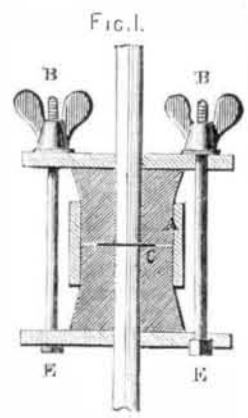
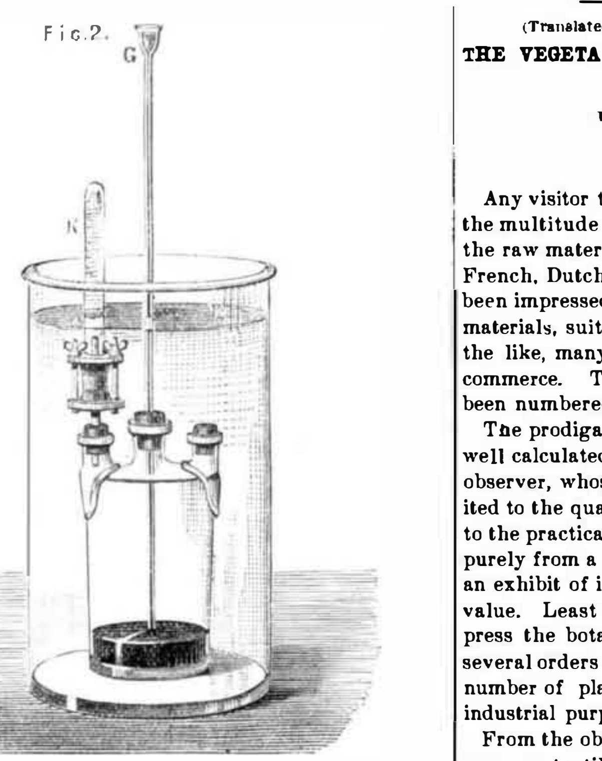
THE PHYSICAL PHENOMENA OF GERMINATION.

In order that a seed may germinate, it must be acted upon by two agents—humidity and oxygen. These are necessary and also sufficient, and the truth of the assertion is susceptible to a very interesting experimental demonstration, the substance of which, together with the illustrations, extracted from *La Nature*, we now present.

It is first proposed to show that the part of the water is peculiarly to soften the husk or shell of the seed in order to render it permeable to gases. To this end the apparatus shown in Fig. 1 has been constructed by MM. Dehérain and Vesque. The shell of a seed—a bean, for example—is removed and placed behind two caoutchouc cushions, through which a central aperture has previously been made. To prevent the rubber from bulging, a ring of copper, A, is placed so as to inclose the ends of the cushions, and the latter are forced together by the screws, B E. Three screws are provided in each apparatus, so that a uniform pressure may be produced. Two tubes are next introduced, the lower of which enters the cork of a quart bottle containing only air. The upper tube enters an inverted test tube. Thus arranged, the apparatus is plunged in water, as shown in Fig. 2. The fluid penetrates the upper tube and reaches the inclosed seed shell; but the softening effect on the latter is not instantaneous, as, if mercury be poured into the tube, G, it will compress the air in the bottle, and remain stationary without driving a bubble





of air through the shell. The test tube, K, remains filled with water. We have thus the proof that a dry shell, or even one recently wet, is totally impermeable to gas.

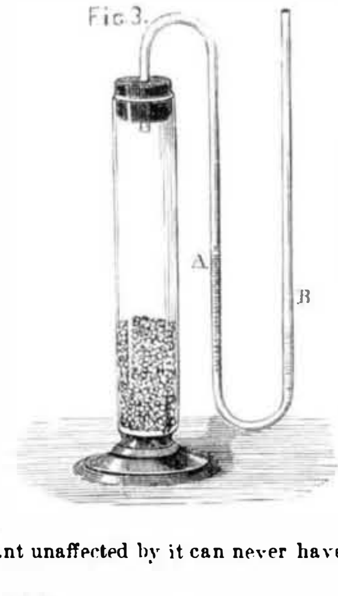
If the apparatus be left quiet for two or three days, a change takes place. A fine thread of escaping gas first enters the tube, K, then, as the shell softens, a larger current; and finally the tube is emptied, the water being driven out by the entering air, thus proving the proposition which we set out to establish.

Seed which is slightly moistened by water has the peculiar property of condensing gases with which it is in contact. Grains thus treated are placed under a bell glass over mercury. During the first days of germination a sensible diminution of the volume of contained gas takes place, and this before any disengagement of carbonic acid. This condensation of air cannot take place without a quite notable production of heat, resembling that which happens when hydrogen is condensed in platinum sponge or illuminating gas in a palladium plate. It is this elevation of temperature—as the investigators conclude—due to condensation of the gases, which determines the attack of the immediate principles of the grain by oxygen; it is, figuratively speaking, the spark which causes the beginning of the slow combustion which accompanies germination, and perhaps supports it.

The phenomena which take place, then, from the moment when life begins in the seed, happen in the following order: 1. Passage of atmospheric oxygen through the envelope of the seed, already softened by water. 2. Condensation of gases in the tissues of the seed. 3. Slow combustion of the products contained in the tissues, and evolution of new substances destined to form the young organs.

It is the second point, the most important, which it is next proposed experimentally to demonstrate. In the cork of a test tube is arranged a curved pipe, to serve as a manometer, Fig. 3. The tube is filled about one quarter full with seed (cresses are specified) some hours before it is intended to show the results, and the grains are well moistened. Water is poured into the manometer, and the apparatus is adjusted until the level of the liquid is the same in both branches of the pipe.

After the lapse of a few hours, the water will be seen to ascend tube A, and to continue doing so for several hours; sometimes a few bubbles will rise through and enter the test tube, thus replacing that condensed by the seed. If the apparatus be set aside for a few days, the inverse phenomenon occurs. The seed gradually absorbs all the oxygen in the test tube without leaving a trace; but the emission of carbonic acid continuing, the water is forced back in the manometer, so that, if the whole be placed under water, a gas formed of a mixture of carbonic acid and nitrogen may be collected from the tube, B, Fig. 3.



That air and water are the only requisites for seed germination is proved in those beautiful little ornaments which may be made by sprinkling a pine burr with grass seed and suspending it over water, or by placing seed in the orifices of a damp sponge or on a piece of moist porous earthenware. The grain will germinate, sprout, and grow. This will take place even in the dark; but the plants will be yellowish white and not green, thus proving the well known fact that, while light is not necessary to growth, the plant unaffected by it can never have green foliage.

(Translated from the Official Reports upon the Exposition.)

THE VEGETABLE FIBERS AT THE UNIVERSAL EXPOSITION, VIENNA.

BY PROFESSOR DR. JULIUS WIESNER.

Number I.

Any visitor to the Exposition who attentively observed the the multitude of products from tropical lands, and especially the raw materials brought for exhibition from the English, French, Dutch, and Portuguese colonies, cannot fail to have been impressed with the richness of the display of fiberous materials, suitable for spinning, weaving, paper-making, and the like, many of which were (and are) quite unknown in commerce. The vegetable fibers on exhibition might have been numbered by the hundred.

The prodigality of Nature in this domain of production is well calculated to arouse amazement in the mind of the casual observer, whose familiarity with the vegetable fibers is limited to the qualities and uses of hemp, flax, and cotton; while to the practical mind of the specialist, viewing the subject purely from a utilitarian standpoint, the collection is chiefly an exhibit of interesting novelties of questionable industrial value. Least of all, perhaps, this imposing array would impress the botanist, who, familiar with the structure of the several orders of the vegetable kingdom, is aware that the number of plants that will afford a fine fiber, suitable for industrial purposes, is legion.

From the obvious differences in the character of threthee common textile fibers before named, it may reasonably be premised that the fiberous materials prepared from so many heterogeneous plants will vary greatly in value. A careful inspection not only verifies this presumption, but demonstrates further that many of them are of by no means trifling value, but, in everything that relates to quality and adaptability for industrial uses, will bear close comparison with cotton, hemp, or even flax. This assertion, incidentally remarked, is borne out by the fact that not a few of them have been employed from time immemorial by the native races of tropical countries for useful purposes, such as articles of dress, cords, ropes, etc., just as in Europe flax has been similarly utilized for many ages. The world's fairs, so popular in our times, afford the technologist the most admirable opportunity of becoming acquainted with the extent of our resources in the raw materials and products in which he is interested; and as an illustration of their utility in relation to the subject of this communication, it may be remarked that the former expositions at London and Paris contributed materially to the introduction of several now highly prized textile fibers—such as jute and China grass—as articles of European commerce and industry. It appears to us, however, that at Vienna the opportunity for extending this precedent was not properly appreciated.

We shall now invite attention to such of the raw materials of this class as appear to us to be deserving of introduction in our domestic industries.

At the time of the preparation of our report upon the Paris Exposition of 1867, the jute fiber—the inner fiberous bark of *corchorus capsularis*—was comparatively little known. At that time, we dwelt with emphasis upon the importance of the jute industry, illustrating our comments by reference to the unexpected and extensive proportions which jute consumption had assumed in England. To preach the value of jute to-day would be labor lost and unnecessary, since the progress of its manufacture in our midst affords the best evidence that it has received due appreciation.

It may be of interest, in this connection, to note the fact that spun and woven jute may be completely bleached; the practicability of this was formerly denied. The bleached product has not only a white color, but also a fine luster, possessing, in these particulars, decided advantages over hemp. The greater bulk of the jute of commerce is brought from India and neighboring islands, its native home. Of late years, however, the attempt has been made, with promising results, to introduce the culture of the jute plant into other tropical countries. As instances of these endeavors, the Exposition contained jute from Algeria, French Guiana, the Mauritius, and other localities.

The introduction of the China grass (tschu-ma)—the inner bark fiber of *Böhmeria nivea*—into the textile industries of Europe, does not keep pace with that of jute. This is to be attributed partly to the fact that fabrics woven of this fiber, although decidedly inferior to silk both in point of luster and durability, are more expensive than cotton goods of equal quality, and partly to the circumstance that European manufacturers have yet to master the mode of properly manufacturing this material, and thus far have been unable to produce, from the crude bark of *Böhmeria*, the fine, lustrous, long-stapled fiber that is sent abroad from China under this name, either in the fibrous state or woven into its reputed product, the grass cloth. The future of the China grass in Europe will depend largely upon its price. If, by the extensive and systematic cultivation of the plant, the crude fiber is placed upon the market cheaply, and this is supplemented by the acquisition of the skill now wanting in its preparation, its superior qualities—as compared with cotton—cannot fail to secure for it a wide field of usefulness. The cultivation of the *Böhmeria nivea* is spreading quite rapidly. Besides the exhibits of China and Japan, samples of this fiber were displayed from the East Indies, North America, Martinique, Jamaica, Trinidad, Queensland, the Mauritius, and Algeria; and the reports from these countries, as to the facility with which the plant adapts itself to climatic conditions, are generally quite favorable.

A material closely related in character to the China grass, for which indeed it is often mistaken, is the ramie fiber, the inner fiberous bark of *Böhmeria tenacissima*, a native of the south and east of Asia, where it has been cultivated from a remote period. The fiber is coarser, and (in prepared condition) shorter, and less lustrous than that of the China grass. In England, handsome and lustrous goods, both white and colored, are woven from the fiber, but they are inferior to the China grass products. The importance of the ramie, in our estimation, consists rather in the nature of the fiber itself than in the fine, cotton-like product that may be obtained from it Whoever has seen the unusually strong and handsome ropes and cordage, made of this material by the natives of India, and is furthermore acquainted with the fact that the raw ramie fiber far surpasses hemp in point of durability and tenacity, will be forced to admit that its introduction into these last named industries will mark an era of decided progress. The acclimatization of the ramie has lately been attempted in a number of countries, among others in Central Europe. Concerning many of these experiments, nothing positive may be stated, although the specimens on exhibition from various tropical regions were not appreciably inferior to those from the land of its nativity.

Similar in this respect to the ramie is the so-called New Zealand flax, an article known in Europe, and especially in England, for a number of years. It is an extremely strong, tough, and (even in a wet condition) durable fiber, prepared from the leaf of *phormium tenax* (the New Zealand flax lily). It is possible to manufacture from this material woven fabrics that may be used either bleached or unbleached, as many of the New Zealand exhibits demonstrated. But of vastly more importance than these are the wonderfully firm and tenacious ropes, cords, twine, and the like that are prepared therefrom. *Phormium tenax* is cultivated in New Zealand, Australia, the East and West Indies, the Mauritius, Réunion, and Natal; and quite recently its introduction into the south of Europe has been attempted, though with indifferent success.

Precautions in Case of Fire.

An excellent sot of rules for guidance for the prevention of and in case of fire, by Dr. Hall, may be briefly summarized as follows:

Keep all doors and windows of the structure closed until the firemen come; put a wet cloth over the mouth and get down on allfours in a smoky room; open the upper part of the window to get the smoke out; if in a theater, keep cool: descend ladders with a regular step to prevent vibration. If kerosene just purchased can be made to burn in a saucer by igniting with a match, throw it away. Put wirework over gaslights in show windows; sprinkle sand instead of saw dust on floors of oil stores; keep shavings and kindling wood away from steam boilers, and greasy rags from lofts, cupboards, boxes, etc.; see that all stove pipes enter well in the chimney, and that all lights and fires are out before retiring or leaving place of business; keep matches in metal or earthen vessels, and out of the reach of children; and provide a piece of stout rope, long enough to reach the ground, in every chamber. Neither admit any one if the house be on fire, except police, firemen, or known neighbors; nor swing lighted gas brackets against the wall; nor leave small children in a room where there are matches or an open fire; nor deposit ashes in a wooden box or on the floor; nor use a light in examining the gas meter. Never leave clothes near the fireplace to dry; nor smoke or read in bed by candle or lamp light; nor put kindling wood to dry on top of the stove; nor take a light into a closet nor pour out liquor near an open light; nor keep burning or other inflammable fluids in rooms where there is a fire; nor allow smoking about barns or warehouses.

In "butting" or meeting belts, the crossings of the lacings should be on the outside.