arteriovenous malformations over a period of 26 years. One hundred and thirty-two of these were supratentorial and 18 infratentorial. Patients seen in the earlier years were referred because of haemorrhage and had in general larger lesions than those seen more recently. This fact was related to the increasing use of angioencephalography, especially with respect to patients with convulsive seizures. Fifty-four patients were operated on by the authors and 17 underwent operation by surgeons with whom the patients had been seen in consultation. Surgical intervention was contraindicated in 40 patients and was declined, though advised, in the remainder. On three occasions radiotherapy was administered by a 1 000 kV source and on two occasions by the Synchrotron (70 000 kV) without benefit.

In nine patients with supratentorial lesions there were coexisting saccular aneurysms. Haemangioblastomas were found in three patients.

EMBOLIZATION IN THE PREPARATION FOR SURGERY OF LARGE CEREBRAL ARTERIOVENOUS MALFORMATIONS

B. M. STEIN, R. A. R. FRASER, and S. WOLPERT (Boston) considered that controversy existed regarding the best method of treating intracranial arteriovenous malformations. The operative mortality was probably 10% and in conservatively managed series the long term mortality was 15–20% with a morbidity rate of about 30%. The authors had used silastic emboli varying in size from 0.5 to 2.0 mm and introduced by femoral arterial catheters as a preoperative treatment. During a nine month period seven patients had been treated in this fashion. The objects of the procedure were to produce better preoperative status of the patient, to cut down the blood supply of the malformations, and to promote better perfusion of normal brain by reducing the steal phenomenon through the malformation. Indications for terminating the procedure were appearance of neurological deficit, lodging of emboli in normal vessels, significant reduction of perfusion to the malformation, and improvement in normal circulation. There was one operative death in a patient in whom embolization of a large malformation in the right Sylvian region had been unsuccessful. It was concluded that embolization was an important adjunct to surgery but was not in itself a cure, that occlusion of normal cerebral arteries during embolization was associated with transient neurological deficits and rapid development of collateral circulations and normal flow patterns, that arteries near to the malformation could compensate for vessels occluded by embolization, and that changes in the arteries feeding the malformations were slow to resolve.

ANALGESIA DOLOROSA AFTER DIFFERENTIAL RETRO-GASSERIAN THERMAL OR MECHANICAL RHIZOTOMY: TACTICS EMPLOYED TO DECREASE ITS INFLUENCE

W. H. SWEET (Boston) noted that after differential thermal retrogasserian rhizotomy with sparing of some touch fibres there might be a state of continuing pain described in the same terms as those used by patients with the anaesthesia dolorosa found after total division of rootlets. This had occurred in patients with idiopathic trigeminal neuralgia sufficiently frequently for the author to halt the procedure after producing a smaller lesion than customary in any patient in whom concern was caused by subjective numbness. Analgesia dolorosa has been more common after treatment of facial pain other than that caused by trigeminal neuralgia. For the past 18 months he had included in the preoperative appraisal a temporary differential lidocaine block of the retrogasserian rootlets so that the patient might be given a trial period of hypalgesia or analgesia without loss of touch sensation. The clinical results were described in the treatment of (1) idiopathic trigeminal neuralgia, (2) symptomatic trigeminal neuralgia, (3) periodic migrainous neuralgia, (4) pain after trauma, (5) pain due to neoplasm, (6) post-herpetic pain, (7) pain due to no demonstrable cause.

The results were correlated with the various grades and types of sensory loss in each variety of case.

MEDICAL MODIFICATION OF SENSORY LOSS OPERATIVE DENERVATION

CHARLES J. HODGE, JR, and ROBERT B. KING (Syracuse, New York) pointed out that denervation of the head and neck by sectioning the descending tract of the trigeminal nerve, the nervus intermedius, the ninth cranial nerve, the upper parts of the tenth cranial nerve, and the upper cervical dorsal roots would be expected to provide adequate relief of craniocervical pain. They felt, however, that the results of this type of surgery were often poor. Detailed sensory examination of two patients after such surgical procedures and after having received L-dopa, alphamethyldopa, and nitrous oxide revealed that the sensory loss from extensive denervation was variable in a predictable fashion. The return of preoperative pain associated with administration of L-dopa had been correlated with return of sensation to areas presumed to be completely denervated. The subjective and objective decrease in sensory loss could be reversed by alphamethyldopa and nitrous oxide. They concluded that sensory overlap by way of neighbouring dorsal roots was more extensive than previously described in man and further that the pathways involved in the return of sensation and subjective pain did not develop as a result of the denervation but were always present.

The quantitative amount of sensory information transmitted by these overlapping pathways depends to some extent on the pharmacological balance of the individual's catecholamine metabolism, presumably reflecting subliminal interneurone activation by aminergic pathways.

SURGERY FOR MOTOR TICS OF THE FACE AND NECK

W. B. SCOVILLE (Hartford) described a series of cases of various forms of facial tic, including hemifacial spasm, bilateral blepharospasm, and platysma spasm, with the appropriate surgical measures for their correction. It was pointed out that these motor tics could be totally disabling and that psychiatric and drug treatment was often of no avail. Selective microsurgical section of the proximal submastoid portion of the 7th nerve was simple and safe. Mild partial return of the tic might occur two or more years after operation which might, however, be repeated. The operations could be done on one or both sides at one sitting without a noticeable scar and with a simpler approach than that which was required for selective operations distal to the parotid gland. Jannetta's technique of microsurgical decompression of the 7th nerve at the cerebellopontine angle was discussed. It was suggested that this technique was highly successful but it required considerable microsurgical expertise and carried with it some risk of unilateral hearing loss because of the vulnerability of the blood supply to the internal auditory artery in patients with hemifacial spasm. Stereotaxic lesions of the thalamus had proved unsatisfactory in the surgical treatment of spasmodic torticollis. In intractable cases of this condition, anterior cervical rhizotomy and spinal accessory nerve section constituted the treatment of choice, although selective unilateral section of the spinal accessory nerve in the neck was sufficient in early cases.

IMPROVED PERFORMANCE IN SOME DYSNOMIC STATES AFTER HUMAN VENTROLATERAL THALAMIC STIMULATION

G. OJEMANN (Boston) investigated the effect of stimulating the human ventrolateral thalamus two to four days before object naming in, firstly, the transient dysnomia which sometimes follows ventrolateral thalamotomy, especially when carried out on the dominant side (11 patients) and, secondly, in a single case of dysnomia resulting from a left hemisphere cerebrovascular accident. This investigation was carried out during a study of the acute effects of thalamic stimulation on language and memory during a course of stereotaxic operations for dys-

kinesias. During this study the thalamus was stimulated during object naming in a random fashion and the patients were retested two to four days after thalamotomy. The presence of an anomie state after thalamotomy was shown by an increase in object naming errors during postoperative testing when no stimulation had occurred at the time of operation. In an unselected series of 11 patients showing dysnomia after thalamotomy, 10 showed fewer errors when stimulation had occurred at operation than would have been expected from performance after operation without stimulation ($T=1$, $P<0.01$). The mean error rate for object naming after stimulation at operation was 56% of that which would have been expected had no stimulation occurred at operation. The patient with the pre-existing anomia made errors on naming 21% of objects when no stimulation had been applied at operation. No change in this percentage followed the infliction of a lesion in the left pulvinar for the treatment of spasticity. Naming errors occurred in only 7.7% of objects when stimulation had been carried out at operation. When stimulation had not been applied the error rate was 34%. These observations suggested that stimulation of the human lateral thalamus at the time of input of verbal information enhanced the accuracy of identifying this same material several days later. This effect seems to be present even when there was pre-existing dysnomia and the technique might prove useful in the treatment of some language disorders.

COMPUTER MAPPING OF HUMAN SUBCORTICAL SENSORY PATHWAYS DURING STEREOTAXIS

R. R. TASKER, I. H. ROWE, P. HAWRLYSHYN, and L. W. ORGAN (Toronto) had developed a computer technique for on-line display of physiological data collected for target localization during stereotaxic surgery performed for the relief of intractable pain or involuntary movement. Atlas detail for the appropriate brain-stem plane was plotted in terms of stereotaxic brain coordinates corrected for the patient's thalamic height and length. As the electrode was introduced and serial threshold stimulation carried out in 2 mm steps the trajectories, stimulation sites, and thresholds were added together with the quality and body location for all responses in the form of a Woolsey type figurine chart. Data were stored so that the results from every patient could be scanned, permitting a computerized plotting on appropriate brain-stem sections of all responses of any particular type of pain. Illustrative data were presented charting the course of the human auditory, vestibular, and somatosensory pathways.