of heat and the temperature of the river Niagara will be raised about one fifth of a degree by its fall of 160 feet.

Admitting the correctness of the equivalent I have named, it is obvious that the *vis viva* of the particles of a pound of water at (say) 51° is equal to the *vis viva* possessed by a pound of water at 50° plus the *vis viva* which would be acquired by a weight of 817 lb. after falling through the perpendicular height of one foot.

Assuming that the expansion of elastic fluids on the removal of pressure is owing to the centrifugal force of revolving atmospheres of electricity, we can easily estimate the absolute quantity of heat in matter. For in an elastic fluid the pressure will be proportional to the square of the velocity of the revolving atmospheres, and the *vis viva* of the atmospheres will also be proportional to the square of their velocity; consequently the pressure will be proportional to the *vis viva.* Now the ratio of the pressures of elastic fluids at the temperatures 32° and 33° is 480: 481; consequently the zero of temperature must be 480° below the freezing-point of water. We see then what an enormous quantity of *vis viva* exists in matter. A single pound of water at 60° must possess 480°+28°=508° of heat; in other words, it must possess a *vis viva* equal to that acquired by a weight of 415036 lb. after falling through the perpendicular height of one foot. The velocity with which the atmospheres of electricity must revolve in order to present this enormous amount of *vis viva* must of course be prodigious, and equal probably to the velocity of light in the planetary space, or to that of an electric discharge as determined by the experiments of Wheatstone.

I remain, Gentlemen,

Yours respectfully,

JAMES P. JOULE.

Oak Field, near Manchester,
August 6, 1845.

Science News Letter, January 21, 1933

PHYSIOLOGY

Motion Pictures Made of Growing Nerve Fibers

MOTION PICTURES demonstrating how nerve fibers grow through living tissue, and how they repair themselves when injured, have been made by Prof. Carl C. Speidel of the University of Virginia. Prof. Speidel was the winner of the $1000 prize of the American Association for the Advancement of Science at the midwinter meeting at New Orleans last year. A recent report to the Association summarizes his work up to that time and describes advances made since then.

As pictured and explained by Prof. Speidel, nerve growth is pioneered by what are known as "growth cones" on the ends of the nerve fibers. These are thickenings of the tips, which probe their way through the tissues, constantly sending out and retracting tiny processes from their surfaces, like finger-tips feeling their way. As the nerve progresses, special cells develop along its course. They hug its sides closely, though they take no part in its actual growth process, nor in its function as a nerve. These are known as the "sheath cells." Finally, as the nerve becomes more mature, it develops around itself a layer of fatty material called the "myelin sheath."

All these developments were shown in the motion picture. In life, the growth process is rather slow, but by taking only one picture in two seconds and then projecting them at normal movie speed of sixteen to the second, the apparent rate of growth was speeded up 32 times. Another portion of the film was taken at the rate of one frame in eight seconds, giving them a speeding-up effect on the screen of 128 times the natural rate.

Growth after injury, as well as normal growth, was studied by Prof. Speidel. It has long been a disputed point whether a severed nerve grew together again or started afresh from the cut end nearest the central nervous system. Evidence apparently supporting both views has been produced in the past. Prof. Speidel's studies showed that where the two cut ends apparently grew together again, there was an anastomosis, or anatomical detour, connecting them by another path. A cut end really quite separated from the central nervous system degenerates and disappears, and a new nerve fiber grows out to replace it.

Prof. Spediel's first studies were conducted by watching the growth of nerve fibers in the transparent tissues of a frog tadpole's tail. During the past year he has also been studying nerve fiber growth in salamanders, which are rather remote zoological cousins of the frogs. He finds that the growth process in this order of animals is essentially the same as those he observed in the tadpole tails.

Science News Letter, January 21, 1933

PHYSIOLOGY

First Step Taken Toward Synthetic Sex Hormone

THE FIRST STEPS toward making a female sex hormone in the chemical laboratory seem to have been taken by two British investigators, Dr. J. W. Cook of the Cancer Hospital and Dr. E. C. Dodds of the Middlesex Hospital, London.

These two scientists have produced a chemical compound which, when injected into castrated rats, has an appreciable oestrogenic action similar to that of the sex hormone, oestrin. In their report to *Nature,* Drs. Cook and Dodds give the following formula for their compound: one keto, one, two, three, four tetrahydro phenanthrene.

Phenanthrene is a coal tar product used in the artificial production of dyes and drugs. The rest of the new compound's long name tells the chemist the way in which additional hydrogen and oxygen are combined with the phenanthrene.

At least four female sex hormones have been reported in recent years from research centers in the United States, Canada, England and Germany. They have been obtained from human placental material and from the kidney secretions of expectant mothers. These substances appear to be the same chemically, but they differ somewhat in the effects they have on the animal body.

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