and Ludwig in their writings upon the phenomena which seem to reveal a vegetable instinct. They all incline to the belief that plants experience every order of sensations.

F. Edward Smith, the English botanist, thinks that plants can feel, and are capable through that faculty of a consciousness of well being and felicity.

Percival believes that plants perform voluntary actions when they turn their branches to the light.

Among the philosophers of the eighteenth century who saw animated beings in plants must also be ranked Dr. Erasmus Darwin, the grandfather of the celebrated naturalist, whose recent works have thrown some light upon the vexed question of the origin of species. In that book, too little known, but the delight of Goethe ("The Botanic Garden"), Dr. Darwin plainly asserts that in his eyes the plant is an animated being—a creature capable of numerous sensations, as of existence, of pain, and gladness.

Dr. Martius, one of the most eminent men of modern science, accords to plants not only the faculty of feeling, but also an immortal soul. To the voice of that celebrated botanist there has been lately added that of another, namely, Theodore Techner, an independent thinker, and not the least inspired among his German cotemporaries. He was one of the first to enter into the questions which bear upon the development of the soul in plants. The new ideas and original views with which his book abounds entitle it to be considered as the first advance towards a true vegetable psychology. A soul in plants was recognized by the ancients. Empedocles, Anaxagoras, Democritus, Pythagoras, and Plato believed plants to be animated, and consequently ranked them with animals.

Entire peoples—the Hindoos, for example—have also regarded plants as animated beings. Among the laws of Manu, laws which in India are believed to have emanated from God, and to be more ancient than those of Moses, are to be found doctrines and commandments as follows:

"It is good and equitable that each father of a family, without prejudice to his children, should reserve one part of his wealth for other animated beings, to wit: plants and animals."

"Plants and animals have internally the sentiment of existence, and also of pain and happiness."

According to Loubère and some other travelers, the priests of Siam and Laos apply the law forbidding to kill not only to men and animals, but also to living plants. They exhibit as much repugnance to the destruction of a tree, or simply the cutting of a branch, as to the mutilation of a man; and they refuse to eat of green fruits lest their development should be arrested. These views are entirely opposed to those which belong to the people of the Occident. From earliest childhood, in our schools and elementary books, children are taught that men and animals have the faculty of motion and are living beings, and that plants attached to the soil live, it is true, but are not animated.

But, as M. Techner has observed, it would be quite otherwise if the preceptor said to his pupil, "Animated beings are divided into classes. One is composed of beings which possess the power of transporting themselves from place to place; these are men and animals. In the other class we find beings fixed in the soil where they are born; these are plants. The latter resemble us less than animals, yet live and grow as we do." For these and many other reasons we believe them equally animated. If our children are thus taught they will be less indisposed when older to deprive the plant of its soul than we are to recognize its existence at the present day.

Such numerous and striking analogies in the vital functions of beings in the two kingdoms, animal and vegetable, are revealed by physiology every day, that no one can refuse to reflect upon the facts or reject without a candid examination the proposition we are about to consider in a succeeding paper, that the plant is an animated and sentient being.

R. C. K.

WILD BEAST EXTERMINATORS WANTED.

It is somewhat strange that with the full knowledge that is possessed of the frightful numbers of human beings yearly slaughtered in India by wild beasts, some efficient means are not taken for the extermination of the latter. In 1875 20,805, and in 1876 19,273 people perished from this cause. This is considerably beyond the total mortality produced by wars before the invention of breechloaders and machine guns. For example, in 1855 statistics were published in England showing that in 22 years of war 19,796 people were killed. In nine great battles, including Waterloo, 4,740 fell. Even at the present time such a number of deaths occurring in a two years' war would be deemed large, and if they occurred through a pestilence in a great city the situation would be considered very grave. Yet to prevent such mortality in both instances every refinement of medical ingenuity and skill would be exerted; in the present case nothing is done beyond offering small rewards for the killing of the wild animals.

The loss does not end with that of human life. During the above two years the aggregate of cattle killed by tigers, snakes, and wild beasts generally aggregated 101,635. One tigress is known to have slaughtered 127 people, and stopped the traffic for many weeks on a public road. Another killed upwards of 50 people and caused the abandonment of 13 villages. Against the death rate of victims we can place the amounts paid for rewards for killing the animals, namely, for 1875, $52,326, and in 1876, $54,314, which is absurdly small in view of the magnitude of the evil to be prevented.

We look in vain through Dr. Fayrer's exhaustive paper on this subject, recently read before the Society of Arts, for a suggestion of a practical plan for checking these inroads. But one project is proposed, that of Captain Rogers, and that is the clumsy expedient of setting spring guns, which can with doubtful economy be made, we are informed, of old muskets. In connection with this system, which seems like the patent double-ender gun, dangerous alike to friend and foe, it is proposed to organize hunting parties of natives. These expeditions might also be considered as of doubtful value if we are to credit the assertion elsewhere made that the inhabitants have a "deep-rooted prejudice against killing a snake." Unfortunately the snakes have no deep-rooted prejudice against killing the inhabitants, as the latter succumb to poisonous bites at the rate of some 1,200 a year.

We have no means of knowing the exact value in which a Hindoo's life is held by the British Government, unless we divide the number killed by the amount paid to stop the source of death, and the result is two dollars and sixty-six cents per life; but from a humanitarian point of view it seems that the need of some potent means of eradicating this scourge is pressing. This consideration might be especially commended to the philanthropic gentry who so mercilessly condemned Stanley for his destruction in battle of a few dozen African savages. But if British ingenuity, which, by the way, still stands nonplussed over the grave problem of intercommunication between railroad carriages and locomotive, cannot suggest a feasible project, we venture to believe that the offer of an adequate reward will speedily bring forth plans from this side of the Atlantic. There are plenty of adventurous geniuses in the West who probably would willingly organize a corps of tiger exterminators to employ machine guns, hot water projectors, Greek fire, poisonous chemicals, or potent explosives, as their ingenuity might suggest, provided somebody made it an object to them to do so. Why cannot we have a "Scientific Expedition," under the auspices of the projectors of that much advertised one now begging Congress for a boost, to undertake this work? If participants cannot otherwise be obtained, there is the question of how to dispose of tramps still open.

THE PROGRESS OF ASTRONOMICAL PHOTOGRAPHY.

Astronomical photography comprises, first, the representation of the surface of celestial bodies sufficiently near to us to give a magnified image when observed with the telescope. Thus the sun with its spots and faculæ, the moon with all the details of her surface, and such large planets as Jupiter, Mars, and Saturn, have all been photographed. Secondly, it is possible to obtain by this means exact images of star groups, and thus to determine at once the relative situation of certain stars for a given epoch. By means of photography it is possible to observe as it were automatically passages of planets before the sun, eclipses, occultations of planets by the moon, and passages of stars at the meridian for the determination of absolute time. By its aid also we are enabled to reproduce the solar spectrum with all its lines, and to extend the limits thereof beyond the visible rays. Photographic pictures in the stereoscope also show very clearly the sphericity of the bodies represented. Lunar craters, the rings of Saturn, the spots and faculæ of the sun, there appear in high relief, and the observer is enabled to see that the faculæ are elevations and the spots depressions.

The finest astronomical photographs have been produced by Warren de la Rue in England, the late Father Secchi in Rome, Mr. Lewis Rutherford in this city, Ellery at Melbourne, Negt at Ghent, Gould at Cordova, and Janssen at Paris. Mr. Rutherford has obtained superb views of the moon with an exposure varying from one fourth second for full moon to two seconds for the first and last quarters. With these photographs M. Elie de Beaumont has shown how much may be deduced geologically with reference to the lunar surface, which is not affected by the destructive action of water or of any atmosphere. The comparison of photographs taken at long intervals apart also allows of the recognition of any changes which may have occurred in the lunar surface. It is now reasonably certain that active forces are at work in the moon's interior, and the disappearance some twelve years ago of a cavity which is shown on the maps of Maedler made in 1829 has educed the theory that it was filled up by an eruption of white material. This can only be verified by comparisons of photographs taken over many years.

Astronomical photography has recently, however, assumed a higher place than as a mere mode of reproduction of the images seen through the telescope. It has, in fact, become an important means of discovery, and the researches of Janssen have shown that photographic pictures reveal phenomena otherwise totally invisible. It was through such prints that he discovered the photospheric network around the sun. The great difficulty encountered in studying the solar photosphere has been to determine the exact form of the granulations or "willow leaves" which appear to form currents of semi-liquid matter. Small photographs showed little or nothing of these, and the reason is found in the phenomenon of irradiation, which causes the image formed by a very intense light to extend beyond its real boundaries and so to assume a false form. This was especially noticeable in all photographs of total eclipses; the images of protuberances trenched on the lunar disk often to the extent of 10 or 20 seconds. The same effect is produced on the eye. Now the average diameter of the granulations of the photosphere is but a second of arc, and it is therefore easy to perceive how a very small degree of irradiation suffices to confuse all the details of their form. Janssen has overcome this difficulty by enlarging the image and shortening the time of exposure. In a minute fraction of a second he obtains an image 10·8 inches in diameter. On this can be seen, first, a fine general granulation covering the solar surface. The grains, more or less rounded, have diameters varying from some tenths of a second to 3 or 4 seconds. The illuminating power of these granular elements is very unequal, doubtless because they are situated at very different depths, and those which attain maximum luminosity occupy but a very small portion of the solar surface. The most curious result, however, derived from an inspection of the photograph is that the photosphere appears divided into a multitude of compartments, having rounded or polygonal contours, the dimensions of which attain sometimes a minute or over (the diameter of the entire solar disk is about 32 minutes). In the intervals between these figures the grains are clear and well defined; in the interior they are half effaced, broken, and often absent. It may be supposed that in these spaces a violent commotion has mixed together or confounded the granular elements, and thus a new confirmation is afforded of the fact that the activity of the photosphere is always very great even when no spots are visible.

We have already fully described the apparatus used by the various expeditions for photographing the transit of Venus of 1874. It may well be asked if the immense labor spent upon the observation of that phenomenon has served to fix a value of the solar parallax more exact than that already obtained by other methods. All that is known at present is that the parallax deduced by the British Astronomer Royal from the direct observations of English astronomers (8·76″) is a little less than that determined by Professor Newcomb by taking the average of the best known results (8·85″). Examination of the photographs has further resulted in proof of the existence of an atmosphere around Venus.

Mr. Rutherford, of this city, has the honor of being the first to photograph the star groups, and he uses for that purpose a refracting telescope, 13 inch objective, mounted equatorially, and moved by clockwork. The duration of exposure depends upon atmospheric conditions, but about 4 minutes suffice for stars of the 10th magnitude. Mr. Rutherford has obtained very exact charts of the Pleiades, of the constellations Præsepe and Perseus, and of the stars near 61 Cygni. Gould, at the observatory of Cordova, has also achieved remarkable success in this line. Last November he possessed proofs suitable for the micrometric measurement of 84 celestial bodies, of which three fourths were star clusters. The plate representing the cluster of Eta of the Ship showed 180 stars, many of which are of the 9th magnitude. Mr. Gould has also obtained fine photographs of the moon, Jupiter, Mars, and Saturn.

THE NEW EGYPTIAN COTTON.

The Bahmian cotton, a new kind of plant not long since discovered in Menoufieh, Egypt, is puzzling botanists to determine whether it is a hybrid or some foreign kind accidentally brought into the country. It appears to be a cross between the Bahmian (*Hibiscus esculentus*) and the ordinary plant (*Gossypium barbadense*), the former having fertilized the latter at the time of blooming. The new plant presents marked characteristics. It has several straight stalks, of which the largest grow to a height of about three yards. In place of branches there are two or three pods, springing from the junction of the leaves and the stem which they surround. While the ordinary kinds of cotton resemble a shrub or bush, with one or more stems carrying a number of branches, sometimes much extended, bearing the pods (though often with intervals of two, three, or four leaves, without any at their junction), the leaves of the Bahmian cotton are large, strongly indented, and are of a much darker green than those of the other plants. The flower is yellow with interior purple spots, very like the ordinary cottons, though generally rather larger and carried on long stalks.

The report of the Egyptian Government on the plant points out that if it be a hybrid, the fact is of great importance scientifically, for such instances are rare in horticultural records between species so different; and those which have been produced to this time are generally sterile, while the new plant is more fruitful than the ordinary description. Last year all the great Egyptian growers tried the seed, and the crop is reported to be from 6,720 to 7,680 lbs. per acre. It is claimed that this will increase nearly 30 per cent with carefully selected seed and plants not overcrowded.

New Agricultural Inventions.

A Household Press for Fruits, etc., has been invented by Miss E. A. Stears, of Brooklyn, N. Y. This apparatus may be described as a box having formed on it a support for the nut of a compressing screw, and containing a drawer for receiving the juice expelled by the press, and having fitted to it a removable perforated cylinder for containing the fruit or other article to be pressed.

In an improved Plow and Seeder, or machine for scattering seeds and plowing them in, invented by Mr. P. H. Elliott, of Greenville, Texas, the essential addition is a rotating flanged drum composed of two perforated cylinders, one of which is adjustable about its axis, for the purpose of filling it with seed and also regulating the size of the discharge openings. This revolving seed distributer is placed in front of turn plows, applied to the draught frame.

An improved Grain Bagging Machine has been invented by Mr. F. H. Relph, of New York city. The chief element of the apparatus is a horizontal rotating frame carrying the bags to be filled, and also funnels for guiding the grain into the bags as the rotating frame brings them successively beneath the discharge spout of a hopper. When filled, the weight of their contents causes the release of the bags from their suspending hooks, and at the same time closes the mouth of each bag by tension on a cord attached to it. The carrying frame is intermittingly rotated by means of a hinged trap and ratchet mechanism. Each bag, as it drops, falls upon and tilts the trap, which then rotates the frame sufficiently to bring the next empty bag in position for filling.

Mr. C. M. Mallory, of Wauseon, Ohio, has patented an improved Hay Elevator, by which the hay may be carried to and dropped in any corner of the mow, thus economizing space in a barn. This invention consists in a novel arrangement of hoisting, balancing, and guiding tackle of ropes, pulleys, etc., in connection with a windlass or horse power, arranged suitably for the purpose.

An improved Fruit Drier has been recently patented by Mr. Peter Riley, of Fort Scott, Kan. It has several tiers of sliding trays arranged laterally above a longitudinal fireplace at the bottom of the drier. The tiers are separated by vertical draught channels, and the front and rear parts of the trays are heated by lateral T-shaped pipes. A convex guard plate on the central part of the fire chamber protects the center of the trays from too great heat. The smoke pipe extends upward at the rear of a shorter tier of trays, and centrally through the space at the top part of the drier, to reheat the air at the top and keep up a draught through the trays.

IMPROVED SAW MILL DOG.

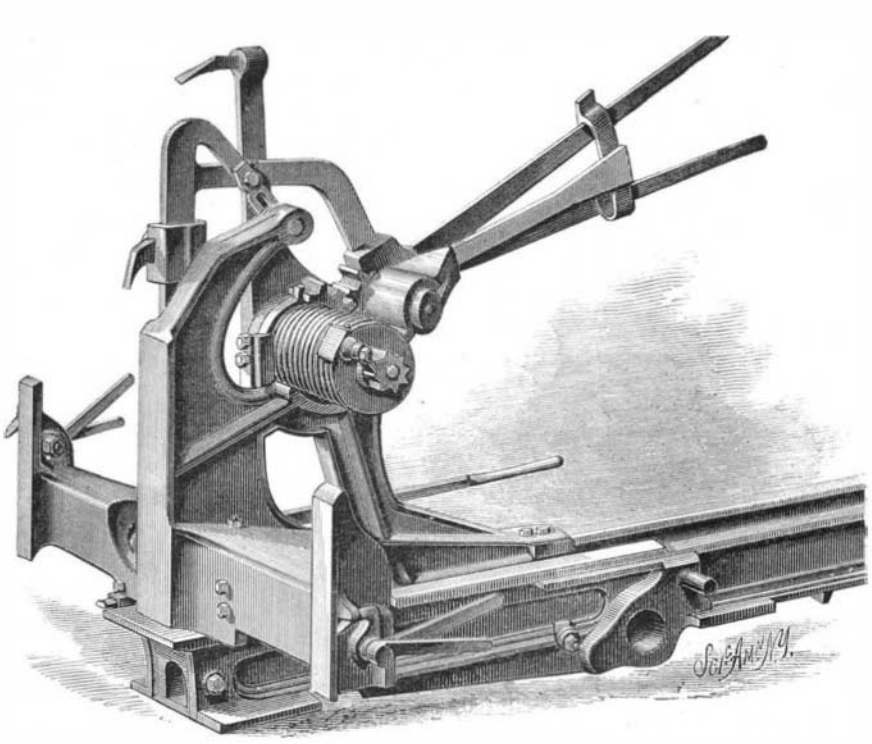
In the annexed engraving we illustrate a new dog for holding logs in the saw mill, which, we are informed, is built of the best material, is strong and durable, has very few joints, and retains the log with great firmness.

The arms are of such certain length, and their pivoted point of such height and distance from the face of the standard, that logs of large, small, or medium size are held with equal facility. The bits are of cast steel, set so as to enter the log easily, and are easily taken out and sharpened or replaced by duplicates. The shafts on which the arms are hung carry springs of such length, strength, and flexibility as make them convenient and effective in forcing the dogs into the log and holding them with a relentless grip until withdrawn by the lever by which they are operated. The length of the dog arms is made adjustable by spring pins, so as to allow a log of any size to be sawed into the thinnest flitches without danger to the saw.

The board dog, also of cast steel, is carried in a socket made to slide on an upright bar. The dog is raised or let down into the edge of a cant by a link and arm from a lever pivoted back of that by which the log dog is handled. Cogged segments connect this lever with one end of the spring case, so that the spring is utilized to operate either the log or the board dog as the lever of either is released from the latch which holds them when withdrawn from the timber. Pawls from the cases catch notches in the log dog shaft, so that more or less strain may be given to the springs at pleasure. The upright bars extend above the standards, so that the board dog may rise high enough to catch the highest cants. Its lower end is pivoted to the knee, so that the upper end will recede and allow large logs to come back over and rest on the standards. Strong leaf springs throw the bars forward when the log is turned away from them. Link joints connect the upper ends with the standards and hold them perpendicular or parallel with the face of the standards. The levers come back within convenient reach of the setter, who does not have to stoop to handle them.

A single dog only in each block is required to hold either the log or the cant, and its hold is sure. Any vibration or straining of the timber to get away only causes it to work in deeper, and to maintain its hold. The single dog, with straight tooth or bit, is easily kept in order and easily operated. Improved yielding spring dogs catch the under side of the cant and hold its lower edge. Thus both edges of the cant are held between jaws drawn together by powerful springs, and the face of the timber is uninjured by the perforations of any dog teeth.

The device has been in use in one of the largest mills in Michigan, and has, we are informed, proved in every way efficient. For further information address the Stearns Manufacturing Company, Erie, Pa.

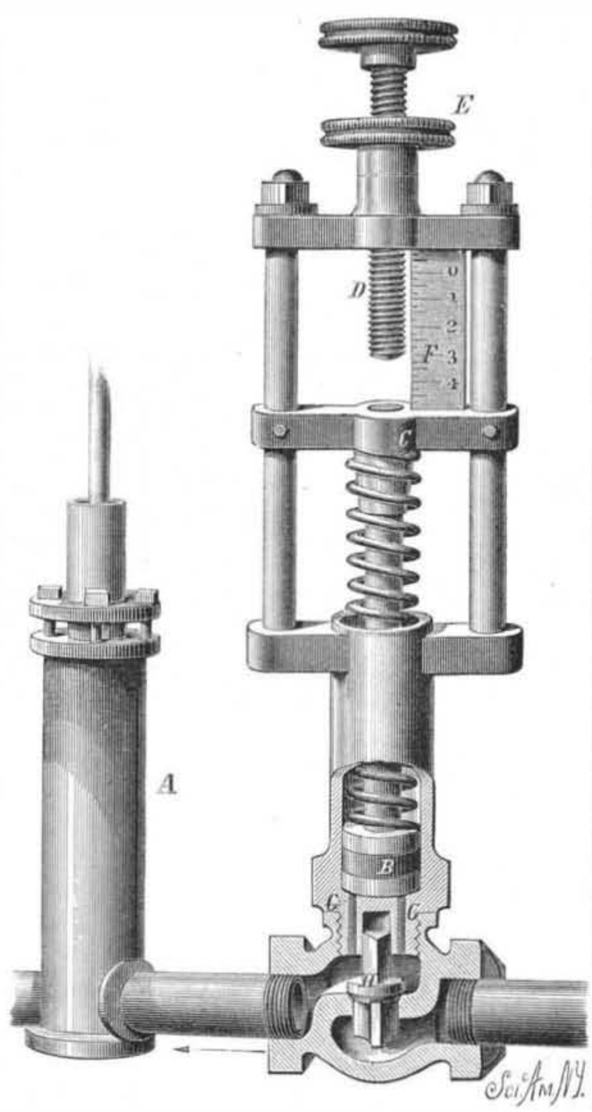


IMPROVED SAW MILL DOG.

OIL DISCOVERIES IN PENNSYLVANIA.—A singular circumstance is reported from the Holder Run oil section, in the shape of the striking of a deposit of oil which exhibits none of the impurities of petroleum when it comes from the ground, but, on the contrary, spouts from the sand in a refined condition. The oil comes from the well a pale green transparent fluid, and can be used in lamps at once. It gives a brilliant light, with no smoke or odor, and stands a fire test of 110°, a lighted match being thrown into a vessel containing the oil failing to ignite it. It deposits very little sediment.

IMPROVED FEED REGULATOR FOR BOILERS.

It is the usual practice of engine builders to make the feed pump about two or three times the theoretical size, and to regulate the supply of water to the boiler by partially



FEED REGULATOR FOR BOILERS.

closing the suction valve. A little thought will convince any engineer that this system is open to many objections. Suppose the pump, if completely filled and discharged at each stroke, to deliver twice the volume of water into the boiler that was required. Thus the suction would be closed off so that the pump would only half fill with water at each stroke. When the plunger descends and is half down it meets the water coming up, and the result is a disagreeable pounding causing much strain and wear on the connections, and a rapid destruction of the check valves. Moreover there is a tendency for air to leak into the pump through the stuffing box. This, in very high pressure engines such as are used on small boats, is a source of great annoyance and danger, as a very little air will from its elastic nature prevent the pump from working. In small boats it is also a desideratum to have a certain and definite volume of water enter the boiler at each stroke of the engine. This cannot be done with the common pump now in use. For suppose the engine is making 400 turns per minute and the valve in the suction is opened just sufficient to allow the proper volume to enter, half filling the pump. If the engine is slowed to 200, less than one half the steam is being used and twice as much water being pumped into the boiler per stroke, or fully three times as much as is required. When the engine slows down from a lack of pressure the trouble is greatly aggravated by a much larger quantity of cold water than is requisite being put into the boiler. Boat boilers, being very active and liable to quick fluctuation, require very close watching when supplied in the usual manner.

Our illustration shows a very simple device which, it is claimed, obviates all the above objections. It is the invention of Hiram S. Maxim, M.E., who contrived it for use on his small and fast steam yachts. A is the ordinary form of feed pump, the discharge valve being on the left and not shown. The regulating apparatus is placed on the right between pump and suction valve. It consists of a cylinder of the same volume as that of the pump in which works the airtight piston, B. The stem of this piston passes up through the guide piece, C, and is surrounded by a coiled spring which keeps it down. On the upper part of the device is a screw, D, which may be adjusted so as to limit the upward movement of the piston rod when the piston is raised against the action of the coiled spring. On said screw is a binding nut, E, and beside it is placed a graduated scale, F, whereby the screw may be set to limit the movement of the rod or stem at any point, as for instance at one half, one third, or one quarter the total possible travel of the piston in the cylinder. Beneath the piston are two apertures or channels, G, and between them is a recess in which plays the stem of the valve, H, which is seated in a horizontal partition in its casing as shown.

Supposing for example the screw, D, is brought down so as to prevent any motion of the piston, B. Then when the pump makes an upstroke water will be drawn through the valve, H, and the latter closing in the down stroke of the pump all the water drawn into the pump barrel will be forced on into the boiler. This is the ordinary condition of affairs with the regulating device being rendered inoperative. Now suppose the screw, D, moved up to 0, so that the piston, B, has full play. The up stroke of the pump draws in water through valve, H, as before, but on the down stroke the conditions are altogether different from before. The water will, as a matter of course, pass in the direction where it meets the least resistance, and it must either enter the boiler against the pressure or it must lift the piston, B, and enter the barrel of the regulator. Now, the strength of the coiled spring in the latter is so adjusted as to make it easier to raise the piston against it, than for the water to pass to the boiler. Hence the contents of the pump barrel will flow into the regulator barrel and fill the same, the piston rising. Consequently no water would enter the boiler, and there would simply be an oscillation of the fluid alternately from pump to regulator and regulator to pump as the latter continued in operation.

This brings us to the third condition, namely, suppose the screw, D, to be moved partially down, say to 3, as in our engraving. Obviously, then, the piston, B, will be permitted to rise only one fourth of its stroke, only one fourth of the contents of the pump barrel can therefore enter the regulator cylinder, and the remaining three fourths must go on to the boiler.

It will be clear that we have simply to adjust the screw, D, and secure it by the binding nut so that no jar can displace it, to reduce the quantity of water delivered by the pump by any desired fraction.

One very important advantage claimed for this invention is the facility with which the discharge of the pump may be ascertained. A glance at the movement of the piston rod indicates whether the pump is or is not working. Should the water supply give out the motion ceases. The contact of rod and screw makes a slight click like that of a telegraph sounder, the cessation of which would attract attention to any failure of supply. The device may be made of any size and adapted to any form of boiler.

For further particulars address H. S. Maxim, M. E., 74 Coal and Iron Exchange, New York city.

Absorption and Evaporation in Plants.

M. Vesque has recently made some researches into the relation between taking up water by the roots and evaporation by the leaves of plants. He concludes that the absorption of water by the roots is not proportional to the temperature of the leaves if these be placed in an unsaturated atmosphere. At a low temperature it increases but slowly in proportion as the temperature rises, but at a certain temperature fixed for each plant the absorption rapidly increases. It becomes stationary at a temperature maximum, which is different for different species.

The absorption of water by the roots is independent of the temperature of the leaves, when these are in an atmosphere which is saturated, dark, and protected against heat radiations. Dark heat rays act very powerfully on the transpiration in saturated air, and have the same action on the absorption as a rise of temperature when the leaves are in a dying condition.