. The contraction will be in proportion to the amount of cicatricial tissue, to the entire size of the stomach and to the area of the sinus which is established. The first is the most important point. We find in anastomosis of the intestines that we have no great degree of cicatricial deposit and, therefore, less cicatricial contraction. The encouragement to operate on these cases in contrast to the very discouraging results produced in malignant disease is something to appreciate. The important point is to make a differential diagnosis. I believe that gastro-enterostomy in malignant disease is being relegated to the past as the mortality is enormous and the improvement very slight. Besides, patients who live through the operation are not benefited much. We have contractions of the stomach which make pyloroplasty impossible. If you examine a gastric ulcer at the end of the third week you will find a thickened mucous membrane in the neighborhood, and this cicatricial tissue is what you must endeavor to avoid in the operation of repair. An operation some distance from the pylorus is the more favorable I think.

Dr. SOMBERGER of New York—It has been said that there is probably a contraction after the operation of gastro-enterostomy and I would like to ask if this has been proven. It seems to me that there is but little more probability of contraction there than in anastomosis of the bowel. The case I will refer to I saw in the Cook County Hospital and Dr. Murphy operated. It was an operation for fecal fistula. In opening the

abdomen the lumen of the bowel was somewhat larger than normal instead of being smaller. If the atrophy caused by this button is such that we do not get contraction by anastomosis, why should we expect to find it?

Dr. A. J. OCHSNER of Chicago—This Section is fortunate in receiving the reports of Dr. Mayo's cases, as he is situated where he can have an enormous amount of material. In many cases the cicatricial stenosis occurring in acute conditions has not been overcome and there is still a certain amount of irritation there which is the cause of considerable tenderness. Whenever there is tenderness over any point of the abdominal cavity the muscles over this point will contract and one will therefore find a distinct tumor in many cases, simply from the contraction of the muscle. In a number of instances I have seen tumors diagnosed absolutely, before the anesthetizing of the patient, which could not be distinguished after the muscles had been relaxed, notwithstanding that the technique of the examination was as perfect as possible. We should not therefore make a positive diagnosis of carcinoma.

SOME ADDITIONAL FACTS RELATING TO SKIN GRAFTING.

Read in the Section on Surgery and Anatomy at the Forty-eighth Annual Meeting of the American Medical Association held at Philadelphia, Pa., June 1-4, 1897.

BY Z. J. LUSK, M.D.

WARSAW, N. Y.

At the meeting of the New York State Medical Association, held Oct. 15 and 17, 1896, I read a paper the title of which was "The Vitality of Cutaneous Epithelium After Its Separation from the Body." Believing the subject of great surgical importance, and having additional testimony of interest, I decided to briefly submit my experience at this meeting.

The question of the "limit of vitality" of skin separated from the body has been the subject of a great deal of experimentation. The longest period of which I can find record is ninety-six hours, or four days.¹

Experiments have been made² to ascertain the vitality of skin removed from the cadaver. Skin grafting has been successfully done with epidermis removed from the thigh six hours after death. Skin taken from amputated³ limbs has been found to make good material. After numerous trials, thirty-six hours was found to be the limit of vitality. These experiments are of importance no farther than demonstrating that cutaneous epithelium possesses great vitality, but beyond this fact, they are of no practical value with "the limit of vitality" terminating at thirty-six or even ninety-six hours.

The cuticle or external layer of the skin removed so that it includes *only* the *epidermis* and *Malpighian* layer is the material used in skin grafting, and I have found that their viability depends not upon the low temperature nor confined air, but *solely* and *absolutely* upon the elimination of all moisture. This discovery renders the foregoing experiments of value, offering a source whence material could be obtained. Great care is, under these circumstances, necessary in separating the cuticle. I would prefer the epidermis obtained by vesication with cantharis to any other method, as the cuticle is more perfectly separated, requiring only from two to four hours, more often about three hours, drying quickly at ordinary temperature after its removal; and if kept free from moisture it will retain its vitality for an indefinite period, being always ready for use. I shall briefly refer to cases of which a full description can be found in various peri-

odicals giving⁴ technique, etc., considering in this paper only the dates of operating, illustrating length of time intervening between dates of removal of cuticle and their successful employment in skin-grafting.

An important change in the manner of applying grafts has been made which simplifies the operation and removes the cause which may have led to failure by applying the wrong surface of the graft. Grafts are now applied *dry* and *not moistened* before using on account of the curling up of the edges, making it difficult of planting, failure resulting from applying the wrong surface of graft to granulation. By the method above described, equally good results follow and this danger is avoided. The following cases are given without history or detail, but only to show the date of injury, skin-grafting, and of recovery.

Case 1.—E. S., saltlifter, injured by falling into a pan of boiling brine, Jan. 14, 1895. Nearly eight hundred square inches of raw granulating surface on body. I began skin-grafting February 16, using the dried epidermis, separated by vesication, adhering by one edge to body. He did nicely, whole surface healed and he was able to be up and about by April 1.

Case 2.—M. C., scalded Dec. 3, 1895. December 26 I began skin-grafting, using dried skin which had been separated twenty-three days from cutis by vesication. At date of skin-grafting I removed several pieces of the dried skin, placed them between sterilized gauze and borated cotton, careful to note surface, tucked into envelope, labeled with date of separation from cutis, Dec. 3, 1895, and placed in office desk.

Case 3.—F. H., raw granulating surface two by two and one-half inches on dorsal surface of foot. Did skin-grafting with the dried skin which was removed as stated, Dec. 3, 1895; grafts took nicely and patient was up and about February 5.

Case 4.—J. O., switchman, hand crushed between draw-heads April 2. Did skin-grafting May 15. There was a large granulating surface on dorsal aspect of right hand. Used same material heretofore described. Development of grafts was vigorous and rapid so that one month later the surface had a good substantial epithelium covering.

Case 5.—July 20, Mrs. S., widow, aged 52, carcinoma of left breast, which was atrophied and adherent, while nipple appeared as if pushed up; it was large and indurated. Commencing above the nipple there was an ulcerated surface extending upward and inward two and one-half inches and one and three-fourths inches. Commenced using mixed toxins with no perceptible change for three months, when she began to improve in general health, gained in flesh and spirits, and by January, 1897, the ulcerated surface appeared more like healthy granulation, and had slightly diminished in size.

On February 9, Dr. Mann assisting, I used the remainder of material separated now over one year, and skin-grafted. Did not disturb proximal dressing for ten days, at which date there was no discharge. Dressings were moistened with balsam, peru mixture and six days later all the dressings were removed. To my surprise grafts had taken well and were doing nicely, except at lower surface where no evidence of epithelium appeared; ten days later, except a surface one-fourth inch square, all was doing nicely and covered with skin, which at each examination appeared more vigorous. About the month of March she was seized with a severe attack of rheumatism and was unable to leave her bed. I was obliged to suspend treatment. Two weeks later, April 1, the lower granulating surface began to extend its boundaries, destroying the new skin.

The longest period that the cuticle has been made to live and grow after removal from the body was ninety-six hours, or four days. This was an experiment made by Georges Martin, who believed that the prolonged vitality was due to the low temperature and confined air at which it was kept. I am of the opinion that its vitality was due to its being dry, or so nearly so as to prevent molecular change.

The cases reported by me show that in case No. 1 the material used had been separated from the cutis forty-eight days. In No. 2 it was separated twenty-three days. In No. 3 the skin was taken from No. 2,

¹ Encyclopedia of Surgery, Vol. i, p. 543.

² Medical Record, Vol. xx, p. 110.

³ Medical Record, Vol. xxi, p. 433.

⁴ Medical Record; Journal American Medical Association; International Journal of Surgery.