solution. This proteid has been referred to as lacto-protein by other workers upon the subject.

The process may hence be summarized as follows: 1. The rennin acts upon the caseinogen of the milk and forms two soluble proteids (calcium salts being absent), "soluble casein" and lacto-protein. 2. The "soluble casein" combines with calcium, when calcium salts are present, so forming casein. 3. In the coagulation of whole milk the casein entangles the fat globules forming the curd, and on contracting presses out the water, inorganic salts, lactose, lactalbumin, lacto-protein, and lacto-globulin which form together the whey.

Benjamin Moore.

REPARATIVE SURGERY.—Plastic reparative surgery is that department of the operative art which contemplates the repair of defects and deformities, congenital or acquired. Limited in its early history to the restoration of parts destroyed by trauma, plastic surgery has, in the course of centuries, widened its range of utility until its present achievements have been carried to all parts of the body covered by the general integument and to many of the cavities lined with mucous membrane. When the nose is destroyed by lupus, the eyelid shrivelled out of all semblance by chronic inflammation, the palate cleft, the fingers webbed, or the arm bound down by the scars of a burn; when a gastric or vesico-vaginal fistula, an eversion of the bladder, or a ruptured perineum makes life a burden—a plastic operation is the only measure of relief.

History.—The history of plastic operations presents fluctuations of use and oblivion unknown to the generality of operative measures. For its earliest development we must look to the shores of the Ganges, where from time immemorial mutilations of the face were inflicted in the way of punishment or revenge.

Later, the practice became the portion of the potters and brickmakers, who knew nothing of sutures, but retained the parts in position by the application of clay. There is no evidence that the skill of any of the operators of antiquity went beyond the restoration of mutilated noses, or that they attempted the repair of other parts. It is generally believed that before the Christian era the Brahmins had achieved great proficiency in the restoration of noses, forming them from integument brought down from the forehead or transplanted from another individual, and preferably from the gluteal region. What is truth and what is fiction as regards the rhinoplastic skill of the early priests of India, only appears from the recent translations of relevant parts of the *Súsrutás Ayurveda*, according to which the nose was formed from the integument covering the cheeks. "The physician takes a leaf the size of the nose to be formed, and, placing it on the cheek for a measure, raises a flap of skin in such a manner as to leave it attached at one part. After vivifying the scarred part the new nose is quickly brought in position, elevated, and retained by placing two tubes in the nostrils."[1] The classical writers of Greece and Rome were for the most part unacquainted with transplantation of skin as a method of relieving defects, which were treated only by freshening the edges by incisions and drawing contiguous portions of skin together.

On the other hand, Celsus certainly entertained a rational idea of the gliding of flaps. He advised that the defect be removed in the form of a square and that two parallel incisions be continued transversely outward and inward, so that the loosened edges might be easily united. If this could not be done, he recommended that two semilunar lateral incisions, which should involve only the skin, be made with the concavity looking toward the defect.[2]

Although Galen and Paul of Ægina repeated the precepts of Celsus, the little that was known of plastic operations lapsed into an oblivion even greater than that which befell general surgery, and from which it was not recovered for over a thousand years. In 1442 Pietro Lonzano, bishop of Lu, published a statement in the *Annales du Monde* that a Sicilian named Branca had found a new method of supplying the loss of a nose. Whence he derived his knowledge does not appear. Among the pupils of Branca was his son Antonio, who had improved and extended his father's method by taking the integument from the arm, and by replacing the loss of lips and of ears in the same way. Plastic surgery doubtless spread rapidly in Italy from the time of the elder Branca, since Vesalius, Fallopius, and others make mention of it. It remained, however, for Gaspardus Taliacotius or Tagliacozzi, professor of anatomy at Bologna, to develop plastic surgery to a degree unknown before him, and to publish the first scientific work on it two years before his death in 1599. In it are described his methods of operating and of retaining the parts in position; and the illustrations accompanying the text have been utilized from century to century by almost all authorities who have written upon the subject. A father of conservative surgery in its best sense, respected by his confrères and beloved by his students, Tagliacozzi well merited the marble statue erected after his death in the amphitheatre of Bologna. In this monument he contemplates a nose which he holds in his hand. The methods of Tagliacozzi failed to obtain a permanent foothold—Paré, Fabricius, Heister, and many others denied the possibility of success. A little over a hundred years after Tagliacozzi's death, the art which he had perfected had again fallen into disuse. Dionys, Desault, Richter, and Chopart only mentioned his practices to condemn them. Such was the state of plastic surgery when, in 1794, a Madras journal brought to England the account of a successful rhinoplasty practised by one of the Koomas, who transplanted skin from the forehead. Although the first rhinoplasty in England was made by Lucas, it was not a success. In 1814 Carpue was more successful in replacing the lower portion of the nose. In 1816 von Graefe introduced plastic operations on the Continent, giving preference to the method of Tagliacozzi. Since the last-mentioned date the utility and feasibility of plastic surgery have not been seriously questioned, and particularly within the last twenty-five years so many additions and improvements have been made that the achievements of the present day doubtless eclipse the best efforts of all former masters in this special art. Associated with the more recent progress of plastic operations are the names of Skey, Liston, and Fergusson in England; Sédillot and Jobert in France; Dieffenbach, B. von Langenbeck, Fritze, and Thiersch in Germany; and the elder Pancoast and Gurdon Buck in this country.

Indications.—Congenital or acquired defects and deformities demand the resources of plastic surgery when, from their exposed position, æsthetic reasons make their removal desirable, or when disturbances of function and impaired utility are plainly due to them in parts that are hidden from view. Hence it is evident that, regarding the imperativeness of plastic operations, cases in which they are indicated may properly be divided into two groups, in which the necessity to interfere varies as much as the end to be obtained. In the first class of cases the operation is designed merely to improve the appearance of the patient by removing a distorting scar, by suturing the fissured lobule of an ear, or by elevating a depressed nose. Here the indications for an operation are far from imperative, and it is not infrequently the importunity of the patient that impels the surgeon to operate. It is well to remember that operations done solely for cosmetic effects are ordinarily the least satisfactory; it is within the experience of almost every surgeon that results obtained by plastic operations in this group of cases, although eminently gratifying to himself and deemed excellent by his colleagues, are sources of deep disappointment to the patients themselves. In the second group of cases the chief indication for operative measures is the repair of defective function or the protection of parts that are exposed. When the absence of the lower lip, destroyed by lupus or noma, permits of the continuous loss of saliva, derangements of the digestion and of the general health necessarily follow. When the lower eyelid is everted or lost, the defect causes characteristic

changes in the eye and face which often make vision imperfect, and the overflow of tears adds the suffering from an eczema to the other ills of the patient. A large urethral fistula at the peno-scrotal angle, while neither disfiguring nor detrimental to health, is a bar to the full exercise of the procreative function. In each of these cases the indication for recourse to plastic surgery is apparent, and its imperativeness is commensurate with the impairment of function caused by the deformity. To this group of cases belong extensive destruction of the lips, the nose, or the eyelids; cleft palate, cicatrix from burns, or webbing of the fingers; fistulæ, urethral, vesico-vaginal, or recto-vaginal; lacerated perineum, and exstrophy of the bladder. In this group of cases must also be included those in which the operative production of a defect is to be immediately followed by its closure by plastic means. Thus an ulcer of the leg that has proven refractory to all other means frequently yields to excision and immediate transplantation of skin; or an extensive epithelioma of the lip can be relieved only by extensive ablation of the part, the large defect being at once closed by dermatoplasty.

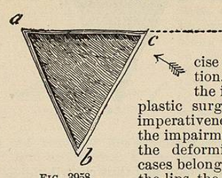


Fig. 3958.

In considering the urgency of a plastic operation, it is necessary to consider the pathological nature of the defect which it is intended to overcome. A loss of substance may be congenital, traumatic, or the result of destructive neoplasms, like lupus, ulcerative syphilides, or epithelioma. In congenital deformities plastic operations are generally not urgently demanded, unless, as in the case of deficiency of the rectum, the life of the child depends upon their correction. But there are milder cases, congenital in character, in which greater deformity can be avoided by early interference. This is true in cases of harelip associated with cleft palate. In simple fissure of the lip the surgeon may abide his time. In complicated cases, on the other hand, early closure of the labial cleft must be advocated, since it has an undoubted influence in approximating the edges of the bony cleft and greatly increases the probability of success in subsequent attempts to close it. In two complicated cases in which I have thus operated during the first week the result was eminently satisfactory. Due regard should necessarily be paid to the general nutrition of the child before a plastic operation of considerable severity and entailing the loss of no slight amount of blood is performed. Defects that are traumatic in origin almost invariably demand removal by plastic operation while the wound is in condition to promise immediate union. This applies particularly to wounds of the face, the soft parts of which are so mobile that they may be stretched to almost any extent, provided the soft structures be thoroughly lifted from the bone. When suppurative processes have been established it is, as a rule, best to delay operative procedures until complete cicatrization shall have taken place. When the loss of substance is inflicted by the surgeon in the removal of malignant growths, its immediate repair is indicated, since there is every reason for believing that when this is accomplished the danger of recurrence of the primary disease is materially decreased. In such cases the all-important object of the operation is the removal of all diseased tissue, irrespective of the size and form of the wound that remains. In the category of defects that result from destructive inflammations, or from tuberculous or syphilitic ulcerations, operative measures are never indicated until the complete cessation of the original disease has taken place. It is in these cases that patients are most importunate in their demands for relief, and injudicious haste on the part of the surgeon is most frequently followed by disaster. Until a lupous or syphilitic ulceration is entirely under control, until, indeed, the whiteness of the cicatrix and the absence of other evidences of constitutional vice give us reasonable assurance that there is no tendency to recurrence, a plastic operation should not be attempted. An operation too soon performed will often give a new impetus to a disease that has simply been dormant.

Nomenclature.—A number of terms have been suggested as suitable for designating plastic operations. French and German writers generally prefer the word autoplasty (*αὐτός*, self, and *πλάσσειν*, to form). In rare cases, in which the transplanted tissue is taken from a subject other than the patient, this term is evidently inappropriate. To overcome this objection, Velpeau and Guérin have suggested the word anaplasty, signifying to form anew or again. In this country and in England these terms have been generally discarded for the less objectionable one of plastic surgery. When, however, such an operation is performed for the repair or new formation of a particular part, the latter properly gives to the operation a particular name. Thus the formation of a nose is called rhinoplasty; of the lip, cheiloplasty; of the eyelid, blepharoplasty; of the mouth, stomatoplasty; of the urethra, urethroplasty, etc. The scope of this article will not permit the consideration of all the plastic operations. Those of the palate, fingers, urethra, perineum, and vagina are treated of in other parts of the Handbook, while in the following pages will be studied the principles underlying plastic operations in general, and the methods of repairing deformities and defects of the face only.

The underlying basis of plastic surgery is the inherent vitality of the various tissues of the body. This permits them, after partial or total separation, to maintain an independent existence for a greater or less period, and to form new and permanent attachments when brought into contact with freshly wounded surfaces in proximity to, or at a distance from, their original sites. The introduction into defects of strips of epidermis, of the cutis vera, of tendon, of nerve, or of bone, which have been entirely severed from their former connections, constitutes transplantation or grafting. In plastic operations proper, this severance is never complete, a small bridge always being left through which the part to be utilized in the closure of a defect continues to live under the influence of the circulatory, and probably, also, of the nervous, apparatus of the structures whence it was taken, until perfect agglutination in its new position ensues. This occurs in from twenty-four to forty-eight hours, when no untoward complications in the process of wound repair supervene. By the end of a week the union is solidified by the free interchange of blood-vessels between the edges of the defect and the part inserted into it. In wounds of skin more than in those of any other structure is there a manifest tendency to early and firm repair, without which plastic operations would rarely succeed.

Methods.—The pathology, nature, and extent of a cutaneous defect, and the condition of contiguous parts, will direct the surgeon in the choice of one of a number of methods that are at his disposal. Thus he may utilize the integument from a near or distant part of the body for its closure. Referring, for the present, to the former method only, I will state that the skin in the vicinity may be made serviceable by (1) traction, (2) by gliding, and (3) by transplantation of skin flaps. While typical illustrations of each of these methods differ sufficiently from each other to warrant a separate consideration of each, it is well to bear in mind that in their practical application the simpler often verges into the more complicated procedure.

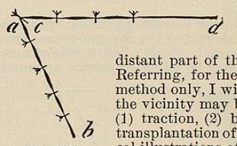


Fig. 3959.

1. The method of closing a cutaneous defect by traction on the vivified edges of the integument surrounding it is based on the extent to which skin can be stretched and yet retain its vitality. This is well illustrated after removal of the breast, in which even the largest wounds can ordinarily be readily closed. In the surgery of the

face, however, plastic procedures by traction alone are justified only in wedge-shaped or oval defects, the margins of which can be easily approximated and retained

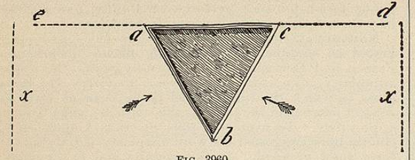


FIG. 3960.

in position without dangerous traction on the sutures. If there be any strain on them after complete closure of the wound, it may be relieved by an incision through the skin on either side of the wound, parallel with, and at a short distance from it. This method is therefore applicable for the closure of fissures and fistulæ, and for the removal of prominent and ungainly cicatrices.

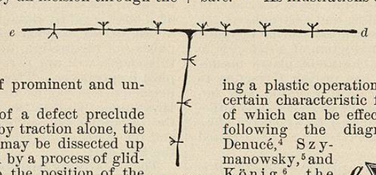


FIG. 3961.

2. When the size and form of a defect preclude the possibility of its closure by traction alone, the skin in the immediate vicinity may be dissected up in a patch of requisite size, and by a process of gliding be brought edgewise into the position of the part to be repaired, where, after proper adjustment, it is retained by sutures. Triangular and rectangular defects, such as result from the partial removal of the lower and upper lip, respectively, can be best remedied in this way. This method of operating by gliding, although mentioned by Celsus, as Linhart suggests, was probably practised before his time, since every operator, even if without previous knowledge, would naturally adopt it.

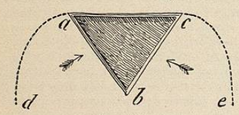


FIG. 3962.

3. The above methods are applicable only when the integument in the *immediate* vicinity of the defect can be utilized. If this is not feasible the borrowed integument, after being given the shape of the defect and being raised from its substructure, is transferred into the defect, but retained in relation with the tissues of its former position by means of a pedicle. Around this latter the flap must then necessarily be turned or twisted. Such a flap, in being transferred to its new site, may be made to describe an arc of

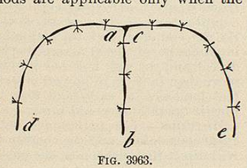


FIG. 3963.

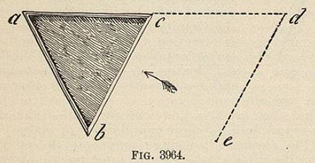


FIG. 3964.

90°, or even 180°. In order that the raw under surface of the flap may be everywhere in contact with the subjacent surface, the skin bounding this must in part be displaced. "This displacement, however, should be effected in such a way that the displaced skin, retaining a connecting pedicle for its support, may be made to change

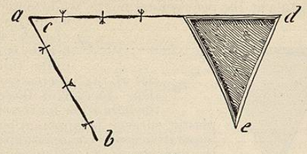


FIG. 3965.

places with the transplanted flap, and thus contribute, as far as it can, a covering for the surface that has been left bare."[3] As illustrations of this method may be cited the formation of a nose from the forehead, and of the upper eyelid from the integument of the temple.

Although every case requiring a plastic operation is a law unto itself, there are certain characteristic forms of defect the effacement of which can be effected in well-defined ways. In following the diagrammatic representations of Denucé,[4] Szymanowsky,[5] and König,[6] the reader must bear in mind that the shaded parts of each illustration represent the defect, that the dotted lines indicate the incision, and the arrow the direction in which a flap is to be displaced. The supplementary illustration, in each case, indicates the appearance of the parts after union. (König.)

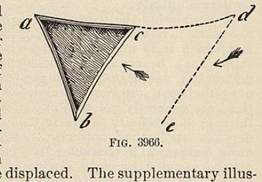


FIG. 3966.

(*a*) Small triangular defects may often be closed by gliding the angles of the wound toward its centre, and suturing the edges, which, when the integument is freely movable, can readily be brought in contact with each other in the form of a small triradiate star. If the defect is too large to be closed in this manner, one or two flaps may be easily prepared by carrying a straight or curvilinear incision from one or two angles of the triangular defect. Figs. 3958, 3959, 3960, 3961, 3962, and 3963 illustrate the manner of sliding the flaps into position. Should the tension of the flaps be too great, liberating incisions may be made (Fig. 3964, *a*), the wounds thus left healing by granulation. If, in addition to the incision *c d*, a second incision (Figs. 3965 and 3966, *d e*) be made, parallel to the side of the triangle, a quadrangular flap will be obtained for the closure of the defect (Dieffenbach, blepharoplasty), and a small triangular wound left to granulate. If the first incision be made at an angle to the margin of the defect, and the second be made in the manner already described, the wound can generally be entirely closed by sutures (Figs. 3967 and 3968). When the triangular defect has a large

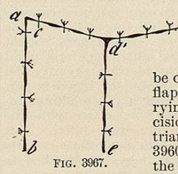


FIG. 3967.

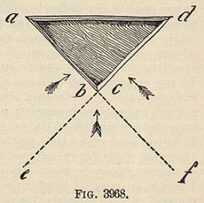


FIG. 3968.

base, as is often the case after removal of an epithelioma from the lower lip, straight or semilunar incisions carried from the apex in the direction of its sides (Figs. 3969 and 3970) will outline two flaps that, by sliding, can be brought into apposition along a line at right angles to the base of the original defect. Burow, of Königsberg, has devised a method of closing triangular defects which, probably because it sacrifices healthy tissues, has not received the attention which it merits. It is practised as follows: From the base of the defect, and continuous with it, a straight or curvilinear incision is made (*b d*, Fig. 3971), somewhat larger than the base of the defect. From the side opposite to this a triangular piece of integument (*f e d*), equal in dimensions to the defect, is removed. The flaps *c b d* and *a f e*, being then dissected up and glided along the base line *a d*, readily close the wound. The line of suture is shown in Fig. 3972. If the defect is a large one, Burow sacrifices two smaller triangles of healthy integument, as shown in Figs. 3972 and 3973.

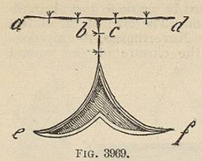


FIG. 3969.

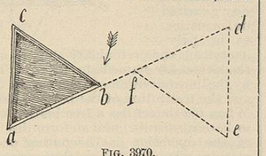


FIG. 3970.

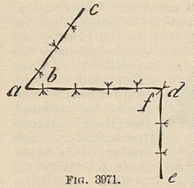


FIG. 3971.

(*b*) Quadrangular defects can, as a rule, not be effaced by suture alone. It is usually necessary to continue the incision in one or two directions, making one or two flaps, after the method of Celsus (Figs. 3974, 3975, 3976, 3977). The tension on these flaps will be materially decreased by making angular or semilunar liberating incisions as indicated in Figs. 3978 and 3979. When the defect is a large one, smaller flaps may be obtained from three directions as illustrated in Figs. 3980, 3981. Quadrangular defects may often be closed by the formation of one or two flaps, which are turned into their new positions around a broad pedicle (Figs. 3982, 3983, 3984, 3985, and 3986).

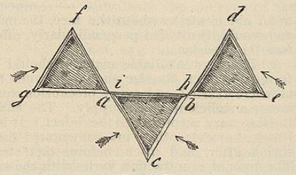


FIG. 3972.

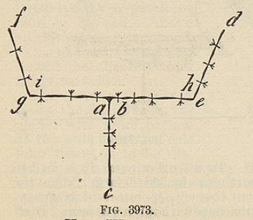


FIG. 3973.

(*c*) Oval and elliptical defects can generally be closed by a little traction along the line of their long axes. If the defect is broader, a liberating incision (Figs. 3987 and 3988) may be made, for the purpose of overcoming dangerous tension in the sutures. Lisfranc closed defects by constructing two flaps from one side of the ellipse by an incision perpendicular to its axis (Figs. 3989 and 3990). If this does not suffice, two curvilinear incisions, *b d*, *b e* (Figs. 3991, 3992), will facilitate the closure of the

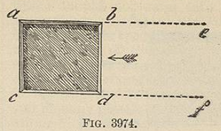


FIG. 3974.

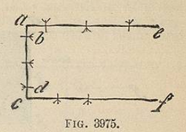


FIG. 3975.

wound by two flaps that can easily be displaced to cover the wound. The flaps may also be so devised that they can be obtained from both sides, if the integument on one side be insufficient. Thus, by the incisions *a c* and *b d*

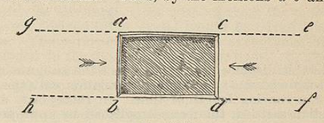


FIG. 3976.

(Figs. 3993 and 3994), two semilunar flaps will be formed that almost completely cover the defect. Weber's method of obtaining two flaps from one side, the one underneath the other, is shown in Fig. 3995. It is especially serviceable in defects of the lips.

(*d*) Circular defects, if not too large, are most readily overcome by converting them into oval or triangular wounds, preferably oval. If the defect is large, a semicircular flap must be obtained from the vicinity, and turned into the wound in the manner in which the quadrangular defect was closed.

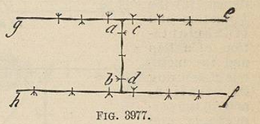


FIG. 3977.

It frequently happens that the integument in the immediate vicinity of the defect is unavailable for plastic purposes. This applies particularly to the extensive ravages made in the face by lupus and noma. After the cure of those diseases, extensive cicatrices often remain in the skin for a considerable distance around the defect. It then becomes necessary to go to a part farther removed from the latter for healthy skin. Thus the surgeon may be forced to fashion an eyelid from the skin of the temple, or a nose from that of the forehead (Indian method). In exceptional cases, it may even be deemed advisable to go still farther from the defect for a flap of healthy skin, as in the Italian method of rhinoplasty, in which the nose is formed from the skin of the arm. In the same manner, the place of a cicatrix from a burn of the wrist may be supplied by skin taken from the abdomen, or, as Maas[7]

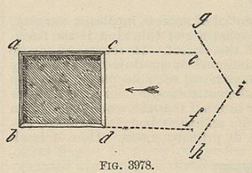


FIG. 3978.

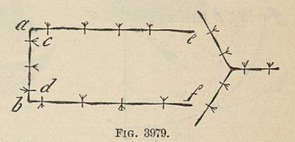


FIG. 3979.

demonstrated to the congress of German surgeons in 1886, otherwise incurable crural ulcers may readily be closed with a flap of skin obtained from the sound leg. In every case in which flaps are thus brought from a

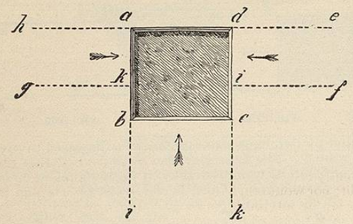


FIG. 3980.

considerable distance, the part whence the integument is to be borrowed must be retained in relation with the defect for a varying length of time. In rhinoplasty after the Italian method, this is accomplished by appropriate bandages. In the case of Maas, the parts were retained in position by a plaster-of-Paris dressing until union was secured.

Nearly all plastic operations may be subdivided into a number of steps which refer, respectively, (1) to the preparation of the defect; (2) the formation and transplantation of a flap and the methods of assuring its vitality; and (3) the permanent and speedy closure of the wound.

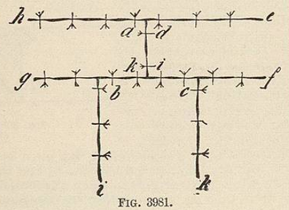


FIG. 3981.

1. The apposition of freshly wounded surfaces being practically an essential of success in plastic surgery, the first step in any operation of this kind is the freshening or vivifying of the defect. In recent traumatic defects, accidentally inflicted or produced intentionally by the surgeon in the removal of a neoplasm, this step of the operation is sufficiently simple. In cases of accident, it is well to bear in mind that the wounds are often irregular in the extreme and their margins bruised, lacerated, and ill suited to primary union. Here it is always essential to give the defects as regular an outline as may be, and to remove, with scissors or knife, the contused parts before attempting closure with or without the aid of a flap. When the defect follows the extirpation of a growth, and is to be closed at once by a plastic operation, every sacrifice must be made to procure radical removal of the neoplasm. The size of the defect is of secondary importance. Nevertheless, the incisions may be so arranged that the closure of the wound may be greatly facilitated. A glance at Fig. 3996 will make this sufficiently evident. In many cicatricial contractions and in congenital deformities, as in polydactylism, the preliminary step is also the formation of the defect for immediate closure. This is easily effected by the linear division of the cicatrix or connecting bands, and the restitution of the parts to their normal positions. When the defect has a free border, on the other hand, as in harelip, fistulæ, oral deformities, etc., the initial step of the operation is the paring or vivification of this margin, whereby the mucous, cutaneous, or cicatricial tissues are removed in such a manner as to procure a surface that is clean, smooth, and well adapted for primary union. Whether the paring be accomplished with scissors or knife, it is an essential of success that the border be removed in its entire thickness, since the presence of any undenuded spot in the line of proposed union destroys the possibility of a perfect result. To insure a broader surface for contact, and thereby greater probability of firm union, it is advisable to vivify the defect obliquely. This is particularly serviceable when, as in defects of a mucous membrane or of old cicatrices about the face, the margins are thin and would, if divided perpendicularly, offer a small surface for adhesion.

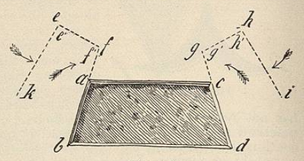


FIG. 3984.

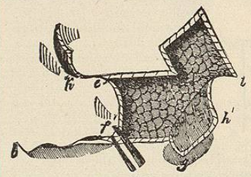


FIG. 3985.

2. The most available material should be selected in forming a flap; its size should be such that tension is nowhere exerted, and every precaution must be taken to insure a sufficient blood supply. The shape and size of the flap vary according to the defect. It is to be remembered, however, that integumentary flaps invariably shrink after, and often before, their transplantation. The amount of retraction varies with the subsequent disposition of the flap. If a raw surface is brought in contact with a plane surface or denuded bone to which it can form adhesions, the danger of primary retraction is less imminent. Thus it is certain that a periosteal flap only slightly larger than a fissure in the palate will easily suffice for its closure, whereas almost twice the integument must be taken from the temple to form an eyelid. In all other cases it is well to make the flap one-fourth or one-third larger than the breach it is intended to cover. Operators of large experience can fashion the flap without a pattern. Dieffenbach always condemned its use, giving to the part to be formed ample dimensions at first, and remodelling it by supplementary incisions. It is certainly safer in all cases to make an accurate model of the part to be replaced, of paper, leather, adhesive plaster, or soft wax, which can be directly applied to the part from which the integument is to be taken, and serve as a guide to the lines of incision. The closest attention is required in the delineation and management of the pedicle. It should never, in a formal plastic operation, measure less than one-third of an inch in width, the probability of the survival of the flap being in direct proportion to the width of its pedicle and its capacity for arterial supply. As far as possible, therefore, the flap should be so outlined that the incisions will not necessitate the division of large arterial twigs. For the same reason, excessive torsion of the pedicle must be scrupulously avoided. Verneuil[8] aptly proposes the name of hilum for this portion of the flap, since this term expresses its important function in the nutrition of the flap.

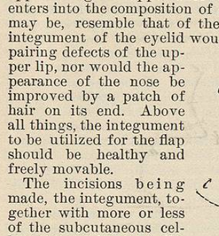


FIG. 3982.

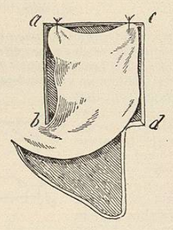


FIG. 3983.

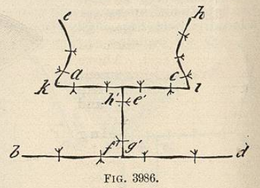


FIG. 3986.

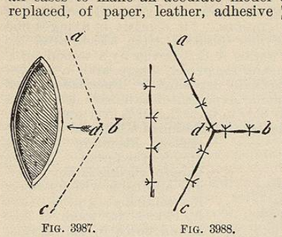


FIG. 3987. FIG. 3988.

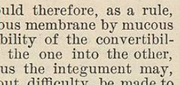


FIG. 3989.

Into the composition of the flap there should enter, as far as possible, tissues histologically analogous to those of the part to be repaired. Skin should therefore, as a rule, be replaced by skin, and mucous membrane by mucous membrane; although the possibility of the convertibility, in the course of time, of the one into the other, should be borne in mind. Thus the integument may, without difficulty, be made to substitute the mucosa of the bladder or of the nares. Mucous membranes, however, do not, as a rule, assume the characteristics of common integument, although that of the vagina forms an exception. The mucous lining of the nares, of the lips, of the nose, and of the bladder may be exposed for years without sensibly approaching the appearance of the skin. When skin enters into the composition of a flap it should, as far as may be, resemble that of the part lost. The delicate integument of the eyelid would not be suitable for repairing defects of the upper lip, nor would the appearance of the nose be improved by a patch of hair on its end. Above all things, the integument to be utilized for the flap should be healthy and freely movable.

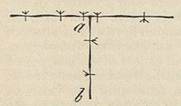


FIG. 3990.

The incisions being made, the integument, together with more or less of the subcutaneous cellular tissue, is to be dissected up from the underlying structures. The thickness of the flap should always be commensurate with its other dimensions. Large and thin flaps often succumb to defective nutrition. The subcutaneous cellular layer is an essential of all large flaps, since it is the medium through which the skin receives its nutrition. An excess of adipose tissue, however, is an element of danger to the vitality of the flap. It has been claimed that muscular tissue should not enter into the composition of a flap when it can be avoided, on the ground that muscle without function is speedily converted into fibrous tissue, and the presence of this cicatricial tissue may become an important factor in marring the final result in many plastic operations.[9] In those upon the face muscular elements cannot be excluded, since they are directly inserted into the skin; nor would their exclusion be advisable, since without them the mobility of a newly formed lip or eyelid would be out of the question. The periosteum may also, in exceptional cases, be included in the flap in plastic operations. B. von Langenbeck[10] and Ollier[11] have thus sought to utilize the osteogenetic function of the periosteum in rhinoplasty and uranoplasty, in the belief that the new bone developed by it would give the normal resistance to the repaired part.

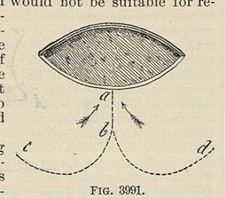


FIG. 3991.

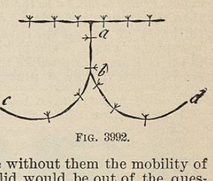


FIG. 3992.

Verneuil, Sédillot, and others question the utility of this procedure, believing, and in some instances with good reason, that the inclusion of the periosteum in a flap is an element of danger to the vitality of the part whence it is taken, and that it increases the probability of sepsis. With modern wound treatment this is excluded. Regarding operations on the palate, the danger of necrosis after periosteal denudations is certainly theoretical. Langenbeck,[12] who has probably operated oftener than any one else for cleft palate, by this method, has never seen the bone exfoliate. He has, however, noticed such an accident after rhinoplasty. Nor can there be any question as to the formation of new bone from periosteal flaps. In every congenital defect of the palate operated upon by this distinguished surgeon which was under observation more than four weeks after uranoplasty the formation of new bone was confirmed. It begins about the third week, and is completed at about the fourth week, although it subsequently gains in solidity. So far as time is concerned, the periosteal regeneration of bone after plastic operations may then be said to be chronologically analogous to that which takes place in the repair of fractures. Nor, any more than after fractures, is there any danger that the newly formed bone will subsequently undergo retrograde changes.

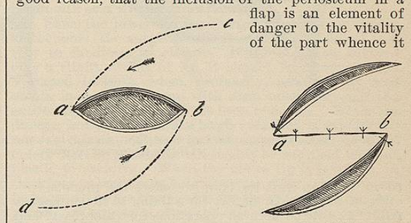


FIG. 3993. FIG. 3994.

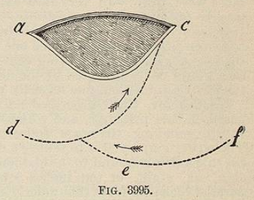
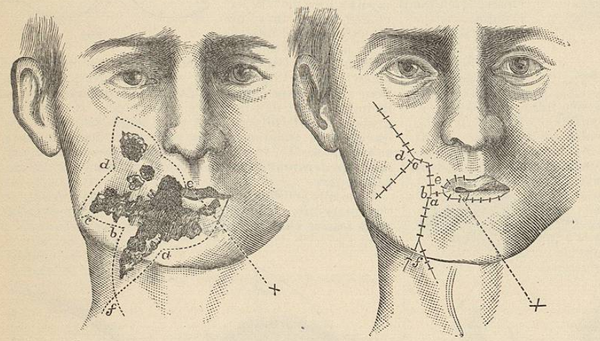


FIG. 3995.

To increase the thickness and, therefore, the vitality of large flaps, and at the same time approximate the repaired part to the normal structure and function, very thick and even duplex flaps must often be formed. Thus, while a large defect of the lower lip may be covered with a flap from the neck, the new lip will be thin, devoid of muscular fibre, and, therefore, of movement, and soon becomes firmly attached to the lower jaw. It is preferable, therefore, when possible, to make the flaps of the entire thickness of the cheek, covered with skin and mucous membrane, which, when brought into position, subserve in the best manner possible the purposes of the part destroyed. Or it may be practicable, if it be deemed best



A. B.

FIG. 3996.—Plastic Operation for Cancer of Lip. Showing (*A*) the proposed lines of incision, and (*B*) the completed operation.

to use the flap from the chin, to reflect the mucous covering of the alveolar border for a lining to the cutaneous flap. As will be seen in operations for rhinoplasty and exstrophy of the bladder, this doubling of the flap may be practised with two folds of skin, the lower of which subsequently becomes converted into mucous membrane. For this method Ad. Richard,[13] in 1854, proposed the term "autoplastie par doublure."

3. The transplantation and permanent attachment of the flap constitute the last steps of formal plastic operations. At present all authors are agreed that, save in exceptional cases, the fixation of the flap should at once follow its formation as soon as all oozing has ceased. Tagliacozzi, however, in his rhinoplasties, allowed the under surface of the flap, taken from the arm, to suppurate before fixing it in the new position. Graefe, on the other hand, successfully practised fixation while the surfaces were fresh. In very rare cases the old operation may be followed by good results. Thus the author, in 1876, saw Billroth close a gastric fistula with a flap that had been lifted from its surface one week before fixation, the reason given for this being that the suppurating surface would be less affected by the deleterious influence of the gastric juice than one recently prepared.

In 1889 Mr. Croft described an operation which was based on this principle, and which was particularly useful in relieving the scars following extensive burns. The writer employed it to relieve a dense scar which held the thigh firmly bound to the abdomen. A broad strip of skin, six, eight, or ten inches long, is lifted between parallel incisions from the underlying structures, but left attached above and below. Strips of gauze are inserted underneath for six or seven days until granulations have formed. The flap thereby becomes thickened. At the second operation, after the defect is vivified, the granulations are curetted from the flap, its attachment at one end is severed, and the placing in position follows as in the one-time operation (Med.-Chirurg. Trans., 1889).

In 1854 Roux was compelled by circumstances, in a defect of lip and chin, to resort to a practice which some writers have sought to elevate into a special method, that by successive migrations. "It consists in fixing a flap temporarily in a new position, from which, after the lapse of several weeks, it is removed by a second operation to a part nearer the defect, where, after a number of migrations, it is finally deposited."[14] Buck has resorted to a somewhat similar expedient in extensive deformities of the face. It is only in these that it is ever practicable.

To facilitate the transplantation of a flap and to relieve tension, liberating incisions are often required. Thus, in harelip, success is not generally attainable without freely liberating the segments of the lip which are more or less bound down to the maxilla. Such liberating incisions cannot always be concealed, as in the instance cited. They should then be made as small as is consistent with the effect desired, and in the manner indicated (*g i h*, in Fig. 3978).

To close the wounds resulting from these liberating incissions is permissible only after the defect has been covered and when it is evident that closing the secondary incisions does not cause traction on the more important line of sutures closing the primary wound. Where there is any doubt, it is best to leave the liberating incisions unsutured, and the wounds to heal by granulation. In very many cases these wounds can at once be closed by skin-grafting or by using a Wolff or Krause flap. (See *Skin-grafting*.)

The fixation of the flap by sutures forms the final step of the plastic operation. The care and accuracy in apposition of the raw surfaces observed in other surgical procedures are particularly demanded here. The absence of blood within the wound is an essential to success. Hence Dieffenbach, Lisfranc, and others often postponed fixation for two or three hours until all oozing had ceased. As Verneuil justly says, while admitting the value of this method in former times, "in our day operations are generally made under anæsthesia, from which, when the patients awake, they like to believe that the operation is completed; hence it is a source of great suffering to mind and body to delay the completion of the operation."

In closing the wound the continuous or interrupted suture may be employed. Whenever applicable, the buried subcuticular suture should be used. Suture marks are in themselves often quite disfiguring. As a rule, small needles should be used. The angles of the surfaces are first approximated. While the number of sutures must be sufficient for accurate apposition and the avoidance of wrinkles in the flap, an excessive number is doubtless harmful, since every suture, however fine, interferes in a measure with the circulation in the part, and every suture may become a source of suppuration. When considerable traction must be made to hold the flap in position, one or even two deep sutures of heavy silk may profitably be inserted far from the edges of the wound, as after amputation. In this way the tension on the more numerous superficial sutures is effectually removed. The material used for sutures varies according to the length of time they are to remain. In plastic operations about the face an iron-dyed silk probably answers the best purposes. These sutures can be removed, a few at a time, in from forty-eight hours to five or six

days after the operation, according to the union obtained. When it is desirable to retain the sutures longer, as in operations on the vagina, silver wire is to be preferred, since metals produce vastly less reaction in the tissues than silk.

Regarding the after-treatment, little need be said. The wounds are frequently in a position where aseptic measures cannot be successfully carried out; as, for example, about the lips or nose. In these cases dry gauze compresses, held in position by properly adjusted bandages or adhesive strips, will go far toward supporting the parts and assuring primary adhesion. The writer has found gauze strips steeped in collodion an excellent dressing in many small plastic operations on the face. Wounds made for plastic purposes should be frequently examined to determine the condition of the parts, and particularly if a flap has been utilized. Immediately after its application a flap is cool, pale, and insensitive. Within from twelve to twenty-four hours, as circulation is established, its temperature rises, and a marked redness distinguishes it from the integument surrounding it. This redness easily yields to a bluish discoloration and excessive swelling, both indications of venous stasis, which, if not checked, often leads to sloughing. Loosening one or two sutures, or scarification of the flap itself, may avert such a result. If suppuration under the flap is suspected, the most dependent sutures must be removed for proper drainage. With proper precaution the presence of suppuration does not necessarily entail failure of the operation, since the flap may be held in position with small strips of adhesive plaster or by a number of sutures inserted at its salient points.

Supplementary treatment and even operations are often necessary after complete closure of the wound. Thus constant attention must be given the nostrils after rhinoplasty, the lower lip after cheiloplasty, lest the former close, or the latter become adherent. Or it may be that the contraction of the flap has not ensued to the degree anticipated, and the newly formed organ presents wrinkles of redundant skin. In the same way, the pedicle of a flap which has subserved its purposes must be excised if at all prominent. Such redundant masses can always be easily removed by oval incisions. In the case of the pedicle, several months must elapse before its excision is even to be thought of. A premature attempt in this direction of improving the result of a plastic operation may easily annul the advantages already obtained.

As has already been observed, every case requiring a plastic operation is a law unto itself. The more complicated the defect, the greater the study and practice required in overcoming it. When the destruction of tissue has been very extensive, as in noma, lupus, or burns, a single operation rarely suffices. Three, four, and even more operations may be necessary before the appearance of the face is in a measure restored. In these complicated cases, too much should not be attempted at one time, and an interval of from one to six months may often be advantageously observed between the different operations. It is in this way that the most successful workers in this field have, by repeated efforts, often extending over a period of two or three years, given a new life to individuals who, from very extensive destructions of prominent parts of the face, have been objects of disgust to themselves and of horror to those with whom it was their misfortune to come in contact.

BLEPHAROPLASTY.—Plastic operations in the eyelids as a rule come under the care of the ophthalmic surgeon. A full description of the various methods of blepharoplasty is given in the article by Dr. Van Fleet on *Eyelids, etc.*

CHEILOPLASTY.—The reconstruction of a lip after its partial or total destruction by injury or disease is termed cheiloplasty. In the preponderance of cases it is performed for epithelioma, and for the most part, therefore, is practised on the lower lip. The upper lip, also, at times is destroyed by noma, lupus, burns, or wounds, and thus becomes the subject of plastic repair. Except in cases of epithelioma these operations are particularly complicated, and tax the ingenuity of the surgeon through the involvement and distortion of the angle of the mouth and of more or less of the integument of the cheek or of the nose. Owing to the great variety displayed by individual defects of the lips, many methods have been devised for their relief. Only those are very serviceable in which a flap covered by integument without and mucous membrane within can be utilized. In all other methods, although at times they must be followed, the flap speedily becomes adherent to the maxilla, immovable, useless for mastication, and incompetent to retain the saliva. Another defect in the immediate result that appertains to almost all methods is the disparity in size between the sound and the reconstructed lip. The latter usually being smaller, the other projects far beyond, while the mouth presents an unnaturally contracted appearance. Still, this abnormal condition is recovered from after the lapse of a few months, the mouth being spontaneously remodelled.

In all cheiloplasties it is essential that the flap be obtained from the immediate vicinity of the defect, since failure is certain to follow any attempt to obtain it from a distance. The mobility of the parts during mastication is such that fixation of the arm cannot be maintained for a sufficiently long time or accurately enough to prevent the loss of the flap.

Cheiloplastic operations may be divided into: (1) Those that affect the lower lip; (2) those that affect the upper lip; and (3) those that affect the angles of the mouth, or the mouth as a whole (stomatoplasty).

1. Since the lower lip is repaired most frequently for epithelioma, the surgeon can often shape the defect in a way to facilitate its closure. If the neoplasm involve only a slight extent of lip, it should be removed by a V-shaped incision, when, ordinarily, no difficulty will obtain in closing the gap with deep sutures, even if the entire thickness of the lip has been removed. When the disease, however, covers a large area but is superficial, removal by a curvilinear incision is preferable, since the defect thereby produced will readily be supplied without plastic procedures. When the entire lip is involved, in thickness as well as in height, rectangular or curvilinear incisions alone are serviceable for the removal of the neoplasm. When, as is often the case, the disease involves the angle of the mouth, the incisions must necessarily be more complicated and altogether regulated by the extent of the disease. Even in extreme cases the gap can often be closed by a combination of V- or W-shaped incisions. Weber mentions a case in which the disease was very extensive. When circumstances compel the surgeon to borrow the material for the flap from the chin or neck, the methods of Chopart, of Lisfranc, or of Berg may be adopted. In Chopart's operation the diseased tissue is included between two parallel perpendicular incisions carried over the chin and on to the neck as far as the hyoid bone, if necessary (Fig. 3997) (Nélaton). When the diseased part is then removed by a horizontal incision, there remains a quadrangular flap which, when dissected up, is brought by a process of gliding to the level of the labial commissures, where it is retained by sutures. Lisfranc preferred to remove the neoplasm by a curved incision, from the centre of which (Fig. 3998) a perpendicular cut of greater or less length, carried downward, outlined two flaps which, when detached, were brought into position. Berg also gave the defect a curvilinear outline, but preferred to use a single flap from the chin and side of the neck. Fig. 3999 shows the manner of delineating the flap, of bringing it into position, and of closing the primary and secondary wounds. If the upper margins of the flap be covered, from each angle of the mouth, by a portion of the ver-

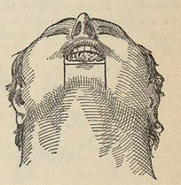


FIG. 3997.