2. That persons rich in blood constituents are seldom inoculated with the disease, its onset depending upon anæmia and general depreciation of the health, and that these conditions but seldom prevail in mountain climates, owing to the fact that the blood, at these high altitudes, is richer in red corpuscles than it normally is at low levels.

3. That while a cold fresh air prevails in the mountains even in the summer, there is the additional fact that in winter mountain atmosphere is fresh and dry with sunshine of great intensity.

When the change of residence is first made from a low level to that of a mountain resort the individual is likely to experience what is known as the *maladie de la Montagne*, the symptoms of which are heat sensations, turgidity of lips and conjunctiva, with flushed face, nose-bleeding, sleeplessness, breathlessness, headache, and vertigo. This is rapidly followed by improved appetite, a sensation of *bien-être*, improved spirits, decrease of nervousness and dyspnœa. The first symptoms were due, according to Regnard, to an anoxæmia and the physiological needs created by this condition. Under the stimulus of this demand for more oxygen a condition of hyperhæmoglobinæmia soon becomes established. In other words, the blood of anæmic persons who transfer their residence from a low to a high altitude will soon contain the amount of oxygen which a fairly healthy person would possess at the lower level, and this can only be attained through an increase in the number of red blood corpuscles; for experiments on animals subjected for weeks to atmospheres of reduced atmospheric pressure show that the capacity of red corpuscles to hold oxygen varies directly with the decreased pressure or with elevation above sea level. The corpuscles will rise in number from a normal at sea level of 4,000,000 per cubic millimetre of blood to 6,000,000 or 7,000,000, according to height, within a fortnight. Paul Bert's law is thus expressed:—If at 760 mm. (30 ins. on barometer) blood absorbs 20 c.c. of oxygen, at 370 mm. it absorbs only 16.5 c.c., and at 30 mm. it absorbs only 7.4 c.c.

Regnard, after a review of the experimental evidence regarding nutrition, the changes in the composition of the atmosphere and the increased hæmatopoiesis having an intimate relation to it, says that when the atmospheric pressure diminishes, the oxygen supplied for organic combustion diminishes. Then the red corpuscles begin to increase, and soon the normal condition of tissues is restored and even passes the normal. It is certain, then, that in the mountains the appetite, stimulated by the fresh air and walking, determines a more active nutrition and more intense combustion. Similarly, there is an excess in the moisture given off in the mountains by pulmonary respiration. Probably, however, there is a tendency to increase in weight by residence in the mountains.

Much may be said concerning the stimulating influences derived from the ozonized air and the salt breezes blowing from the ocean. These must, however, be associated with a mild air, otherwise the dampness and fogs of the coast cannot fail to injure all except early cases of consumption, in which general debility is chiefly present. In such cases the coast from Boston southward during the summer, and the Gulf of Mexico during the winter, seem to best fulfil the indications. Los Angeles, etc., on the Pacific coast may, with good cause, be considered in this connection. The equable character given to the climate of the Pacific coast by the *return equatorial current* flowing from the north to join the parent stream at the equator, has of recent years given it many claims to prominence in the treatment of consumption. In many respects the climate of Southern California supplies America with a resort in a fair way of becoming as celebrated a winter residence for invalids as the far-famed Riviera of the Mediterranean; and, if lacking in some of the historic interest attaching to the latter, it certainly surpasses it in a freedom from the unsanitary conditions too often present in these old towns.

Any attempt to enumerate the almost infinite number of health resorts whose special claims have, even in America, but especially in France, Italy, Germany, Spain, England, Scotland, Switzerland, Algiers, Australia, and Tasmania, been set forth by special advocates, would be as impossible as it would be unscientific; and it is only by a careful review of the many conditions in connection with each case that satisfactory results are at all likely to be arrived at as regards its treatment.

P. H. Bryce.

CONTAGION. See *Infectious Diseases.*

CONTRACTILITY, CONTRACTION.—Contractility is one of the fundamental and inherent properties of living matter. Nearly all of the movements which are so characteristic of living nature are due to this property; that is, they are due to the contraction of protoplasm.

The contraction of a body or of a substance implies an alternating compensatory expansion or relaxation. If it were not for the alternating contraction and expansion (or relaxation), a repetition of a movement could not occur, and the end for which contractility seems to exist could not be accomplished.

Contraction is active, while relaxation is passive. Contraction can be accomplished only through a catabolism of the living substance, while relaxation involves no catabolism and may take place at the same time with anabolism.

I. The Significance of Contractility.—Contractility in its most primitive form is possessed by the active protoplasm of unicellular plants and animals. In a more advanced form it is the property of more or less specialized portions of the metaphyta and of the metazoa. The active protoplasm of higher plants forms so small a portion of the plant body, and the activities of this portion are so obscured by the more prominent and apparent portions of the plant, that one is likely altogether to lose sight of the importance of contractility in the plant kingdom.

On the other hand, the extreme prominence of this property and of the highly specialized muscular tissue which manifests it in the higher animals leads the casual observer to associate contractility with the animals, and to look upon it as one of the characteristics distinguishing animals from plants.

Being an inherent property of living matter, contractility must have a significance which bears a fundamental relation to life.

Only through the study of primitive forms can one elucidate these problems of life. Let us suppose that one has before him under a microscope an amœba just

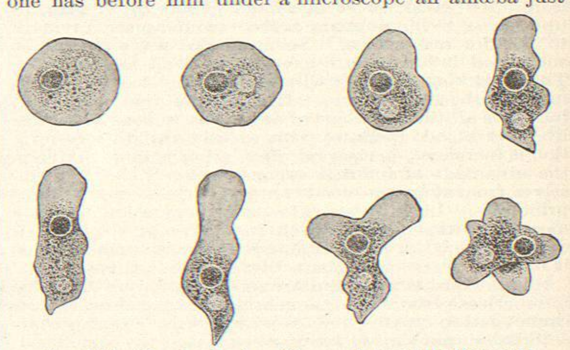

Fig. 1499.—Showing Various Phases of Amœboid Movement.

taken from an aquarium (Fig. 1499). When first seen under these conditions the organism is likely to be a fairly compact subspherical grayish mass. Presently one sees a portion of the mass slowly extending out from the main body. Other portions may extend out in other directions. These extensions or pseudopodia seem to be feelers. Through them the organism seems to get information regarding its immediate environment. Presently one of the pseudopodia gets rapidly larger through a

flowing of the protoplasm into the growing pseudopodium from the cell body and its other extensions. In this way the organism moves across the field.

Should it by accident or otherwise come in contact, at any part of its periphery, with a small solid body, such as a unicellular plant of smaller dimensions than itself, it immediately flows around the foreign body, thus engulfing it. A plant body thus engulfed or swallowed is actually digested and assimilated by the amœba.

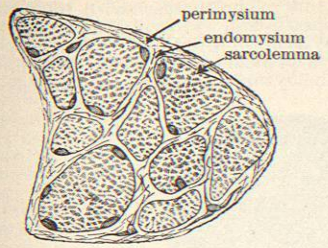

Fig. 1500.—Cross-Section of a Fasciculus of Muscle. Note that each muscle fasciculus is surrounded by a sheath called the perimysium; that the fibres which constitute a fasciculus are separated from one another by endomysium, and that each fibre is surrounded by a cell wall called the sarcolemma. The dots just within the sarcolemma represent nuclei.

If the glass slide upon which the organism is resting be jarred, or if in any way the animal is suddenly stimulated, it quickly draws up in a spherical mass, and remains thus contracted until everything is quiet and the way seems clear for another reconnoitring of the environment—another foraging tour.

Finally, after a preliminary period of rest the old amœba divides into two young ones, thus completely merging its individuality into that of the succeeding generation. This act of reproduction is accomplished through the means of a certain amount of contraction and movement.

The foregoing is, of course, an interpretation of the movements of the amœba in terms of the known activities of the higher animals, especially of man. How far this is justifiable is, of course, a question; but if we interpret the actions of low organisms at all we must of necessity do so in terms of our own experience.

Accepting this as a basis for our reasoning, we may say, then, that there are three fundamental ends served by the movements of the amœba: (*a*) nutrition; (*b*) protection; (*c*) reproduction.

In serving these three great realms of life activity, contractility stands in most intimate relation to the whole of life. If we study the higher ranks of living nature, we shall find that contractility holds just as important a relation to nutrition, protection, and reproduction as is observed in the protozoan.

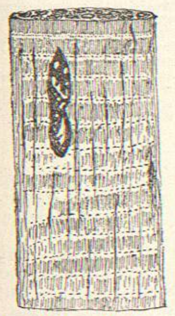

Fig. 1501.—Portion of a Fibre of Human Muscle. Note the transverse bands or striations. The light discs are divided by a dotted line (plane), first described by Krause and supposed by him to be a membrane.

II. The Structure of Contractile Substance.—It has been stated above that all living substance possesses the property of contractility as one of its inherent characteristics. It follows that the discussion of *the structure of contractile substance* is really the discussion of the structure of *living substance.* It is the intention of the writer to discuss in detail only those features of protoplasmic structure which are of especial significance in contractility.

Beginning with that substance which is most highly specialized as to contractility, viz., muscle tissue, one notes that the cell is a fibre and that the cell substance is fibrillated. In action it is observed that the cell becomes shortened in its long axis while its lateral dimensions increase, the volume remaining the same. The shortening of the muscle fibre (cell) is universally conceded to be the result of the shortening of the fibrillæ, which take a prominent part in the structure of each muscle cell.

Each fibre or cell is surrounded by a delicate cell wall, the *sarcolemma*, shown in Fig. 1500.

In the figure the shaded areas (areas of Cohnheim) into which the cross-section of each fibre is divided, represent bundles of fibrillæ, *muscle columns*, which are separated by the sarcoplasm.

The proportion of sarcoplasm to fibrillar substance may vary enormously in the muscles of different species as well as in the different muscles of the same animals. "Those muscle fibres which serve the most persistent or most strenuous actions are richest in sarcoplasm." "The great pectoral muscle of the best fliers (among the birds) consists exclusively, or almost exclusively, of plasmic (rich in sarcoplasm) fibres, while in the weak-winged

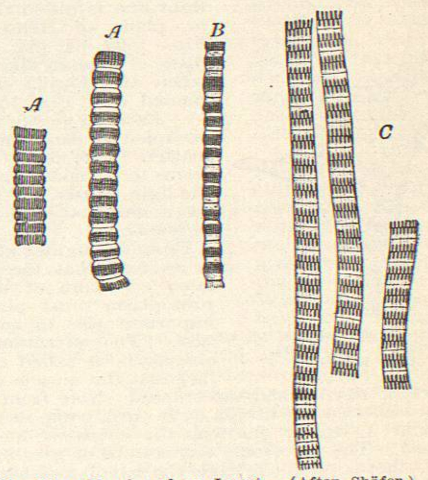

Fig. 1502.—Wing Muscles of an Insect. (After Shäfer.) *A*, Contracted; *B*, same, relaxed; *C*, moderately extended.

fowls it consists predominantly of aplasmic (poor in sarcoplasm) fibres." "There can be no doubt that energetic chemical changes go on in the sarcoplasm, as is proved by the frequent appearance within it of fat drops." "All indications favor the proposition that *the sarcoplasm* furnishes the pabulum which nourishes the fibrillæ during its activity." "If, then, it really is the rôle of the interfibrillar plasma (sarcoplasm) to preside over the nutrition of the contractile substance, the greater abundance of sarcoplasm in the muscles which serve the most strenuous and persistent functions is readily intelligible." (Quotations from Biedermann's "Electro-Physiology.")

The structure of the fibrilla has been under discussion for many years. Many of the points at issue are still

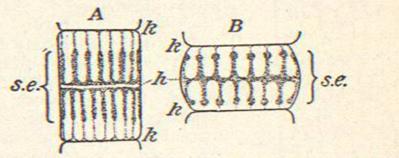

Fig. 1503.—Diagram of a Sarcomere. (After Shäfer.) *A*, Extended; *B*, contracted. The shaded portion of each sarcomere is a sarcosome. *h*, Plane of Hensen; *k*, *k*, membranes of Krause; *s. e.*, poriferous sarcous element.

unsettled. Fig. 1501 shows a human muscle fibre under high magnification. Note that the fibre presents alternating light and dark bands and that the light bands are subdivided by a fine dotted line. This line is called *Krause's membrane*, because it was at first thought to be a membrane. The whole fibre is composed of a great number of parallel fibrillæ. Each fibrilla is segmented and presents the same alternating dark and light segments shown by the fibre as a whole. Furthermore, each fibrilla possesses a portion of the "Krause membrane."

The most favorable material for the study of the finer structure of the fibrillæ is presented by the wing muscles of insects. Shäfer's preparations shown in Fig. 1502 give a very good idea of this structure. The portion between two Krause membranes is called a *sarcomere*. Note that in the extended condition the dark band has a light line dividing it transversely; this light line is called the line or plane of Hensen (see Fig. 1503, *A*, *h*). This plane of Hensen disappears when the fibrilla is contracted (see Fig. 1503, *B*, *h*). Each sarcomere then is occupied by dark and light matter. The dark matter seems to be more solid than the light matter. It is called a sarcous element or *sarcosome*.

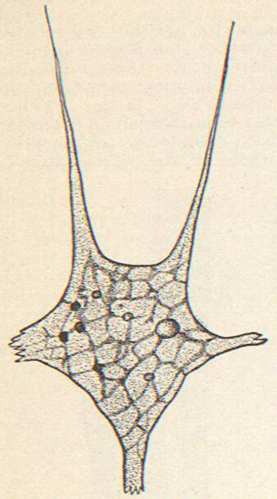

Fig. 1504.—Expanded End of a Foraminifer's Pseudopod. × 3,000. (After Bütschli.)

From the figures given it is evident that the fibrillated structure of muscle protoplasm must play an important rôle in contraction. The attention has already been called to the fact that the muscle cell is composed of fibrillæ and sarcoplasm. Note from Figs. 1502 and 1503 that the fibrilla is, in turn, composed of a darker and a lighter portion, the *sarcosome* and the *sarcolymph*. The sarcosome seems to be of greater consistency—that is, viscous; while the sarcolymph seems to be limpid in consistency. Not all of the substance of the fibrilla is contractile. The sarcosome is actively contractile, while the sarcolymph is passively adapted to the movements of the sarcosome, flowing to and fro in response to pressure from the sarcosome. Biedermann, cited above, has called attention to the fact that it is the sarcoplasm that serves as passive food for the active fibrilla. But within the fibrilla the passive sarcolymph probably serves as food for the active sarcosome.

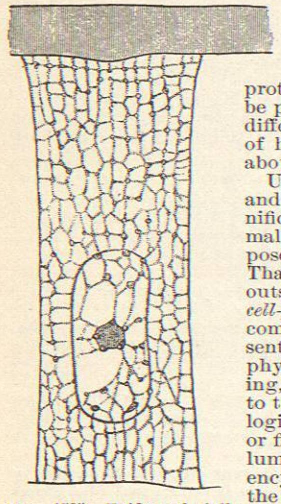

Fig. 1505.—Epidermal Cell of an Earthworm. × 3,000. (After Bütschli.)

In the muscle cell we seem to reach the highest order of differentiation in protoplasmic structure. It will be profitable to study less highly differentiated cells in the search of homologues to the structures above described.

Under favorable conditions and with sufficiently high magnification the protoplasm of animal cells is found to be composed of a meshwork of fibrillæ. That portion of the protoplasm outside of the nucleus, viz., the *cell-plasm* or *cytoplasm*, is thus composed of substances representing at least two well-defined physical conditions, and belonging, without reasonable doubt, to two categories from a physiological standpoint. The threads or fibrillæ which form the reticulum are of more viscous consistency, while the liquid which fills the meshes of the reticulum is more watery in consistency. The denser thread substance is called *spongioplasm*, while the liquid in the meshes is called *cytolymph*.

A study of Figs. 1504, 1505, and 1506 will reveal all of these features in cells representing a wide range of differentiation in the animal kingdom.

This reticulated structure of protoplasm with its differentiation into spongioplasm and cytolymph is so general and constant that Wilson, of Columbia University, has made a diagram of a typical cell (see Fig. 1507) in which the reticulum in the cytoplasm is a prominent feature. The nucleus, centrosome, plastids, and metaplasm are of importance in any discussion of the cell reproduction and nutrition, but may be passed without further reference at this time.

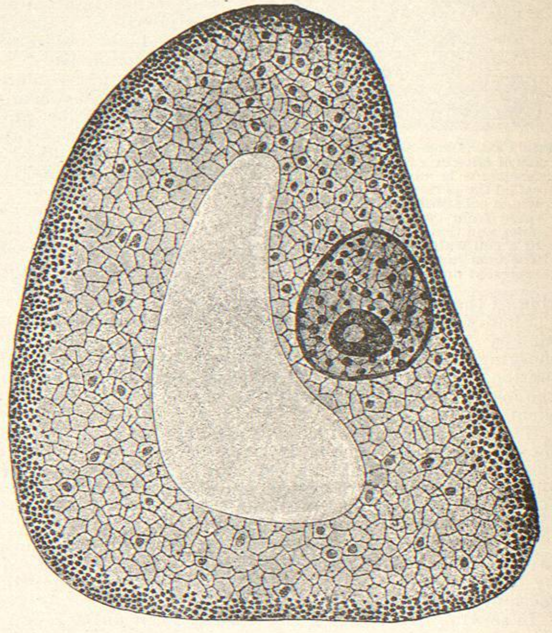

Fig. 1506.—Section through a Nephridial Cell of the Leech, Clepsine. (Drawn by Arnold Graf from one of his own preparations.) The centre of the cell is occupied by a large vacuole, filled with a watery liquid. The cytoplasm forms a very regular and distinct reticulum with scattered microsomes which become very large in the peripheral zone. The larger pale bodies, lying in the ground substance, are excretory granules (*i. e.*, metaplasm). The nucleus, at the right, is surrounded by a thick chromatic membrane, is traversed by a very distinct linin network, contains numerous scattered chromatin granules, and a single large nucleolus within which is a vacuole. Above are two isolated nuclei showing nucleoli and chromatin granules suspended on the linin threads. (Wilson: "The Cell, in Development and Inheritance," 1896.)

There can scarcely exist a doubt in one's mind that the fibrillæ of a muscle cell are homologous to the spongioplasm, while the sarcoplasm is homologous to the cytolymph. The spongioplasm is not homogeneous, but consists of substances of different consistency, notable among the denser substances being the *microsomes* or protoplasmic granules. Though a homology may be traced between different features in the structure of the fibrillæ and those of the spongioplasmic threads, it is probably too early to venture a judgment on such a relation. This thing is certain: the cells which have parallel, contractile fibrillæ are lineal descendants of cells which possessed the spongioplasmic reticulum. Furthermore, the spongioplasm is active, while the cytolymph is a passive food supply, so that the analogy between fibrillæ and sarcoplasm on the one hand, and spongioplasm and cytolymph on the other, is perfect.

Let us turn briefly to a consideration of other contractile structures. The ciliated cell possesses permanent cell extensions—the *cilia*—which are in constant motion. Fig. 1508 shows the structure as it appears under favorable conditions. The fibrillæ of the cytoplasm represent the spongioplasm of the ciliated end of the cell. The cilia seem to be simple extensions of the cytoplasmic fibrillæ, interrupted at the cell border by a zone of microsomes, which, in Fig. 1509, are strongly suggestive of sarcosomes.

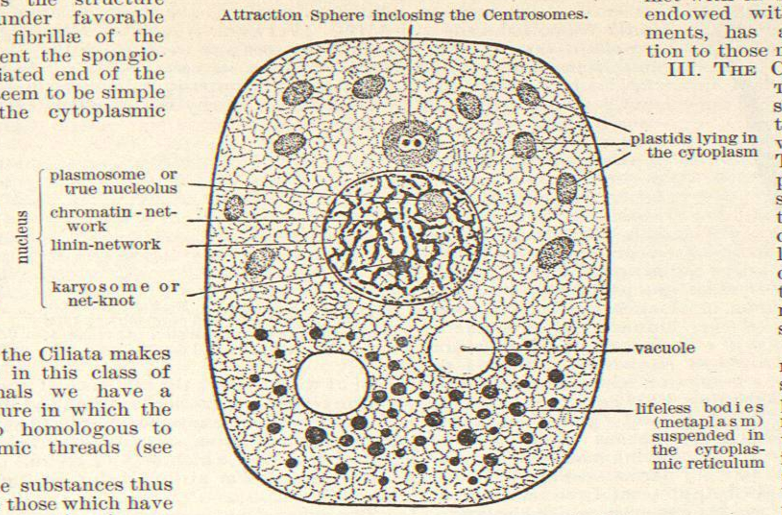

Fig. 1507.—Diagram of a Cell. (After Wilson.) Note that this diagram contains everything which a study of actual cells, as shown above, would seem to be essential and typical in cell structure.

Biedermann's study of the property of contractility among the Ciliata makes it evident that in this class of unicellular animals we have a fibrillated structure in which the fibrillæ are also homologous to the spongioplasmic threads (see Fig. 1510).

The contractile substances thus far discussed are those which have the power of contracting in one particular direction. The Rhizopoda among one-celled animals, also the undifferentiated protoplasm of plant cells, possess the property of contractility, but the character of the movement is quite different from that of any of the animals above the Rhizopoda in that the contraction may take place in any direction whatsoever. This particular character of movement is called amœboid (see Fig. 1499). The amœba, the monera, the leucocyte, and the protoplasm of plant cells do not seem to have a protoplasm differentiated into spongioplasm and cytolymph. The protoplasm of certain, perhaps all, foraminifera is, however, thus differentiated, and it is capable of typical amœboid movements and of no other kind of movements. Fig. 1504 shows the expanded end of the pseudopod of a foraminifer. The spongioplasm is very evident in the body of the expansion, but Bütschli has not shown it in any of the extensions. The literature of the subject would not lead one to believe that the fibrillar reticulum, met with in some of the animals endowed with amœboid movements, has any causative relation to those movements.

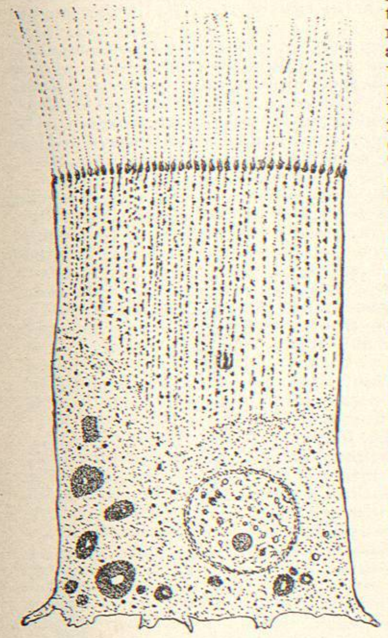

Fig. 1508.—A Ciliated Cell from the Intestinal Epithelium of Cyclas. Note the cytoplasmic fibrillæ terminating in a zone of peripheral microsomes to which the cilia are attached. (From Wilson, after Englemann.)

III. The Character of Contractions.—As stated above, contractions alternate with relaxations. This condition is a physiological necessity, because contractions are the result of catabolism, while relaxations take place during anabolism, though they are not necessarily the result of anabolism.

Contractions invariably decrease the surface of a body exposed to the surrounding medium, while relaxations as invariably increase the surface exposed. When an amœba relaxes it at the same time sends out one or more extensions of the body wall, thus increasing the surface, and through the increase of surface also increasing the absorptive area, and the opportunity to come into contact with solid bodies that may serve as food. With these two advantages there always comes the disadvantage that the expanded animal is subjected to greater danger of attack by other organisms, or of injury by the environment. Contraction decreases danger, decreases supply of nutriment and knowledge of environment. This seems to be a general law applicable to higher animals and to higher orders of individuals, *i.e.*, to the municipality, the state, and the nation.

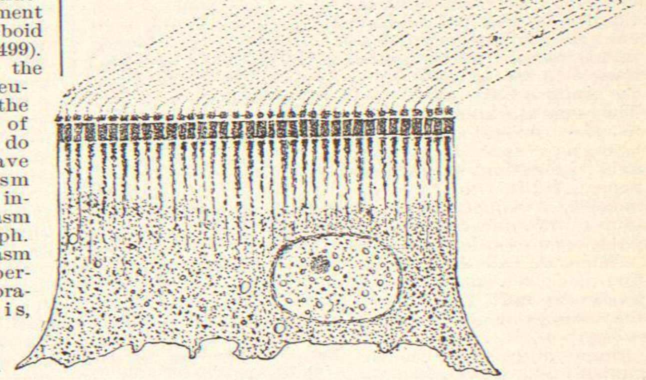

Fig. 1509.—A Ciliated Cell from the Gill of a Fresh-Water Mussel. The cilia are contracted. (From Wilson, after Englemann.)

A. The Character of Amœboid Movements.—Amœboid movements, so called because first observed in the amœba, are characteristic of the Rhizopoda in general, of leucocytes, and of some of the lower plant forms as well as of the unmodified protoplasm found in active plant cells.

The movements usually classified under this category differ slightly among themselves, and may be subdivided into the *flowing movements* which in plant cells become a distinct *circulation* of streams of protoplasm in the form of threads or strands of varying diameter from the region of the nucleus out to distant portions of the cell, usually along one side or through the middle, and returning along the opposite side or, in the latter case, along both sides. It is inconceivable that these movements could take place in protoplasm formed in part by a reticulum, much less that the reticulum could be active in causing the *flowing* and *circulation*. In this form of movement we probably have to do with the most primitive, spontaneous movements of living matter. That the terms contraction and expansion may be applied appropriately to this kind of movement is evident from the response which the protoplasm gives to any sudden, efficient stimulus it contracts into globular masses either along the course of the threads or around the nucleus (see Fig. 1511).

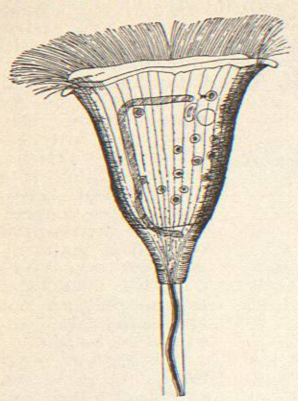
FIG. 1510.—A Vorticella (*Carchesium polypinum*). Note the converging fibrillæ developed from the exoplasm; also the muscle fibre of the pedicel.

The other form of amœboid movement shown by the higher Rhizopoda and by leucocytes is characterized by a slow pushing out of a pseudopod from any point in the surface of naked animals, but from the foramina of the foraminifera.

The mechanism of this pushing out is a matter of interest. A pseudopod cannot be thrust out as a result of simple relaxation. Relaxation is passive, and passivity never pushes. We must then have to do with some other factor than simple relaxation. There is relaxation in one dimension only and contraction in the other two. When one thrusts his tongue out of his mouth the transverse muscle fibres contract, while the longitudinal ones relax. The result is a sudden change in the dimensions of the tongue; the longitudinal axis elongating at the expense of the transverse dimensions. Something analogous to this takes place in the pseudopod of an amœba.

What we call the contraction stage is a contraction in all dimensions. This leads to the assumption of the spherical shape.

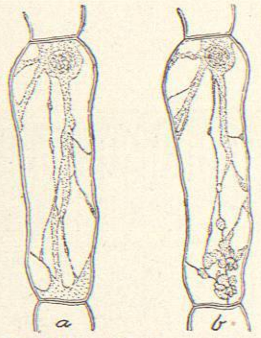
FIG. 1511.—Showing the Protoplasm of a Stamen-hair Cell of Tradescantia, expanded (*a*) and contracted (*b*).

Some, at least, of the organisms which possess the power of amœboid movement, possess also a reticulated spongioplasm (see Fig. 1504). The threads of the reticulum lie in the three dimensions and, therefore, from a mechanical standpoint may cause the movements. Inasmuch as contraction in its higher differentiation is clearly the function of the fibrillated spongioplasm or its homologue, we are justified in searching for the beginnings of this differentiation as soon as we find contractility and fibrillated spongioplasm possessed by the same organism.

B. The Character of Ciliary Movements.—In ciliary contractions we have for the first time an indubitable relation between fibrillated spongioplasm and contractility. Note that the contraction is transverse to the axis of the fibres (see Figs. 1508 and 1509). This can be accounted for only on the grounds of a contraction upon one side of the fibre or cilium, the other remaining relaxed (see Fig. 1512). (Verworn, *Allgemeine Physiologie*, p. 258).

Nobody seems to have raised the question as to how a cilium regains its erect position. Is it through a contraction of the opposite side or through elasticity?

The time and rhythm of ciliary contraction must be governed by the cells of which they are extensions, because all of the cilia of one cell contract in rhythmical unison. Upon ciliated surfaces all of the cilia act in harmony, sending a series of undulations over the surface similar to those which run over a field of wheat under the influence of the wind.

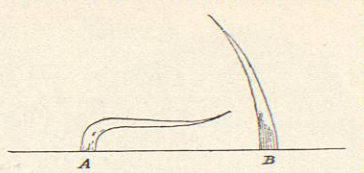

FIG. 1512.—Showing the Position and Condition of the Large and Slow-moving Cilia from a Rib of a Tunicate. *A*, Stage of relaxation; *B*, stage of contraction.

The ciliary contraction is strong and quick in one direction, while the relaxation is slow in the other; this results in a transportation, over the ciliated surface, of any bodies or matter which may be resting upon the surface, the transportation always being in the direction of the contractions.

The ciliated surfaces of the body are the respiratory tract below the larynx, the oviducts, and the vasa deferentia. The columnar epithelium of pharynx, œsophagus, and small intestine in many of the lower vertebrates is ciliated; while in man there remains of this ciliated field only a sort of vestigial, non-motile, crown of short cilia upon the columnar epithelium of the small intestine.

The function of the cilia is evidently to carry secretions along a duct or passage, or, in addition to that, to remove foreign matter, as in the case of the cilia of the respiratory tract.

Ciliary contraction may be grouped in two classes: (1) Concerted, rhythmical, undulatory movement over a ciliated area; and (2) the whip-like movements of a single large cilium called *flagellum*. A good example of flagellate ciliary movement is found in the spermatozoon. The zoöspores of the algæ usually possess one or two flagelli. The locomotion of a spermatozoon is a sculling movement.

C. The Character of Muscular Contraction.—Muscular contraction is characterized by the shortening of fibrillæ. We have already discussed at some length the minute structure of a muscle cell of some of the higher orders of animals. Biedermann ("Electro-Physiology," vol. i., pp. 3–5) traces the muscle fibrillæ phylogenetically back through the whole invertebrate division of the animal kingdom, back to the longitudinal contractile fibrillæ of the stentor and the vorticella (see Fig. 1510). In the case of the stentor the fibrils are separate throughout their course; but in the vorticella note that the separate fibrils of the exoplasm are gathered into the contractile fibre of the pedicel. The spiral course of this fibre down the inside of the elastic sheath of the pedicel causes the latter to be thrown into a cylindrical spiral when the fibre contracts (see Fig. 1513). Biedermann ("Electro-Physiology") demonstrated that a contracted vorticella returns to the expanded condition through the elasticity of the pedicel. Muscle fibrils never push; they are capable of active contraction of their longitudinal dimensions, but not of the transverse dimension to restore the original length. In this respect muscular contraction differs fundamentally from the amœboid movement. Muscle fibres may *contract and relax*, but they cannot *contract* and *expand*. During their condition of relaxation they are absolutely passive. They are, during this stage of their change, expanded; but the expansion depends upon the action of some factor outside of the fibre itself. In the case of the vorticella it depends upon the elasticity of the pedicel; in the case of the ciliary muscles of the eye it depends upon the elasticity of the tissues to which the muscles are attached; in the case of hollow viscera it depends upon intravisceral pressure; while in the case of the skeletal muscles the return to the expanded condition depends in part upon the elasticity of tissues and in part upon the active contraction of opposing sets of muscles.

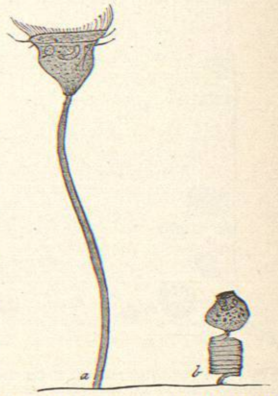
FIG. 1513.—A Vorticella Expanded (*a*) and Contracted (*b*).

Other topics on the subject of muscular contraction are discussed at length in Dr. Simon H. Gage's admirable article on *Muscle* (*q. v.*).

Winfield S. Hall.

CONTUSIONS.—A contusion is a surgical injury—other than a fracture or a wound proper—in which the skin remains intact. If there be a solution of continuity of the skin also, the term contused wound is used.

The force producing a contusion is necessarily blunt in its nature—a blow or a fall with resulting violent compression. The lesion produced thereby is chiefly a laceration of the subcutaneous structures, varying in amount according to the degree of force applied and the resistance or state of health of the part subjected to injury.

A contusion may, of course, involve the skin alone (without breaking it), or any deeper structures, as muscle, blood-vessel, nerve, viscus, or bone. There is, in a contusion, probably always vascular rupture of some degree. The resulting extravasation has received various names, according to its apparent shape, its amount, etc. For instance, hemorrhagic spots when small and round are called *petechiæ;* when elongated, as in stripes from a whip, *vibices;* when of irregular shape, though small, *ecchymomata* or *ecchymoses*. *Hæmatomata* are localized collections of blood of some size. The term *purpura* while sometimes applied to small extravasations into the parenchyma of the cutis, is more generally given to a systemic disease (Werlhof's) in which such hemorrhages are a prominent symptom. *Peliosis* is used in a similar sense. *Suggillation* is sometimes considered synonymous with ecchymosis; some medico-legal writers, however, have employed the former term to indicate certain post-mortem appearances produced by the settling of the blood beneath the skin. The diagnosis between these conditions may be made by examining a section of the skin—which, if the injury was ante mortem, will be found infiltrated with blood, and firmer and thicker than natural; but if post mortem, the blood will be beneath, or upon, but not in, the cutis. Moreover, the post-mortem mottling will generally occur at the most dependent parts, and the effused blood will be found fluid.[1]

Of medico-legal interest also is hæmophilia, as those subject to this diathesis are liable to extensive extravasations resulting from slight violence; and this is also true of certain chronic cardiac, hepatic, splenic, renal, and blood diseases, in which the blood is unhealthy and the vessels of diminished resisting power. It is a fact of common observation that certain people—perhaps women more often than men—even though not subjects of serious disease, nevertheless have such delicate blood-vessels as to suffer rupture of these from even trivial causes. "Black-and-blue" spots of even extensive degree will in them consequently result from the most trifling blows or falls; and in divorce suits where "cruel and inhuman" treatment is alleged, also in suits for assault and battery, this fact should be borne in mind.

The *amount* of extravasation in any contusion will vary with the extent of vascular involvement, the degree of vascular tone, and the density of the surrounding tissues. If the bleeding take place from an artery of some size, a false aneurism, either circumscribed or diffused, may result. Or, it may be that there is no immediate escape of blood from a large vessel, and yet its walls have been so injured as finally to disintegrate, and permit a violent secondary hemorrhage beneath the skin. Or, again, an immediate true aneurism may be produced through partial rupture, usually involving the inner and middle coats.

We sometimes see cases of contusion in which the pulsation entirely ceases in the main artery of a limb beyond the point of injury. Here there has generally been rupture of, at least, the inner coat, with consequent thrombosis; or, if pulsation is lost only after some time, this is due to obliteration from adhesive inflammation. Such instances may well be followed by dry gangrene, or moist if the accompanying vein or veins be occluded.

DIAGNOSIS.—It is impossible to estimate the gravity of any case of contusion from mere inspection of the patient. The weight and velocity of the missile, or the distance fallen, the posture in which the injury was received, etc., should be ascertained. The surface may show no evidence of a contused and ruptured viscus within. If the vascular lesions have taken place deep in the tissues, several days may elapse before the extravasated blood reaches the skin, becoming thus of diagnostic value; and not infrequently it makes its appearance several inches distant from the seat of contusion, commonly in the direction of gravity, having dissected its way to the surface between layers of dense fascia. A late-appearing ecchymosis is thus one of the signs whereby in difficult cases a fracture may be diagnosticated.

Contusion presents a certain superficial resemblance to gangrene, but is to be differentiated by the following points: 1. The discoloration, although present in both, becomes gradually less marked and lighter colored in ecchymosis, and steadily more marked and darker in gangrene. 2. There are often numbness and diminished sensibility over a contused surface, but in gangrene the dead part is devoid of sensibility, while the dying portion adjoining is often hyperæsthetic. 3. The local temperature is frequently elevated in a contusion, whereas in gangrene it is lowered. 4. In moist gangrene, more frequently than in contusion, the epidermis becomes raised in blebs; these are less sharply defined and more easily moved about, in gangrene. 5. Emphysematous crackling may be felt in gangrene when decomposition with consequent liberation of gas has set in. 6. The foul odor of putrefaction, very faint at first, may be detected in gangrene.

The diagnosis between hæmatoma and abscess, or between it and soft malignant disease, is not always easy; but the history, the employment of the aspirating needle, and microscopic examination of the fluid withdrawn will suffice.

In the scalp a hæmatoma with hard, sharply defined border and soft centre is sometimes mistaken for depressed fracture. Here deep pressure, if need be preceded by aspiration, will show the bone to be at its proper level.

SYMPTOMS AND COURSE.—The immediate pain from a contusion is commonly not great. There is usually numbness of some degree, followed by heavy aching, or throbbing during the inflammatory stage, and accompanied by loss of function.

The inflammatory symptoms are simply those occurring after any traumatism, but with less tendency to become of the septic or the suppurative order than those following similar lesions exposed to the air.

Shock, in contusion, is generally proportionate to the amount of injury inflicted; but bruising of certain parts—as the breasts, testes, and large joints—induces shock in an unusual degree.

Pulping of the tissues, or injuries of the large vessels, will often be followed by gangrene.

The discoloration of the tissues and the swelling are due sometimes to the extravasation of pure blood, and sometimes to blood-tinged serum. In extravasation un-