work. With the former, sixty-four eclipses of Jupiter's satellites were observed photometrically, an improvement having been introduced by which the number of settings is largely increased. A single observer, it was found, could make but three settings in a minute, or one in twenty seconds. With an assistant to record, the time is reduced to about nine seconds, while by the employment of two assistants, one of whom reads the photometer circle, while the other records and observes the time by the chronometer, the time is reduced to five seconds. It is probable that, as the observer does not remove his eye from the eyepiece, the accuracy of the observations is increased, and the satellite followed nearer to the point of disappearance. The search for objects having singular spectra, which only admits of being carried on in perfectly clear, moonless nights, had been much interrupted by other current work. The most notable result was the discovery of the peculiar spectrum of the star Lalande 13412, a seventh magnitude; two of the lines appear to be coincident with two in the spectrum of the great comet of 1881, as described by Dr. Konkoly; "accordingly, while other comets have a spectrum identical with that of the stars of Secchi's fourth type, this comet contains a substance as yet unknown, which one star only is as yet known to contain." The star L^2 Puppis was found to have a banded spectrum; its declination is more than forty-four degrees south of the equator, and at the time of Prof. Pickering's examination it was less than two degrees above the horizon. Its variability was pointed out by Dr. Gould (*Uranometria Argentina*, p. 279); he inferred a period of about 135 days; maxima occurred in 1874 on Feb. 8 and June 25; the star is stated to be red in all its stages and remarkably so about minimum, limits of variation 3·6 and 6·3. The position for 1875·0 is in R.A. 7h. 9m. 43s., N.P.D. 134° 26'. 2. The spectra of all the stars north of − 40°, marked as red or coloured in Dr. Gould's work have been examined at Harvard College, no peculiarity of spectrum being detected in the majority. Algol and the star D.M. 81°, 25 were assiduously studied photometrically. The meridian-circle had been in use on 250 days. The work originally proposed for the meridian-photometer, viz., the measuring on three nights the light of each of the naked eye stars visible in the latitude of the Observatory, was essentially completed on August 25, 1881, but it is intended to continue the observations for another year, as the necessary delay in reduction and publication will not be greatly increased thereby. With the view to a more complete comparison of the photometric observations with those made by the naked eye, which the *Uranometria Argentina* affords the means of doing as far as 10° north, all the stars in the *Atlas Cœlestis Novus* of Heis north of the equator and brighter than the sixth magnitude, are being measured by the eye, aided by an opera-glass when necessary. It is intended that each star shall be measured by three observers, who are to compare it with two stars in the vicinity of the pole, one a little brighter, the other a little fainter; the interval between the two stars is supposed to be divided into ten parts, and the brightness of the star under comparison is estimated on terms of this interval. Prof. Pickering mentions that out of about nine thousand comparisons required for this work, nearly a quarter have been already made.

Vol. xiii. of the "Annals" now in process of publication will contain results of work with the large equatorial, under the direction of the late Prof. Winlock, and micrometrical measures up to the present time. These include measurements of double stars, observations of nebulæ and their spectra, satellites of Saturn, Uranus, and Neptune, satellites of Mars during the oppositions of 1877 and 1879, &c. Vol xiv. will contain the measures made with the meridian-photometer.

An important and much-wanted bibliographical work has been undertaken by Mr. Chandler, viz., the collecting of references to observations of stars of known or suspected variability, those of each star being brought together; on the completion of this work it is intended to measure the comparison-stars photometrically, and to effect a reduction on a uniform system of all the observations of the variable-stars of long period.

The staff of computers employed upon the ordinary reductions of observations with all three instruments includes several ladies. We suspect that those who are competent and have had opportunity of judging of the work of the lady-computer (who is to be found elsewhere than at Harvard Observatory) will be of opinion that she is well able to hold her own against even the practised computer of the other sex. If proper opportunities and encouragement were afforded, we might hear of Madame Lepautes in our own day.

BIOLOGICAL NOTES

Delicate Test for Oxygen.—T. W. Engelmann proposes, in the *Botanische Zeitung*, a new test, of an extremely delicate nature, for determining the presence of very minute quantities of oxygen, namely, its power of exciting the motility of bacteria. If any of the smaller species, especially *Bacterium termo*, are brought to rest, and then introduced into a fluid in which there is the minutest trace of free oxygen, they will immediately begin to move about freely; and if the oxygen is gradually introduced, their motion will be set up only in those parts of the drop which the oxygen reaches. In this way Engelmann was able to determine the evolution of oxygen by *Euglena* and by chlorophyll-granules.

Prothallium and Embryo of Azolla.—The development of the prothallium and embryo of Azolla, hitherto but imperfectly known, have been followed out by Prof. Berggren (*Lunds Univ. Arsskrift*) in the case of *A. caroliniana*, and found closely to follow the phenomena in Salvinia. The endospore splits, on germination, along its three edges; and the prothallium, on escaping, has the form of a slightly convex disk, consisting in the middle of several layers of cells, at the margin of only one, and separated below by a thin hyaline membrane from the large protoplasmic spore-cavity. Shortly afterwards an archegonium is formed, consisting of four cells inclosing the oospore, and of four neck-cells. When quite mature, the part of the prothallium which projects outside the spore is nearly hemispherical, and three obscure wings are produced by three longitudinal furrows. After fertilisation the oospore is divided by the first oblique division-wall into a smaller upper cell facing the neck of the archegonium, and a somewhat larger lower cell filled with coarse-grained protoplasm. By successive walls vertical to one another and to the first division-wall, and parallel to its longitudinal axis, the embryo is then divided into octants. In each octant a wall next appears parallel to the first division-wall, and the entire embryo then consists of sixteen cells arranged in four parallel rows. After fertilisation the embryo breaks through the prothallium near the archegonium, and the prothallium then surrounds the foot of the embryo like a cup, carrying the withered archegonium on its dorsal side behind the scutellum. To prepare for fertilisation the massulæ of the macrosporangia, with their anchor-shaped glochidia, fix themselves in large numbers to the epispore of the macrospores which are floating on the surface of the water. The central fibrous portion of the floating apparatus is perforated by a narrow canal, through which the antherozoids probably reach the archegonium. By their subsequent growth the prothallium, and later also the embryo, force themselves into this canal and increase its size. By this means the three floating bodies are displaced from their original position, and finally stand at a right angle from the macrospore. The indusium which covers the floating apparatus in the form of a brown cap is at the same time pushed upwards, and finally forced against the embryo. The hood like fibrous layer which is closely applied to the floating apparatus is turned over, and surrounds the foot of the embryo like a collar. Shortly afterwards the embryo detaches itself from the macrospore, the margins of the scutellum become broader, and then lie on the surface of the water in the form of cups or scales.

Phyllomic Nectar Glands in Poplars.—In a very interesting memoir on this subject, Mr. Wm. Trelease calls attention to the fact that these glands have been very generally overlooked, and that they have been considered of little value by the systematic botanist. He accounts for this by their being occasionally suppressed, and of their limitation to the earlier-formed leaves. Still most of the American botanists refer to them, and Michaux figures them in his monograph of the genus. In May, 1880, Mr. Trelease's attention was drawn to examine the leaves of a small aspen by the action of some bees. The tree was covered with its newly expanded foliage, and the bees were flying from leaf to leaf; they were seen to be collecting nectar which was poured out from a double gland at the base of each leaf. These glands were placed on the upper surface of the petiole at its union with the blade. On section and microscopical examination they showed the usual structure. They were found not to occur on all leaves, but as a rule only on the first half dozen or less which appear on each branch in the early spring; and later on in the season, when these have fallen off, one may sometimes examine all the leaves without detecting a single glanduliferous one, and this on a species which produced them in abundance earlier in the year. From an examination of the American species it would seem that the greater number possess two or more distinct or confluent glands situated where the blade and petiole join, and in these few species where none were discovered, it is quite possible that a closer examination in the spring time may show that they exist. Thus on *P. tremula*, the weeping variety, a careful examination in early May failed to show a single gland; but a week or two later, after several days' rain, the young branches grew very rapidly for a short time, unfolding many new leaves, and the first three or four of these on each branch bore large and active glands. The nectar is greedily gathered by insects, chiefly Hymenoptera and Diptera. The most numerous were the ants, who, as is usual in such cases, would fight rather than give up a good position near a nectar-secreting gland. The author regards these glands as protective. (The *Botanical Gazette*, Crawfordsville. November, 1881.)

FAUNA AND FLORA OF THE WHITE SEA.—At a meeting of the Natural History Society of St. Petersburg (April 23, 1881) Dr. Chr. Gobi gave a sketch of Prof. Cienkowski's report on his expedition to the White Sea, which appears in the *Proceedings* of the Society, in the Russian tongue, and is illustrated with three coloured plates. The bathymetrical distribution of the algæ seems to show a connection between the marine flora of the Solowezk Islands and that of the Scandinavian and Arctic coasts. In the White Sea there is a distinct though fully developed littoral zone, chiefly marked by the presence of Fucoids, with a few Chlorophyceæ and Florideæ. As new to the White Sea flora may be mentioned *Bulbocaulon piliferum*, Pringsh., and *Gloeothamnin palmelloides*, Cnk. The sea was by no means rich in microscopical organisms, but still a few new and interesting forms were found, and are described and figured, such as *Wagneria mereschkowskii*, a new genus and species of Protista, somewhat between Haeckeliana and Clathrulina; several new Flagellata, *Multicilia marina*, new genus and species having a protoplasmic body of protean form without nucleus or contractile vesicle, but having several cilia; *Exuviaella marina* also new, with an ovum-like body, flattened horizontally at the top, with two cilia and one or two round marks (*Schildchen*); *Daphnidium boreale* n.g. and sp., with a spherical body, prolonged into a curved beak, giving origin to one long cilium. In the dead cells of Pylaicella and other Phæospores there was found a colourless form of a Labyrinthula which had previously been found thriving in the cells of a Lemna; Finally, a new Moner, *Gobiella borealis*, which shows a great resemblance to Vampyrella, but the green contents seem never to extend into the pseudopodia (*Botanische Zeitung*, January 13, 1882.)

THE GROWTH OF PALMS.—In a paper (Russian) recently read before the Botanical Section of the St. Petersburg Natural History Society, Mr. K. Friderich describes in detail the anatomical structures to be met with in the ærial roots of *Acanthorhiza aculeata*, these roots presenting a remarkable example of roots being metamorphosed into spines. Supplementing this, E. Regel made the following remarks:—Palm trees, grown from seed, thicken their stems for a succession of years, like bulbs, only at the base. Many palms continue this primary growth (*i.e.* the growth they first started with) for fifty to sixty years before they form their trunk. During this time new roots are always being developed at the base of the stem, in whorls, and these always above the old roots. This even takes place in old specimens, especially in those planted in the open ground which have already formed a trunk. In such cases the cortex layer, where the roots break through, is sprung off. In conservatories, under the influence of the damp air, this root-formation, on which indeed the further normal growth of the palm depends, takes place without any special assistance. When the palm is grown in a sitting-room, one must surround the base of the trunk with moss, which is to be kept damp, in order to favour the development of the roots. When the base of the palm-trunk has almost reached its normal thickness, then begins the upward development of the trunk which takes place more slowly in those species whose leaves grow close together than in those whose leaves are further apart. In specimens of many species of Cocos and Syagrus, whose leaves are particularly far apart, the stems grow so quickly when planted in the open ground that they increase by five to six feet in height per annum. The stem of those palms which develop a terminal inflorescence have ended their apical growth by doing so, and wither gradually. In addition to this (withering) in the case *e.g.* of *Arenga saccharifera*, new inflorescences are developed from the original axils (*Blattachseln*) from above downwards, so that one sees at last the already leafless trunk still developing inflorescences in the direction towards the base of the trunk. Almost all palms with this latter kind of growth develop off-shoots in their youth at the base of their trunks which shoot up again into trunks after the death of the primary trunk, if they are not taken off before. As to the structure of the palm-trunks out of unconnected wood-bundles, the assertion has been made that the palm-stem does not grow thicker in the course of time, and that this is the explanation of the columnar almost evenly thick trunk. But careful measurements that were made for years have led Regel to the conclusion that a thickening of the trunk actually takes place, which probably amounts to an increase of about a third over the original circumference of the trunk.

ACTION OF GASES AND LIQUIDS ON THE VITALITY OF SEEDS

MY experiments extend over a period of nearly three years. They were made principally with the seeds of *Medicago sativa*, these seeds resisting in a remarkable manner the action of chemical agents. The observations were very numerous and frequent; but in the present abstract those results alone are given in which the action of the gases and liquids lasted longest.

I. *Action of Gases*. The chief difficulty in these experiments is an easy method of keeping many samples of seeds in the several gases the action of which is to be tested. I devised the following simple plan:—A thick glass tubing was heated in the middle and blown into a bulb of sufficient size to contain a certain quantity of seeds and a relatively large volume of gas; after introducing the seeds into the bulb, the two extremities of the tube were heated, and drawn out, so as to form, on each side of the bulb, a nearly capillary neck; one end was left free, while the other was connected, by means of an india-rubber tube, with the generator of the gas that was to fill the bulb. The air was completely displaced in the latter by allowing the gas to pass for some time through the apparatus; after which, without previously interrupting the passage of the gas, the bulb was sealed by fusing at the blowpipe the two capillary necks.

I prepared a large number of bulbs with seeds and with different gases; the greater number of bulbs contained air-dry seeds, while some contained seeds that had been moistened and swollen with water. On opening the bulbs the seeds were sown, and their vitality measured by the percentage of those that germinated on moist quartz sand.

Experiments with air-dry seeds of *Medicago sativa* in dry gases:—

Gas.	Number of days in which the seeds remained in the gas.	Percentage of seeds that retained the germinating power.
Air (not in bulbs)	More than two years	83
Air (not in bulbs—another sample)	More than three years	50
Nitrogen	789	93
Oxygen	758	59
Hydrogen	1005	63
Carbon monoxide	803	93
Carbon dioxide	1035	24
,, ,,	408	73
Marsh-gas	550	58
Nitrogen protoxide	214	70
,, dioxide	776	48
Ammonia	832	0·5
,,	398	1·2
Sulphur dioxide	838	4·5
,, ,,	405	10·6
Sulphuretted hydrogen	976	58
Arseniuretted ,,	802	87

Chlorine and hydrochloric acid gas rapidly disorganise the seeds, and destroy their vitality. It is remarkable how air-dry seeds can resist for so long a time the action of nitric oxide, of sulphuretted hydrogen, and of sulphur dioxide, and how some can even survive the action of dry ammonia-gas. The percentages that represent the vitality of the seeds that have been under the action of the different gases cannot be compared, for the experiments were not all begun at the same time, nor extended over the same period, nor was the same sample of seeds used in all the experiments.

Whenever seeds moistened with water are kept in the above-named gases, their germinating power is very rapidly destroyed.