luminous beam has traversed a thickness of 60 metres of the gas under the pressure of two atmospheres. The dark band situated near D requires for its production a thickness of 60 metres at a pressure of six atmospheres. It is extremely difficult to raise such long columns of gas to high temperatures, and the better plan is to reduce the length and increase the pressure. By means of an electrical method, Dr. Janssen has been able to heat a column of oxygen to incandescence without sensibly heating the tube containing the gas. He has used a steel tube 2·2 metres long and about 6 centimetres in external diameter, with an internal diameter of 3 centimetres. This tube is able to resist pressures of over 1000 atmospheres. The temperature of the gas is raised by means of a platinum spiral traversing the length of the tube, and insulated from it by means of a layer of asbestos. Dr. Janssen will shortly give an account of the results obtained when oxygen was introduced into the tube, heated, and spectroscopically observed.

MELTING OF THE POLAR CAPS OF MARS.—In the April number of *Astronomy and Astro-Physics*, Prof. W. H. Pickering calls the attention of astronomers, to the fact that on May 30 Mars will reach the same part of its orbit with regard to the sun that it did on July 12, 1892, when a series of conspicuous changes were observed upon the planet's surface (see NATURE, vol. xlvi. p. 179). It is therefore presumable that a similar series of changes will occur about the end of next month, and though the planet will not be so favourably situated for observation, the phenomena will probably be observable with any telescope of moderate size. Mars is a morning star at the present time, rising an hour or two before the sun. At the end of May it will be in Aquarius, and will then rise shortly after midnight, and be on the meridian at about 6.30 a.m. Prof. Pickering points out that the centre of the Northern Sea, around which a series of striking changes of shape and colour occurred, is central on May 30, at 17h. 5m. Eastern Standard Time. There is no reason, however, for expecting the meteorological phenomena to occur on precisely the same date in two different years, and observers would do well to take every opportunity of watching the planet, as it is possible that the southern ice-cap may begin to melt earlier than usual.

EPHEMERIS FOR DENNING'S COMET (*a* 1894).—The following ephemeris is given for Denning's comet in *Astronomische Nachrichten*, No. 3223.

Ephemeris for Berlin Midnight.

1894.	R.A. h. m. s.	Decl. ° ′
April 19	11 4 0	+19 59·6
21	8 19	19 7·0
23	12 29	18 15·9
25	16 30	17 26·1
27	20 25	16 37·6
29	24 14	15 50·3
May 1	27 55	15 4·4
3	31 32	14 19·7
5	35 4	13 36·1
7	38 32	12 53·6
9	41 55	12 12·2
11	45 14	11 31·8
13	48 30	10 52·4
15	51 43	10 14·0

The comet's brightness on April 22 is 0·31, that at the time of discovery (March 26) being taken as unity. It is fading, and on the last date given in the above ephemeris it will only be about one-tenth of the original brightness, and therefore extremely difficult to see.

THE SPECTRUM OF NOVA NORMÆ.—Prof. W. W. Campbell made some visual observations of the spectrum of Nova Normæ during February (*Astr. Nach.* 3223). On February 13 the star exhibited an exceedingly faint continuous spectrum in the yellow and green, and four bright lines apparently identical in position and relative intensity with the bright lines at wave-lengths 575, 501, 496, and 486 in the spectrum of Nova Aurigæ in August 1892. Rough measures of the two brightest lines gave the positions 5013 and 4953. Prof. Campbell says that there can be no doubt that the star has a nebular spectrum.

A NEW SOUTHERN COMET.—Mr. Gale, of Sydney, discovered a comet in R.A. 37° 42′, Decl. 55° 35′ S., on April 3. This was the second comet of this year, and will therefore be known as comet *b*.

IRRITABILITY OF PLANTS.

AT the last meeting of the Versammlung, or meeting of German naturalists and physicians, Prof. Pfeffer gave an address on the above subject—one which his own work has done so much to elucidate. Irritability, he points out, is not an exceptional characteristic found in special plants; it is a fundamental quality existing in all plants, from the highest to the lowest, although its manifestations in great measure escape superficial observation. The sensitiveness of a Mimosa, the curling up of tendrils when touched, or the curvatures of growing internodes in response to light and gravitation, are well known and easily observed instances of irritability. But the less obvious reactions are of equal interest. Pfeffer instances the remarkable researches of Hegler on the effect of mechanical traction on growth stems, which when stretched by a weight, gain mechanical strength through the development of the mechanical tissues, which follows as a response to the pull to which they are subjected. Pfeffer has recently shown that resistance put in the way of growing roots increases enormously the energy with which they grow. Other instances of adaptive stimulation escape ordinary observation because of the microscopic character of the reaction. For instance, the extraordinary directive influence of malic acid on the movement of the antherozoids of ferns, or of potash salts on the movement of bacteria. In the same way the irritability of the higher plants is commonly exhibited by movements so slow as to be imperceptible to the naked eye. It is no wonder indeed that the layman does not realise that plants have the same power of reaction to stimulation as animals. Pfeffer remarks, in a striking passage, that—"Man would not have inherited such a belief, if the world of plants had been visible to him from childhood as it appears under the higher powers of the microscope. Then he would have had constantly before his eyes the innumerable host of free swimming plants and other low organisms; and the hurrying bacterium turning and rushing towards its food, would have been as familiar as the beast of prey springing on its victim. To such eyes the growing stems and roots of the higher plants would have appeared circling with a search-like movement, and many other rapid reactions to stimulus would have been apparent. Under the influence of a multitude of such images, irritability would, without a doubt, have seemed to be a self-evident and universal property of plants."

He goes on to point out how necessary it is to clear our judgments in regard to reactions in which movement is the observed factor. A bacterium rushing across the field of the microscope moves nothing like so fast as a snail, yet it moves rapidly in reference to its own minute dimensions, since it will traverse three to five times its own length in a second, while man at a walk only gets over half his height per second.

The one thing common to all the varied stimulus-reactions is that in each of them we recognise a phenomenon of release (Auslösung-), or, to put it in familiar language, a trigger-action. Stimulation is therefore release-action in living matter.

In classing irritability among trigger-effects, we express the fact that the stimulus is only the releasing agent: the nature of the effect depending on the specific qualities of the organism. Just as the touch of a finger may, in the case of human machines, either blow up a powder magazine, start a steam-engine, or set a musical-box a-playing, so in the case of plants, the same stimulus produces different or even opposite effects on different species.

In machines, as in the living organism, every degree of disproportion between the releasing agent and the amount of energy released occurs. The latent period again is not peculiar to the manner of reaction of organisms, but finds a place in machines of human manufacture. In a clock set in action, a period elapses before the striking of the hour (part of released action) comes into play.

It is again no peculiarity of the organism that reaction to stimulus is usually adaptive, since machines are adaptive and self-regulating. The adaptive character of most reactions is as comprehensible as the failure of an organism to adapt itself to conditions not met with in nature. A bacterium being lured to certain death in a mixture of corrosive sublimate and extract of meat, is an example of what is meant.

Doubts may arise whether or no certain processes are to be called release-actions. Take the case of enzymes, from the point of view of the plant they serve to bring about a wide change at the cost of a relatively small amount of energy. Or take a simpler instance, the tensions which allow the capsule of Impatiens to burst or the stamens of Parietaria to explode, are the product of vital activity, and have, moreover, an adaptive quality. But the release is purely mechanical; there is nothing like *perception* in the ordinary sense of the word, so that these phenomena differ from the reaction of Mimosa. Pfeffer, therefore, prefers not to consider the explosions of Mimulus, Parietaria, &c. as cases of irritability, while he acknowledges that there is no real objection to the word irritability having a wide enough meaning to embrace such cases. All that matters is that we should have a clear conception of the existence and importance of release action in the vegetable organism. Pfeffer points out that in his "Physiology" (1881) he laid down the same general principles that are developed in the present address, together with examples in various regions of change, and that even earlier, in his "Osmotische Untersuchungen" (1877), he expressed, without reserve, the same views as applicable to the phenomena of life generally. He claims for these views a practical priority in botanical literature, although he fully recognises that Dutrochet, in 1832, set forth perfectly clear and sound views on the subject.

In 1881, too, he used the word *Reiz, i.e.* stimulus-effect, as equivalent to physiological release-action; and he used the expression *Release* intentionally, because of the mystic conception attaching to the terms stimulus and irritability. In fact, he would at the present moment throw over altogether the word *Reiz* if it were not that the time has gone by for those mystic conceptions of life which are inconsistent with the law of the conservation of energy.

Pfeffer goes on to point out that when, in 1882, Sachs set forth his belief in the general existence of irritability, and in its necessity for the machinery of the organism, he spoke of it not as a phenomenon in the wider category of release-actions in general, but as a specific peculiarity of living organisms. Sachs, according to Pfeffer, holds the specific character of irritable organs to be not so much their unstable equilibrium as the fact, that after stimulation they return automatically to the labile condition. Pfeffer claims that this definition does not apply to many undoubted cases of stimulation. When callus is produced by injury, or when adventitious roots are developed in response to certain stimuli, there is no such automatic return, but a permanent alteration.

To produce a stimulus-reaction, a change in external or in inner conditions is necessary. The sensitive-plant does not react to steady pressure, but to variation in pressure. An analogous state of things is found when a plant in a condition of cold-rigor is made to grow by heat. For the change in temperature is merely a stimulus, since it only releases activities which are carried on by the energy at the plant's disposition, not by the heat. At a constant temperature the plant is in a statical condition of irritability, which is a necessary condition for the realisation of vital activity. If the results of temperature-changes are not generally recognised by botanists as phenomena of stimulation, this is only a proof of the need of accurate conceptions in this branch of physiology. The association of the word with strikingly visible phenomena is partly to blame for this. Everyone recognises that, for instance, in the opening of the crocus or tulip flower, the change of temperature is a stimulus. In these instances the action of heat may be compared to the regulation of certain machines of human construction by the heat-expansion of a metallic rod.

Even when the increased temperature, by increasing molecular action, brings about a union with oxygen, still the temperature-change is only the indirect cause of the combustion; and this reasoning applies to respiration.

In a similar sense the addition of a salt of potassium to a culture-fluid produces a release action in a plant in which growth was checked by the absence of this element.

Pfeffer has some interesting remarks on the condition of irritability of organs in a condition of equilibrium: for instance, on the continued action of the gravitation stimulus on a geotropic organ growing vertically. Bacteria are less sensitive to the attraction of meat-extract when themselves immersed in dilute extract; that is to say, the homogeneous medium, which has no directive action, shows its effect in diminished irritability. The same is true of heat, which stimulates when it varies, and which, when constant, is a necessary condition for certain states of irritability. The idea is not a new one, for no less a man than Johannes Müller (Pfeffer points out) defined the formal conditions of animal and plant life as *Lebensreize* or *integrirende Reize*.

The stimulus need not come from the outside, for just as a clock by internal machinery strikes at intervals, so in the organism combinations occur which function as stimuli for certain effects. These are naturally obscure, and for this reason we do well to fix our attention principally on external stimulation; but it can hardly be too much impressed on us that the development and ordered activity of the living body is inconceivable without the co-operation of stimulus from the inside.

With regard to stimulus and reaction, we are in the position of a man, ignorant of mechanics, who sets a machine in motion by a touch of his finger, and who has no idea whether the effect is due to a falling weight, to water-power, or to steam. Considerations of this sort make us realise our ignorance, so that when a new result is observed (in a case of stimulation) we do not even know whether the cause is to be sought in the perception of the stimulus or in the machinery of reply. While denying himself the discussion of cognate points, Pfeffer finds room to call attention to one or two interesting points of resemblance in the irritability of plants and animals. Thus, for instance, in plants as in man, an increase in the stimulus produces a dulling of sensitiveness. Just as a beggar is stimulated by the gift of a shilling, which on a rich man has no such effect, so a starving bacterium is stimulated to movement by excessively minute quantities of meat extract, while the same organism living in the midst of plenty can only be stimulated to similar movement by an absolutely greater quantity of extract. In the irritability of plants we find, in fact, the relations which are expressed in Weber's law—a proof that the relation in question has nothing to do with the higher psychic functions.

A plant or a plant-organ is never sensitive to a single stimulus only; thus during a geotropic curvature mechanical traction may bring about a strengthening of cell walls, and an injury may produce protoplasmic movement. Here lies a proof that different stimuli do not produce one and the same effect in a given cell, that, in fact, the cell does not react like our eyes, in which the most varied stimuli produce the effect of light. In the case of plants there can be no question of such a limited capacity—of specific energies in the sense of Johannes Müller.

The development of distinct organs of sense whose function is the perception of a single agent, is well known to be as little characteristic of plants as of the lower forms of animal life. But distinct organs of sense are no more a condition of irritability than they are of life. Indeed, plants exhibit a variety of sensibilities equal to that of animals, while in delicacy of perception the vegetable kingdom has the advantages. Bacteria are attracted by a billionth or trillionth of a milligram of meat-extract or of oxygen, infinitesimal quantities which we cannot weigh, and of which indeed we cannot form any adequate conception. It is just because the whole secret of life is contained in protoplasm, that the simplest organism, such as a bacterium, can be the theatre of as rich and varied a play of stimulus and reaction as the most complicated plant.

CHEMISTRY IN RELATION TO PHARMACO-THERAPEUTICS AND MATERIA MEDICA.

[BY the courtesy of the editor of the *Lancet* we are able to give the following translation of an address delivered at the Eleventh International Medical Congress, by Prof. B. J. Stokvis of Amsterdam University.]

THE TERM AND SCOPE OF PHARMACO-THERAPEUTICS.

"Therapy" or "therapeutics," by which terms we understand the art of serving the cause of humanity by assuaging human suffering and healing human ill, avails itself of every means in its power to arrive at these ends; *elle prend son bien où elle le trouve*. And the art of therapeutics, like all of us here assembled at this Eleventh International Medical Congress, has discovered that all ways lead to Rome. To Rome therapeutics has come—now in the guise of electricity, now as a water cure, now as psychical influence; so that we here are able to review, as they defile like armies before us, electro-therapy, pneumo-therapy, hydro-therapy, hypnopsis, and psychic suggestion, and compare their merits as healing agents when placing themselves at our orders to combat disease and put death to flight. But most ancient of all the branches of medical art is that which makes use of drugs; and in