myelinated with the small myelinated that a sufficient number is obtained to account for the great number of pain spots. It is true that some of these small fibers are of sympathetic origin and are destined for the innervation of the blood vessels, sweat glands and smooth muscles of the hair follicles, but the majority of them are undoubtedly sensory and take origin from cells in the spinal ganglia.[11]

Table 3 shows the distribution of the sensory spots on the front of the thigh and of fibers in a nerve

TABLE 3

SENSORY SPOTS ON THE FRONT OF THE THIGH AND NERVE FIBERS IN THE LATERAL CUTANEOUS NERVE OF THE THIGH

	Sensory spots in 1 sq. cm.	Per cent. of total spots	Fibers: Myelinated	Fibers: Unmyelinated	Per cent. of total fibers
Pain	192	91.2	(1–5 μ) 1082	5824	94.17
Temp. ...	5.4	2.6	(5.1–8 μ) 161		2.19
Touch	13	6.2	(8.1–16 μ) 266		3.62

which supplies that area. The agreement is again satisfactory between the percentage of pain spots and small fibers and between the percentage of temperature spots and medium-sized fibers, but we are a little short of the large fibers for touch. A comparison of the distribution of the myelinated fibers of different sizes in these two nerves is instructive. The medial cutaneous nerve of the forearm which supplies skin having twenty-three touch spots per square centimeter has a higher percentage of large fibers than has the lateral cutaneous nerve of the thigh which supplies skin having only thirteen touch spots per square centimeter.

Gasser and Erlanger,[12] working on nerve action currents amplified by vacuum tubes and recorded by means of a cathode ray oscillograph, have furnished evidence of great importance. When cocaine is applied to a nerve, function is not lost all at once but gradually and in the following order: pain, cold, warmth, touch and motion. Analysis of the action currents shows that with this sort of block the small fibers are first affected, then those of medium size and finally the large fibers. When a pressure block is applied to a nerve, function is lost in the reverse order: motion, touch, cold, warmth and pain; and in this case the cathode ray oscillograph shows that the fibers are thrown out of function in the order of their size, beginning with the largest. The fine fibers and the sense of pain are the last to be affected by pressure and the first to be affected by cocaine. It is impossible to escape the conclusion that pain is mediated by small fibers, temperature sensations by those of intermediate size and touch by the large ones.

The threshold for direct electrical stimulation of small fibers is very much higher than that for large fibers. This is significant, since it has been found that when the electrodes are applied directly to the nerves, weak stimuli which could activate only the large fibers give rise to sensations of touch and that much stronger stimuli which could activate the small fibers are required to produce pain.[13]

Additional evidence pointing in the same direction is available from the phenomenon of sensory dissociation following nerve section in man and from the section of the fine fibers composing the lateral division of the dorsal root of a spinal nerve in the cat,[9] but since time is limited this evidence can not be presented here. Enough has been said to make it evident that progress is being made toward the positive identification of the sensory endings which serve as receptors for each of the varieties of cutaneous sensation and that the new evidence supports the current belief regarding the functions of these end organs. It is also becoming clear that the four varieties of sensations are mediated by different types of fibers—touch by the large myelinated fibers, temperature sensations by those of intermediate size and pain by the fine myelinated and unmyelinated fibers.

OBITUARY

FRANCIS LEROY LANDACRE

DR. FRANCIS LEROY LANDACRE, professor of anatomy and secretary of the College of Medicine of the Ohio State University, died at Columbus, Ohio, on August 23, 1933. His death removes from its faculty of medicine a veteran teacher and one of its most faithful servants and counselors.

Professor Landacre was born near Columbus, Ohio, on February 13, 1867. He attended Ohio Wesleyan and Ohio State Universities, receiving the B.A. degree

[11] S. W. Ranson and H. K. Davenport, "Sensory Unmyelinated Fibers in the Spinal Nerves," *Am. Jour. Anat.*, 48: 331. 1931.

[12] H. S. Gasser and J. Erlanger, "The Rôle of Fiber Size in the Establishment of a Nerve Block by Pressure or Cocaine," *Am. Jour. Physiol.*, 88: 581. 1929.

[13] P. Heinbecker, G. H. Bishop and J. O'Leary, "Fibers in Mixed Nerves and Their Dorsal Roots Responsible for Pain," *Proc. Soc. Exp. Biol. and Med.*, 29: 928. 1932.

from the latter institution in 1895. He began his academic career, the following year, as an assistant in the zoology department of his Alma Mater under the leadership of Professor David S. Kellicott, and as lecturer in embryology in the old Ohio Medical University. He carried this double load of teaching for many years. In 1902 he became professor of histology and embryology in the Medical School, and in 1908 professor of zoology and entomology in the Ohio State University. He was appointed professor of anatomy in 1914. During the summer of 1924–27, he conducted classes in neurology at the University of California.

It falls to the lot of few men to excel as a teacher and an investigator, but Professor Landacre's ability in both was soon recognized. He developed early in his career an interest in comparative neurology. This interest was sustained and stimulated by Dr. C. J. Herrick, who was during this period professor of zoology at Denison University, a neighboring institution. At Professor Herrick's suggestion he began a study of the origin of the functional components of cranial ganglia. After Professor Herrick was called to the chair of neurology in the University of Chicago, this association was continued. Professor Landacre studied at Chicago during the summer periods and received the Ph.D. degree in 1914. It was a happy circumstance that Dr. G. E. Coghill, who was also just beginning a study of the nervous system from the standpoint of its functional components, filled the vacancy at Denison University. His association with these distinguished neurologists determined definitely the course of his subsequent researches, for he undertook the task of studying the mode of development of the functional patterns of the nervous system, as revealed by these men in their investigations. His contributions in this field have dealt chiefly with the origin of ganglion components, the behavior of ectodermal placodes and the origin and fate of the neural crest. The recent verification of many of his findings by L. S. Stone, using experimental methods, was a source of great satisfaction to him.

It is difficult to comprehend the services of this man to the Ohio State University. During his thirty-eight years of service, he came in contact with thousands of students, who remember him as a profound thinker and a great but critical teacher. When the Ohio Medical University was incorporated in the Ohio State University as its College of Medicine, he was offered the post of professor of anatomy and chairman of the department. He accepted the appointment on condition that the Department of Anatomy be placed upon a proper academic basis. In the reorganization of the Medical School he pleaded vigorously for the establishment of university standards in all its various departments, clinical as well as preclinical. In the ensuing years, whatever he believed was beneficial to the Medical School as a whole, he vigorously championed, but as vigorously opposed any move to strengthen one department at the expense of another or any effort to modify or expand in personnel or student body if it meant a sacrifice of scholastic standards.

He was also deeply interested in pre-medical and pre-dental education. He served faithfully on curriculum committees and strove zealously to improve the training of pre-medical and pre-dental students. At his recommendation, the Department of Anatomy took over the teaching of comparative vertebrate anatomy and embryology in order to establish a closer correlation between pre-medical and medical anatomy —an arrangement which although unique has won the commendation and admiration of all his colleagues in American medical schools.

His most outstanding personal traits were his loyalty to his friends, his scientific sincerity, his devotion to and his admiration for scientific investigators, his adherence to principles without fear or favor, and his hatred of academic ballyhoo and hypocrisy.

R. A. K.

RECENT DEATHS

DR. HOWARD AYERS, from 1899 to 1904 president of the University of Cincinnati, formerly professor of biology at the University of Missouri, died on October 17, at the age of seventy-two years.

MAJOR R. Y. STUART, chief of the U. S. Forest Service, died on October 23 from a fall from a window on the seventh floor of the down-town building housing the national headquarters of the service. Major Stuart was fifty years old.

SAMUEL WASHINGTON MCCALLIE, since 1908 state geologist of Georgia, died on October 26, at the age of seventy-seven years.

DR. NELSON C. DAVIS, a member of the field staff of the International Health Division of the Rockefeller Foundation, an expert on yellow fever, died at Bahia, Brazil, on October 21, at the age of forty-one years.

DR. ALEXANDER QUACKENBOSS, since 1920 professor of ophthalmology at Harvard Medical School, died on October 27, at the age of sixty-seven years.

DR. ERNST VON KESSELER, employed in the plant protection department of the I. G. Werk at Leverkusen am Rhein, died suddenly in Cologne on August 29, 1933, at the age of thirty years. He spent 1930–