PHYSIOLOGY

Answer to Muscle Riddle

The question of how living muscles contract and relax subject of research by Hungarian Nobelist during Nazi persecution.

By MAXIM BING, M.D.

➤ THE QUESTION of how living muscles contract and relax seems to have been answered by research by Prof. A. de Szent-Gyorgyi of Hungary, winner of the Nobel Prize for his isolation of vitamin C.

The muscle research, finished by Prof. de Szent-Gyorgyi during severe persecution by German and Hungarian Nazis, was reported in full at a meeting of the Hungarian Society for Natural Sciences, the first public act of scientific life after Hungary's liberation.

Discovery of a previously unknown protein and its role in muscle contraction were reported by Prof. de Szent-Gyorgyi. He and his collaborator, Bruno Staub, named this protein actin.

Under certain conditions, actin forms filaments consisting of globular particles arranged in a string like the beads of a rosary. These actin filaments or strings of beads unite with another previously discovered muscle protein, myosin. Rod-shaped particles of myosin cling together side by side and at their ends adhere to the globules of the actin string.

When a potassium salt is added, the myosin is precipitated. The consequent shrinkage bends the actin string toward the side of the shrinking myosin. The shortening which follows is seen as muscle contraction.

The myosin particles are attached to the actin string in a spiral pattern which much resembles a winding staircase, the actin particles forming its axis and the myosin particles its steps. Through muscular contraction, the complete system assumes the shape of a corkscrew.

The cross-striation of voluntary muscles of the body is due to this spiral arrangement of the clusters of myosin-actin systems of which the muscle fibers are composed, Prof. de Szent-Gyorgyi reports.

This has been proved by rotating the muscular fibrils under the microscope. During such rotation, the cross striation moves along the axis of the fiber. This explains the difference between cross-striated muscle, such as that in the arms, and smooth muscle such as that of the heart. Inside smooth muscle, the actin-myosin systems are less closely packed and thus neighboring actin-myosin spirals differ in their phases.

The three known conditions of muscles, relaxation, contraction and rigor mortis (the stiffness of the muscle shortly after death), are accounted for by Prof. de Szent-Gyorgyi's findings. Like myosin, actomyosin is precipitated by potassium chloride. If this reaction is performed in the presence of another chemical, adenosintriphosphate, the actomyosin not only precipitates but contracts.

This precipitation and contraction is limited to a very narrow range of salt concentration, outside of which the actomyosin splits into actin and myosin. Furthermore, the range of concentration depends also on the adenosintriphosphate concentration. Very slight variations of either cause a transition of the dissociated (relaxed) system into the contracted one.

Relaxation of muscles corresponds to the dissociated actin-myosin system. Contraction of muscles corresponds to the associated one, while rigor mortis corresponds to the salt precipitation of actomyosin through decomposition in the absence of adenosintriphosphate.

Actin was discovered during investigation of what happened during a mistake, as scientists considered it, in extracting myosin from muscles.

The consistency of myosin differs considerably according to the duration of the process of extracting it. Short extraction yields a thin fluid. Prolonged extraction produces a jelly. Previous researchers usually discarded the jelly-like product, believing it to be the result of having "spoiled" the process of extraction.

Prof. de Szent-Gyorgyi, however, prepared filaments from the jelly-like product and immersed them in a muscle "soup," that is, a boiled extract of muscle tissue. The filaments from the "spoiled" extraction contracted vigorously. Prof. de Szent-Gyorgyi thus reproduced the vital function of muscle in the test tube and made it accessible for analysis.

Prof. de Szent-Gyorgyi's results seem to open new vistas for explaining the nature of wave excitation and the mechanism of neural action. They represent a new approach to one of the oldest and most important problems of biology. He has been invited by the Soviet government to give a number of lectures in Moscow about his fundamental researches.

Prof. de Szent-Gyorgyi

Science News Letter, July 14, 1945

VOLCANOLOGY—AERONAUTICS

Army Helicopter to Hover Over Mexican Volcano

➤ A U. S. Army Sikorsky helicopter will shortly hover over Paricutin volcano in order to discover for the joint Mexican-U. S. volcano commission secrets of this geological wonder that burst forth from a cornfield two and a half years ago.

In this scientific exploration the Army's Air Technical Service Command will study performance of the latest model R6A helicopter under conditions of high altitude, turbulence and temperature similar to those in the Pacific war theater which do not exist anywhere in the United States. While making the scientific flights, Capt. George D. Colchagoff and Flight Officer Roy P. Beer, with 200 hours of helicopter experience, will be investigating rescue, observation, supply and liaison uses of the helicopter.

The first helicopter to be used in scientific collaboration with any country has arrived in Mexico dismantled in a C47 Army transport so snugly packed that only one inch space remained. The

helicopter is being assembled and flown to a base three miles from the volcano in full view of the cone.

Igor Sikorsky, designer of the helicopter, will participate in the double-barrelled helicopter volcanological observations. Geological work will be directed by Dr. L. C. Graton of Harvard and Dr. Ezequiel Ordonez, Mexican geologist, while Dr. O. H. Gish of the Carnegie Institution of Washington is in Mexico to study the electrical phenomena of the volcano which results in lightning-like discharges with accompanying thunder within the erupting material.

From the leisurely hovering helicopter the scientists expect to look down the throat of erupting Paricutin to discover what happens there, accomplishing in a half hour what ordinarily takes days.

Science News Letter, July 14, 1945

MEDICINE

Neostigmine for Polio

Has been found disappointing in acute cases, but two medical groups believe it should get further trial. Recovery said to depend on nervous system damage.

WITH the infantile paralysis season at hand, physicians will read in the *Journal of the American Medical Association* (July 7), that:

1. A synthetic chemical called neostigmine plus hot packs help relax muscle spasm a little, or temporarily, in acute cases and are promising enough to warrant further trial and study.

2. The amount of ultimate recovery from infantile paralysis depends primarily on the extent to which the central nervous system was involved and not the type of treatment.

Studies of neostigmine treatment are reported by two medical groups: Drs. Henry Brainerd, Hilliard J. Katz, Albert Porter Rowe, Jr., and J. C. Geiger, of San Francisco, and Drs. M. J. Fox and W. H. Spankus, of Milwaukee.

The point about recovery depending on amount of nervous system involvement is made by Dr. Mary S. Sherman, of Chicago.

The use of neostigmine for infantile paralysis was first suggested by Dr. Herman Kabat, now with the U. S. Public Health Service, and Dr. Miland E. Knapp, of the University of Minnesota, in 1943. They reported the chemical relieved the excessive muscle tone or tension and the muscle spasm and helped reduce incoordination. Neostigmine, also called prostigmine, had heretofore been used successfully to relieve fatigued muscles in myasthenia gravis, a disease of muscle weakness.

The San Francisco group reports from their studies that neostigmine relaxes muscle spasm at least temporarily, that its value requires further proof but that its further use is "definitely warranted" under controlled conditions.

"The Kenny treatment with or without neostigmine is an effective method of preventing contracture and deformity," they also report, adding they found neither proof nor disproof that either neostigmine or Kenny packs reduced the incidence of paralysis.

The Milwaukee doctors were disappointed at finding no pronounced or even consistent relaxation produced by neostigmine. They felt their results differed from those of Drs. Kabat and Knapp because all the Milwaukee cases were acute, whereas chronic cases predominated in the group treated by Drs. Kabat and Knapp. Using neostigmine with hot fomentations, the Milwaukee doctors believed a persistent and perceptible relaxation of spastic muscles resulted in most cases and that this treatment should be used further.

The condition of 70 patients stricken by paralysis in 1943 and examined 18 months later is the basis for Dr. Sherman's report. These patients were not treated with Kenny packs, splints or special apparatus. They were kept at absolute rest in bed and given as nearly normal a diet as possible. As soon as the pain and fever subsided, physical activity with early active exercise under water was started. The patients were got up and encouraged in the normal use of their legs and arms as soon as possible.

Of the 64 survivors, 13 had no detectable weakness at any time, 44 had some muscle weakness but are not now handicapped, six have "functionally significant weakness," but require no further treatment, and seven require braces or operations. No patient has gotten worse during the 18 months and major improvements, as expected, have occurred without exception in those patients who were not completely paralyzed.

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Bauxite deposits in Oregon are the only known commercial reserves of this material for making aluminum in the United States west of the Rockies.

Horse serums are used for the production of antitoxins because they are more easily borne by the human organism in large quantities than those of most other animals.

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