Calcutta, India. Baptized Gonxha (in English, Agnes) Bojaxhiu, she was one of five children of a middle-class family. Her father Nikola, a grocer, died in 1919, and her mother, Dronda, in 1968. At the age of 18, Gonxha joined the Sisters of Loreto with the intention of serving in the missions. En route to India she spent two months in Ireland, studying English. When she entered the novitiate in 1929 at Darjeeling in the foothills of the Himalayas, she became known as Sister Teresa. Professed in 1931, she was sent to teach at St Mary's School for Girls in Calcutta. On Sept. 10, 1946, while riding the train to Darjeeling, Sister Teresa experienced ''a second calling,''a vocation to serve the poor of Calcutta. In August 1948, she left the sisters of Loreto with the blessing of her superiors and the permission of the archbishop of Calcutta to live in the slums of Matizhil. She donned the sari and applied for citizenship in her adopted country. Teresa's initial effort was to organize dispensaries and outdoor schools where she fed, clothed, and taught poor children. The women, including some of her former students, whom she enlisted as volunteers to assist in the work became the nucleus of the Missionaries of Charity. In 1950 the order received canonical approval from church authorities.

In 1952 Mother Teresa opened the first of many hospices for the dying. In 1957 she founded a leper colony called Shanti Nagar (Town of Peace) near Asansol, India. Under her guidance the Missionaries of Charity established numerous centers where they ministered to the aged, lepers, cripples, AIDS victims, and the dying. In 1963 the Indian government awarded her the Padmashri (''Lord of the Lotus'') for her services. As the Missionaries of Charity expanded their ministry to other countries, Mother Teresa's reputation spread throughout the world. In recognition of her work Pope Paul VI awarded her the first Pope John XXIII Peace Prize in 1971, and she received the Nobel Prize for Peace in 1979. Upon accepting the Nobel honor she said, ''I choose the poverty of our poor people. But I am grateful to receive [the Nobel] in the name of the hungry, the naked, the homeless, of the crippled, of the blind, of the lepers, of all those people who feel unwanted, unloved, uncared-for throughout society, people that have become a burden to society and are shunned by everyone.''

The sisters continued every six years to reelect her as major superior until early 1997 when, because of her rapidly failing health, they acceded to her wish to step down. In March they elected Nepal-born Sister Nirmala to head the order. Surrounded by sisters of the community Mother Teresa died peacefully on Sept. 5, 1997. On September 13, they buried her in a simple white marble tomb in the mother house of the Missionaries of Charity. In reminiscing about Mother Teresa some weeks after her death Pope John Paul II who had met with her on several occasions said, ''I hope she will be a saint.'' Eighteen months later, he dispensed with the normal five-year waiting period and allowed the archbishop of Calcutta to initiate the formal process for beatification.

See Also: MISSIONARIES OF CHARITY.

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[B. L. MARTHALER]

MOTION

Motion (Gr. κίνησις, Lat. *motus*) can be taken in a wide and in a strict sense. In the wide sense it stands for any CHANGE, for any transition from one state or condition to another. In a strict sense it means successive and continuous change, usually spoken of as movement. Aristotle held that it is unnecessary to prove the existence of motion, since the fact is evident. This notwithstanding, motion constitutes the first and enduring problem of philosophy, and through the study of it philosophers come to significant insights into material being and into the nature of being itself. It is also of interest to psychologists, for the perception of motion—examined in scholastic and modern psychology alike—has given rise to several theories on this subject. Accordingly, the present article treats motion under two aspects, the first part dealing with it from the standpoint of philosophy, the second from that of psychology.

Motion In Philosophy

Originating among the early Greeks, the philosophical analysis of motion reached its fullest development in the thought of Aristotle and the scholastics. This analysis forms the conceptual background against which the characteristic approach of modern science, as well as further contributions by modern philosophers, are most easily discussed.

Early Greeks. Since the early Greek philosophers lacked precise concepts of the different kinds of being, they reduced all changes to the simplest type of motion, local motion or change of place. From the beginning they spoke of the process of becoming in this terminology: things came into being by being ''separated'' from an original mass, by condensation and rarefaction, or by a downward and upward path. The only philosophers to deny the possibility of change were PARMENIDES and his Eleatic school. The famous paradoxes of ZENO OF ELEA, for example, purported to disprove the intelligibility of local motion. Because his concept of being was absolute,

Parmenides himself denied that anything could come to be. The subsequent atomists were one in denying the possibility of absolute coming into being. They reduced all change to local motion, that is, to the redistribution of atoms in space (*see* ATOMISM; GREEK PHILOSOPHY).

PLATO distinguished motion from becoming (γένεσις; *Theaetetus* 152D–153E), although he usually understood motion as local motion (*Laws* 893B–894A). In *Theaetetus* (181C–182A), however, he introduced the concept of qualitative change or alteration (ἀλλοίωσιν) as one of the two types of motion. He also defined soul as ''the motion which can move itself'' (*Laws* 896A), and he listed psychic operations as examples of motion (*Laws* 897A). Yet he was constrained to think even of the movement of reason as similar to the local motion of a sphere and its relatively immobile central point (*Laws* 898A; cf. *Tim.* 33B–34A).

Aristotelian concept. It remained for ARISTOTLE to give the first reasonably complete analysis (*Physics* 200b 12–231a 20; 250b 11–267b 26). In this he was followed by St. THOMAS AQUINAS, whose commentary on Aristotle's *Physics* is the fullest account of a philosophy of motion. Beause of his historical milieu, Aristotle had first to justify the possibility of motion by assigning principles that would account for motion in the face of the Eleatic denial. The possibility of change he saved by distinguishing being into ten categories and into actual and potential being. For Aristotle motion was the proper formality from which to study nature and natural phenomena. No other formality, such as being or extension, can in his view reveal the nature and explain the sensible properties of matter. He maintained it necessary, however, to distinguish motions that are natural from motions that result from art, chance, or compulsion. The first kind is of fundamental relevance to his scientific study of the world.

In Book 3 of the *Physics* the famous definition of motion is given. Aristotle begins by stating the concepts to be used in its definition. Since motion spans several CATEGORIES OF BEING, the elements of the definition must also transcend the categories; the only available prior concepts for defining motion are POTENCY AND ACT. Motion must be situated midway between potentiality and full actuality. When a body is only in potency, it is not yet in motion; when it has been fully actualized, the motion has ceased. Therefore, motion consists of imperfect ACT. But since imperfect act can be the termination of a motion or the starting point of a new motion, it is necessary to indicate motion as the act of a being in potency precisely as still in potency to more of the same act. Hence, motion is defined as ''the fulfilment [act] of what exists in potency in so far as it is in potency'' (201a, 10).

Types of motion. Plato had adumbrated various types of motion, but Aristotle put the classification on a scientific basis. Motions are distinguished by the goal or *terminus ad quem* (*Physics* 224b 7). Motion does not of itself belong in the categories of being, since it is not BEING, but BECOMING; however, it is reduced to the category of the being in which it terminates.

Local Motion. The first, most obvious, and easiest motion to observe is change of PLACE, or local motion. It is divided into circular, straight, and mixed, as well as into uniform and accelerated. The nature of motion is most easily seen in local motion, and even the terms one uses to describe other types are terms applied primarily to local motion. Local motion clearly goes from term to term, from a point of departure to one of arrival. These two terms are opposed and incompatible, but admit intermediary states: thus, they are called contraries. The motion between them is continuous, or unbroken and successive, that is, traversing the intervening positions. It is divisible by reason of the extension crossed. Since an instant is not divisible, motion cannot be instantaneous, but takes TIME. Likewise, motion properly speaking belongs only to bodies, since only they have the divisibility essential to motion. Local motion of some sort is involved in all other motions, and other motions are called such by analogy with local motion.

Alteration. Qualitative motion is called alteration. It is realized only in the third species of QUALITY, namely, sensible qualities. Only these fit the definition of motion as continuing and successive actualization of potency. Changes occurring in the vital or psychic orders are not motions in the same sense as loca1 change and change of sensible qualities. One speaks of the mind as ''proceeding'' from known to unknown, of discursive REASONING; this, however, is only by analogy with local motion. Vital and psychic operations are not acts of beings in potency, but of beings already proximately determined to act; these operations are not the fulfillment of potentialities, but the products of potentialities already actualized (cf. St. Thomas, *Summa theologiae* 1a, 18.3 ad 1). Further, in psychic acts there is not the successiveness characteristic of motion, nor the contrariety between the terms of the process. In SENSATION the preliminary stimulation of the sensory organs is a qualitative change, but the determination of the faculty itself is not a gradual reception of act and thus is not motion. In the sensitive appetite there is motion, insofar as there is a physical accompaniment to the psychic act; the motion may be qualitative or local. Changes of moral disposition, although gradual, are not truly motions, but rather one or a series of instantaneous changes. Substantial changes are preceeded by alterations that dispose matter toward becoming a new being, but the actual generation of a new substance and destruction of the old are instantaneous,

and are thereby not classified as motions in the strict sense. (*See* SUBSTANTIAL CHANGE.)

Augmentation and Diminution. Motion in the category of QUANTITY is called augmentation or growth and diminution or decrease. Augmentation does not consist of mere addition of distinct quantities to form an aggregation; such would reduce to local motion and would be augmentative, but not the motion of augmentation. The motion of augmentation must take place within the unity of a single SUBSTANCE. This happens only in living beings. By nutrition these assimilate their food into their own substance and consequently achieve growth. This is a true motion. It involves some local motion, as a growing body extends spatially. It is gradual, ordinarily so slow as to escape observation. It passes through successive stages, from the smallest one-cell stage to the full measure of growth determined by the specific nature. It also goes from contrary to contrary, from one positive state to another in the order of quantity. Such a motion is obviously immanent operation on the part of the living subject as agent, but it is true motion on the part of the subject as receptive of a new perfection. The opposite of augmentation is diminution or decrease.

Other Categories. The two categories of ACTION and passion do not constitute separate types of motion, for they are really identified with motion. Action is motion considered as being *from* the agent. Passion is the same motion considered *in* the patient. There is no motion in the category of ''when'' (*quando*), since time itself is the measure of motion. Nor is there motion in the category of RELATION. A new relation arises as a result of a change in some other category; for instance, by reason of a change of place, a relation of proximity arises, and from change of quality in one being, a relation of similarity or dissimilarity results in another being. A mutual relation can come into being and cease to be without any change in one of the related members. Hence, change is merely incidental to relation. The categories of SITUATION (*situs*) and condition or vestition (*habitus*) are constituted by relations, and so do not found separate types of motion.

Reality of motion. The objective reality of motion is known through a recognition of the various stages of actualization from the beginning to the ultimate termination of motion, even though these stages are not identified with motion. Fundamentally, each one has immediate experience of his own motions, particularly local (see below, Motion in Psychology). The paradoxes of Zeno, while purporting to disprove the reality of local motion, can be solved by an analysis of the CONTINUUM and of the infinite (cf. *Physics* 239b 5–240a 18). Though directed against the intelligibility of motion, they do not overturn the immediate EVIDENCE of the fact of motion.

The reality of motion is further confirmed by the need of an efficient cause or mover. Motion is an emergence from a state of potentiality to one of actuality. This is possible only under the influence of some being in act. Even vital movement requires that one part of a living being function as agent and another part as patient; otherwise the same being would be in potency and act together. The mover must be distinct from the moved and must be proportioned to the motion produced. There must be contact, at least mediate; there is no action at a distance. In a series of movers that are themselves moved, there is no ultimate explanation for the motion unless there be a first unmoved mover, a first cause of motion (*see* MOTION, FIRST CAUSE OF).

Motion in modern science. The Aristotelian requirement of a mover in act as necessary to account for motion was not easily satisfied; this was particularly the case in assigning the cause of projectile motion, such as of a stone thrown upward. Aristotle had explained the motion of the projectile after it left contact with the mover by supposing that the agent moves not only the stone, but also the surrounding air, giving the air motive power to continue projecting the stone. In the 6th century, JOHN PHILOPONUS of Alexandria criticized the Aristotelian theory and proposed the theory of IMPETUS in its stead: the mover imparts a ''motive power'' or energy to the projectile itself. In the 14th century JOHN BURIDAN spoke of the impetus as a qualitative power given to the body by the mover. He suggested that impetus theory could explain the motion of the heavenly bodies, once God had put them in motion. His doctrine has been assimilated into Aristotelianism and scholasticism, where impetus is explained as a quality or an instrumental power communicated by the mover. It is usually not thought to be an efficient cause of motion, but rather it is seen as analogous to the internal principle of natural motion.

Ockhamist Critique. WILLIAM OF OCKHAM reduced all physical being to the two categories of substance and quality, the only two that denoted distinct realities. The reality of local motion and position in place were thus denied, and there was no longer need to find a cause for the continuance of projectile motion. Accordingly, Ockham could deny both the original Aristotelian and the impetus theory.

Galileo's Contribution. Galileo GALILEI initiated a radical departure from such theory and study of motion. Confining himself to local motion, he stated that he had discovered by experiment certain properties of motion not hitherto observed or demonstrated. He set himself to study these properties through the method of measurement and correlation. Motion, for him, gave way to mo-

mentum, the product of the quantity of matter and velocity. Galileo identified momentum with impetus, and this became no longer an instrument or principle of motion, but a property of motion. He was not interested in an efficient cause for the continuance of motion, but in a measurable external cause of the acceleration or retardation of motion. Therefore, observing that a velocity once imparted to a body is accelerated or retarded according to the slope of the plane along which the motion takes place, he inferred that frictionless motion along a horizontal plane is uniform and perpetual. However, since in the real world this horizontal plane is circular—the surface of the sea, the path of the heavenly bodies—then the motion of bodies continues in a circular path, rather than in a straight line. Thus did Galileo give partial formulation to the principle of inertia.

Newton and Mechanism. Sir Isaac Newton correctly stated the principle of inertia as the first of his axioms, or laws of motion: ''Every body continues in its state of rest, or of uniform motion in a straight line, unless it is compelled to change that state by forces impressed on it.'' From this and other axioms, Newton developed the science of mechanics, discovering in the process a formula of gravitation that is applicable to celestial as well as terrestrial phenomena. He also studied the properties of light according to principles of motion, and in his *Optics* he proposed a science of nature guided and inspired by mechanics. Newton's successors thereupon extended mechanics into every region of science, into acoustics, hydrodynamics, magnetism, electricity, heat, even into biology, psychology, economics, and sociology, at the expense of denying all that is not reducible to matter and motion (*see* MECHANISM).

Recent Physics. The use of mechanical principles as ultimate explanations of physical reality ran into difficulties in the 20th century with the advent of relativity and quantum theory. The Heisenberg principle of uncertainty, according to which it is impossible in principle to measure both the position and velocity of a particle, makes it impossible to construct a mechanical model of the world. Moreover, the concept of quantum jumps is interpreted by some to involve a denial of the continuity of motion.

Motion in modern philosophy. René DESCARTES recalled the common doctrine that NATURE is the principle of motion and rest, but he could conceive of motion only as local motion. Therefore, he attempted an explanation of all material reality from a mechanical point of view, i.e., in terms of matter and local motion. He held that all that man can know of external objects are their figure, magnitudes, and motions—all modes of extension. Color, odor, taste, and other sensible qualities, in this view, are not objective. Descartes also taught that in the beginning God created a definite quantity of motion, which remains constant. Not interested in the Aristotelian or qualitative definition of motion, which he never understood, he concentrated instead on the quantity of motion, or momentum. Motion became, for him, an actual and measurable state of a body, without consideration of a potential state that is being further actualized (cf. *Principles of Philosophy* 2.24–36).

Leibniz and Kant. LEIBNIZ objected to Descartes's idea that the quantity of motion in the universe remains constant; this, for Leibniz, is true rather of force (*Discourse on Metaphysics* 17–18). Likewise, he denied that extension is a clear and distinct idea. Extension, together with size, figure, and motion, are subjective phenomena, no less than the other sensible qualities the mechanists had rejected. Accordingly, he formulated his monadology, a doctrine in which bodies are composed of simple forces, psychic in character (*see* MONAD). The DYNAMISM of the system did not prevent Leibniz from interpreting bodily actions mechanically, even though they do not act upon one another. Bodies are divine machines or natural automatons (*The Monadology* 64). The motions of bodies, however, are regulated by their preestablished harmony with one another and with souls, which act according to final causality and the divine plan of the best possible world.

Immanuel KANT, in his precritical days, developed the monadology of Leibniz. In his definitive philosophy he defined motion as ''actuation in space'' (*Critique of Pure Reason* B291). Motion is an empirical concept, since experience apprises one of something moving in space and time. But there is also a subjective element to it: the two forms of sensibility, space and time, organize the successive determinations of a movable object.

Bergson's Critique. The most searching criticism of such views was that of Henri BERGSON, who held that the scientific mind cannot grasp the reality of motion. The intellect makes static, snapshot views of various stages of a transition, thereby solidifying into discontinuous images the fluid continuity of the real. Just as a movie projector, by reason of the movement of the apparatus, reconstitutes the motion that had been immobilized in a series of still pictures, so does the mind string snapshots of reality upon an abstract ''becoming'' contributed by the mind itself. The mechanism of ordinary knowledge is ''cinematographical.'' In order to grasp reality, which is duration or change itself, one must escape from the cinematographical mechanism and employ a metaphysical intuition. Since change is the essence of reality, there is no underlying subject of change; movement does not imply a mobile [*see Creative Evolution* (New York

1911); *The Creative Mind* (New York 1946)]. The mobile continuity of the real, or concrete duration, is for Bergson the subject of metaphysics. If Bergson's critique accomplishes nothing else, it at least intimates that modern thinkers, by reducing motion to a state, have allowed reality in flux to escape them.

See Also: PHILOSOPHY OF NATURE; MATTER AND FORM; SCIENCE (IN THE MIDDLE AGES).

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[M. A. GLUTZ]

Motion in Psychology

The study of motion in psychology has a long and interesting history. Once it was realized that motion could be experienced when there was no physical movement and that actual physical motion might not be experienced as such, the investigation of just how man perceives movement captured the interest of psychologists. To explain these illusions, most psychologists relied upon some type of logical analysis in terms of space and time, until the significant research of Max Wertheimer on apparent movement showed that a new phenomenological approach was needed.

Perception of Movement. Current investigation of the perception of movement may be classified under the following headings: induced movement; autokinetic movement; direction, speed, and causality of movement; and apparent movement.

Induced Movement. In induced movement one object is displaced in relation to another, but the subject is not able to perceive which has moved. He may, for example, see the object move when in reality it is the frame that has moved. The tendency is to interpret the figure as moving rather than the background. Also the meaning of the stimulus for the particular subject can determine which of two stimuli the subject perceives as moving.

Autokinetic Movement. Another interesting illusion of movement is the autokinetic effect, in which a stationary point of light is perceived as moving in a completely dark room. This phenomenon is explained largely in terms of nystagmus eye movements, but it is influenced also by the posture of the body, and kinesthetic sensations from the muscles. Moreover the autokinetic phenomenon is greatly influenced by social suggestibility of the subject. In both induced and autokinetic movement, the experienced movement cannot be differentiated from real movement.

Direction, Speed, and Causality. More recently it has been discovered that both direction and speed of movement depend upon the organizational factors present. It appears that the speed of movement is apprehended independently of distance or time. One peculiarity of directional movement is the trapezoidal illusion, in which a rotating trapezoid is perceived as oscillating because of the conflict in cues. Another interesting piece of research by A. E. Michotte (1881–1965) indicates that movement can have more complex attributes such as causality. The simulated appearance of one ball striking another is perceived as the first ball causing the second to move, even though there is no actual contact.

Apparent Movement. Of great importance is the study of the perception of movement. To illustrate this phenomenon two lights are mounted side by side. First one, then the other, is turned on and off. By varying the time between the turning on of the two lights, one induces three different perceptual experiences. If the time interval is long, the first light is perceived simultaneously. If the time interval is just right, one light is perceived as moving from position *A* to position *B*. *A* light is seen as moving when in fact there is no movement at all, and across a space where there is no stimulus present. The same phenomenon of apparent movement has also been reported for skin sensitivity of two successive stimuli, and for the hearing of two successive clicks.

The conditions governing the occurrence of the phiphenomenon were investigated by Korte (1915). He found that the threshold was determined by distance between stimuli, the time interval of the succession, and the intensity of the stimuli. Moreover, the direction of the apparent movement was determined by the grouping laws of proximity and similarity. Finally the spatial arrangement of the successive stimuli may direct the apparent movement.

Theories of Perception. On the basis of the phiphenomenon, field theorists maintain that movement is a primary sensory phenomenon not reducible to sensory attributes or to space or time. On the other hand the sensory-tonic theory of H. Werner and S. Wapner stresses the role of muscle activity in enhancing the autokinetic effect of apparent movement. The transactional functionalism theory of Ames's group and the probabilist theory of Brunswick attempt to explain the illusion of movement in terms of the cues of position, size, distance, and past experience, maintaining that these operate immediately and unconsciously.

The explanation offered by Thomistic psychologists is that movement is a *per accidens* sensible known through the operation of the internal senses, operating simultaneously in conjunction with the external senses and through physiological and psychological cues. The IMAGINATION is the faculty that supplies the sense of movement in conjunction with the work of the senses; thus the phenomenon of apparent movement results from the work of the imagination. This faculty fuses together the successive sense impressions, e.g., moving pictures, and at the same time relates this information to the past experience of actual moving things to give an experience of movement. Such a Thomistic view can give a rational explanation of all the phenomena of movement reported in experimental psychology; yet it should be noted that what it subjects to complex analysis is in reality a spontaneous and frequently an unconscious process.

See Also: SENSATION; SENSE KNOWLEDGE; SENSES.

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[J. H. VOOR]

MOTION, FIRST CAUSE OF

Experience shows that some things in the world are in motion, whereas others are at rest, and that things pass from rest to motion and from motion to rest. In view of these facts, the question arises whether each and every thing is so constituted as to be capable of both motion and rest, capable of being either a mover or something moved, or whether besides things of this sort, something exists that is a mover, but is itself unmoved by any other. Is there an unmoved mover that is the primal source or first cause of motion? Scholastic philosophers commonly answer this question in the affirmative.

Existence of an Unmoved Mover

The scholastic proofs for the existence of a first unmoved mover are based upon an argument first proposed by ARISTOTLE (*Phys.* 241b 24–267b 27) and subsequently commented upon by St. THOMAS AQUINAS (*In 7 phys.* 1–9; *In 8 phys.* 1–23) in the context of their natural philosophy. In what follows, the concepts and distinctions presupposed to this argument are first explained, then the argument itself is exposed, and some observations made on the place of such a proof in natural philosophy and its relevance to traditional proofs for the existence of God.

Presuppositions. By MOTION is meant the act or process of change. This is not a disembodied energy, nor something purely and simply actual, but an actual determination of a natural body precisely as this is capable of further actuation. Motion thus conceived requires a mobile or potential subject that remains the self-same throughout the change, but becomes different from the way in which it was before the change. When a body passes from REST to MOTION, motion itself begins to be in this mobile subject. Whatever begins to be does not spring from mere nothing, nor does it produce itself, but depends for its being on some active principle, called the efficient cause. The efficient cause is the mover, or active source of motion, whereas motion is an effect produced in the moved or mobile subject. Each kind of motion requires a mobile subject capable of being moved with that motion, as well as a mover able to produce the motion.

Atemporal Aspect. If the supposition is made that motion had a beginning in time and has not existed from eternity, then it is manifest that there must be a first efficient cause of motion, because anything that begins to be requires an efficient cause from which it originates. However, since it is not clear from human experience or scientific reasoning that motion did have a beginning in time, the present discussion does not assume this.

Accidental vs. Essential. In order to prove by reasoning that there is a first cause of motion, a distinction should be made between motion that is caused or possessed accidentally and motion that is caused or possessed essentially. Motion is accidental when it is associated with something that merely belongs to something moved, as a color belongs to an animal and is moved accidentally when the animal moves. Motion is also accidental to something contained as a part in a whole; when the whole is moved, the part shares the motion of the whole, as a man in a boat is moved with the boat. On the other hand, motion is essential to something that is moved of itself, and not merely as part of another. Thus the motion of a stick moved by the hand, or of a thrown stone, is essential motion. Accidental motion presupposes and requires essential motion, and to the latter the argument is confined.

Mover and Moved. Several conditions must be fulfilled in order for essential motion to occur. First of all there must be a distinction between the mover and the moved: whatever is moved is moved by something else. The distinction between the mover and the moved appears by way of induction from sensory experience, and by reasoning from effect to cause. Among the things that have essential motion, some derive their motion from themselves, and others from something else; in some cases the motion is natural, whereas in other cases it is mechanical, that is, by impressed force.