The Missouri Station has succeeded in chemically combining the proteins of skim milk with iodine to produce an artificial thyroprotein which has the physiological properties of thyroid substance. In short feeding trials, milk production of goats was increased by feeding 5 to 10 gm daily of the artificial thyroprotein, and cows which were falling off in milk production were stimulated to produce more milk by feeding 50 to 100 gm daily. This cheap source of thyroprotein may prove a practical way of increasing milk production of dairy cattle.—*Experiment Station Record.*

SCIENTIFIC BOOKS

Muscle. Vol. 3, Biological Symposia. Edited by WALLACE O. FENN. ix + 370 pp. Lancaster, Pa.: Jaques Cattell Press. 1941. $3.50.

IN the explosive, self-restituting phenomena associated with the substance myosin, muscle presents a challenge to many minds. "As a gadget which works," remarks the editor, "it has an obvious fascination for any boy or girl. It has," he adds, "a similar fascination for physiologists, the what-makes-it-go boys of biology." Augmented by additions to the initial list, the range of this symposium stretches from the rigors of bio-mathematics to the whimsies of bio-reminiscence; indeed, from the mechanics of powerful locomotor systems to that of the submicroscopic protein particle.

With rare technical skill, the Ramseys have subjected the individual muscle fiber to many crucial tests. That the functionally end-plateless fiber can be, throughout, both receiver and transmitter of excitation is strongly supported in their experiments. One of the most interesting of these reveals a singular perversity on the part of fibers permitted to shorten to 60–70 per cent. of resting length. In this "delta" state the fiber, among other changes, loses its intrinsic property to relax.

As an outgrowth from a discussion of the above studies, F. H. Pratt's historical sketch of the all-or-none concept as applied to muscle seeks its motive in Ranvier's expression, *la devise du coeur*. The type of response formulated by this "motto" is compared as a norm with deviations common to muscular behavior.

H. A. Blair analyzes mathematically the alternative features of the excitatory process: a threshold quantity of local change, and a phase of subsidence when that change falls short of threshold value. It is evident that the field is charted by the strength-duration curve. The conditions are treated with reference to selected models, of which the single polarizable membrane is found to be as adequate as the double. Dr. Street collaborates in the ingenious experiments on single fibers.

The behavior of smooth muscle is traditionally capricious. Can it be harmonized with the stereotyped capacity of skeletal and heart muscle to discharge discrete impulses and to conduct them in all-or-none fashion with a concomitant action potential? E. Bozler makes the distinction between the "multi-unit" type of smooth muscle, dependent upon outside innervation, and the automatic "visceral" (syncytial) type. Their potentials are interpreted respectively as (1) bursts of impulses referable to the discharge of discrete motor units; (2) repetitive impulses accompanying syncytial conduction. The rat's ureter presents a special case, with potential-complex typically cardiac.

A. S. Gilson, Jr., assuming protoplasmic continuity in smooth muscle, suggests that lack of uniformity in size of bridges may explain the electrical irregularities; and suggests that repetitive activity of one cell might simulate the responses of a group.

It is pointed out by A. Rosenblueth that smooth muscle is conductively heterogeneous. Long fibers, striated or smooth, show much the same type of conduction—an all-or-none effect, with potential ahead of contraction. As in Bozler's experiments, the same may be true of the short, presumably syncytial uterine muscle during estrus. Nictitating membrane and pilomotors fail to share the conductive function: here the diffusion of a chemical mediator can be invoked to explain nervous control of relatively distant cells.

The nerve-muscle junction is examined by T. P. Feng, chiefly in the light of Wedensky inhibition. Numerous important sub-topics conclude with "Local Potentials in Non-curarized Muscle." These, in summating, resemble those in completely curarized muscle, although probably not strictly localized to the end-plate. The many data analyzed lead to the following via media:

> If the spike potential and the liberation of AC [acetylcholine] in the nerve endings are intimately coupled concomitant events, the least arbitrary view at present is perhaps that which allows the actions of AC and of the spike to be mutually reinforcing, forming together an exciting complex which might even include other elements, *e.g.*, potassium ions.

In surveying the past decade of work on action potentials, A. C. Young deals first with investigations extending the membrane theory. The speeding of propagation by rise of temperature and by stretching is cited in its contributory relations. The after-potential as connected with the chemical changes is also considered, with emphasis on its temporal relation to a tension development so variable as to necessitate a separation into types. In rejecting "the conclusion that the action potential is due mainly to electrical changes at the end plate," the author voices his adherence to the intrenched theory.

In the article by Dugald Brown we witness an attack upon the redoubt that guards the secret passage between the chemistry and the mechanics of contraction —"the link between the chemical cycle and the shortening in the myosin linkages." It is possible only to note the main concept emerging from this penetrating study:

> We may suppose that at rest the active linkages are maintained in the resting state by a chemical system, some component of which is built into the linkage. In terms of a chemical system, this may well be a phosphoric ester. On stimulation, it is supposed that the linkages are activated, and that energy liberation ensues.

It is easy to think of muscle as acting universally by direct exercise of tension. But we are reminded by H. Elftman that in the great phylum of arthropods and the subphylum of vertebrates, where pivoted levers are "standard equipment," the somatic musculature employs a rotational system compelling the recognition of *torque,* of which tension is but one component. The oscillatory nature of bodily movement involves initial tension of the stretched muscle, and falling tension with rising speed. The author's analyses of torque-values in locomotion are based largely upon his own work in this reclaimed field.

In further aid to the concept that begins with the chemo-mechanics of the protein chain, and ends with torque, we are introduced by Ernst Fischer to the fascinations of dynamic crystallography. X-ray diffraction permits assumption of a three-dimensional, intramicellar, molecular lattice-work, the "repeat" pattern of which is prototype to the rhythms of microscopic structure.

F. O. Schmitt, agreeing with Dr. Fischer's view that the molecular changes educed "may still be far away from the conditions realized in nature," warns against too strict interpretation of form-birefringence data, and notes the modern substitution (for the concept of Naegeli) of an intermicellar lattice in what would correspond to Fischer's second-order pattern, intermediate between the microscopic and the molecular-crystalline.

The broad evidence from respiratory metabolism that food-stuffs are "burned" in the body favored the earlier concept of an internal-combustion engine. The peril of such analogy is long since realized. In Dr. Meyerhof's welcome contribution—the only one from Europe—oxidative factors are examined in the light of their history. The upshot of the author's analysis is his adherence to the "classical" view, in appraisal of work based upon the opportunely slow reactivity of cold-blooded muscle, and supported in the face of newly threatening revolution by the results (1940) of D. K. Hill. Agreement between the course of oxidative restitution heat and the determined assumption of oxygen is cited in affirmation of "the anaerobic nature of the fundamental process of contraction."

The general physiology of muscle—a discipline still in its inception—to an important extent owes its retardation to the unorganized state of comparative histology; and it is well to remember the diversity of conductive and contractile mechanism lying outside our own numerically insignificant group. Consider that our fellow chordates, the tunicates, outpoint the Mammalia in number of species by perhaps 50 per cent. Mysteries there are in C. A. G. Wiersma's account of what lurks within the exoskeleton of the arthropod legion: a single nerve fiber that actuates a whole muscle to quick contraction; another that is "slow" in its effect; another that inhibits; on each muscle fiber a dense feltwork of terminals like the stops to an elaborately keyed flute!

Medically, muscle has long failed of intrinsic interest. Save as indicator of nervous derangement, muscle, like consciousness, was left to take care of itself, if in so saying we ignore the debt it owes to the surgeon's hand. But the debt is reciprocal; and the thought that muscles not only keep us warm, but move the governing levers of the world's work and implement man's subtlest emotion, should be not without its share of inspiration.

Seldom have results of apparently pure academic interest had a speedier application to medicine than those recently derived from the chemistry of muscle and of neuromuscular transmission. Drs. Gammon, Harvey and Masland review the mechanisms involved in myasthenia gravis, myotonia and allied states. The reversible contributory relation between pathology and therapeutics, on the one hand, and physiology, on the other, is vividly illustrated.

The sensitivity of electrolyte balance and distribution to muscular behavior, conditioned as it is by the properties of the plasma membrane, admits of highly exact treatment; and in R. B. Dean's mathematical study, where unexplained facts must be faced, the operation of a mechanism for doing work upon the system is postulated in order to "pump out the sodium or, what is equivalent, pump in the potassium" against obstacles imposed by the equilibria of classical theory.

The issue between those who ascribe neuromuscular transmission to chemical means and those whose choice of transmitter is electrical, is not sharply drawn in this series: as already noted, Dr. Feng has offered a via media to the pilgrim. But our concluding contribution is from the frankly "electragonist" camp, where Drs. Eccles, Katz and Kuffler analyze the potentials peculiar to the neuromuscular junctional region with the aid of modifications imposed by curare, eserine and the ingenious use of the muscle impulse itself, back-fired against the junction. The conclusion is significant that endplate effects are depolarization effects, and so germane to the classical excitation process.

The Protean physiology of muscle can provide in this single volume hardly more than a sample antebellum cross-section. Yet to secure it can have been no light task. The succinct treatment of the parts minimizes the lack of an index; and the format, uniform with other numbers, continues the tradition of a finely wrought series.

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REPORTS

SECOND REPORT OF THE WAR POLICY COMMITTEE OF THE AMERICAN INSTITUTE OF PHYSICS[1]

REVIEW OF FIRST REPORT

IN its first report[2] issued on May 1, the War Policy Committee of the American Institute of Physics explained the reasons for its existence and discussed matters of policy of concern to physicists as follows:

(1) Professional status of physicists—definitions of "physicist" and "professional physicist."

(2) Training in physics for the war—its strategic importance.

(3) Emphasis on the study of physics—as justified by war and post-war needs of the nation.

(4) Special training of physicists—required for the war.

(5) Use of physicists—the importance of making full and efficient use of trained men in physics.

FURTHER REPORT ON MANPOWER

Since publication of the first report, the War Policy Committee has devoted special attention to the national manpower situation in physics. The situation has the proportions of a national emergency and is, the committee believes, coming to be recognized as such by the Army, the Navy and the War Manpower Commission. The emergency may be stated as follows:

(1) The design, production, operation and maintenance of new physical instruments of warfare are essential to the successful prosecution of this war. (Examples: submarine and aircraft location, improvement of anti-aircraft fire, automatic fuses, signaling devices, magnetic mines, etc.)

(2) The need for more physicists for these purposes is large and urgent.

(3) The number of physicists in this country is small, only about 7,000, and a substantial portion of these are already engaged in direct war work, leaving much too few to provide physics training for Army and Navy personnel and those needed for war research and production.

(4) Training of physicists is not an easy or short-time process.

(5) Unless prompt, effective measures are taken the shortage of physicists will be disastrously acute and no adequate program for training new physicists can be effected.

To meet this emergency the committee urges the Army, the Navy and the War Manpower Commission to take the following steps:

(1) Arrange for teacher training to provide for the very great amount of physics teaching which will be needed, not only in producing physicists, but in connection with training programs of the Army and Navy in which it is essential to convey some knowledge of physics to over 200,000 men and women within a year.

(2) Revise the situation of physicists with respect to Selective Service so as to assure students and teachers of physics the possibility of continuing their work without uncertainty.

(3) Provide loans, scholarships or other assistance to well-qualified students who need aid to continue their training in physics.

(4) Any men in the Army and Navy with physics training who are not actually employing that training in their work should be transferred to positions where physicists are now urgently needed either by detail or discharge.

(5) Start a public relations program as to the meaning of physics and its importance in the war, this being necessary to secure public approval and understanding of the necessity of the preceding four steps.

TEACHING LOAD 1942–43

The committee has studied plans of the Army and the Navy to enlist a large fraction of next year's college and university students in training programs to be carried on at the institutions. The programs include the Army Enlisted Reserve and the Navy V-1 program. The services rely on these programs to provide large pools of officer material and can be expected to make every effort to recruit them to the necessarily large enrolments to meet the essential

[1] July 19, 1942.
[2] SCIENCE, May 15, p. 508.