animals. His tissue-serum ratio of bromide in the pituitary of the pig was 0.22. This compares reasonably well with the ratio of 0.28 for rabbits and 0.36 for rats in the present series, and contrasts sharply with the ratio of 17 obtained by Bernard and Ucko(1).

The results are also in agreement with those of Perlman *et al.*(5), who found no selective uptake of Br^{82} by the hypophysis of the rat. At variance is the failure to demonstrate preferential uptake by thyroid tissue. Perlman and coworkers found a higher concentration of Br^{82} in the thyroid gland than in plasma, and also succeeded in augmenting the content of the gland by 30% with thyrotropin. The lack of such selective concentration of Br^{82} in the animals of the present series might be dependent on either a fortuitously low level of thyroid activity in the animals, or the existence of a state of relative iodine saturation. It would appear from the work of Bauman, Sprinson, and Marine(9) that a significant substitution of bromine for iodine requires the presence of a pre-existing iodine depletion. In a recent report by Verkhovskaya(10) the Br^{82} uptake of the pituitary, while in most instances not different from that of other organs, was in 2 out of 19 rats, 15 to 30 times greater than in the remainder of the animals. Although it is possible that a variation in the functional status of the gland might be responsible for such divergent values, a technical error would seem to be a more likely explanation. Dixon found no more bromide in the pituitary of the ox, in which gonadotropin synthesis should be very pronounced, than in the cow or bull.

Summary. In confirmation of previous work(3,5), no evidence was adduced for the selective concentration of bromide in the form of Br^{82} by the pituitary gland of the rat and rabbit. The activity of gastric contents and gastric tissues was relatively high, but no preferential uptake by thyroid tissue(5) was demonstrated.

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Some Results of Substituting Other Nerves for the Phrenic. (19507)

DONALD DUNCAN AND ROBERT H. EANES.
From the Department of Anatomy, University of Texas Medical Branch, Galveston.

The reports of Brown and Satinsky(1,2) on successful substitution of the phrenic nerve by the vagus caudal to its inferior laryngeal branch suggested the possibility of using other nerves for the same purpose. The results of a variety of such cross anastomoses are reported in this paper. In general, powerful contractions of the diaphragm are obtained on direct stimulation of these nerves, but lack of proper central control makes them inadequate to serve as the only route for respiratory impulses. In this respect the results of the present study differ from those obtained by Brown and Satinsky after vago-phrenic anastomosis, and likewise from the results reported by Colledge and Ballance(3) following cross anastomosis of the descendens hypoglossi and the phrenic nerve.

Materials and methods. Under nembutal anesthesia the trapezius portion of the acces-

sory nerve was anastomosed to the phrenic nerve on the right side of 5 adult cats and the long thoracic nerve was used likewise in 2 cats and 5 rats. In one cat buccal branches of the right facial nerve were anastomosed to the distal end of the fourth cervical contribution to the phrenic. The nerve ends were held together with a single loop of .005 or .003 inch tantalum wire. The wire was sharpened under a binocular microscope and each nerve was stabbed through the middle one or two millimeters from its cut end. The wire was then formed into a small loop bringing the two cut ends in contact. The anastomosed nerves were under no tension as previous trials with tension nearly always resulted in separation of the opposed ends.

Results. After 140-218 days, the site of anastomosis was exposed and the nerves freed from surrounding structures. The substituted nerve was then stimulated with a Harvard inductorium 2-3 cm above the site of anastomosis. Vigorous contraction of the diaphragm occurred in all cats tested; of these, 4 had an accessory, 2 had a long thoracic, and one a facial nerve substitution. The 2 surviving rats with long thoracic replacement gave similar results. Procedure from this point varied with developing experience. In the cat with the facial anastomosis, the opposite phrenic, both long thoracic nerves and the infrahyoid muscles were cut. These procedures resulted in a considerable increase in respiratory effort. The right facial nerve then was cut and additional respiratory effort followed, but the cat continued to breathe regularly for 20 minutes presumably with the intercostal muscles only. The animal was then sacrificed. After death, stimulation of the distal end of the cut facial nerve caused vigorous contraction of the exposed diaphragm. In the other animals the adequacy of the substituted nerve was checked by transection of the cord between the eighth cervical and first thoracic vertebrae combined with avulsion of the left phrenic nerve. Only one animal breathed rhythmically after these maneuvers, using the right side of the diaphragm. However, it continued this respiration after the substituted nerve was cut. Further dissection of the phrenic nerve at the thoracic inlet led to abrupt cessation of all diaphragmatic movement in this animal indicating the presence of accessory phrenic fibers that escaped notice at the time of anastomosis. Failure of respiration in these animals was not due to insufficient motor innervation of the diaphragm by the substituted nerve as demonstrated by the following procedure. After cord transection and left phrenic avulsion 2 cats and one of the rats were kept alive for an hour by periodic electrical stimulation of the substituted nerve.

Discussion. Brown and Satinsky consider x-ray visualization of diaphragmatic movement and severance of the opposite phrenic nerve as sufficient proof of the effectiveness of vago-phrenic anastomoses. Colledge and Ballance depended on x-ray visualization alone. Such measures are inadequate in the rat and cat since they survive very well, at least for short periods, on the intercostals alone. In these species, elimination of all intercostals, the other phrenic nerve, and careful exclusion of any remaining phrenic fibers on the operated side are necessary for the evaluation of a phrenic nerve substitution in acute experiments. When these precautions are taken, the facial, the accessory and the long thoracic are unable to induce rhythmic contractions when innervating the diaphragm. This failure is not due to diaphragmatic weakness but to the absence of rhythmic bursts of nerve impulses even under extreme respiratory distress. The failure of the "external respiratory nerve of Bell" suggests that this term for the long thoracic is a misnomer at least when applied to the cat and rat. The motor adequacy of the nerve crosses suggests that a human being with the same types of anastomosis could breathe with such an arrangement by attempting to move the muscle ordinarily supplied by the nerve anastomosed to the distal end of the phrenic. In other words, while awake he might substitute dependence on a respiratory machine for voluntary efforts that would result in adequate contractions of the diaphragm.

Summary and conclusions. The spinal accessory, the long thoracic and facial nerves were substituted for one phrenic nerve in cats and rats. All of these nerves will supply motor fibers to the diaphragm sufficient for it

to serve as the only respiratory muscle. Lack of proper central connections prevents spontaneous use of this power in the animals tested.

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A Simple Electrode Carrier for the Exploration of Subcortical Structures.* (19508)

M. KLETZKIN. (Introduced by E. A. Spiegel.)

From the Department of Experimental Neurology, Temple University School of Medicine, Philadelphia, Pa.

Electrode carriers for use in the stimulation of or recording from subcortical areas have been developed by Hess(1), and his school (2), Harris(3), Hunter and Jasper(4), and recently by Knowles(5). These technics for implanting brain electrodes, particularly that developed by Knowles, are elaborate and laborious, requiring careful construction of various parts and sub-assemblies, such as base plates, electrode carrier plates, assembly jigs, and electrode carrier assemblies. In addition, the curvature of the skull necessitates, in the Knowles method, the formation of a broad foundation to receive the electrode carrier or base plate; and finally the electrode carrier must be fixed securely and aligned with great exactness in the plane of the stereotaxic apparatus, a process demanding repeated checking and leveling of the electrode carrier. All this is avoided in the method described here, yet the electrodes are accurately placed, the procedure is simple and quick, and no assemblies or sub-assemblies are used.

Procedures. Under general anesthesia a piece of 3/8 inch plexiglas, 15 mm x 20 mm (a, Fig. 1) is fastened over a trephine opening in the skull as securely as possible, disregarding its orientation to the stereotaxic apparatus in which the animal is fixed. A dental drill mounted in the electrode holder of the stereotaxic apparatus is then used to drill guide holes (b, Fig. 1) at the chosen coordinates and in the desired direction. Upon recovery from anesthesia, the electrodes (c, Fig. 1) can be inserted without discomfort to the animal to the desired depth. The depth may be varied throughout the experiment, or the electrode

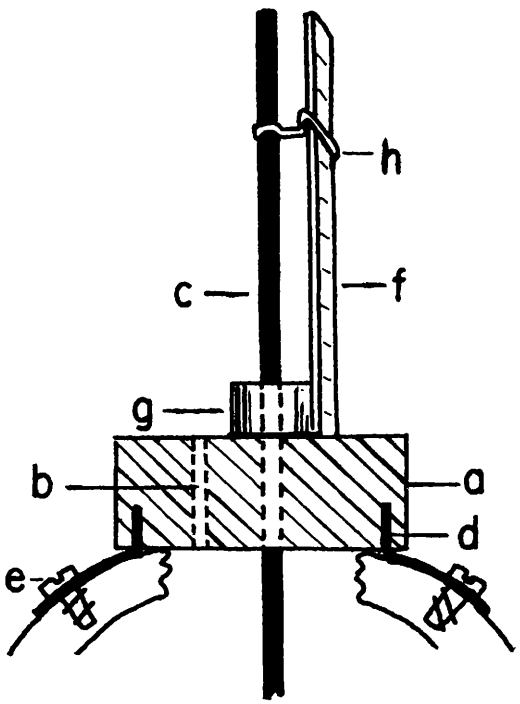

FIG. 1. Plexiglas plate with electrode in place. a—plexiglas plate; b—guide holes; c—electrode; d—solder lug; e—screw; f—scale; g—stop; h—scale indicator; i—spring.

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