source of voluntary actions. Stimulations, according to him, arise in the peripheral sense organs and are mediated to the psychic realm, which determines the nature of muscular response. Absence of all senses would thus make psychic life impossible. However, the reflex activity itself is regulated by other cerebral centers (especially that in the mid-brain), which serve in an inhibitory capacity. His assertion that “the initial cause of any human action lies outside the person” ran counter to the point of view of the Czarist government, who regarded the concept as materialistic, anti-religious, immoral, and therefore dangerous to society. For a time the Government considered destroying Sechenov’s monograph and indicting him under the penal code. In spite of this he went even farther and claimed that “physiology possesses a number of data that establish the affinity of psychic phenomena to those purely somatic acts which are called the nervous processes of the body.”

Sechenov’s independence as a thinker was also demonstrated by his opposition to Virchow’s dominant teaching that only the cell is responsible for disease. He maintained, as did Lasègue, that physicochemical factors in the environment of the cell are of equal if not greater importance, a view which brought him in conflict with numerous contemporary worshippers of Virchow. This and the Government’s hostility toward him were the causes of his frequent changes in academic residence. Wherever he went, the ablest physiologists (Voroshilov, Tarkhanov, Spiro, Pashutin, Kravkov, Vvedensky, to mention only a few) flocked to his laboratory. His work was also a great inspiration to Pavlov. He was successful in recording “spontaneous fluctuations of current” in the medulla and spinal cord of frogs (1882).8

Sechenov was admired not only for his intellect and scientific achievements, but even more for his idealism, exceptional honesty, and fearlessness in fighting injustice and stupidity. In 1861, when only thirty-two years old, he declined the invitation to become a member of the Imperial Academy of Sciences, though assured of election. The reason given was that his contributions to science were, in his opinion, not of sufficient importance to entitle him to so great an honor. When twenty-five years later he was elected—this time not against his objections—his appointment was vetoed by the government.

The scientific world, and especially the intellectuals in Russia, held him in high esteem and revered his memory. Each of the members of the 15th International Physiological Congress held in Russia (1935) was presented with a special edition of selected works of Sechenov and a Sechenov medal. In 1943 the Academy of Science of the U.S.S.R. republished a volume by him on Elements of thought. The Russian Journal of Physiology was named the “Sechenov Journal,” which is only proper, for Sechenov’s school of physiology achieved a fame equivalent to that of any of the great schools of Western Europe.

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References


Charles Scott Sherrington (1857–1952)

T he life of Sir Charles Sherrington spans a long period of the most active growth in the medical sciences, during which he himself gave enormous impetus to neurophysiology. Although best known for his long series of studies on spinal reflexes, he made equally great strides in the physiology of perception, reaction, and behavior, and with remarkable clarity succeeded in con-
terested in the classics. One of his schoolmasters, Thomas Ashe, was a poet of considerable distinction, who imbued the young Sherrington not only with a great fondness for poetry but also for literature and travel. From his stepfather, Caleb Rose, came his interest in science and medicine. After a brief introductory period as medical student in London and Edinburgh he transferred to Cambridge University in 1879. There he was strongly influenced not only by Michael Foster—the "father of British physiology"—but also by Foster's already remarkable pupils Langley and Gaskell.

Following graduation in medicine Sherrington became assistant in anatomy for a year during which he began a series of studies of Marchi degeneration of corticospinal fibers, at first with Langley and later independently. As part of this investigation Langley and Sherrington reported on the anatomical changes in the cord and brain stem of a decorticate dog exhibited by Golitz at the International Congress in 1881. This led to the first of many visits to Golitz' laboratory in Strasbourg.

Following the discoveries of Pasteur and Koch, Sherrington, caught up in the enthusiasm of the day, devoted his whole effort to bacteriological studies for a time between 1884 and 1887. With C. S. Roy he set out to establish the cause of cholera, but not much came of it. Traveling in Spain in pursuit of outbreaks of the disease he met Cajal and later persuaded him to lecture in England. His travels also took him to Berlin, where he met Robert Koch and worked for a time in the laboratory of Virchow (1886–87).

In 1887, at the age of thirty, Sherrington was appointed lecturer in physiology at St. Thomas' Hospital Medical School in London and continued his studies of degeneration of spinal tracts. In 1891 he succeeded Victor Horsley as Professor of Pathology at the Brown Institution, a veterinary institute, an appointment that provided facilities for observation of animals with chronic spinal lesions.

Though general observations on spinal reflex activity had been made in the chronic spinal dog by Golitz and Freusberg in 1874, by Haycraft in 1890 and by Golitz and Ewald in 1896, the systematic analysis of their patterns and interaction awaited the inquiry of Sherrington. Liddell's memoir of Sherrington2 eloquently describes the painfully slow evolution of his ideas of reflex transmis-
sion and interaction prior to 1890. That the nervous system consisted of a congregation of separate units had become accepted from the neurone theory of Waldeyer. Cajal had demonstrated the "end-feet," or "boutons terminaux," but it was Sherrington who provided the evidence for a one-way transmission at the "synapse" and the concept of convergence of reflex channels on a "final common path." This for the first time provided an explanation for flexibility and adaptation in nervous function. He began with a systematic delineation of the innervation of muscles and skin by the nerve roots, published in three large papers: in 1892, 1894, and 1898.

In 1895 Sherrington was appointed professor of physiology in Liverpool, where he did much of his best work. By 1900, when he wrote the sections on sensation, spinal cord and mid-brain in Schäfer's *Textbook of physiology*, he had amassed an enormous amount of information on reflex activity. In addition he had commenced studies on the interaction of various reflexes, revealing their use of neurones shared in common, and the inhibitory effects resulting from conflict between them. Inhibition was found to be an active process; not the simple absence of activity. Concepts of facilitation and reciprocal innervation emerged. In his chance observation of decerebrate rigidity in 1896 he found a background against which to demonstrate the presence of reciprocal inhibition even when no conflicting reflex discharge was evident. The patterns of excitation and inhibition inherent in neuronal connections, deduced from these studies, were the subject of his Silliman Lectures, published in 1906 as the *Integrative action of the nervous system* and reprinted five times. This was and will remain a classic of neurophysiology.

In following years Sherrington established the nature of postural reflexes and demonstrated their dependence on the anti-gravity stretch reflex, tracing the afferent stimulus to the proprioceptive end-organs, of which he had shown the sensory nature many years earlier. In 1913 he was appointed to the chair of physiology in Oxford University, where he stayed until retirement in 1935. In these years his investigative talent turned to more quantitative studies of the interaction of reflexes, enabled by this development of recording by isometric myograph. (The principle of this instrument is that, provided the rate of neuronal discharge is high, the amount of muscular contraction recorded represents the number of active motor neurones ["motor units"]; overlapping and subliminal effects could be recorded precisely.) These studies indicated the activity of cumulative excitatory and inhibitory transmitter substances at the synapse, in distinction to the electrical theories of transmission favored by others. In this period he was President of the Royal Society, and the recipient of many honors, including knighthood in 1922, the Order of Merit in 1924, and the Nobel Award (shared with Adrian) in 1932. With all this, he retained his kindly, courteous ways, his gentleness in criticism. In 1925 he published a modest volume of his collected verse.

In 1935 he retired to live in Ipswich where he wrote the philosophical study of dualism, *Man on his nature* (the Gifford Lectures at Edinburgh University for 1937–38). His fascinating historical and bibliographical study, *The endeavour of Jean Fernel,* published in 1946, was his last major contribution. By 1941, when he was eighty-four, he was becoming greatly disabled by painful arthritis, which he endured with extraordinary courage. Even so, his capacity as raconteur was not lessened. Nor his perceptiveness, judging from his contribution to a radio symposium on brain and mind shortly before his death.

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ALFRED VULPIAN (1826-1887)

Born in Paris, Edmé Félix Alfred Vulpian was descended from the aristocracy, the legal profession, and a father who also wrote wittily for the stage, refused vaccination, died of smallpox, and left four children to poverty. Despite his brilliance, Alfred failed in the entrance concours to the École Normale (the top teacher’s college). By this accident neurology gained a great scientist who also was a stylist. To make a living, Vulpian obtained a technician’s job; it was at the Muséum and with Flourens; through his influence the promising nineteen-year-old was matriculated in medical school. While an interne Vulpian taught natural history at a high school. Perhaps this hard, mixed upbringing accounted for the unusual success of his doctoral thesis (1853) on the still somewhat vague origin of the cranial nerves III to X.

He became médecin des hôpitaux in 1857, agrégé in 1860, and continued to teach physiology of the nervous system until 1866 when he was named to the chair of pathological anatomy vacated by Cruveilhier, its first occupant. Vulpian was seated only over violent opposition, because he had written a memoir on the higher functions of the brain that had aroused the wrath of the bishops and barons in the Senate. In 1862 he took over, with Charcot, that chaotic welfare institution for the chronically sick, known as the Salpêtrière.

Vulpian was more restrained and perhaps even more learned than his great friend, and he was an experimenter. He worked out the principles of degeneration, and particularly the regeneration, of nerves; he established the principles and added many new facts concerning the vasomotor and sudomotor apparatus, and he made them common knowledge. He discovered the chromaffin system of the adrenal marrow by the application of chromium salts; he showed that curare had its effects at the point between nerve and muscle; he wrote magisterially about the action of various drugs upon the nervous system—strychnine, pilocarpine, anaesthetics, and nicotine. With unprecedented conscientiousness he went over

Portrait, courtesy of Dr. Maurice Genty, Académie de Médecine, Paris, France.