fully confirmed, the residual potentiation persisting for many hours.)

Thus we are introduced to the concept that activity enhances the functional effectiveness of synapses over a much longer period than the several minutes of ordinary post-tetanic potentiation, though it must be realized that there is as yet no direct evidence to relate these two causes of enhanced function. Nevertheless, it may be postulated that disuse is a probable cause of the defective monosynaptic excitatory action of volleys in our operatively severed roots, for no impulses will have passed along those roots during the post-operative period of five weeks or so. Such an explanation implies that the normal level of synaptic activation by discharge of stretch receptors ordinarily maintains the excitatory effectiveness of the monosynaptic reflex path.

In conclusion, it can be stated that in the simplest mammalian reflex (the monosynaptic myotatic reflex) direct experimental evidence has been obtained in support of the hypothesis that usage leads to increased functional efficiency of synapses and disuse to defective function. The plasticity that has been postulated for higher nerve centres in explanation of conditioned reflexes[1,2] and of memory would appear to be an important attribute even of the synapses of the simplest reflex pathway. An opportunity is thus provided for precise systematic study of plasticity.

It has been suggested that learning processes, for example, memory and conditioned reflexes, can be attributed to specific dynamic patterns created by impulses circulating continuously in closed self-re-exciting chains of neurones[13,14]. Repetitive activity of this kind doubtless accounts for functional changes of brief duration, but raises grave difficulties when applied to enduring memories or conditioned reflexes[2,14]. The existence of plastic changes at synapses, as demonstrated in the monosynaptic reflex arc, would remove the necessity for making the improbable postulate of enduring dynamic patterns of circulating impulses, and would provide experimental evidence for an explanation based on patterned changes in synaptic efficacy, possibly of a morphological character[1,2]. Such an explanation, however, presupposes that these enduring plastic changes are initially brought about, and are susceptible to reinforcement, by barrages of impulses occurring during temporary phases of patterned re-excitatory activity.

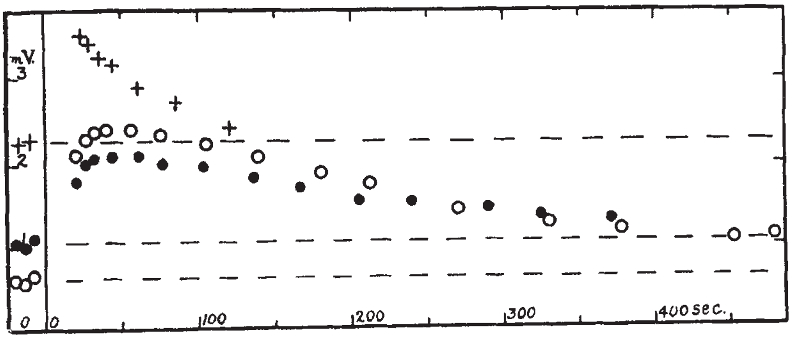

Fig. 2. Time course of post-tetanic potentiation (6,000 volleys at 400 a sec.) of monosynaptic reflex discharges into gastrocnemius nerve in response to single volleys in L_7 dorsal root. L_6, L_7 and L_8 roots on left side were severed just distally to ganglion forty days previously. Ordinates, sizes of reflex spikes; abscissæ, testing intervals in seconds after onset of conditioning tetanus. Crosses show responses on control *R* side, open circles on operated *L* side. Preconditioned spikes are plotted in same convention to left of vertical line at zero time, the horizontal broken lines showing mean spike voltages at respective control-levels. Note that to left of the zero time-line the open circles plot preconditioned spikes before any dorsal root tetanization, that is, after a complete quiescence of forty days, while afterwards the open circles give the response to the first conditioning tetanus. Filled circles show repetition of the *L* series several hours later

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NATIONAL PHYSICAL LABORATORY OF INDIA

Of the eleven national laboratories planned by the Council for Scientific and Industrial Research, India, the National Physical has very appropriately been located in Delhi itself, the seat of the Union Government. Unlike some of the other national laboratories specializing in problems peculiar to particular industries and therefore of greater interest to some regions than to others, the National Physical Laboratory is concerned with basic fundamental work; further, this Laboratory is expected to provide the standards of length, mass, etc., which will be given statutory acceptance, and is therefore of peculiar importance to the State.

An account of the plans for this Laboratory appeared in *Nature* of February 8, 1947, soon after its foundation stone had been laid by Mr. Jawaharlal Nehru. The Laboratory was inaugurated by the late Sardar Vallabhbhai Patel, Deputy Prime Minister, on January 21, 1950.

The Laboratory now functions in an imposing building, carefully planned for its purpose. The architects visited leading foreign laboratories of similar character, and an assistant director spent a good deal of time making a detailed study of the National Physical Laboratory at Teddington. On the architectural side, the Delhi institution has borrowed certain features from the R.C.A. and Bell Telephone Laboratories in the United States; in its functions its two main sources of inspiration have been the National Physical Laboratory at Teddington and the National Bureau of Standards, Washington.

The Laboratory's work was originally planned in nine Divisions: (1) Weights and Measures; (2) Applied Mechanics and Materials; (3) Heat and Power; (4) Optics; (5) Electricity; (6) Electronics and Sound; (7) Building and Housing Research: (8)

Hydraulic Research; (9) Analytical Chemistry. To these nine Divisions of the original plan, a tenth has been added which concerns itself with industrial physics. Meanwhile, for building and housing research a separate national laboratory at Roorkee has been decided upon.

The National Physical Laboratory has a spacious site, about sixty-six acres in area, and is situated next to a great centre of scientific research, the Agricultural Research Institute. The National Physical Laboratory buildings already cover 150,000 sq. ft. and are not yet completed. The laboratories, workshops, library and administrative rooms were naturally given precedence. The lecture theatre is now ready and a cafeteria nearly so. Social amenities are not being neglected. The National Physical Laboratory can well feel proud of its modern and noble building, and the first impression on the considerable number of visitors that it attracts is an excellent one. The rooms in the main building are of adjustable length in steps of 6-ft. units and are air-conditioned. The *L*-shaped basement, with its larger limb 590 ft. long, serves as a store as well as a tunnel for protected services; these go to every room in the Laboratory, not disfiguring the walls and corridors and yet eliminating the necessity of having to dig in to the walls and floors when new service lines have to be laid.

Sir K. S. Krishnan, who was associated with Sir C. V. Raman's discovery of the Raman effect, is director of the Laboratory and is ably assisted by six assistant directors. Besides metrological work and work connected with the maintenance of standards, fundamental research in various sections is being carried on, including that on supersonics. The Laboratory is the only one in India equipped with an electron microscope. The Laboratory was fortunate in getting at a nominal price very valuable equipment for its excellent workshop, where it may be possible to make a large variety of instruments needed in its different sections. Surplus war-stores have been useful, and the Indian scientific liaison officer in London made an excellent selection of items from such disposal sales in Great Britain. The Laboratory is already interesting itself in applied research, and new processes for printing inks using new ingredients perfected by its workers have gone through the necessary laboratory tests, and are entering on the commercial stage in the Laboratory itself.

The inaugural ceremony was attended by leading men of science from many countries, who went to Delhi after participating in the Indian Science Congress session in Poona, and by Mr. C. Rajagopalachari (then Governor-General of the Indian Dominion), who presided, Mr. Jawaharlal Nehru, Dr. S. P. Mookerjee (at that time Minister for Industries and President of the Council for Scientific and Industrial Research), and Sardar Vallabhbhai Patel, who declared the Laboratory open. Great appreciation was expressed of the devoted work done by Sir Shanti Swarup Bhatnagar, director of the Council, and by Dr. K. N. Mathur, assistant director for planning, and there was general rejoicing over the choice of Sir K. S. Krishnan as director of the Laboratory. Speaking of Sir Shanti Bhatnagar, Mr. Nehru said that "this large programme of building the national laboratories would never have gone as far ahead as it has if Dr. Bhatnagar had not been in charge of them". He also paid tribute to Sir. K. S. Krishnan: "It will be difficult," he said, "to find a shyer and more modest man, and yet those who know him know that under that shyness and modest exterior there is a depth and profundity of learning, and it has been a particularly good fortune for us to have him as our Director".

Sir Shanti Bhatnagar, in his address, gave a history of the planning of the National Physical Laboratory since the idea was conceived in 1941, and spoke of its scope and possibilities. Both he and Sir K. S. Krishnan referred to the need for "large-scale specialized organizations for scientific research" and for "team-work". Elaborating on this aspect, Sir K. S. Krishnan observed: "It was not so long ago that we used to speak of the genius in the garret, not so much with a guilty sense of our neglect of values, but almost as though it were the proper atmosphere for genius to flourish in. A story is told of a great past president of the Royal Society that when a visitor from the Continent wished to see his laboratory, he requested him to be seated in the drawing-room and had the laboratory brought to him on a tray. Many great scientists have grown under, and lent enchantment to, this tradition, which has since been called, with some appropriateness, the 'string-and-sealing-wax tradition': Faraday, the Curies, Thomson, Rutherford and Raman. But for the majority of us the Muse of Science has become a little too sophisticated to be wooed under such simple surroundings. Large laboratories, liberal equipment, and enthusiastic teams are the least that seem to satisfy her—the more so when science has to be applied to industry, as it will be, in these Laboratories."

Dr. H. J. Bhabha, director of the Tata Institute of Fundamental Research, Bombay, also stressed this point. As a member of the Planning Committee for the Laboratory, he recalled that "the Committee endeavoured to plan the Laboratory on the most modern lines and to make its scope, design and equipment such as would place it among the best laboratories of its kind in the world to-day. It is not often in human affairs that the realization of an idea exceeds the dreams of those who planned it, but I think I would be right in saying that none of the members of the Planning Committee of this Laboratory could have fully realized what a magnificent Laboratory it would become."

Sir Robert Robinson, at the time president of the Royal Society, referred with "justifiable pride" to the achievements of the National Physical Laboratory in Britain, which was due to celebrate in a few days its fiftieth birthday, and conveyed to its new-born sister the warmest good wishes on behalf of the Council of the Royal Society and of the governing body of the National Physical Laboratory at Teddington. Greetings were conveyed also by Prof. J. D. Bernal, professor of physics in Birkbeck College, University of London, and a member of the General Board of the National Physical Laboratory, who in the course of his address observed: "Money spent on science is money saved. Science is economy. This economy, however, can only be realized if the people feel and have reason for feeling that the work of science and industry is for the common welfare and not diverted to the service of private profit and war."

Prof. P. V. Auger, speaking as director of the Natural Sciences Section of Unesco, and as professor in the Faculty of Science, University of Paris, offered the warmest congratulations on the occasion, and said of the new institution: "This is no small pearl, but rather a big diamond like the Koh-i-Noor of the history of this country". The greetings of the scientific men of the U.S.S.R. were conveyed by Prof. W. D. Englehardt. Prof. D. E. H. Rydbeck, of the Chalmers Institute of Technology, Sweden, expressed the hope that under the scientific and spiritual leadership of Sir K. S. Krishnan the new institution would work in the spirit of Tagore and Gandhi, and show the world that "even in the times of tremendous technical and scientific developments ahead of us, it will be possible to develop and maintain a non-violent form of society with no human exploitation".

It was particularly appropriate that Dr. E. U. Condon, of the National Bureau of Standards, Washington, was present on the occasion, as the National Physical Laboratory in its scope will very much take after the Washington Bureau. Dr. Condon pledged hearty co-operation between Indian and American men of science, "and in particular between our sister institutions, the National Physical Laboratory of India and the National Bureau of Standards of U.S.A.".

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

In January of 1947 the faculty of the Massachusetts Institute of Technology appointed a committee to review the state of education at the Institute*. The committee was instructed to re-examine principles of education that had served as a guide to academic policy at the Institute for almost ninety years and to determine whether they were applicable to the conditions of a new era emerging from the social upheaval and the disasters of war.

The study lasted more than two years and, since the members of the committee believed that major revision should be undertaken only after a basic re-evaluation of the educational philosophy on which the Institute is based, little attention was paid to details of curricula. The committee did, however, examine the concept of professional education upon which the Institute was founded and re-assessed the way of teaching. The task, therefore, was to determine whether the Institute should alter the direction of its effort or apply its methods in new ways or to new areas.

It may be asked why there was felt to be the need of critical appraisal at a time when the Institute was conspicuously healthy and vigorous ? In formulating questions to guide the deliberations of the committee, the Faculty expressed concern about the educational implications of changes that have taken place both in the Institute and in the society that it serves ; its studies have revealed apprehensiveness among the staff and alumni that, in an exciting inflationary atmosphere when money was easy and physical expansion tempting, members of the Institute may have yielded uncritically to temporary pressures and lost sight of long-range educational goals. The committee also feared that the Institute was adhering to a kind of education that proved successful a generation ago without taking into account significant changes that may have made this kind of education obsolete.

* Report of the Committee on Educational Survey to the Faculty of the Massachusetts Institute of Technology. Pp. vii+148. (Cambridge, Mass.: Technology Press of the Massachusetts Institute of Technology, 1949.)

For these reasons the committee recommended that the Institute should boldly undertake new experiments in education and new explorations into the unknown, withdrawing at the same time from ventures in which its leadership is no longer required. They also made recommendations as to how the Institute might accomplish these purposes most effectively.

Among these were the important points that William Barton Rogers's original concept of higher education with a scientific and technical basis on which the Institute is based, of learning by doing, and of the value of an integrated professional and liberal education, are important guiding principles for its educational policy to-day. These principles, however, must be interpreted broadly and applied with full cognizance of the many changes which have taken place since Rogers founded the Institute in 1865. The committee recognized, too, that the educational programme at the Institute has at times veered unduly towards the vocational and recommended that such tendencies be avoided in future by the adoption and effective application of certain policies and procedures which are elaborated in its Report. Further, despite the fact that the Institute's long period of emphasis upon engineering education at the expense of science, the humanities and social sciences, and perhaps even architecture, was followed by an awakening to a broader mission in the 1930's, the committee felt that the Institute has not yet begun to exploit to the full its opportunities in these other fields.

As a result of the Second World War the rapid growth of the Institute has given rise to dangers of over-expansion, and the committee recommended that a serious effort be made to stabilize the overall size of the Institute within limits that would avoid purposeless dissipation of abilities and resources.

In addition, many factors, including expansion of knowledge and enlarged support of research and development activities, have led to pre-occupation with graduate education at the sacrifice of attention to the undergraduate programme. The committee re-affirmed its belief in Rogers's concept of undergraduate professional education and advocated the establishment of an appropriate balance by strengthening and re-vitalizing undergraduate education ; this should not be done by curtailing the achievements of the graduate school. The four-year undergraduate professional education has special advantages to-day, either as direct preparation for a career or for advanced work in science or technology ; no advantage would be gained in a gradual lengthening of the undergraduate curriculum to five or six years.

The committee also believes that a scientific and technical environment affords special opportunities for many individuals who wish to acquire a broad cultural education and a full appreciation of modern trends in society. The fundamental problem of technological institutions is that of developing sufficient strength in the social sciences and humanities, and the Institute is advised to take advantage of new opportunities to give the social sciences and humanities full professional status ; there is a strong recommendation for the immediate establishment of a school of humanities and social sciences.

The growth of sponsored research at the Institute has provided invaluable opportunities for realizing the educational advantages of an active research and development programme ; it has also led to possibilities of indiscriminate participation in activities of