tissue. A study of the action of curare convincingly demonstrates the truth of this statement. Curare acts on the motor nerve endings in such manner as to abolish the faculty of transmission of the nerve impulse from nerve to striated muscle. Stimulation of the nerve remains, therefore, without effect on the muscle, but the muscle continues to respond promptly to direct stimulation. That the nerve too retains its irritability is shown by the fact that its stimulation, be such of a mechanical or chemical or electric or other nature, gives rise to a "current of action" demonstrable by a galvanometer.

In a case of slight curare poisoning the faculty of transmission of the impulse from nerve to muscle is not entirely abolished, but only impeded more or less according to the severity of the poisoning, so that strong stimulation of the nerve will produce only a slight muscular contraction. Nevertheless the irritability of the nerve remains unimpaired, as shown by the "current of action." Consequently if in this case we were to measure the degree of irritability of the nerve by the effect of its stimulation on muscle, we should clearly come to a wrong conclusion.

However, the method of direct measurement of the irritability of a tissue is often practically not feasible, and we then have to resort to the *indirect* method in spite of its fallacies.

The degree of irritability of a tissue is expressed by the inverse proportion between the strength of the stimulus and the demonstrable or manifest dynamic change produced. It may be expressed by the formula: $I = \frac{D}{St}$ in which I denotes irritability while the denominator St represents the stimulus, and the numerator D the demonstrable dynamic change produced by it.

In many cases the disproportion between the strength of the stimulus and the amount of demonstrable dynamic changes wrought by it is very great, the amount of energy evolved by the stimulation being often ten times or even hundreds of times greater than the amount of energy represented in or spent by the stimulus itself.

Verworn gives the following interesting instance in substantiation of this statement: "A nerve-muscle preparation is suspended on a myograph, the muscle is loaded with a weight of 100 gm. and its nerve is laid over a glass plate supported by a stand (Fig. 2965). Upon the nerve rests a small aluminum pan having a sharp keel on the lower side, and into this a weight of 10 gm. falls from a height of about 10 cm. At the moment of stimulation the muscle contracts and raises the 100 gm. about 1 cm. Here the quantity of energy that corresponds to the work of the muscle is approximately ten times greater than the quantity of energy that has operated as a stimulus upon the muscle."

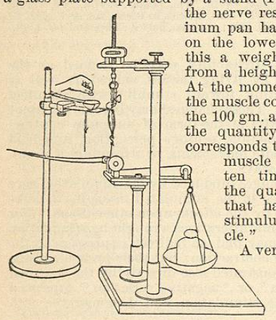


FIG. 2965.—Mechanical Contrivance for Demonstrating the Disproportion between Stimulus and Effect of Stimulus. (From Verworn.) For details see the text.

A very striking parallel fact from the inorganic world is familiar: The spark from a small battery which, applied to the human body gives a hardly noticeable sensation, is sufficient to blow up a whole house if applied to a definite quantity of nitroglycerin in the proper manner.

In accordance with the law of the preservation of energy this disproportion must be explained, not by the addition of energy not before existent, but by the transformation of one form of energy into another form—for instance, of chemical energy into physical energy.

However, while in the instance of the spark exploding the nitroglycerin, the produced effect is to a great degree independent of the size of the "stimulus," inasmuch as a small spark applied to a certain quantity of nitroglycerin will produce no less explosive effect than a large flame applied to the same quantity, this does not hold true or at least is not the rule for the phenomena of irritability in animal and vegetable life. Here—and this is especially true for the nervous and muscular systems—very frequently the manifest dynamic change produced by a stimulus increases with the size of the latter, but only up to a certain point; beyond that point it rapidly diminishes and the stimulus then rapidly reaches that size which causes death of the tissue.

Here a definition of the term *stimulus* is in order. In harmony with the definition of irritability, a stimulus may be defined as any agency which is capable of producing manifest or demonstrable changes of dynamics in the tissue on which it acts; changes that may be directly demonstrable in the stimulated tissue itself or indirectly by the effects on some other tissue, as has already been explained in the case of nerve and muscle.

This definition comes very near that of Verworn, who distinguishes the vital phenomena as spontaneous phenomena—when all the external conditions remain unchanged, and phenomena of stimulation—when other influences act upon them, and who accordingly defines a stimulus as every change of the external agencies that act upon an organism. This definition has been slightly modified by us in view of the fact that, as Verworn himself remarks, a strict dividing line between spontaneous phenomena and phenomena of stimulation cannot be drawn. Wherein our definition corresponds with that of Verworn, however, is that both depressive as well as exciting agencies are included in the definition of stimuli, and this is perfectly appropriate if one considers that in many cases it is very difficult, if not next to impossible, to state whether the effect of the stimulation is depressive or exciting. In this connection the existence of inhibitory nerve fibres and nerves should be called to mind, the excitation of which produces a depressive instead of exciting effect on the tissue (muscular, glandular, etc.) which it innervates, and yet the agency which thus acts on said nerve or nerve fibres must be called a stimulus.

As to the kinds of agencies that may act as stimuli, such are very numerous and may be, according to Verworn, classified into chemical, mechanical (including sound vibrations), thermic, photic, and electrical.

Another distinction to be made is between the *exciting* and the *depressing* effects of a stimulus, by which is meant the increase or diminution respectively of the activity or function of the stimulated tissue. Almost every kind of stimulus probably may have either effect, according to the intensity, duration, and other attributes of the stimulus.

The responsiveness to all kinds of stimuli can be traced down to the lowest forms of life in the animal scale and is seen also in plants. As an instance of the irritability of certain plants to mechanical stimuli, one may mention that of Mimosa pudica, the leaves of which fold together when the plant is shaken; or, again, electrical currents have been seen to increase granular streamings in protoplasm of plants, such as Nitella and Tradescantia (quoted from Verworn).

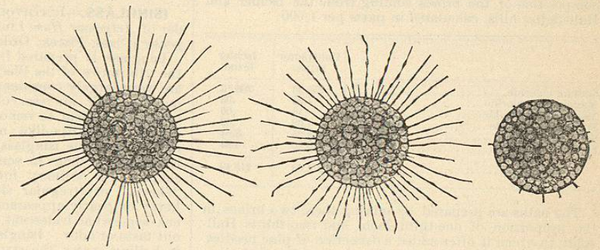
No less interesting is the narcosis of plants as observed by Claude Bernard, who found that under the influence of chloroform certain Algæ (spirogyra) cease to evolve oxygen, certain Diatomeæ cease to secrete, and growth and division of plant seeds become arrested; while Mimosa pudica, when under the influence of ether, entirely loses its above mentioned responsiveness to mechanical stimulation.

The effect of mechanical stimulation on bacteria was shown by Horvath (confirmed by Meltzer), who observed not only inhibition of growth but even death and granular disintegration of these micro-organisms as the result of regular vibrations.

That bacteria too may be excited by light is shown in the Bacterium photometricum, the flagellum of which moves under exposure to light, but ceases to move when the amount or intensity of light diminishes beyond a certain level.

In amœbæ and amœba-like rhizopods responsiveness to all kinds of stimuli—chemical, mechanical, thermic, photic, and electric—has been seen by Engelmann, Max Schultze, Kühne, Verworn, and others. (See Fig. 2966.)

The ciliary and flagellar motion of infusoria too has been found to be influenced by all the above kinds of stimuli in the direction of acceleration as well as that of retardation. Narcotics, such as ether and chloroform, retard this movement (Engelmann); high temperatures up to a certain point accelerate and low temperatures retard it.



a. b. c.

FIG. 2966.—Actinospherium Under Chemical Stimulation. (From Verworn.) *a*, Unstimulated; *b*, slightly stimulated; *c*, strongly stimulated.

An adaptability of amœba-like organisms to stimuli of all classes, brought about by gradually increasing the amount of stimulation, has been demonstrated by Engelmann. This author noticed particularly that Actinospherium, a rhizopod, if placed in salt solutions of gradually increasing strength, could finally be made to extend its pseudopodia in solutions of such concentration as would have made it contract immediately to a ball and eventually would have produced death, had it been brought into them directly.

A parallel phenomenon in higher animals is observed in the adaptability of the organism to such poisons as morphine and the like.

However, this adaptability is by no means the rule, since in the case of the rectal and vesical sphincters, for instance, as Verworn points out, the response continues the same in spite of the prolonged stimulation to which they are subject.

In the course of evolution of the animal series the use of organs or tissues for particular purposes leads to such a differentiation that each organ or tissue becomes excitable particularly by a definite kind of stimulus. An instance of this is the retina, the exquisite responsiveness of which to photic stimuli makes it adapted for the purpose of vision. This is, however, not due solely to the photic responsiveness of the retina, but is greatly furthered by the refractive apparatus of the eye and the arrangement of the retinal elements, which make it possible to concentrate, differentiate, and isolate the stimulations in the most perfect manner for the particular purpose of vision.

Moreover, experiences with the Roentgen rays have convinced us that even in the highly differentiated organism of man the retina is not the only tissue that can be stimulated by light. The deep trophic cutaneous disturbances following long exposures to this kind of light bear out this statement; and similarly, sound vibrations, although finding a particularly responsive recipient in the peculiarly constructed auditory apparatus of the labyrinth, evidently also have some effect on other tissues.

The irritability par excellence of nerve tissue is shown among other things by comparison with that of amœbæ, since nerve fibres are put into activity by extremely feeble galvanic currents, while amœbæ demand much stronger currents for this effect.

Threshold and Threshold Value of Stimulation.—Very feeble stimuli cause no visible or demonstrable effects on the stimulated or other tissues. By gradually increasing the intensity of the stimulus a point is finally reached when its effect becomes just perceptible or demonstrable. This point is called the threshold of stimulation and the intensity of the stimulus producing this minimal effect is called the threshold value of stimulation. This threshold value is not an immutable entity but dependent on the demonstrable effect that is expected, as well as on other factors.

For instance, the threshold value for a stimulation of the planta pedis might be that degree of stroking which is sufficient to produce a plantar reflex; or it might be that degree of stroking which just suffices to give a conscious tactile impression. The first would be the threshold value of reflex, the other the threshold value of conscious perception for the tactile stimulus.

For a motor nerve the threshold value of stimulation is usually measured by the intensity of the stimulus required to produce a minimal contraction of the muscle supplied by it; but we have seen in the instance of curare poisoning, which, by a paralysis of the endings of a motor nerve, prevents or impedes the transmission of the impulse from nerve to striated muscle, that the degree of muscular contraction does not give us any true measure of the irritability of the nerve and consequently not of the threshold value of stimulation of the nerve.

Another factor influencing the threshold value is the amount of "charging" existing in a given nerve or nerve-cell group previous to the stimulation. If, for instance, a cell group from which a motor nerve takes its origin is acted upon from some source or other by a temporary nerve impulse or by a continuous stream of nerve impulses (tonus) just weak enough not to produce a muscular contraction, then a very small amount of additional stimulation, whether such is a voluntary nerve impulse, a sensory stimulation acting by way of reflex, or an external direct stimulus, would suffice to transform the latent into potent energy and thus to cross the threshold of stimulation.

On the other hand the nerve impulses acting on a given cell group at the moment of an intended stimulation may be antagonistic to the latter and thus increase its threshold value in a corresponding degree.

B. Onuf (Onufrowicz).

LITERATURE.

Max Verworn: General Physiology. An outline of the science of life. Translated from the second German edition by Frederick S. Lee, London, Macmillan Co., 1899.

ISCHL is one of the most frequented spas of Austria, being often visited by the Emperor and many of the nobility. It is situated in the centre of the "Salzkammergut," in a beautiful Alpine valley, at the point where the little river Traun empties into the Ischl. Its elevation is about fifteen hundred feet above the level of the sea. It possesses a mild, moist climate, the average temperature from May to the end of September being 61° F. Showers are very frequent during the early part of the summer, but the sandy soil absorbs the water quickly, so that

the walking is seldom rendered unpleasant. In the neighborhood of the salt works the atmosphere is very similar to that of the seashore.

The salt hills of Ischl and Hallstädt contain natural salt veins, consisting of saliferous clay mixed with gypsum, resting upon limestone seamed with marl and clay. Pure water is conveyed hither in pipes, becomes saturated with the salts, and the brine then flows into the salt houses in Ischl and Ebensee. The following is the composition of the brines coming from the Ischler and Hallstädter hills, calculated in parts per 1,000:

	Hallstädter brine.	Ischler brine.
Sodium chloride	255.26	236.13
Magnesium chloride	4.94	.93
Magnesium bromide	.16	.06
Potassium sulphate	4.62	.69
Sodium sulphate,	3.25	3.84
Calcium sulphate	3.40	3.84
Total solids	271.63	245.49

The baths are prepared by mixing these two brines in the proportion of one-third Ischl and two-thirds Hallstädt, to which is often added a decoction of pine needles. There are also facilities for mud baths and for inhalations of salt spray.

There are also several mineral springs at Ischl. The following is their composition, computed in parts per 1,000:

	Schwefelquelle.	Klebelsbergquelle.	Maria-Louisenquelle.
Calcium carbonate	0.092	0.015	0.197
Magnesium carbonate	....	.011	.010
Calcium sulphate	.459	.244	.078
Potassium sulphate	.024	.018	
Sodium sulphate	4.125	.274	.071
Magnesium chloride	.732	.406	.098
Sodium chloride	17.005	5.118	5.580
Total solids	22.437	6.086	6.034

In the sulphur spring (Schwefelquelle) there is a considerable amount of free sulphureted hydrogen gas.

In addition to its being a fashionable watering-place, Ischl enjoys a well-deserved reputation as a health resort. The climate and the waters combine to render it admirably adapted for the treatment of nervous and irritable individuals, and of those debilitated by disease, dissipation, or too rapid growth. Children suffering from scrofulous troubles are often much benefited by a visit to the place. Inhalations of the brine spray are used in the treatment of chronic catarrhal affections of the air passages, and many female disorders are relieved by brine baths.

The accommodations at Ischl, at least up to within a few years, have been rather inadequate for the large number of visitors; the cost of living is in consequence somewhat high. There are many private villas in the place, and the scenery in the valley is charming.*

The beautiful situation and the mild, equable, soothing climate, and innumerable charming excursions round about, all conspire to render Ischl a delightful spot for a longer or shorter visit in the season, which lasts from July to the end of September.

It is an excellent resort for an "after-cure." Besides the diseases above mentioned, there may be added neuralgia, anæmia, and rheumatoid arthritis, which are said to improve from a residence here. It is still an expensive and fashionable resort, but the accommodations are said to be excellent. There is a fine Kurhaus, two bath houses, where brine, sulphur and pine baths, and brine vapor baths are given. The "milk and whey cure" is also another resource of the place. The number of inhabitants is about 7,000, and there are nearly 6,000 visitors.

The shortest route from England is viâ Cologne to Munich, thence viâ Salzburg to Ischl. It is 1,048 miles distant from Paris.

Although he visited it some years ago, the writer still vividly remembers the beautifully shaded avenue which is one of the features of the place. *Edward O. Otis.*

* Up to this point the text of the original edition has been followed.—E. O. O.

ISINGLASS.—Ichthyocolla. "The swimming-bladder of *Acipenser Huso* Linn., and of other species of *Acipenser* (Class, Pisces; Order, *Sturiones*)" (U. S. P.).

Isinglass is prepared from these sturgeons, mostly of the tributaries of the Black and Caspian seas where they are very largely consumed for food, by opening and removing their air reservoirs, splitting or slicing them, macerating them to remove their mucous surfaces, and drying; the tripe-like membranes are then rolled in cylinders (staple isinglass), folded in folios (leaf or book isinglass), or done in some other more or less fantastic shape. Its ordinary form in this market is that of "sheets," of irregular size and shape; it is stiff, of a horny or pearly appearance, whitish color, semitransparent, somewhat iridescent, tough, and flexible, but without taste or odor. Isinglass almost completely dissolves in boiling water, the structural character disappearing completely. Besides this, which is generally known as Russian isinglass, and is in this country very expensive, the swimming-bladders of the hake and other fishes are manufactured into sheets and ribbons of thin, light-brownish, gelatinous tissue, known as American isinglass. Its properties are similar to those of the above, but it is darker-colored and not so absolutely free from taste and odor.

Isinglass consists of about ninety-nine per cent. of pure, white, fine, and adhesive gelatin, which forms a jelly with twenty-four parts of water. Its medical and dietetic qualities are identical with those of other pure gelatins, which are frequently substituted for it. Its only medical use is in the preparation of water plasters (isinglass plasters, court plasters, etc.), which are essentially silk or linen cloth, varnished with a thin layer of the isinglass, and backed with some waterproof varnish, like that of gutta-percha or tolu.

Such a plaster is official under the title *Emplastrum ichthyocollæ*.

Japanese isinglass has already been considered under "*Agar-Agar*." *W. P. Bolles.*

ISOLATION HOSPITALS.—In the present article it is proposed to deal only with such portions of the subject as come within the province of the medical man.

In modern days the term "pest house" no longer expresses the attitude of the public toward the segregation of infectious diseases. The necessity of isolating, in some way or other, individuals affected with such diseases, had already made itself evident in the middle ages. Communities had begun to recognize the advantages of isolation in times of epidemics, but had not learned the value of dissociating it from surroundings calculated to arouse horror or repugnance. The modern aim has been to make the conditions of care and treatment such as to invite the confidence of the public. When a community possesses an infectious hospital in which the interests of the patient are known to be better served than by any other means, a great point has been gained. In Brighton, England, for instance, over eighty per cent. of all persons with contagious disease in the city go to the isolation hospital for treatment. The law in England authorizes the health authorities to insist upon treatment, in hospital, of all persons affected with a contagious disease whose surroundings are such that home treatment would constitute a source of danger to others (Public Health Act, 1875). England was the first country to adopt such a regulation. Sending away the sick member of the family leaves the house free from the irksome quarantine, greatly lessens the expense, and, if the hos-

EXPLANATION OF
PLATE XXXVI.