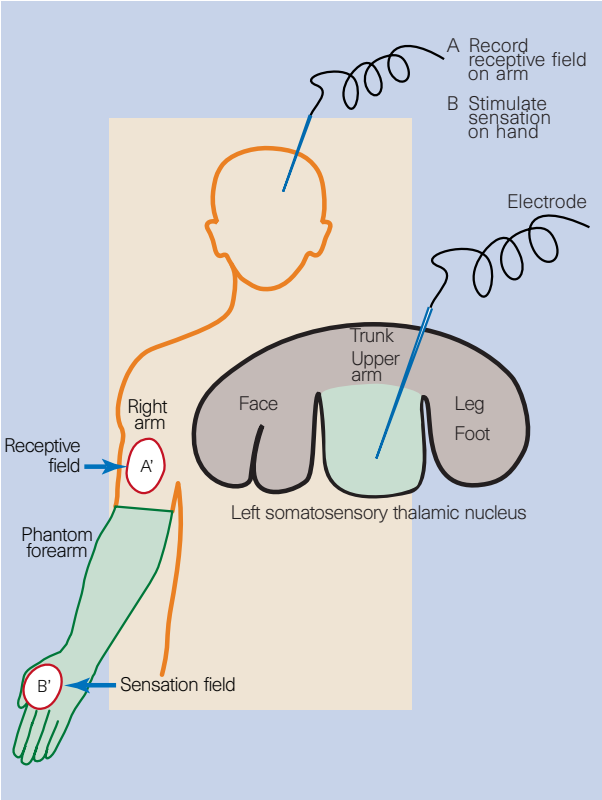

Figure 1 **Evidence of brain reorganization without respecification. The studies of Davis *et al.*[7], discussed here, involved recording and electrically stimulating neurons in the somatosensory thalamus of patients with a missing forearm or lower leg (not shown). When the electrode is inserted into the portion of the somatosensory thalamus where neurons are normally activated by touch on the hand, recordings (A) reveal receptive fields on the stump of the amputated limb (A′ on the right arm). Thus, the thalamus has reorganized so that the hand region responds to the upper arm. When the same neurons are electrically stimulated (B), sensations are felt on the missing hand (sensation field, B′). So the reorganized hand portion of the thalamus continues to signal the hand's existence.**

neurons in the thalamus in turn activate neurons elsewhere in the brain. But we now know that, for at least some people, deprived but reactivated neurons do not take on new and appropriate functions. Instead, these neurons continue to carry out their original roles. However, mismatched receptive and sensation fields were not found in all patients, suggesting that sometimes the reactivated neurons recalibrated to signal stump locations rather than locations on the missing limb.

The results of Davis and co-workers are consistent with limited observations of Woolsey *et al.*[12] on the effects of stimulating somatosensory cortex in a patient with phantom leg pain. Electrical stimulation of the leg area of somatosensory cortex produced the sensations in the phantom leg. No studies were carried out on the possible reorganization of this cortex, but the observation that sensations were referred to the phantom leg indicates that that part of the cortex continued to signal the existence of the missing leg. We can conclude from these studies that neurons in the brain can retain their original functions long after they have had time to adopt new ones.

The thalamic stimulations and recordings in amputees provide support for another important conclusion. Most of the evidence for brain reorganization after injury or altered experience has come from studies of the more accessible sensory representations of the cortex on the surface of the brain. Information from receptors in the skin is relayed through sensory nerves to the lower brain stem, then to the thalamus, and next to the cortex. Depending on the circumstances of injury or experience, reorganizations of cortical maps could depend on modifications of neural circuitry that occur in the cortex, subcortical stations, or both. In monkeys with long-standing therapeutic forelimb amputation, the hand region of cortex is activated by intact inputs from the upper arm and face[3]. In these same monkeys, nerve fibres from the upper arm appear to have sprouted in the lower brain stem to innervate neurons normally contacted by nerve fibres from the missing hand.

From this it seems that the growth of new nerve terminals at the level of the first relay station activates the deprived brain-stem neurons, which project to and activate deprived neurons of the somatosensory thalamus, which in turn relay to the cortex. The extensive reactivation of deprived portions of the human thalamus demonstrates that there is a subcortical locus for much of the reorganization that follows limb amputation. □

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100 YEARS AGO

"Rev. C. L. Dodgson" – A formidable champion of Euclidean methods in the elementary teaching of geometry has just passed away after a short illness. … Without stint of labour he submitted to rigid logical analysis every text-book on the subject that came to his notice, undismayed by their surprising number, the result being the amusing and, at the same time, deep "Euclid and his Modern Rivals," published in 1879, in which he demonstrated the logical superiority of Euclid's method over all the others examined. … He invented a new method of evaluating determinants, which is published in the *Proceedings* of the Royal Society for 1866, and also a method (which was published in NATURE) of easily determining the day of the week corresponding to any date. In October last he described in NATURE a brief method of dividing a given number by 9 or 11; and a second paper on the same subject, which appears in our correspondence columns this week, probably represents his latest contribution to mathematics. … Mr. Dodgson's mind was essentially logical, in spite of the whimsical humour which has endeared "Lewis Carroll" to every boy and girl – nay, every adult – in the kingdom. A shy and retiring man, he was to his friends a most charming companion, overflowing with the quaintest of humour, and one whose love for children was typical of himself, and whom to know was to love.
From *Nature* 20 January 1898.

50 YEARS AGO

The Royal Society Empire Scientific Conference held in June 1946 considered and approved a resolution advocating that where scientific papers or text-books are expressed primarily in British units, provision should be made for the inclusion of metric equivalents or conversion factors. … Sir Charles Darwin in opening the meeting emphasized that the matter to be discussed was one of intelligibility only, and had nothing to do with the introduction of the metric system in Britain. By making it possible for the foreigner to convert British units immediately into metric, publishers of scientific papers and books would assist Britain to attain the position of the centre of science in Europe.
From *Nature* 24 January 1948.