

ever seen such quick returns of balls which it seems absolutely impossible to "get up." Moreover, the players' powers of endurance are taxed to the utmost by the enormous size of the court and the space they have sometimes to cover. These latter are generally known to the public by their nicknames—*El Manco*, the one-armed; *El Chiquito*, the little one, and many other sobriquets, and in the intervals of play are the subjects of much tender solicitude and encouragement. For the spectators are often wound up to such a pitch of enthusiasm by a long rally and a good stroke that at the end of the round they will shower pieces of money and even their hats and walking sticks upon the player who has been fortunate enough to please them.

Unfortunately, the players do not always please them, and the cry of *lindo!*—"pretty stroke"—is not the only one that resounds through the court. The betting is very heavy indeed, and there are always the same suspicions connected with the game as are attached to horse racing. It takes very little to persuade a hot-headed South American, who has got a good deal of money on, that his side are losing the game on purpose; and then the hoarse shouts of *robo!*—"robbery"—entirely drown the applause of the triumphant backers. Indeed, it is to be feared that by far the largest part of the audience is assembled simply and solely for the sake of gambling. Our illustration is from a sketch by Mr. A. R. Airey.

#### BURNS THE DIVER.

To dive from a small platform suspended at a height of 83 feet into a tank of water 18 feet long, 9 feet wide

be exhibits from the technological museum, the technical museum, and the technical college, and from the public schools of the colony. The work of installing the exhibits in the mining court is almost complete, and when finished New South Wales will rank first among the mining nations that will be represented. One of the main features of the display will be an ornamental column 38 ft. high, representing only a seventh of the silver product of the famous Broken Hill mine. All the ethnological exhibits of the colony have arrived.

#### FAMOUS GOLD NUGGETS.

In order to correct many misstatements that are going the rounds of the press in regard to the largest nuggets of gold ever found, the editor of the *Silver Dollar* publishes the following facts, which he obtained while commissioner to the great Mining Exposition held in Denver, Col., in 1882, from the gentleman having charge of the Australian exhibit, which included models of all the large nuggets discovered in that great gold field.

The largest piece of gold in the world was taken from Byer & Haltman's gold mining claim, Hill End, New South Wales, May 10, 1872. Its weight was 640 pounds; height, 4 ft. 9 in.; worth \$148,000. It was found embedded in a thick wall of blue slate, at a depth of 250 ft. from the surface. The owners of the mine were living on charity when they found it.

Welcome Stranger nugget was found on Mt. Molleget, February 9, 1869, weighing 190 pounds, and was worth \$45,600. This nugget was raffled for \$46,000 at \$5 a chance, and was won by a man driving a baker's

The Kohinoor nugget, found at Ballarat July 27, 1860, at a depth of 160 ft. from the surface, weighed 69 pounds, and was sold for \$16,680.

Sir Dominic Daly nugget, found February 27, 1862, weighed 26 pounds, and sold for \$6,240.

No Name nugget, found at Ballarat February 28, 1850, only 16 ft. below the surface. The discovery was made by a small boy. The nugget weighed 30 pounds and 2 pennyweights, and sold for \$7,365.

No Name nugget, found at Webville, August 1, 1869, weighed 12 pounds, and was worth \$2,280.

No Name nugget, found at Ballarat February 3, 1853, just 12 ft. below the surface, weighed 30 pounds, and sold for \$7,360.

No Name nugget, found in Canadian Gully January 20, 1853, at 18 ft. below the surface, weighed 93 pounds 1 ounce 11 pennyweights, and sold for \$22,350.

No Name nugget, found at Bakery Hill March 5, 1853, weighed 40 pounds, and was worth \$9,600.

Nil Desperandum nugget, found at Black Hills November 29, 1859, weighed 45 pounds, and sold for \$10,800.

Oates & Delson nugget, found at Donnelly gold field in 1880, at the roots of a tree, weighed 189 pounds, and sold for \$50,000.

In addition to the above were the Heron nugget, worth \$20,000, and the Empress nugget, worth \$27,661.

Gold in the drift deposits has been found in larger masses in Australia than in any other country. Many large nuggets were found in California during the era of placer mining, but we have no record of any to compare with those we have described in Australia.

#### SEAWEEDS.\*

By E. M. HOLMES, F. L. S., Curator of the Museum of the Pharmaceutical Society of Great Britain.

##### I.—SEAWEEDS APPLIED IN MEDICINE.

It would not be possible in the brief time at our disposal, either to enter into details concerning the classification of seaweeds, or to describe the advances that have been made in the knowledge of this class of cryptogamic plants.

I propose, therefore, to offer a few remarks upon some of the species which have been, or still are, of more or less direct interest to the pharmacist, and to indicate to those who are lovers of nature and of science a few points concerning seaweeds which are still awaiting investigation.

The first fact to which I desire to direct your attention is that every good species of seaweed must be regarded as distinct, not merely in form and structure, but in its vital processes and the chemical products it elaborates.

This individuality is the more remarkable because seaweeds live under less varied conditions than ordinary plants. Although some of the larger algae, such as the oarweeds (*Laminariae*) and honeyware† (*Alaria*), etc., appear to be furnished with roots, yet it is well known that these are mere hold-fasts, and do not obtain nourishment for the plant. It, therefore, has to absorb nourishment through its entire external surface from the medium in which it grows. Although sea water varies, so far as we know, only in its temperature and its degree of salinity, yet different species growing in the same locality not only exhibit peculiarities of growth and structure, but also yield different products.

One of the marine algae best known to pharmacists is, perhaps,

*Fucus Vesiculosus*.—For the sake of comparison it may be pointed out that there are six common and two rare species of fuci (excluding varieties) occurring in Britain that are usually referred to this genus.‡ These are *F. canaliculatus*, *F. ceranoides*, *F. platycarpus*, *F. vesiculosus*, *F. nodosus* and *F. serratus*. The two rare species are *F. anceps* (Ireland) and *F. distichus* (Scotland). Only two of these possess air bladders, viz., *F. vesiculosus* and *F. nodosus*. In the former the frond has a midrib, and the bladders are situated usually on each side of it. In the latter the frond is compressed but thicker, and has the air vesicles immersed in its substance; the receptacles or organs of fructification are borne on short lateral peduncles. These species occupy different situations on the shore. *F. ceranoides* is found in the brackish water of estuaries and marine lochs. *F. canaliculatus* grows on rocks near high water mark, and is exposed to the air during a considerable part of the day; it is a small plant, with channeled fronds. *F. platycarpus* occurs near high tide level, and the others follow in succession toward low water mark in the order in which they are mentioned. In some places, as at Smallmouth, near Weymouth, these plants can be seen forming distinct zones of growth. The species vary much in size and in width of the frond according to the conditions under which they live. Thus, *Fucus vesiculosus* has a very broad frond when growing in still water in bays, and a narrow one when hanging over a rock and exposed to the pouring of the waves over it, the pressure thus exerted probably tending to elongate the cells, just as happens with batrachian *Ranunculi* in rapidly flowing fresh water.

The lifting power of a large plant of the bladder species is very considerable. Some years ago a naturalist was much puzzled by observing tracks in the sand, which began and ended without any visible cause. On watching for some hours he observed that stones of considerable size were floated by the fuci growing on them, and on being carried shoreward left the indentations in the sand.

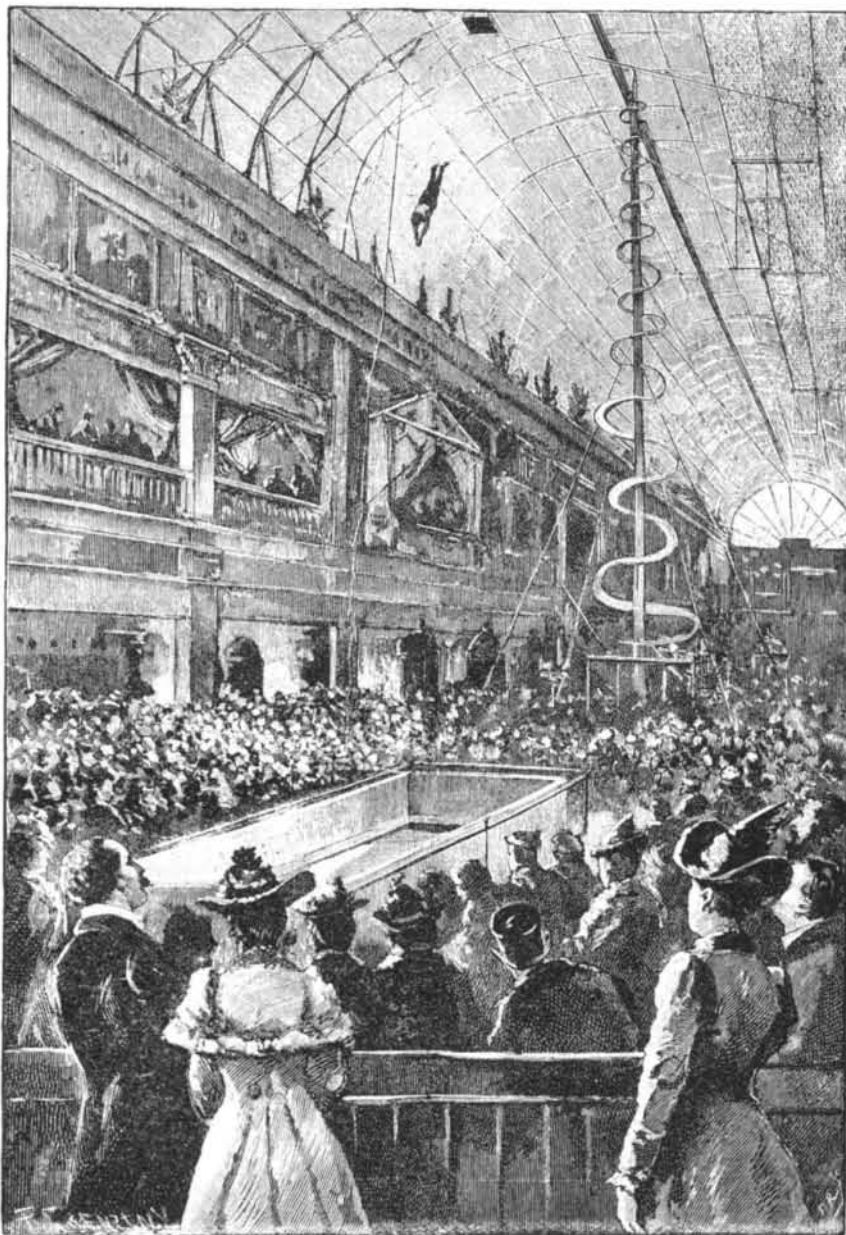
Possibly these bladders serve some purpose in enabling the plant to retain the position that suits it best.

Some idea of the vast quantities of fuci that grow on

\* A paper read recently before the Chemists' Assistants' Association, London.

† The word ware is probably identical with "wrack," the name applied to fuci. The equivalent French word, vareck or varec, is in Jersey, or wrack in England and Scotland, has a double meaning, it being applied to goods or merchandise (as in the English words hardware, tinware, warehouse), and also to goods thrown up by the sea on shore; and in this sense the words vareck and wrack are evidently applied to seaweeds. We see also the connection with the words wreckers and wreck, and with wrack as used in the well known quotation, "Left not a wrack behind." The term hen-ware seems to be a modification of honey, i. e., sweet ware.

‡ *F. canaliculatus* is now usually referred to a distinct genus, *Pelvetia*, in which there are only two oospores in the onium. *F. nodosus* is in like manner placed in the genus *Ascophyllum* characterized, having four oospores in the organism. In *fucus* there are eight.



TOMMY BURNS' DIVE OF 83 FEET AT THE ROYAL AQUARIUM.

and 7 feet deep, is a performance sufficiently thrilling to satisfy the most exacting audience. That is the sensation which "Tommy Burns" has provided for the patrons of the Westminster Aquarium. Since Baldwin made his parachute descent there has been nothing to equal this feat, and when Burns, having been hauled up to the platform, crouched down preparatory to taking his header, there was deathly silence throughout the great crowd of spectators. He comes down in a curve, with his legs over his back, and strikes the water with his shoulders, and the rest of his body comes down almost flat on the surface directly his shoulders touch, as if he had fallen on his back. The near spectators got a splashing, and the whole audience sighed with relief when the excitement was over, and the diver came puffing to the surface.—*Black and White*.

#### AUSTRALIAN EXHIBITS AT CHICAGO.

New South Wales is the only one of the Australian colonies that will be represented at the World's Fair at Chicago. All the courts of the colony are further advanced in the installation of the exhibition than any other nation. The art exhibits of New South Wales will occupy 6,000 square ft. of floor space and 10,000 square ft. of wall space. The arts court will be a most attractive feature of the display the colony is making. There will be a collection of over 600 large photos of the public buildings and works of the colony, street views, and country scenery. There will also

cart. It was sold to the bank for its true value and melted.

The Welcome nugget was found at Bakery Hill, June 9, 1858. It weighed 184 pounds 9 ounces 16 pennyweights, and was worth \$44,356; was raffled for \$50,000 at \$5 a chance and was won by a small boy in a barber shop.

Lady Hotham nugget—named in honor of the wife of the governor of New South Wales—was found in Canadian Gully, September 8, 1854. It weighed 98 pounds 10 ounces and 12 pennyweights, and was sold for \$23,557.

Uncle Jack nugget, found at Buningorg, February 28, 1857, weighed 23 pounds and 5 ounces, and was sold for \$5,620. It was found by a runaway sailor, who sold it for the sum named, and spent the money in just four weeks.

No Name nugget, found at Eureka, Daulton's Flat, February 7, 1874, 50 ft. below the surface, weighed 52 pounds 1 ounce, and was sold for \$12,500.

The Leg of Mutton nugget was found at Ballarat January 31, 1853, at a depth of 65 ft. It weighed 134 pounds 11 ounces, and was sold to the bank for \$32,380. This nugget was shaped like a leg of mutton, hence its name.

No Name nugget, found at Bakery Hill, Ballarat, March 5, 1855, near the surface, weighed 47 pounds 7 ounces, and was sold for \$11,420.

No Name nugget, found at Canadian Gully, Ballarat, Jan 22, 1853, at a depth of 25 ft., weighed 84 pounds 3 ounces 15 pennyweights, and was sold for \$20,235.

our shores may be gathered from Mr. Stanford's statement that he has seen as much as 10,000 tons cut in a single loch during the summer for making kelp. One hundred tons of wet seaweed yield 5 tons of kelp or  $2\frac{1}{2}$  tons of soluble salts. One loch would, therefore, yield in one summer no less than 250 tons of salts.

The work that is effected by seaweeds in abstracting mineral matter from sea water is thus seen to be enormous.

It might be supposed that the mineral constituents of marine algae are due solely to the amount of sea water contained in their cells, but this is not the case, since the character and amount of the salts present vary in different species.

It has also been suggested that the greater or less degree of immersion in water during the ebb and flow of the tide, due to the position in which the plant grows, affects the amount of certain salts present. Thus, in the true fuci, the amount of iodine present is less in those exposed to the air for the longest period, as seen in the following table, given by Mr. E. C. C. Stanford:

	Iodine per ton in lb.
<i>Fucus vesiculosus</i> .....	0.665 bladder wrack
<i>Fucus nodosus</i> .....	1.282 knobbed wrack
<i>Fucus serratus</i> .....	1.887 black wrack

But a comparison with other algae growing in sea water and exposed only at extreme low tides will show that this is not the rule.

	Lb. of iodine per ton.
<i>Himanthalia lorea</i> .....	1.998
<i>Chorda Filum</i> .....	2.688
<i>Haliodyris siligiosa</i> .....	4.773
<i>Chordaria flagelliformis</i> .....	6.298

It may be noted also that the official species of fucus is not the richest in iodine.

**Laminaria.**—The British species usually referred to this genus are five in number, viz.: *L. hyperborea*, Fosl. (*L. digitata*, Lyngb.), *L. digitata*, Edm. (*L. stenophylla*, J. Ag.), *L. saccharina*, Lamx., *L. hieroglyphica* (J. Ag.), *Saccorhiza bulbosa*, De la Pyl. (*L. bulbosa*, Lamx.).

These are technically known to kelp makers as "tangle," in contradistinction to the fuci, which are denominated "wrack." The first two species are those chiefly used in the preparation of kelp, being particularly rich in iodine, the third has been suggested for use in emulsifying cod liver oil, the fourth and fifth are interesting chiefly from a botanical point of view.

The first, *L. hyperborea*, grows below tide mark, being rarely exposed even at the lowest spring tides, but it is often thrown up in immense quantities after storms. It has a rough or watery stem, which stands erect in the water. The second is usually exposed at low tides and has a smooth flexible stem, and is, therefore, more or less decumbent. Both of these species have the lamina or blade split up into ribbon-like pieces. In the third species, *L. saccharina*, the blade is ligulate and wavy at the margins, and has large transverse wrinkles. *L. hieroglyphica* differs from *L. saccharina*, chiefly in the wrinkles being in a longitudinal direction and much more numerous. *L. bulbosa* is quite distinct from all the above, and is now placed in a separate genus, *Saccorhiza*, on account of possessing cryptostomata, i. e., small cavities in the frond, from each of which a tuft of hairs arise.

The mode of development of these plants is extremely curious, and affords an excellent example of intercalary growth. At this time of the year the fronds of *Laminaria saccharina* will be found to have a thin and paler portion developed between the top of the stem and the old lamina, with a constriction between the two parts of the lamina. The paler portion is the new frond which is developed between the stem and the old lamina. After a time the constriction increases and the old frond drops off. This is evidently a provision of nature for distributing the species, since the old frond bears the fructification, which is thus floated to other localities.

If the old frond be held up to the light, the fructification is readily seen. Under the microscope it is found to consist of linear, elliptical, unilocular sporangia, nearly hidden at the base of densely packed paraphyses. It may here be of interest to point out that although the *Laminariae* are extremely common in temperate latitudes, the plurilocular sporangia are absolutely unknown. Yet there is little doubt that all that is needed to discover them is continuous and discriminating observation, for an acute observer, Mr. T. H. Buffham, has recently detected the plurilocular sporangia of the equally common *Chorda Filum* (or sea laces), which until last year were also unknown. These are found on the same plant as the unilocular sporangia, but on the upper portion of individuals which have become enlarged and spirally formed toward the apex. It is a remarkable fact that although the plants of this family exceed all other algae in size,\* yet their reproductive organs are of a low type, consisting only of zoospores.

It may also be mentioned that the zoospores of the subclass *Phaeophyceae*, or brown algae, to which the *Laminariaceae* belong, differ from those of the *Chlorophyceae*, or green algae, in the cilia being of different length, in being attached at the side, and in the longer cilium being carried forward when the zoospore is in motion. In the green algae the cilia are both attached at the narrow end, and are usually of equal length. In both cases the zoospores are ovate, the narrower end being in front when in motion. These zoospores are best observed early in the morning, when they are generally set free. If green algae in fruit be placed in a glass vessel containing sea water, the microzoospores move to the side facing the light, and the macrozoospores to the side away from it. The former germinate after conjugation, the latter without conjugation. Consequently, the former may be regarded as a sexual and the latter as an asexual mode of propagation analogous to that of gemmæ or bulbils in higher plants, or to the tetraspores of the *Rhodophyceae*. The reverse is supposed to be the case with the *Phaeophyceae*, in which the smaller or micro-zoospores found in the unilocular sporangia are supposed to be asexual, and the larger macro-zoospores contained in the pluri-

locular sporangia are believed to be sexual, and these sporangia are hence distinguished as gametes.

Returning to the other species of *Laminaria*, it may be remarked that the young frond of *L. hyperborea* is developed in a similar manner, but when nearly full grown, longitudinal fissures appear here and there in the new frond and extend gradually to its apex; the old frond then decays at the constriction, and is easily torn off by the force of the waves.

In *Saccorhiza* the development of the plant is still more curious. The young plant might be easily mistaken for that of *L. hyperborea*, or of *L. saccharina*, but for a very inconspicuous ring near the middle of the stem. This ring gradually enlarges, and ultimately bends downward until it reaches the rock, the lower part of the stem meanwhile having its growth partially arrested. When the ring touches the rock it attaches itself by numerous warty projections, assumes a hemispherical form, and forms, ultimately, a large, stout globular body, often a foot or more in diameter, and studded all over with warty projections, which serve to attach it to surrounding objects. The lower half of the original stem then gradually disappears. This species grows where the shock of the waves is greatest, hence the use of its strong base. Before leaving the natural history of the *Laminariæ*, it may be interesting to observe these plants, like many other algae, have their own peculiar epiphytic species. Thus, *Ectocarpus Hinchsiae* may be found almost to a certainty on the fronds of *Saccorhiza bulbosa*, but I have never met with it on any other host plant. In the same way, *Ptilothamnion pluma* may be found on the warty stems of *L. digitata*, and rarely, if ever, elsewhere. The warty stems of this species of *Laminaria* are a fertile hunting ground for rare and deep water species, and when thrown up after a storm, especially on our northern coasts, have repeatedly been found to yield epiphytic species otherwise obtainable only by dredging, e. g., *Euthora cristata*, *Petrocelis Henedyi* and *Delesseria angustissima*. From a chemical point of view the species of *Laminaria* are also extremely interesting. The proportion of iodine varies considerably in different species: this will be seen from the following table given by Mr. Stanford:

LAMINARIA DIGITATA, EDM.	
	Lb. of iodine per ton.
Frond.....	10.702
Stem.....	9.021
L. HYPERBOREA, FOSL.	
Frond.....	6.599
Stem.....	10.158
<i>Saccharina</i> , Lanox.....	6.258
<i>Saccorhiza bulbosa</i> , De la Pyl.....	4.403

*L. digitata* is frequently exposed at low tides for two hours or more, but *L. hyperborea* is barely left uncovered by the tide, yet it will be observed that the *L. digitata* contains the most iodine, which is exactly the reverse of the percentage in the fuci.

When we compare the quantity of iodine present in these plants with the amount present in sea water, we find an extraordinary difference. Sea water is stated to contain only 1 part of iodine in 291,000,000 parts, but *L. digitata* contains 1 in 250. It has, therefore, an extraordinary power of absorbing and retaining iodine in its living tissues. As its stem is perennial, its richness in iodine might be supposed to be due to a gradual accumulation, but as the annual deciduous frond of *L. digitata* contains nearly as much as the stem, this supposition will not account for it, nor for the fact that *Chondrus crispus* and many other species contain the merest trace of iodine, or none at all. We are here, therefore, face to face with the problems, by what means is this element abstracted from the sea water and of what use is it to the plant?

In most *Laminariæ* the fronds are observed when collected on the shore to be remarkably mucilaginous, and if a frond in the dried state is observed with a lens, a network of veins can be observed. This network consists of a number of anastomosing tubes, which commence at first as intercellular cavities formed between cells under the epidermal layer. The contiguous cells develop into glands and the cavities gradually communicate in a horizontal direction with each other. From this network of gland-containing tubes vertical canals are formed between the cells, which do not however pierce the epidermis. The free mucilage in which these plants abound is secreted by these glands, and when the epidermis is injured it escapes. The formation of these muciparous glands and anastomosing canals has been carefully studied recently by M. L. Guignard (*Ann. Sch. Nat.* (7) t. xv., pp. 1-46), who watched their development by following the growth of the new frond from its first appearance at the top of the stem.

The chemical nature of the mucilage was ascertained a few years ago by Mr. E. C. C. Stanford, of the North British Chemical Works.\* He found it to consist of salts of a new organic acid, which he named alginic, with magnesium and sodium. The mucilage when evaporated to dryness becomes insoluble in water, but is readily soluble in solutions of alkalies or alkaline salts.

A large quantity of alginic acid is present in *Laminaria*. From the dried plants cold water removes about 33 per cent. of soluble matter, of which about 20 per cent. consists of mineral salts and the remainder of dextrin, extractive and mannite† (7.47 per cent.), leaving 66 per cent. of matter insoluble in water. This appears to consist largely of alginic acid, since when the fresh frond is treated with carbonate of sodium a thick solution of the alginate is obtained, which, however, requires straining. It is so extremely viscous that a two per cent. solution is quite thick and a five per cent. solution cannot be poured out of the vessel containing it.

This new acid differs from albuminous bodies in not coagulating when heated; from gelose in not gelatinizing when a hot solution is cooled; from gelatin in not being precipitated by tannin; and from starch mucilage in not being colored by iodine. It forms precipitates with the alkaline earths, except magnesia, and, like gelatin, becomes insoluble when treated with

bichromate of potassium and exposed to the light. When dissolved in ammonia or borax it can be combined with a similar solution of shellac.

From the crude solution obtained as above described alginic acid can be precipitated by sulphuric acid in the form of flocks, which, by the addition of a bleaching agent and subsequent washing and subjection to hydraulic pressure, can be obtained in the form of a white, hard substance, which will take a good polish.

The mucilage of *Laminaria* has also been suggested by Mr. J. Wheeler, of Ilfracombe, as a vehicle for emulsifying cod liver oil, which is thus administered together with iodine and bromine in an elegant form. For this purpose he prefers *Laminaria saccharina*. He has published a formula for an infusion and tincture of *Laminaria digitata*, Edm. (*L. flexicaulis*, Le Jol.), and for an emulsion of cod liver oil made with a decoction of *Laminaria saccharina*. The use of the dried and powdered *L. digitata* was also recommended as a resolvent poultice (*Pharm. Journ.* [3], xii., p. 642).

## II.—SEAWEEDS USED AS FOOD.

The species of marine algae employed as food in this country are few in number. *Porphyra lacinata* is collected and sold in Devonshire under the name of "laver," and was obtainable even in London a few years ago. In Edinburgh and Glasgow, *Rhodomenia palmata* is still sold under the name of "Dulse," and the midrib of *Alaria esculenta* is eaten in Ireland under the name of "Murlins." Laver is generally served up hot like a vegetable with meat. Dulse is sometimes boiled in milk, but is often eaten raw, and is considered tonic and stomachic.

In China and Japan enormous quantities of marine algae are utilized as food in soups and made dishes. In fact, seaweed is one of the regular articles of trade mentioned in the Chinese Yellow Books. Many of them are sold cut up in shreds like tobacco, and are not easily recognizable. Those that I have seen in a sufficiently entire state for determination consisted of *Porphyra lacinata*, *Laminaria Japonica*, *Gloecopeltis tenax* and *Ulva lactuca*; but there are numerous other kinds used which have not yet been identified.

*Porphyra lacinata* is regularly cultivated in Japan. For this purpose plantations of branches of coppiced oak (*Quercus serrata*, Thunb.), made into fagots, are inserted at low water into the mud or gravelly shore, in which holes are made by a special instrument. After some weeks a crop is collected from these fagots, which are of course immersed to a considerable depth at each high tide. After being picked over, washed and placed on bamboo frames to dry, the seaweed is compressed and packed in neat bundles. The whole process may be seen illustrated in the Japanese book I have placed upon the table; which also contains representations of other edible Japanese algae as yet not identified. Some of the marine algae used in different parts of the world as food are remarkable for the large quantity of gelatinous matter that they contain. Of these may be mentioned *Eucheuma speciosum*, *Eucheuma spinosum*, *Gelidium spinosum*, *Chondrus crispus* and *Gracilaria lichenoides*. In these algae we find that each has its individual peculiarities. From the following figures it will be seen that the amount of jelly yielded, its melting point, and its keeping quality differ for each species.

	Parts required to gelatinize 1,000 parts of water.	Melting point of jelly.
<i>Gelidium corneum</i> .....	8	90° F.
Gelose.....	4	90° F.
<i>Chondrus crispus</i> .....	30	80° F.
Canagheenin.....	30	70° F.
<i>Eucheuma spinosum</i> .....	60	90° F.
Isinglass.....	32	70° F.
Gelatin.....	32	70° F.

It will be observed that *Chondrus crispus* is the only kind producing a jelly that will dissolve quickly in the mouth; but it has the unfortunate peculiarity of not keeping well. That of *Eucheuma spinosum* keeps remarkably well, and that of *E. speciosum* has been found to keep good, even in London, for six months.

The jelly of *Gelidium spinosum* (a Japanese species closely allied to *G. corneum*) possesses the disadvantage of melting at too high a temperature for use as a dietetic jelly, but it has a peculiarity that has been turned to account in the arts. It is capable of gelatinizing a larger quantity of water than any other known alga. In consequence it has been applied extensively as a medium for dressing silks in France under the name of "thao." It is said to preserve their suppleness at the same time that it gives them greater glossiness and softness to the touch. In the proportion of 1 part to 100 of water it is also used for giving substance to calico, a little glycerin being added if it be desired to render the material still more flexible. In pharmacy the use of Japanese isinglass has been suggested for the preparation of tannin suppositories, since it does not precipitate tannin.

A rather objectionable use of Japanese "isinglass" was detected some years ago in a very singular manner. Some fruit jelly was sold at an unusually low price, and it was noticed that the jelly seemed rather less readily soluble in the mouth than usual. Some difficulty was experienced in detecting the adulterant until a microscopical examination revealed the presence of a beautiful marine diatom, *Arachnoidiscus Ehrenbergii*, which gave the clew to the adulterant, for Japanese marine diatoms do not grow on French fruit trees! The more recent application of Japanese isinglass, under the Malay name agar-agar, as a cultivating medium for various *Schizomycetes*, is now well known.

The peculiar properties of *Gelidium spinosum* were found by Payen to be due to a body which he named gelose, and of which he described the chemical properties (*Compt. Rend.*, October, 1859). It differs from gelatin in being but slightly prone to undergo change, so little, indeed, that seaweed jelly containing it, sweetened and flavored ready for use, has been imported to this country from Singapore, and in this state may be kept for years without deterioration ("Hanbury Science Papers," p. 208, "Pharmacographia," st. ed., p. 680).

*Gracilaria lichenoides* is better known as *Fucus amylaceus*, and Ceylon or Jaffna Moss. It is a native of the Indian Ocean and belongs to a genus, the spe-

\* *Macrocystis pyrifera*, found near Cape Horn, is said to reach a length of 1,500 feet (nearly one-quarter of a mile) and species of Lessoni have quite aorescent stems (see Hook, "Fl. Antarct.," tab. 167-171, pp. 156-160).

\* *Journ. Soc. Arts*, xxxiii., p. 717; *Journ. Soc. Chem. Ind.*, v., p. 218.  
† Mr. Stanford remarks that mannite is not present in the fresh plant, and is probably the result of fermentation.



cies of which deserve further chemical examination. It has been found to contain (by O'Shaughnessy) 54½ per cent. of mucilage, 15 per cent. of starch, 4½ per cent. of a gum, and 7½ per cent. of salts. The plant was also examined by Mr. H. G. Greenish, who found that after exhaustion with cold water it yielded to boiling water a substance which made a firm jelly on cooling, and could then be cut into strips, washed white with water, but which differed in some respects from gelose.

The gelatinous constituent of *Chondrus crispus* has been described under the name of carragheenine, but it is doubtful if the substance examined was in a perfectly pure state, and its chemical relationships are at best ill-defined. The exact nature of the gelatin of the *Eucheuma spinosum* of the Indian Ocean and of *E. speciosum* of W. Australia has not, that I am aware of, been chemically examined.

In conclusion, I would suggest the following as points worthy of investigation in connection with marine algae.

The presence of starch or gelatinous matter in some of the commoner British species, *e. g.*, *Gracilaria confervoides*, *Almelfelia plicata*, etc., the value as manure of different species (*e. g.*, it has been found that *Halophytis pinastroides*, which contains very little iodine, yields about 12 per cent. of potash); the nature of the pungent odors given off by certain algae, *e. g.*, *Monospora pedicellata*, *Griffithsia corallina*, *Spondylothamnion multifidum* and *Dictyopteris polypodioides*; the cause of the rapid decay when removed from sea water of various Desmarestiaceæ, and of the nature of the decomposition which they cause in other algae by contact, and the pungent principle (evident to the taste) of *Laurencia pinnatifida*. From a physiological point of view, the galls formed on *Cystoclonium*, *Chondrus* and *Delesseria*, etc., and attributed by Dr. F. Schmitz to the presence of bacteria; the vital and chemical process by which granular sulphur is deposited in the filaments of *Beggiatoa*, and the influence of currents and temperatures and local peculiarities on the distribution of species. For those inclined to the pursuit of systematic botany, I may mention that the comparison of the British marine flora with that of neighboring countries has led to the discovery on the part of myself and a few ex-workers (more especially Mr. E. A. L. Batters, of Wormley, Mr. W. H. Traill, of Edinburgh, and Mr. R. V. Tellam, of Bodmin) of nearly two hundred species previously unknown as British, and fresh species are still being added by a widening circle of algologists nearly every month. It is almost certain that the exploration of the Orkney, Shetland and Scilly Isles would add a considerable number. I may also point out that the reproductive organs of several species are still unknown. (See *Ann. Bot.*, vol. v., p. 524-526.)

#### SOME ECCENTRICITIES OF PLANT NUTRITION.\*

Professor J. R. GREEN.

PLANTS take in certain inorganic constituents from the soil, and others from the atmosphere, but some do not perform this function of nutrition exactly in the same way as what may be called typical plants. The food of plants, as of animals, can be classified into nitrogenous and carbonaceous groups, and some special features of certain plants are connected with the manner in which they obtain a supply of nitrogenous compounds.

Thus, the sundew, Venus' fly-trap, and the different pitcher plants have their leaves adapted in various peculiar ways to capture insects. These are then apparently digested by means of secretions containing ferments allied to pepsin, and the animal matter is assimilated by the plants, which thus save themselves the necessity of obtaining nitrogenous food material in more orthodox ways.

Another group of plants includes the mistletoe, thesium, orobanche, cuscuta, and rafflesia, which are parasitic in a greater or less degree, obtaining all or some of their food from the host plants upon which they develop or to which they attach themselves. Other plants of similar appearance to these vary in habit, living on decaying organic matter, and being hence known as saprophytes.

A subject of much greater importance, however, is the problem which agriculturists have had to face of late, as to whether plants can to any extent avail themselves of the nitrogen in the air. While nitrogenous manures increase the produce of most agricultural crops, they do not so affect the *Leguminosæ*. Leguminous crops accumulate in themselves more nitrogen than any other crop, and contain a higher percentage of nitrogen in their dry substance. Allowing that by their deep roots they draw a good deal from the sub-soil, this does not explain the accumulation.

Mr. Boussingault, fifty years ago, proved that plants do not, under ordinary conditions, utilize the free nitrogen of the air, and his results were confirmed later by other observers, particularly Lawes and Gilbert. Where, then, do the *Leguminosæ* get this excess of nitrogen? Hellriegel's experiments in 1883 are of great importance in this position of affairs. He commenced then a series of vegetation experiments in pots, in which he grew agricultural plants of various families in washed quartz sand, giving them various nutritive solutions, but no nitrogen in some and known quantities in others. In all except the *Leguminosæ* he found the growth of the seedlings was proportional to the nitrogen in the seed and that supplied in the solution. It was different with the *Leguminosæ*. Taking a series in which no nitrogen was supplied, most of the plants were limited in their growth by the amount of nitrogen in the seed. Some, however, growing apparently under the same conditions, were much more luxuriant, and he found that certain curious nodules were present on the roots of these. Further experiments, conducted later, showed that plants could be infected with these nodules, and that then they grew luxuriantly, though no nitrogen was supplied to them. Ordinary soil in which these plants grow contains the infecting material. Taking similar pots as at first, with no nitrogen in the soil, and watering some of them with an extract of the infected soil, the plants in the latter grew well and developed nodules, while the unwatered

ones did not. Boiling the extract caused it to be useless for infection.

In 1888, 1889, 1890, and 1891, Dr. Gilbert and Sir J. Lawes repeated Hellriegel's experiments on many kinds of leguminous plants and obtained the same results. By the kindness of Dr. Gilbert I can show your representations of plants grown under these conditions. 1. Plant (lupin) grown in quartz sand, kept at boiling water temperature for several days, nothing added; 2 and 3, the same, with extract of garden soil added; 4, plant grown in ordinary sandy soil; 2, 3, and 4 showed great growth, and all had nodules on their roots.

Another series of plants, in this case sainfoin, was so arranged that the plants could be examined as to nodule development during their growth. They were grown in pots in the open air, one set being in sand, watered with an extract of rich soil, and the other in mixed soil and sand. The plants were examined at four periods. 1st, at the end of the first year. 2d, in the second year, when active vegetation was established. 3d, when the period of maximum accumulation was reached. 4th, when the seed was nearly ripe. The experiment showed that infection with soil extract was not so effectual as that coming from the soil itself. In the sand the infection was local and limited, but some of the nodules developed to a great size on the roots of the weak plants. The series showed, as did the other, that the absorption of nitrogen by the *Leguminosæ* is associated with nodule development and varies with it.

*The Fungus of Vicia Tubercles.*—The tubercles on vicia are formed without any order, on the tap root and lateral roots, especially affecting the region where the root hairs are in full vigor. They may be only few or many, crowded or scattered. They soon swell and become lobed in various ways. Their color and texture are like those of the rest of the root. A longi-

or by putting pieces of the tubercle upon them. They will stand drying and remain dormant for months. When a root is infected by either of these methods a long period of incubation is noticeable, sometimes as long as five weeks. When infection takes place it is noticed to begin with the root hair. The hypha running down this hair starts from a bright dot, which is probably one of the bacteroids or germs. From this point the progress of the hypha is seen in the sections already shown. The fungus, according to Marshall Ward, is probably a member of the *Ustilaginæ* or smuts, the behavior of the mycelium agreeing with those of the latter. Professor Ward remarks, "I regard the fungus as one of the *Ustilaginæ*, which has become so closely adapted to its life as a parasite in the roots of the *Leguminosæ* that it has come to stimulate and tax its host in an exquisitely well balanced manner, and has lost its needless true resting spores, because the more numerous and tiny sprouting gemmules are kept in the cells of the tubercle through the dry summer and autumn, and freed during the rotting in the soil in the winter and spring. Their very minuteness and numbers enable these germs to become as ubiquitous as bacteria or ordinary yeast forms, thus explaining the ubiquity of the tubercles."

*Fixation of Nitrogen.*—The theories advanced are as follows: 1st. That the fixation takes place in the soil under the influence of the microbes, and that the higher plant absorbs the resulting combined nitrogen. This is rather opposed by the fact that in the experiments with peas in 1888 there was no gain of nitrogen in the soil, but supported by Schloessing and Laurent, who have shown fixation in bare soil and soils growing various lichens and algae. The matter is therefore unsettled, but the evidence is rather against than for the theory. 2d. That under the conditions of the



AMERICAN HISTORICAL EXPOSITION—MEXICAN SECTION—THE GOD TZONTEMOC.

tudinal section through the tubercle shows its chief mass to consist of rather large polyhedral parenchymatous cells, passing at the apex into smaller closely packed thin-walled cells. In the large-celled axial tissue the parasite is rampant. The hyphae can be traced through the cells of the section, showing a curious trumpet-shaped swelling where they penetrate the cell walls. They are thicker in the epidermis and cortex than further inward. As the tubercle becomes older those in the cortex turn yellowish and gradually decompose, so that no trace of them can be detected in the larger tubercles which have broken through the cortex of the root. In the cells of the young tubercle the finer branches of these hyphae can be seen passing through the walls and across the cavities of the cells. The ultimate branches end blindly in these cavities, and terminate in the tufted bodies which look like haustoria or sucking branches. Numerous very fine protuberances stand off from the rest of the mass. Almost every cell of the actively dividing tissue of the tubercle seems to contain them. Then the protoplasm of these cells becomes frothy, and is found to be gradually charged with bacterium-like corpuscles, increasing in number till the cells are full of them, so full indeed that they eventually obscure the appearance of the hyphae.

These bacterium-like bodies seem to be budded off from the hyphae as shown, and then multiply further by budding in the cells. Hence they are V or Y shaped. The irritation set up by these causes the cells to grow, and so the tubercle hypertrophies. It then passes into a state of rest, and later rots, liberating the bacteroids into the soil, causing subsequent development of new tubercles in roots growing to the soil in which they are. This explains the infection of fresh plants when dressed with an extract of the soil in which the plants have been growing, as already described.

Fresh roots can be infected either by such an extract

or by putting pieces of the tubercle upon them. They will stand drying and remain dormant for months. When a root is infected by either of these methods a long period of incubation is noticeable, sometimes as long as five weeks. When infection takes place it is noticed to begin with the root hair. The hypha running down this hair starts from a bright dot, which is probably one of the bacteroids or germs. From this point the progress of the hypha is seen in the sections already shown. The fungus, according to Marshall Ward, is probably a member of the *Ustilaginæ* or smuts, the behavior of the mycelium agreeing with those of the latter. Professor Ward remarks, "I regard the fungus as one of the *Ustilaginæ*, which has become so closely adapted to its life as a parasite in the roots of the *Leguminosæ* that it has come to stimulate and tax its host in an exquisitely well balanced manner, and has lost its needless true resting spores, because the more numerous and tiny sprouting gemmules are kept in the cells of the tubercle through the dry summer and autumn, and freed during the rotting in the soil in the winter and spring. Their very minuteness and numbers enable these germs to become as ubiquitous as bacteria or ordinary yeast forms, thus explaining the ubiquity of the tubercles."

#### THE AMERICAN EXPOSITION NOW OPEN IN MADRID—THE MEXICAN HALLS.

THE republic of Mexico responded nobly to the call that was sent to all the Americas for exhibits for the important exposition that we are now considering. She sent to us those of her students of the historical sciences, of whom there is a legion in Mexico, who are best fitted for the work. The director of the National Museum, Mr. F. del Paso y Troncoso, was selected to preside over the commission, one of the members of which is a clergyman, Mr. Francisco Plancarte, who is as modest as he is learned, and one of the most active collectors of the antiquities of his country. Naturally, Mr. Plancarte brought his collections to Spain with him, and they constitute the greater part of the Mexican exhibit, being its most important contingent.

Objects of such great value should hold a conspicuous place in the Palace de Recoletos, and in fact Mexico occupies five of the large halls of the edifice. In the extent of her exhibit she is surpassed by none of the other republics, and is equaled only by the United States. In regard to importance, I would not dare to say as much, for, although the North American exhibit is very interesting, it lacks unity in the series, continuity in the objects and system in the arrangement, all of which conditions are fulfilled in the Mexican halls with notable effect.

On account of incomprehensible administrative delays in the American Exposition, no catalogue of the objects contained therein is yet ready, and the great

\* Notes of a recent lecture delivered at an evening meeting of the Pharmaceutical Society, London.