In preparations with high concentrations of Mg^{2+}, complete recovery of the initial EJP amplitude could be obtained even after a very short, high-frequency train of stimuli (5/second for less than 1 second). Fig. 2C shows that trains of a few seconds' duration produced complete recovery during repetitive stimulation, after the response had shown its initial decline. Such trains also increased the amplitude of subsequent EJP's above the initial level. This is a further indication that the recovery with added stimuli is brought about by a superimposed potentiation process (*4*). It also adds weight to the suggestion that under normal conditions, high-frequency stimulation produces a mixture of potentiation and depression resembling that at other neuromuscular junctions (for example, *9*). This second kind of depression, process 3, is apparently associated with depletion of transmitter, since it is reduced in high concentrations of Mg^{2+}. It appears to be responsible in our preparation for the slow diminution of EJP amplitudes that takes place during the later stages of high-frequency stimulation, and for the lack of complete recovery after such trains.

Our experiments demonstrate three distinct temporal processes at a single neuromuscular junction. Process 1 is a decline in synaptic efficacy at very low frequencies of stimulation which is unrelated to the loss of transmitter, and probably involves labilities in the presynaptic membrane potential or safety factor. Process 2 is a form of potentiation observed at intermediate frequencies, and process 3 is a high-frequency depression probably associated with the depletion of transmitter stores.

These junctions therefore show extremely complex temporal changes in response to conditioning stimuli or to frequency changes. If the proper frequencies are employed (Fig. 1, A*d* and B), postjunctional responses may even be restored when the frequency of stimulation is increased. This is perhaps the most exacting criterion for classifying such phenomena as habituation and dishabituation; our results show that it can be met by a single neuromuscular junction, and does not require the presence of a complex neural network.

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Embossing Arabic Letters and Numbers on New Raised-Line Polyethylene Paper: An Aid for the Blind

Abstract. *A new polyethylene paper may be marked on a hard surface with an ordinary oversize ball-point pen or dull pencil point. Where the paper is marked, a raised-line imprint appears on the same side of the paper as that used for writing. This imprint may be both felt and seen. Newly blinded and partially sighted persons are able to read ordinary Arabic letters and numerals after a few trials.*

Few sighted persons can communicate in Braille with the nonsighted, but mastering Braille is not a simple task, particularly for the elderly, blind individual or the child with multiple disabilities. Most Braille writing slates require the individual to write from the reverse side of the writing sheet. Thus, although the blind learn to read from left to right, they must also learn to write backwards.

Several attempts have been made to develop forward-writing Braille slates, one of which I developed (*1–3*). The initial experiment with this slate resulted in unwanted "ghost" dots on standard Braille paper, but a polyethylene paper (*4*) proved successful in largely eliminating these dots. Important as this step was, it did not resolve the basic problems of finding a way for the blind or visually handicapped to write or print Arabic letters or numbers without learning Braille or some other coding method.

An improved, cheaper polyethylene paper No. 300 (*5*) may lead to a solution of the larger problem, as well as

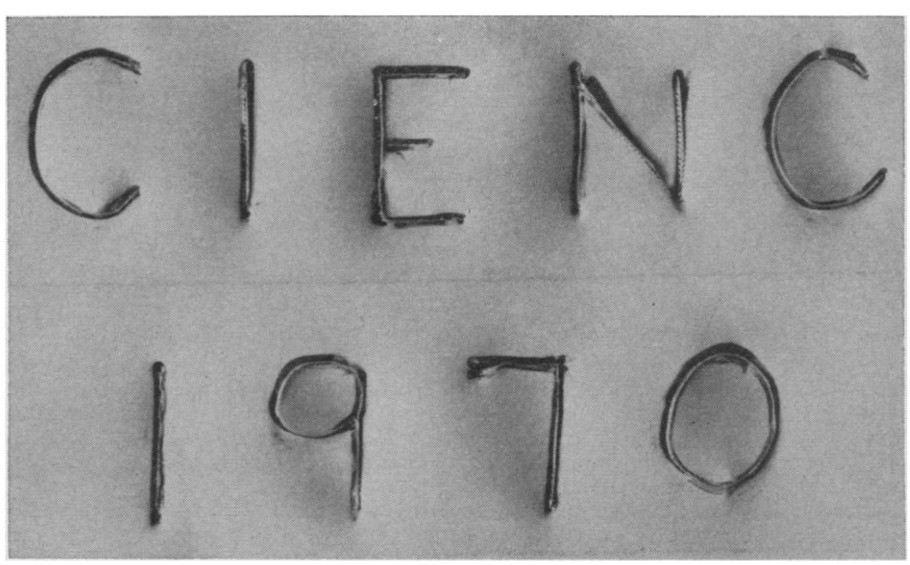

Fig. 1. Sample of simple letters and numbers printed on the new raised-line polyethylene paper. Height of original letters and numbers, ⅜ inch. (Magnified 2 times)

provide improved characters on the upward-writing slate. This new paper makes it possible for a letter or number to be embossed on the working side of the paper without reversing the characters.

The polyethylene paper No. 300 is available in sheets sized 8½ by 11 inches (1 inch = 2.5 cm). Preformed raised guidelines, approximately ¾ inch apart, are recommended to keep rows even. This new paper with guidelines has been designated No. 310 (*5*). A jumbo or oversize ball-point pen gives the best embossed markings, but a somewhat blunt-pointed pencil may be substituted; a very hard writing surface gives the best results. The impressions must be made with added pressure to ensure the embossing effect, which is enhanced by rubbing the finger over the area marked by the pen. Mastering the technique of pressing down on the polyethylene paper takes only a few practice trials. The best type of letter or number is a simply made one, without extra loops or frills (Fig. 1). The embossed letters have a mean height above the page surface of approximately 0.016 inch, but the height varies some with the individual and with the pressure applied. This value is somewhat less than the usual height of Braille symbols, but few of our observers have experienced difficulty with this characteristic. The pen or pencil gives color to the impression, which is an added aid to the partially sighted as well as to the sighted correspondent (Fig. 1).

"The Sewell Raised Line Drawing Kit" (*6*) also produces raised-line characters. This kit comprises a special rubber-covered drawing board, a ball-point pen with colorless lubricant (no ink), and a type of transparent writing material. However, the polyethylene paper described here represents an improvement, because only a special paper is required, and the letters are visible and can also be felt.

Approximately 50 subjects have been tested. Twenty of these were totally blind or partially sighted; 30 were normally sighted subjects who covered their eyes during the test. The subjects were all presented sample numbers, letters, words, and sentences, but they could not see the material before the test. The only comment made by the experimenter was that the number, letter, or word was about ½ inch high and printed in a very simple manner. In less than a minute, virtually all the subjects were able to discern the first number or letter they were evaluating with their fingertips. One subject was able to read an entire page in about 3 minutes.

The new polyethylene paper resolves many problems in communicating with the multihandicapped, such as the person who is both deaf and blind. A newly blinded person can almost immediately write numbers and letters he has always known. With the use of this new paper, the sighted and nonsighted can readily communicate. There is only a brief learning period for the newly blinded person; there is no learning of a difficult system for the sighted friend or family member; and there is no need for any gadget or appliance coupled with the paper. The new, raised-line polyethylene paper and an ordinary jumbo ball-point pen or blunt pencil are all that is necessary to obtain the desired effect. Interestingly, a small number of diabetic patients, who were sighted in youth, learned Braille after the onset of blindness, and had lost much tactile sensitivity (and hence were having difficulty with Braille), were able to read the Arabic letters and numbers presented to them with relative ease.

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26 February 1970

Fetal Movement: Development and Time Course

Abstract. *Prenatal behavior develops in three phases: early rates, acceleration and maintenance, and deceleration to birth. Fetal activity occurs as discrete movements, bursts of activity, and prolonged activity. Four-hour samples were most representative of the daily rates of movement.*

The time course of embryonic development has been determined but the development of prenatal behavior has not been adequately described for either the normal or defective fetus, largely because adequate techniques for recording fetal behavior have been lacking. Fetal development has typically been evaluated from the mother's report of fetal activity (*1, 2*). It is

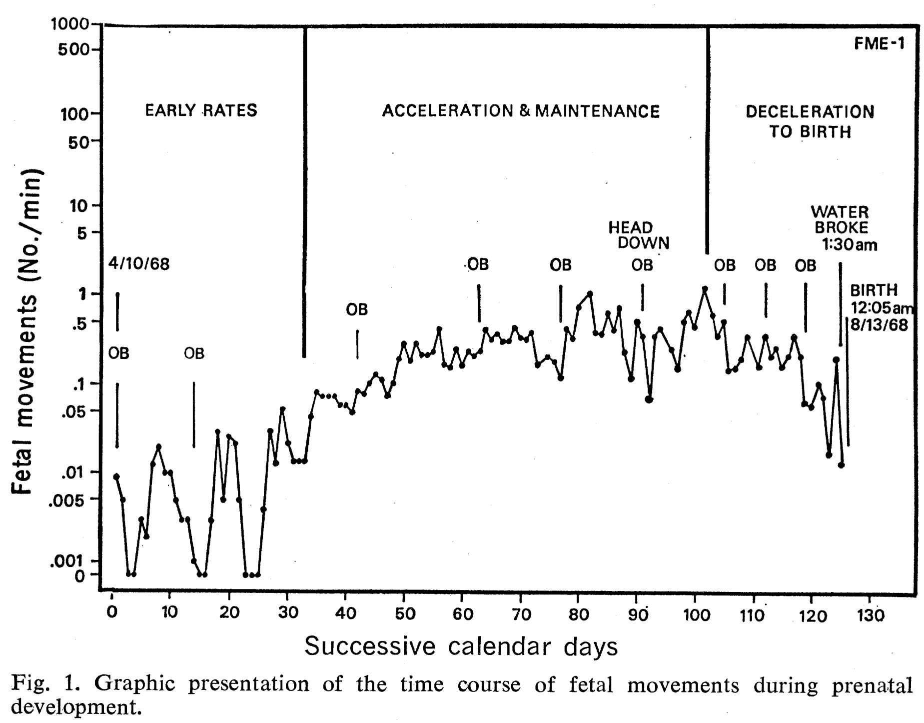

Fig. 1. Graphic presentation of the time course of fetal movements during prenatal development.