man, we find that successively the *caudatus*, the *lenticularis* and the *claustrum* become differentiated from a common gray mass continuous with the cortex at the base of the cerebrum.

I would add in regard to the term CORTEX that the Optic lobes[3, 6] and the Rhinencephalon[5] exhibit the cortical structure as the cerebrum and the cerebellum.

The following terms not included in Professor Wilder's series, are submitted, and for them I invite the severest criticism. Some of them are established by others.

CAPPA (*cinerea*[1])—The gray cap covering the *Optici*, well developed in most mammalia, rudimentary in man.

ECTOTHALAMUS*.—The outer gray thalamic zone.

ENTOTHALAMUS*.—The inner gray thalamic zone.

INTERCRURALE*, (*Ganglion*).—*Ganglion Interpedunculare*[3, 4].

SIGMA*.—The *S* shaped involution of the nerve-cell layer of the cortex which constitutes the basis of the *Hypocampa*.

NUCLEUS TRAPEZII*. — The superior olive. The development of this body seems to bear an inverse relation to that of the true olive. In man the olive proper is highly developed, in the cat poorly—in the latter the nucleus of the trapezium is well marked and folded; in man it is ill-marked.

OBLONGATA*.—The post-pontinal area of man; the *medulla oblongata*.

STRIÆ*.—The *striæ medullares albæ* of the fourth ventricle.

VELUM CEREBELLI*.—The valve of Vieussens; this is the true embryonic starting point of the Cerebellum. The *velum medullare anterius*.

VELUM OBLONGATÆ*.—The *velum medullare posterius*. It arises from the internal division of the *post pedunculus* in its oblongata portion, and covers the posterior part of the fourth ventricle.

VELUM FLOCCULI*.—The *velum medullare inferius*.

GRACILIS* (*Funiculus*).—*Funiculus gracilis*, continuation of corresponding column in cord; part of the posterior pyramids.

CUNEATUS* (*Funiculus*).

TUBERIS* (*Funiculus*).—Funiculus of Rolando; the columnar field containing the Tuberculum of Rolando. There is a *lobulus tuberis*, which is otherwise provided for.

NODI*.—Two symmetrical eminences, situated each in the shallow depression bounded by the *opticus*, *thalamus* and *habena*, probably corresponding to the *ganglion habenæ* (*Gangl. habenulæ*[5]). There is a notable large opening cephalad of these eminences, which resembles the opening under the *tænia* containing the vein which gives the latter its bluish color. I can find no notice of this opening anywhere. The eminences are represented obscurely in Fig. 70 of Henle[2].

DECUSSATIO FONTINALIS.**—Fontanen artige Haubenkrenzung.[5]

In conclusion, I would urge the adoption of some brief arbitrary affix or prefix in place of the words commissure and ganglion. He who limits himself to a study of surface contours will not appreciate the absence of such abbreviations as much as he who is compelled to wade through the labyrinth of the internal cerebral structure.

Gris for ganglion would perhaps do; thus *Grishabena*, *Gristegmentum*, *Grisfastigium* for *Ganglion habenæ*, *Ganglion* and *Nucleus tegmenti*, *Nucleus fastigii*. The term *nucleus* is a very unfortunate one as it has another and very different meaning, which in my experience as a teacher of cerebral anatomy, has led to confusion in the mind of every beginner. Professor Wilder, who appears to be as much at home in etymology as in cerebral anatomy, will solve these problems no doubt better than I could pretend to.

* Terms proposed by myself, not to be found in previous publications.

** A single affix or prefix might be devised in place of *decussatio*, or *fontidecussatio*, *pinidecussatio*, *pyridecussatio*?

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NEW YORK, 130 East 50th street. E. C. SPITZKA.

HOW DOES GRAVITY CAUSE MOTION?

To the Editor of "SCIENCE:"

The interesting article by Mr. E. L. Larkin in "SCIENCE" for March 26, on the Interrelations of Gravity, Heat, Motion, etc., induces me to offer you some thoughts on the subject, with the hope that I may throw light upon it from another point of view. There is one widely accepted doctrine of modern physics which I confess I could never understand, that of Potential Energy. It may serve as a convenient explanation of the mysteries of falling force to say that energy may be at one time motion, and at another time the possibility of becoming motion. The rule explains the problem, but what explains the rule? Can motion become anything else than motion? Can it now convert itself into Rest, into Gravity, into Potentiality, or into anything else than simply motion? Is it not, like force and matter, an unvarying infinitude of the universe?

Motion means simply the translation of substance through space, and it possesses a fixed energy dependent upon the weight of the substance and the speed of the translation. If the portion of substance moved be a minute portion of matter, either forming an elementary constituent of a solid mass, or a separate molecule of a gas, we call its motion heat; and the result of its impact with exterior particles, temperature. If it be a mass of such particles its translation should be particularized as mass motion. In addition to these modes of motion, Electricity and Magnetism must also be considered as more special modes of motion, unless we admit the possibility of motion becoming something else, and this something else again becoming motion.

Can we admit this? What does terrestrial gravity teach us? If gravity is convertible into motion, then we have reason to conclude that the gravity should disappear as the motion increases. The law of gravitation asserts that the action of the earth and of a falling body are necessarily reciprocal. The earth must fall towards the body with the same energy that the body displays in falling towards the earth. The body, then, can not derive its energy of fall from the earth, unless we claim that the earth derives its energy of fall from the body. Such a cross-lending of force is inadmissable. The energy displayed by the body must come from itself, not from the earth. It is not a transformation of the earth's gravity into motion. Is it a transformation of its own? This we cannot admit, since the body loses no gravity. It cannot well give and keep at the same time. The body falls 16 feet in the first second, and ends with a velocity of 32 feet per second. This 32 feet per second is a positive momentum, and must continue until over-

come by counter force. But if a portion of the gravity of the body has become transformed into this motion there will certainly be less to tr nsform during the next second. Yet in the next second the body adds to its 32 feet per second 16 feet more derived from gravity, and thus falls 48 feet, ending with a velocity of 64 ieet per second. In the third second it adds 16 feet to this 64, and falls 80 feet. And so on continuously, so far as observation has gone.

This certainly does not look like a transformation of gravity into motion, since the gravity appears to continue undiminished. And as to potential force, or possibility of motion, being converted into motion, I shall not attempt to combat it, for it is a sorry task to wrestle with an antagonist who changes into a mist when you attempt to grasp him. Gravity is something definite, whatever that something is, but this will-of-the-wisp of potentiality certainly lacks the bones of a solid body.

But if not gravity or potentiality what is it that becomes motion in the ball that falls towards the earth, and in the earth that falls towards the ball? This may seem a difficult question, and yet it admits of but one answer. Nothing becomes motion. Nothing can become motion. Motion is motion and cannot possibly be or become anything else. The motion which appears in the falling body was not created for the purpose. It existed in the falling body in some other form, and has been simply transformed, not created. Every mass of matter has its internal motions; its electrical, magnetic and chemical energies, which are more or less engaged in preserving the integrity of its molecules or of its mass; and its heat energy, which is engaged in a constant effort to overcome the integrity of its mass. The particles of the mass dart backward and forward continually. They would dart in one direction only were they not restrained by each other's resisting energies, and by external resistance. Consequently, any external energy which aids their vigor of movement in one direction and resists it in the opposite must give them a combined excess of vigor in that direction. They must all move more vigorously in that direction than in the opposite; that is, the mass must move as a whole in that direction. And this movement once gained is positive until overcome by exterior resistance. It is a definite energy which cannot be lost unless it be given to some other substance.

Such is the true principle at work in falling motion. Terrestrial gravity is the external energy which aids the vigor of the heat motion of particles in one direction and resists it in the other. This force is increasing. Although a mass be not falling to the earth its particles are incessantly falling. The supporting body resists their fall and their excess energy in this direction expends itself upon this body. But if the support be removed there is no longer any resistance to their fall. The particles strike further downward than they return, since gravity aids their down stroke and retards their upstroke. Thus at each vibrarion of the particles the mass slightly descends. These slight descents continue. They are the energy derived from the pull of gravitative attraction. But each slight descent produces a fixed vigor of downward motion of the mass as a whole, and this vigor of motion is increased by constant new increments, so that the falling speed of the body rapidly increases.

This is the true meaning of potential energy – a change in the direction of motions already existing. No motion is created, or borrowed from any other condition of nature. The body gains force in one direction under the pull of gravity, but it is the force of a motive vigor which it already possessed, and which, instead of exerting itself equally in all directions, now exerts part of its energy specially in one direction. And this change in the direction of its energies is balanced by an equal opposite change in the direction of the earth's energies. The body does not possess the possibility of always falling, but it possesses the reality of always falling. Its particles constantly fall. But when it is supported their falls cannot accumulate. Each single fall is too slight to be observed, and the effect of each fall is overcome by resistance before another can be added to it. But these persistant falls produce a constant pressure upon the resisting substance, and constitute the weight of the body. It is on removal of the support that these rapidly repeated effects can be continuously added to each other, and become a visible descent. But the distance of the fall of the particles during each vibration is the same whether the body be supported or rapidly descending. It is only the preservation and accumulation of the positive mass motion given to the body by each slight fall, which causes the rapid increase in falling speed. These accumulating motions form an energy of motion separate from that of the fall, and which would keep the mass in motion at a fixed rate of speed were the force of gravity to suddenly vanish.

I would like to say a word here in reference to the presumed heated condition of the nebular mass from which it is claimed that the solar system originated. There is another reason than that advanced by Mr. Larkin, which renders it very improbable that the nebula was greatly heated. It is one thing to contain heat, another thing to be in what we call a heated state, that is, in a state of high temperature. For temperature and absolute heat are very different things. A mass of water at 32° contains far more heat than a mass of ice at the same temperature. And so a mass of water gas at 212° contains far more heat than an equal mass of water at that temperature. This rule probably holds good in all cases; namely, that as density diminishes the heat capacity increases, so that a very rare gas may contain a vastly greater quantity of heat than a solid at the same temperature. We see this exemplified in the matter of space. Heat has been pouring into it from the contracting spheres for an enormous period, yet its capacity for heat is so excessive that this outflowing heat has probably had very little effect in raising its temperature.

Such a consideration applies directly to the original nebula of the solar system. It was a very rare gas, and therefore had great capacity for heat. Its latent heat may have been great, and its effective temperature low. It was only after it began to rapidly lose heat that its temperature rose. For the contraction of the nebular mass must have, by condensing its substance, lessened its capacity for heat. If this change in condition took place more rapidly than radiation could balance it there must have been a steady increase in temperature, instead of a decrease as usually assumed. For all that we know to the contrary this phase of the process may not yet be completed. Contraction of the solar mass may yet be increasing its sensible heat, by lowering its capacity for heat, or its power of containing latent heat, more rapidly than this is balanced by radiation. In such a not impossible condition of affairs the sun would be yet rising instead of lowering in temperature, losing heat while increasing its apparent or sensible heat, and its process of actual cooling be not yet begun.

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A CAUSE OF DETERIORATION IN CLOTH.—Goods dyed rust, buff, or chamois shades with salts of iron occasionally undergo a slow combustion. The ferric oxide is alternately reduced by the organic matter of the tissue and re-oxidized by the oxygen of the air.

AT a Berlin feather-dyeing establishment an ostrich feather dyed in shades with methyl-violet was layed upon a paper upon which some ammonia had been poured but had dried up again. After a time the feather became partially green, the green passing gradually into violet, and producing an extraordinary effect. This reaction is being utilized in feather-dyeing, and will probably be applied in the manufacture of artificial flowers.—M. BALLAND.