REPAIR OF LARGE RADIATION ULCERS SITUATED OVER THE HEART AND THE BRAIN*

JOHN MARQUIS CONVERSE, M.D., ROSS M. CAMPBELL, M.D., AND WILLIAM L. WATSON, M.D.

NEW YORK, N. Y.

FROM THE DEPARTMENT OF SURGERY, NEW YORK UNIVERSITY-BELLEVUE MEDICAL CENTER AND THE THIRD (NEW YORK UNIVERSITY) SURGICAL DIVISION, BELLEVUE HOSPITAL.

RECONSTRUCTIVE SURGERY of defects due to radiation faces problems inherent to the nature of the defect. Tissue necrosis and ulceration are complicated by superimposed infection; exudation and suppuration cause protein loss and serious nutritional disturbances. Arrest of wound healing, progressive extension of the necrotic process and a gradual physical decline are a characteristic sequence of events in such cases.

Tissue changes due to radiation are not confined to the ulcerated area alone but affect the surrounding tissue over a variable extent. Excision of the devitalized ulcerated area prior to the transplantation of healthy tissues should extend to well-vascularized surrounding tissues. When the adjacent skin is healthy and when the defect is of moderate size, immediate closure may be effected by means of pedicled flaps of neighboring skin and subcutaneous tissue. Also, if the defect presents a well-vascularized bed after excision of the ulcerated area, immediate covering may be obtained by a free skin graft of intermediate thickness. In two cases reported in this paper, such favorable conditions did not exist. The skin surrounding the defect had been subjected to radiation; the defect in each case was extensive and situated over vital areas limiting further excision, the pericardium in Case 1 and the dura in Case 2. It was necessary, therefore, to supply tissue from a distance source in order to obtain sufficient skin and subcutaneous tissue to cover the defect. Because of the reduced vascularization of the recipient site, the transplanted flap of skin was provided with an autonomous blood supply through its pedicle until vascular connections were established with the tissue surrounding the defect.

Careful preoperative preparation of the patient is essential and comprises control of acute inflammatory episodes; surgical drainage of the wound; removal of sloughs and sequestra; restoration of nutritional status and body weight by all necessary measures including repeated transfusions of whole blood.

The pedicled flap employed for the repair of these defects is an application of a technic used for the restoration of extensive tissue loss in military casualties (Cannon *et al.* 1947; Converse 1948).

Technic of the Closed Carried Flap. This pedicled skin flap is a closed flap; raw areas, open to infection, are thus avoided during the various transplantation procedures. In the cases described, the flap was raised from the abdomen, attached to the forearm and transferred to the defect.

Design and Preparation of the Flap. The ulcerated area represents the apparent defect; the raw area remaining after excision of devitalized and scarred tissue is the true defect which is considerably larger in size. In designing the flap an outline of the area to be excised is made. It should extend widely into well-vascularized surrounding tissues; the size of the true defect is thus obtained. A cloth pattern of the future defect is then made. The optimum position of transfer is determined, the forearm being

* Submitted for publication December, 1949.

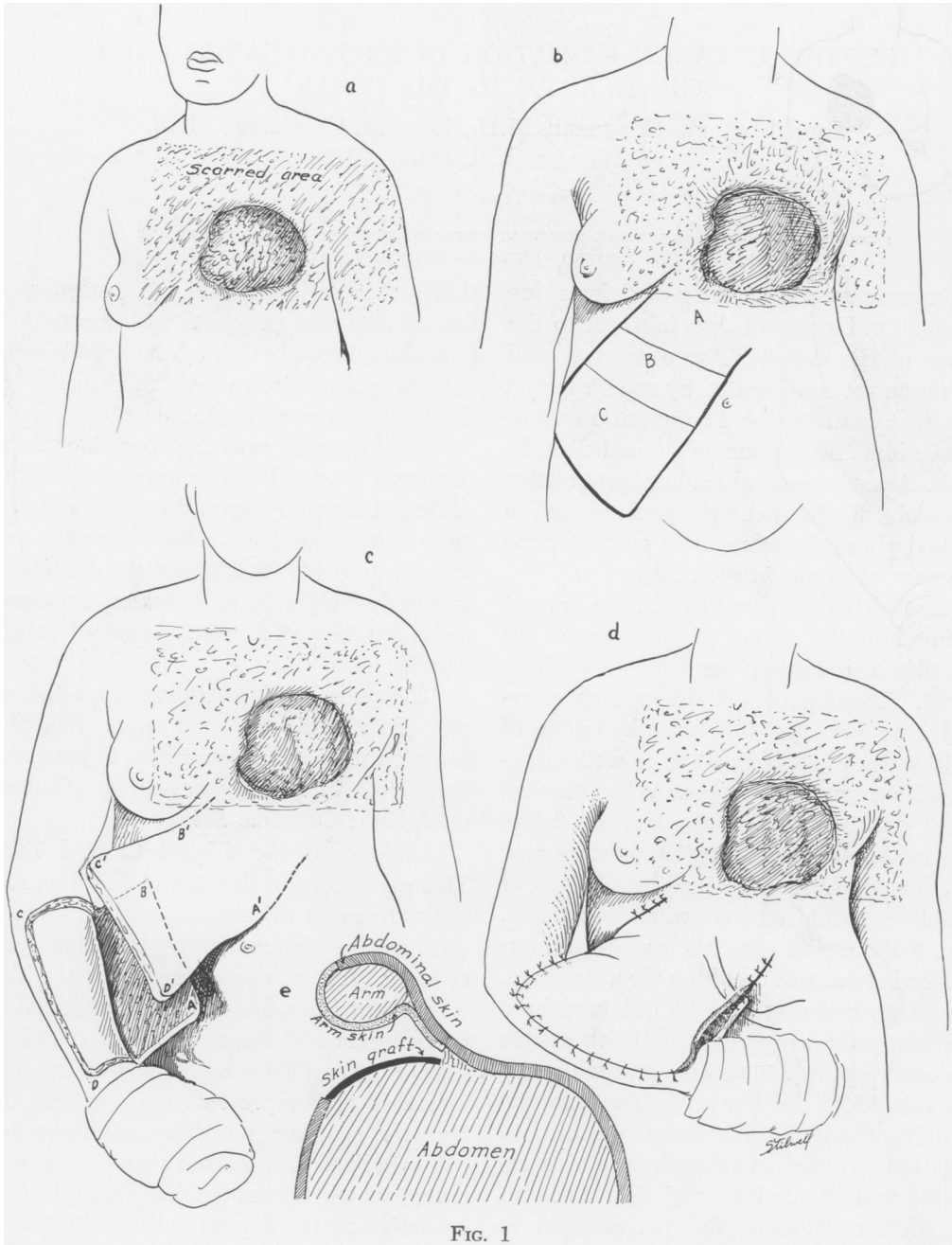

FIG. 1

FIG. 1.—Technic of repair of a thoracic defect. (a) Drawing illustrating the defect in the left thoracic area exposing the pericardium. The shaded area represents the scarred, previously irradiated skin. (b) Outline of abdominal flap. Portion A will remain attached to the abdomen; portion B is the intermediary part of the flap; portion C is attached to the forearm. (c) The abdominal and forearm flaps are raised. Point A of the forearm flap is sutured to A^1, point B to B,[1] (d) Illustrating the manner of suturing the forearm flap to the under-surface of the abdominal flap, thus achieving the closed carried flap. (e) Diagram showing respective positions of abdominal and forearm flaps. The abdominal defect is skin grafted.

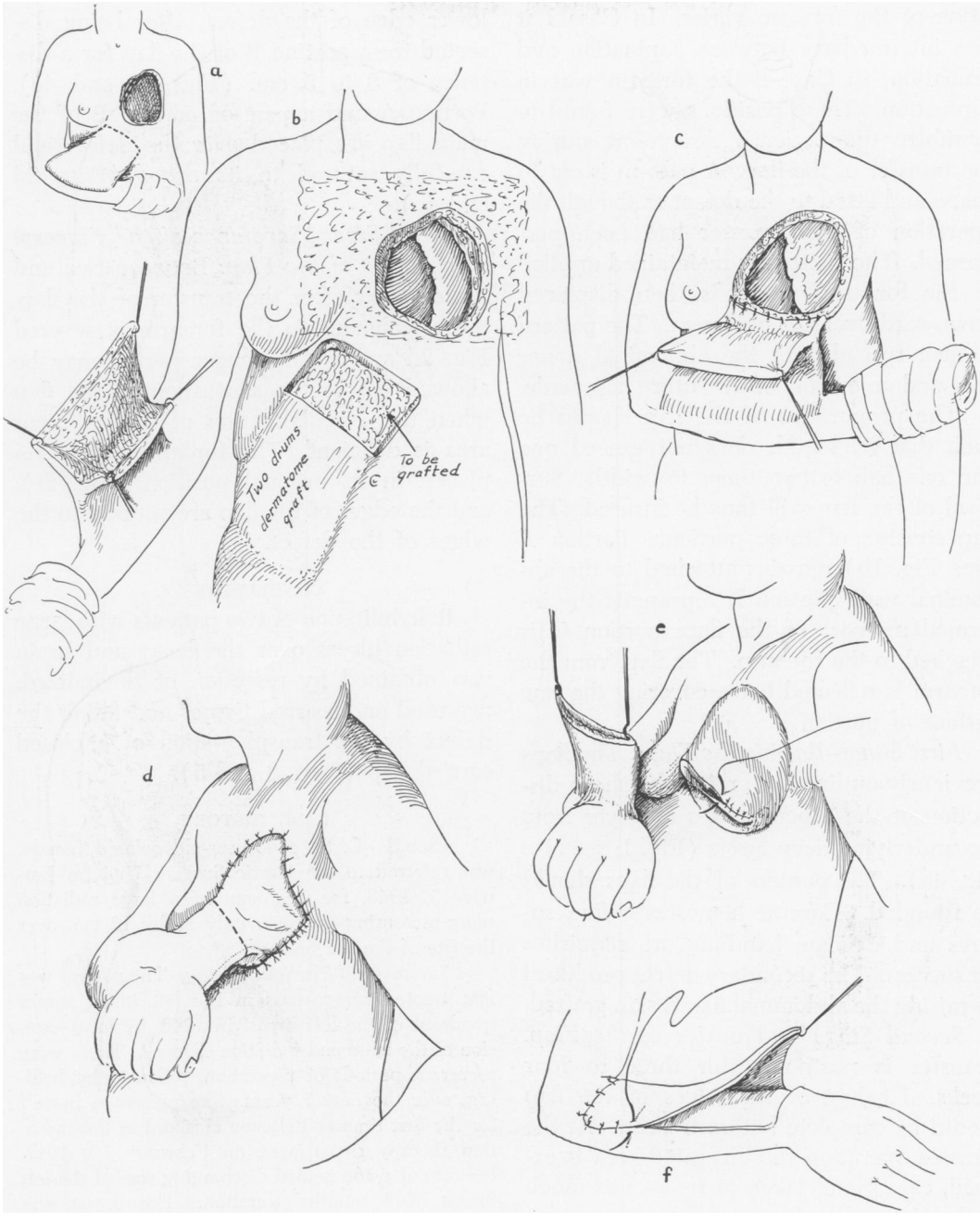

FIG. 2

FIG. 2.—Technic of repair of a thoracic defect (continued). (a) This illustrates line along which the proximal end of the flap is detached from the abdomen. (b) Excision of the devitalized tissues from the ulcerated area reveals the true extent of the defect. The flap is ready for transfer. (c) The distal end of the forearm flap is sutured to the lower border of the thoracic defect. (d) Suture of the flap to the thoracic defect is complete. (e) The flap is severed from its attachment to the chest. (f) The forearm flap is returned to its original position.

placed in proximity to the defect. The position of the forearm varies. In Case 1 it was intermediary between supination and pronation; in Case 2 the forearm was in supination. These positions were found to minimize the patient's discomfort during the transfer of the flap. A pattern is cut to shape and fitted to the defect as though the operation of flap transfer had been performed. The pattern is maintained applied to the forearm, which is then displaced downward over the abdomen. The pattern is then spread over the abdominal donor area and an outline of the future flap made.

The proportions of the flap should be such that its length does not exceed one and one half to two times its width. Survival of the flap will thus be insured. The flap consists of three portions. Portion A (see Fig. 1b) remains attached to the abdominal wall; portion B represents the intermediary part of the flap; portion C is attached to the forearm. The flap from the forearm is reflected back, covering the raw surface of portion B.

First Stage—Raising the Flaps. The flaps previously outlined are raised by sharp dissection of the subcutaneous fat layer from the underlying deep fascia (Fig. 1; see also Fig. 4a). The corners of the flaps should be rounded. Careful hemostasis, fine sutures and delicate handling are requisites for success. The secondary defect produced by raising the abdominal flap is skin grafted.

Second Stage — Transfer of the Flap. Transfer is postponed for three to four weeks. Healing of the edges of the flap should be complete before transfer. At the transfer operation the ulcerated area is excised, care being taken to remove as much of the fibrosed and non-vascular tissue as is compatible with anatomical limitations such as pericardium or dura (Figs. 2b and 4b). The abdominal attachments of the flap are severed and the forearm carrying the flap is placed near the defect, in the previously planned position of transfer. The distal portion of the forearm flap is sutured to the lower edge of the defect, after being dissected from portion B of the flap for a distance of 3 to 5 cm. (Figs. 2c and 4c). Portion A and a part of portion B of the main flap are placed over the defect and carefully sutured to its edges (Figs. 2d and 4c).

Third Stage—Severance of the Forearm Attachment of the Flap: Between two and three weeks after the transfer of the flap, the attachment to the forearm is severed Fig. 2d and e). A longer period may be allowed before the separation of the flap when the vascularization of the recipient area is deficient. The forearm flap is replaced in its original position (Fig. 2f); and the edges of the flap are sutured to the edges of the defect.

CONCLUSIONS

Rehabilitation of two patients with large radiation ulcers over the heart and brain was obtained by resection of devitalized, necrosed and scarred tissues and filling the defect by the transplantation of a closed carried flap (Figs. 3 and 5).

CASE HISTORY

Case 1.—L. S., a 48-year-old colored female, was referred to the Plastic Surgery Unit on January 5, 1948, for treatment of a large radiation ulcer measuring approximately 17 by 12 cm. over the site of the left breast.

Summary of Previous History. The patient was first treated for a mass in the left inner, upper quadrant of the left breast in 1940, by local excision of the mass and radiation therapy. There were recurrent periods of ulceration, followed by healing, over the next 7 years. She presented herself for the first time at Bellevue Hospital in the radiation therapy department on February 19, 1947, because of a non-healed discharging sore of the left breast of 6 months' duration. The breast was markedly deformed and adherent to the chest wall with a mass in the upper, inner quadrant associated with an overlying ulcer and fine palpable nodes in both axillae. A roentgenogram of the chest showed no evidence of metastasis; biopsy was positive for recurrent carcinoma. She received a total of 11,000 mg. hours in the form of radium applications.

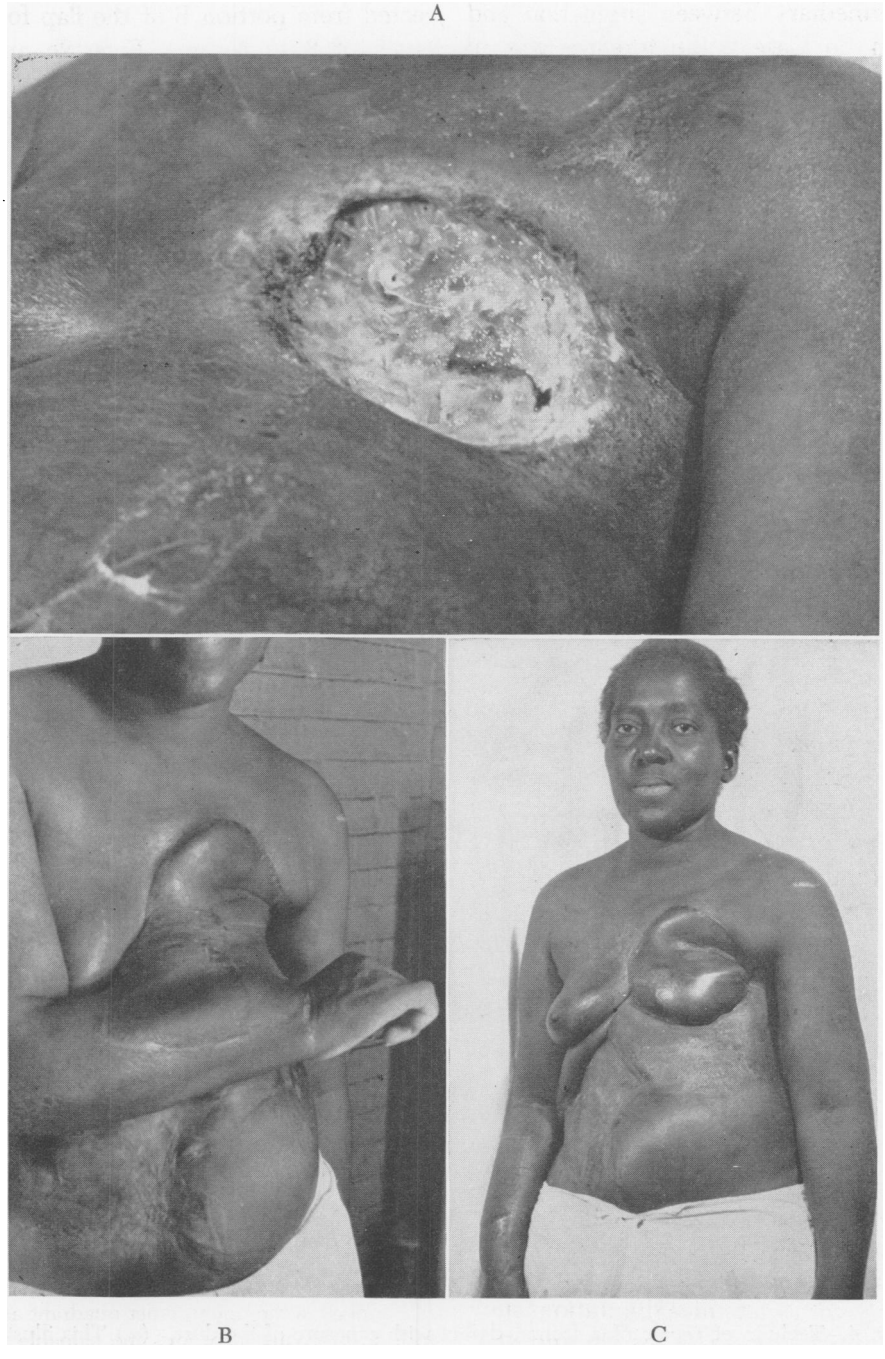

FIG. 3.—Repair of a thoracic defect with exposure of the pericardium. (A) Photograph of thoracic defect over the heart. The skin surrounding the defect is scarred. (B) The closed carried flap transferred to cover the defect. (C) Aspect of the patient after reconstruction by the technic illustrated in Figs. 1 and 2.

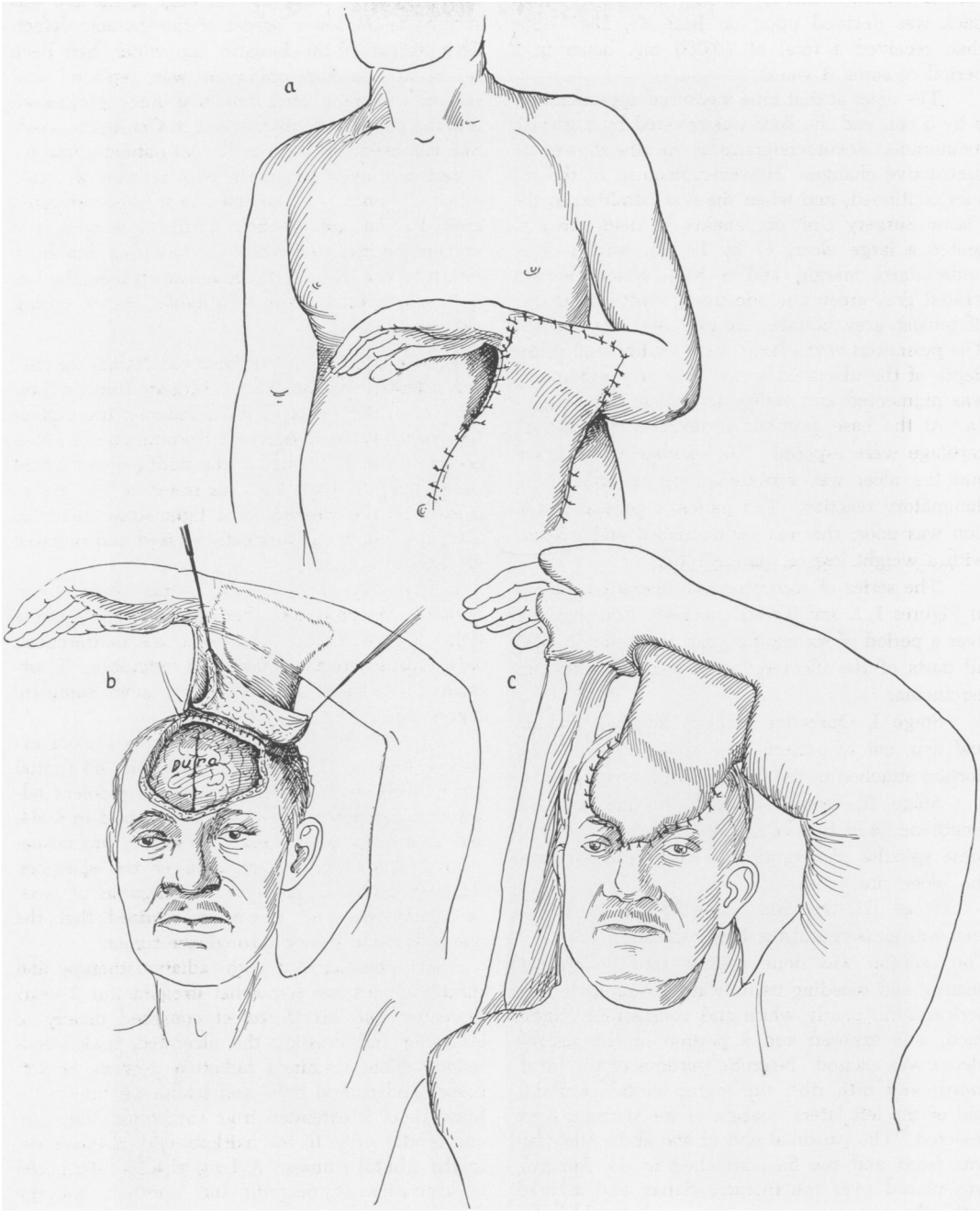

FIG. 4.—Technic of repair of a frontal defect with exposure of the dura. (a) This illustrates the closed carried flap after its attachment to the forearm. The forearm flap has been turned down and sutured to the under surface of the abdominal flap. (b) The flap has been detached from the abdomen and the distal end of the forearm flap is sutured to the upper edge of the frontal defect. (c) Aspect of the flap covering the frontal defect. Immobilization is assured by plaster jacket.

The ulcer and mass regressed for a time but further radiation therapy in the form of a radium pack was decided upon on June 27, 1947. She then received a total of 70,000 mg. hours in a period of some 3 weeks.

The ulcer at that time measured approximately 5 by 5 cm. and the floor was covered by a greyish membrane. Roentgenograms of the ribs showed no destructive changes. However, necrosis of the tissues continued, and when she was admitted to the Plastic Surgery Unit on January 5, 1948, she presented a large ulcer, 17 by 12 cm., with a firm, undermined margin and a base which demonstrated grey-green necrotic sloughs with a number of pinkish-grey nodules diffused over the surface. The pulsations of the heart were readily seen in the depth of the ulcerated area. The surrounding skin was pigmented and scaling as indicated in Figure 1a. At the base, portions of necrotic ribs and rib cartilage were exposed. The exudate was marked and the ulcer was surrounded by an area of inflammatory reaction. The patient's general condition was poor; she was malnourished and anemic, with a weight loss of some 20 lbs.

The series of reconstructive operations shown in Figures 1, 2 and 3 were planned. Four biopsies over a period of six months prior to operation from all parts of the ulcerated area were negative for carcinoma.

Stage I, Operation January 23—The abdominal flap, cut to pattern, was raised and its distal portion attached to the right forearm (Fig. 1).

Stage II, Operation April 15—The flap was lengthened and further delayed. At the same time some spicules of necrotic rib were removed from the ulcer site.

Stage III, Operation June 23—The ulcerated area was excised and the flap transferred (Fig. 2). The excision was done widely until healthy-appearing and bleeding tissue was encountered. The pericardium, pearly white and considerably thickened, was exposed and a portion of the scarred pleura was excised. Necrotic portions of the third, fourth and fifth ribs, the eighth costal cartilage, and of the left lateral margin of the sternum were resected. The proximal end of the abdominal flap was freed and the flap, attached to the forearm, was placed over the thoracic defect and sutured with silk without tension. Intermediate thickness skin grafts, cut with the dermatome were applied over the abdominal defect. The arm was supported by slings and elastoplast to prevent any possibility of kinking of the flap. Pathologic examination of the tissue removed at this operation revealed no tumor.

Stage IV—On September 22 the flap was separated from the forearm. The edge of the flap was sutured to the lower border of the thoracic defect. The portion of the forearm flap which had been raised at the first operation was replaced and sutured. Healing after the final stage progressed and the patient was discharged on October 6, 1948. She has been followed in the out-patient clinic for a period of over 18 months with no sign of recurrence of tumor or breakdown in the reconstructed area. She has gained about 25 lbs. in weight, is in excellent spirits, and while she has been unable to return to her job as a Pullman car cleaner, she has been employed at work of a lighter nature sorting clothes (Fig. 3).

Case 2.—A. C., a 74-year-old Italian laborer, was admitted to the Plastic Surgery Unit on January 25, 1948. Prior to this admission the patient had been treated in Bellevue Hospital on numerous occasions for a "lesion" of the midforehead which commenced in 1933 and was stated to be "a sore caused by the wearing of a tight straw hat." In 1935 the lesion was surgically excised and radiated at another hospital.

Five years later (1940) he first appeared at Bellevue Hospital. At that time he presented a lesion 3 by 4 cm. in diameter in the midforehead with crusting, telangiectasis and induration. Treatment by radium packs caused almost complete regression.

In 1942 the lesion recurred; it was more extensive than on the previous admission and frontal bone involvement was apparent. An indolent adherent ulcer persisted, which was excised in 1944, and an attempt to skin graft the defect was unsuccessful. Pathologic examination of the specimen removed in 1944 confirmed the diagnosis of basal cell carcinoma and it was determined that the line of excision passed through the tumor.

His attendance at both radiation therapy and surgery clinics was somewhat irregular for 2 years thereafter and his treatment consisted mainly of cleansing and dressing the ulcerated, malodorous lesion which combined radiation necrosis of soft tissues and frontal bone and malignant tumor. In May, 1946, it extended from the root of the nose and orbital ridge to the hairline, with involvement of the frontal sinuses. A lung abscess, attributed to aspiration of necrotic and purulent material draining into the nasal cavities, caused him to be hospitalized in November, 1946, at which time he refused operation. His condition became so poor, however, and the lesion so repulsive to himself and others that he consented to operation in April, 1947, at which time an extensive resection of the frontal bone and soft tissues of the forehead was done

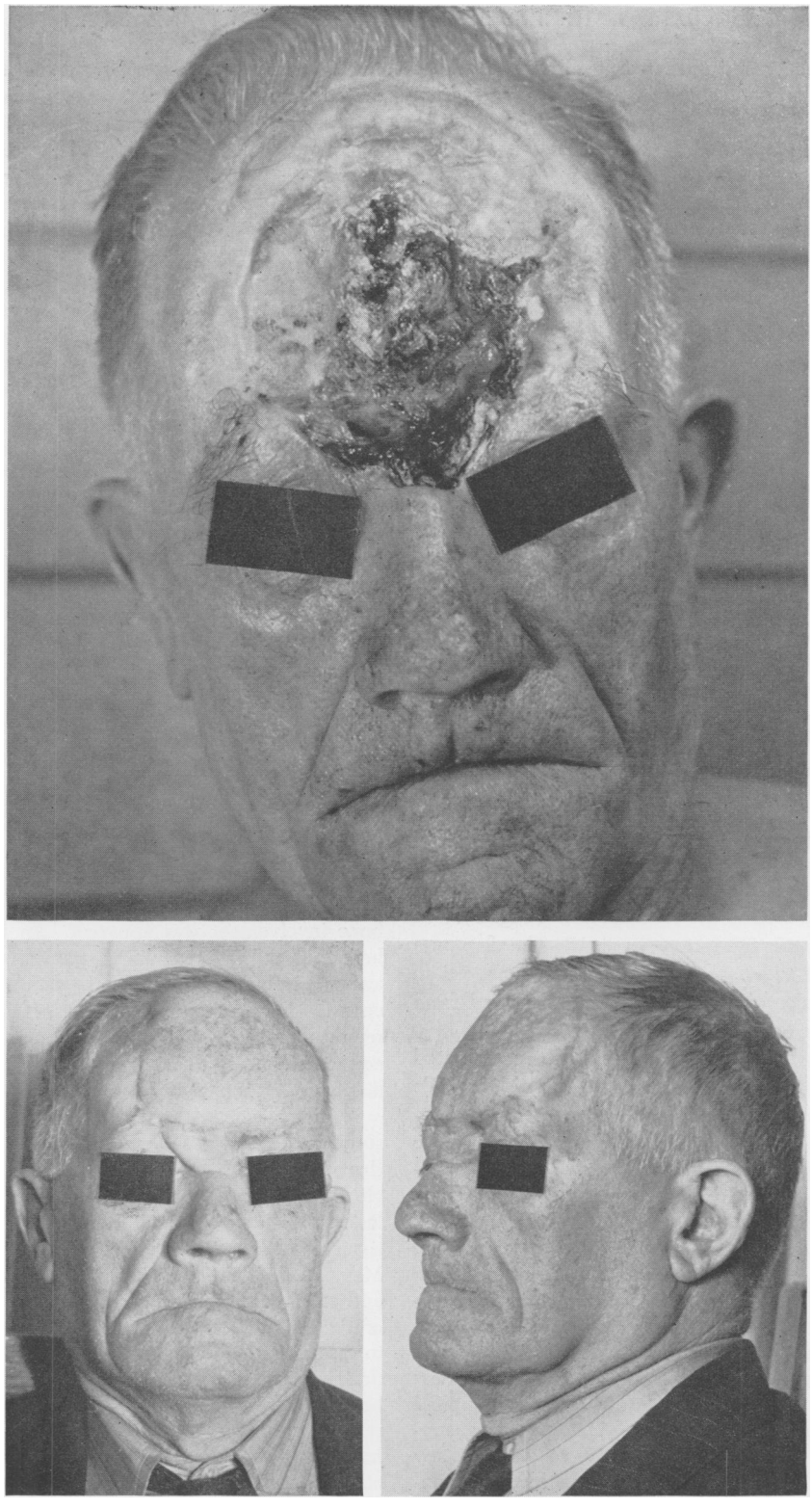

FIG. 5.—Repair of a frontal defect with exposure of the dura. (a) View of frontal defect. The dura is uncovered and sequestrating bone forms the edges of the defect. (b) Aspect of the patient after transfer of the closed carried flap.

under local anesthesia. The pathologist reported basal cell carcinoma of the skin with extension into bone. The frontal sinuses were opened and drained. The dura was covered with split thickness skin grafts. Roentgenograms of the chest revealed a lung abscess cavity in the lower third, right lung field. The skin graft took successfully but the patient's general condition remained such that two additional periods of hospitalization in 1947 were required. On one of these admissions hemolytic streptococci were cultured in the sputum and in the purulent discharge from the sinuses. After a course of antibiotics the patient's general condition improved and signs and symptoms of lung abscess disappeared.

At the time of admission to the Plastic Surgery Unit, examination revealed several small indolent ulcerated areas and the upper ends of the nasal bones and frontal sinuses exposed, dry and necrotic. Pulsation was present beneath the graft over the dura. The patient's general condition was satisfactory. A pedicled skin flap from the abdomen was planned and performed in the following stages:

Stage I, January 28, 1948.—An abdominal flap was raised and attached to the forearm; the abdominal defect was covered by a skin graft (Fig. 4a). Careful attention to the position of the arm postoperatively eliminated any tendency of the flap to kink. Moderate edema of the hand resulted from its dependent position.

Stage II, April 28, 1948.—The flap was severed from its abdominal attachment, the split graft on the dura was removed along with all the surrounding scarred and devitalized tissue, and the edges of the flap were approximated to the edges of the defect in the manner shown in Figs. 4b and c. A plaster jacket and arm support were applied.

Stage III, May 19, 1948.—The flap was separated from the forearm and final suturing of the flap to the edges of the cranial defect was done. The forearm flap was re-sutured into its original position. Following separation of the flap, the arm was maintained at a right angle by an arm abduction splint in order to overcome the stiffness due to disuse and the elevated position. In a gradual manner it was lowered to his side some 24 hours later. After a period of physical therapy and some minor revisions of the forehead scars, the patient was discharged on July 20, 1948.

BIBLOGRAPHY

[1] Cannon, B., C. E. Lisher, W. B. Davis, S. Chasko, A. Moore, J. E. Murray and A. McDowell. The Use of Open Jump Flaps in Lower Extremity Repairs. Plastic & Reconstruct. Surg., **2:** July, 1947.

[2] Converse, J. M.: Plastic Repair of the Extremities by Non-tubulated Pedicle Skin Flaps. J. Bone & Joint Surg., **30:** January, 1948.