circle" is to stimulate an increase of tonus and deeper respiration by inhalation of carbon dioxide. Deeper respiration is the most effective means of inducing a better oxygenation of the blood; it is far more effective than inhalation of pure oxygen without deeper breathing. In the mixtures of oxygen and carbon dioxide now commonly used the carbon dioxide is the effective agent and the oxygen only a slightly better diluent than mere air.[10] A decisive demonstration of the life-saving value of the inhalational treatment of premature infants was afforded by Dr. A. R. Dafoe's success with the Dionne quintuplets.

But is it true that muscle tonus is practically absent in the fetus and develops at birth? The answer is afforded by observations made by D. H. Barron in Professor Barcroft's laboratory and reported by the latter[11] without, however, the full interpretation which I have here assigned to tonus.

The observations of Barcroft and his collaborators have been made chiefly upon sheep at various stages of gestation. The fetal lambs are delivered by Cesarean section and the placental circulation is maintained while the mother's body is immersed in a bath of warm saline. Under these conditions, as Barcroft reports, Barron has recorded the tonus of fetal lambs by means of the method described by Adrian for recording the electrical state of the muscles. "So long as the fetus is in its normal environment, or in a bath of warm saline, with the placental circulation unrestricted, the fetal muscles are entirely devoid of tonus. Take the fetus out of the saline and expose its skin to the air; tone at once appears in its muscles, only again to be abolished by replacing the embryo in the bath."

What tonus means for the beginning of life can be verified by noting the crucial part that this little noticed but fundamental function often plays in the end of life. The condition of physical depression that may follow serious physical injuries and major surgical operations—the state that in its extreme form is termed shock—has long been explained as due to fatigue, paralysis or some other form of failure of the control by the sympathetic nervous system over the vasomotor mechanism. A few investigators, including the writer, have refused to accept this conception; but until recently we failed to offer a wholly satisfactory alternative conception.

Now it is becoming clear that the depression lies, not in the sympathetic nervous system, but in the motor centers of the spinal cord; and that it results in such a depression of muscle tonus that respiratory metabolism and heat production are diminished, the blood stagnates in the tissues, the venous return to the heart fails, and the respiratory muscles relax until parts of the lungs are deflated.[12] Decisive experimental evidence for this conception of postoperative depression and shock is afforded by the fact that a condition in all respects like shock can be induced temporarily by spinal anesthesia. This occurs whenever the anesthetic reaches, not merely the sensory neurones for which it is intended, but the motor neurones that induce muscle tonus.[13]

To summarize: At birth the motor centers of the spinal cord come into action. By inducing tonus in the musculature of the body they increase metabolism and heat production, and render respiration effective. Without muscle tonus the blood would stagnate in the tissues and the circulation would fail. During life a high tonus is a feature of vigorous health. It is such tonus that enables the young soldier to stand long at attention. The elderly man of lessened tonus can not stand long without fatigue. The invalid may have sufficient tonus to permit him to sit, but not to stand. The patient with a low tonus and weak after operation or illness can scarcely hold his head up from the pillow. And, as death approaches, it is the failure of tonus that permits the major functions of respiration, circulation and metabolism to fail.

[10] Y. Henderson, SCIENCE, 83: 399, 1936.

[11] J. Barcroft, *Setchanov. Jour. Physiol.*, 4: 35, 1935; *Physiol. Rev.*, 16: 103, 1936; J. Barcroft and D. H. Barron, *Jour. Physiol*, 88: 56, 1936.

[12] Y. Henderson, *Bull. N. Y. Acad. Med.*, 11: 639, 1935; *Lancet*, July 27, 1935, p. 178.

[13] O. O. Schuberth, *Acta Chir. Scand.*, 78: Suppl. 43, 1936.

OBITUARY

MARSHALL AVERY HOWE

DR. MARSHALL AVERY HOWE, director of the New York Botanical Garden, died at his home in Pleasantville, New York, on December 24, 1936, in his seventieth year. Scion of an old Vermont family, he was born at Newfane, in the southern part of that state on June 6, 1867. In 1891, the year following his graduation from the University of Vermont, he went to the University of California as instructor of cryptogamic botany; there he remained for five years, devoting himself particularly to studies on hepatics and marine algae, the plant-groups which continued to hold his interest for the remainder of his life, although the algae received more of his attention than the hepatics in later years.

In 1896 he enrolled for graduate study at Columbia University, where he was a fellow in 1897–98, received the Ph.D. degree in the latter year, and remained as curator of the herbarium until 1901. At Columbia he was closely associated with those who

were engaged in the early development of the New York Botanical Garden, but it was not until the summer of 1901 that he was appointed to a position on the Garden staff, and relinquished his curatorship at the university. During that summer, accompanied by his brother, Clifton D. Howe, and another assistant, he spent some time in the botanical exploration of Nova Scotia and Newfoundland; collecting trips for marine algae in subsequent seasons took him to Florida, various parts of the West Indies and Panama.

He became assistant director of the New York Botanical Garden in 1923, and so continued until 1935. His directorship was from October 1, 1935, until his death less than fifteen months later; ill health for much of this period interfered with his duties in this office, yet his appointment as director was a fitting climax to his thirty-five years of faithful service in building up this great institution. In spite of his failing health the end came suddenly and unexpectedly.

He was a member of various scientific societies. Perhaps the earliest was the Chamisso Botanical Club, organized at the University of California early in 1891, a few months before his arrival there; of this society he was the third president. In the summer of 1895, while on a vacation in his home state, he was one of the six botanists who planned the Vermont Botanical Club, of which he became an original member when organization was effected. On January 12, 1897, soon after his arrival in New York, he was elected to active membership in the Torrey Botanical Club; the following year he was chosen an associate editor and was reelected annually thereafter, with the exception of the years 1908–10, when he was editor-in-chief of the *Bulletin* and *Memoirs* of the club. When the Torrey Club in 1901 added a smaller monthly, called *Torreya,* to its other publications, he was chosen editor of the new journal and so continued for seven years. At other times he was secretary and vice-president and he had been president for nearly a year at the time of his death.

In 1897, too, he became a member of the New York Academy of Sciences, and was soon thereafter elected a fellow of the academy. He was almost or quite continuously a member of the council from 1914, and was president in 1934 and 1935. His membership in the Botanical Society of America dated from 1899, and he was vice-president in 1913. The ballots for office in this society are cast by mail, and it was announced at the meeting a few weeks ago in Atlantic City that he had been duly elected president for the year 1937. This final honor, alas, came too late.

He was elected to membership in the American Association for the Advancement of Science in 1900, and became a fellow of the association in 1903. In 1907 he joined the Sullivant Moss Society, in 1911 the American Fern Society, in 1914 the American Society of Naturalists and within the few following years the Connecticut Botanical Society. In 1919 his alma mater, the University of Vermont, conferred upon him the honorary degree of Sc.D. And in 1923 he was chosen as a member of the National Academy of Sciences, an honor highly esteemed by most American scientists.

As a worker and as a writer he was extremely painstaking and conscientious. His contributions to botanical literature were numerous, and a few of them were sufficiently bulky to be regarded as books, although they all formed parts of serial publications. The earlier ones related chiefly to hepatics, the later ones to marine algae, but his interest in both groups was continuous throughout his career.

This brief outline of the life of Marshall Avery Howe furnishes unequivocal evidence of the high esteem of his fellow-workers. Those who knew him best respected him most, and his passing leaves his associates with a sense of profound loss.

J. H. BARNHART

RECENT DEATHS AND MEMORIALS

CYRUS R. CROSBY, professor of entomology at Cornell University, died on January 11 on his arrival in Rochester for the annual meeting of the New York State Horticultural Society. He was fifty-eight years old.

DR. ELIAS HUDSON BARTLEY, professor of chemistry and pediatrics at Long Island College Hospital until his retirement with the title emeritus in 1931, died on January 12. He was eighty-seven years old.

DR. MICHAEL H. CORRIGAN, president of the Rhode Island College of Pharmacy and Allied Sciences, died on January 16 at the age of sixty-eight years.

DR. CHARLES V. NOBACK, since 1926 veterinarian at the New York Zoological Park, died on January 16 at the age of forty-eight years.

DR. WILLIAM HENRY COLLINS, consultant to the branch of mines and geology of the Department of Mines and Resources of Canada and acting director of the National Museum, formerly director of the Canadian Geological Survey, died on January 14 at the age of fifty-eight years.

PROFESSOR ROBIN TILLYARD, an honorary fellow of Queen's College, Cambridge, chief entomologist of the Australian Commonwealth from 1928 to 1934, was killed in an automobile accident on January 13. He was fifty-five years old.

DR. BINDO DE VECCHI, professor of pathological anatomy and rector of the University of Florence, died on December 28 at the age of fifty-nine years.