effected by quinine, namely by irritation of the inhibitory centres within the head. As the whole subject of the action of quinine on the functions of the spinal cord is at present unsettled, too much stress must not be laid on this action of picrorocellin.

"3. When an ethereal solution of picrorocellin is added to an alkaline solution of sulphate of indigo, with blood and ozonized turpentine, in the manner recommended by Binz and employed by him in his researches on quinine, the production of isatin is not in the least retarded, whilst quinine retards it very greatly. Picrorocellin thus differs from quinine in not arresting oxidation, a most remarkable characteristic of the latter.

"I regret that I have been unable to test it chemically in a case of ague, as the patients I see come and go so irregularly that little or no information would be gained by administering it to them. The sparing solubility of picrorocellin is a serious objection to its use in medicine, even supposing it to have the same properties as quinine; and as it does not possess one of the most important of these properties, there is no probability that it can ever be used as a substitute for quinine."

IV. "On the Organization of the Fossil Plants of the Coal-measures.—Part VIII. Ferns (continued) and Gymnospermous Stems and Seeds." By Prof. W. C. Williamson, F.R.S., Professor of Natural History, Owens College, Manchester. Received May 2, 1876.

(Abstract.)

Ferns (continued).—Under the name of *Rachiopteris corrugata* a small *stem* of a fern is described, the outer surface of the bark of which is corrugated with innumerable transverse ridges and furrows. It has a vascular axis in its centre composed of several clusters of barred vessels filled with tylose, which clusters are blended together at their periphery, forming a cylinder; its centre is occupied by a cellular medulla, mingled with small vessels, which sends off radiating prolongations into the vascular cylinder, partially separating the bundles of the latter. Besides this cylinder is a second, smaller, isolated oval bundle, which soon escapes from the stem as the centre of a petiole; but before it does so a new one is detached from the opposite side of the central cylinder, which, in turn, imitates its predecessor. Besides these primary bundles, numerous secondary smaller ones are detached, sometimes from the central cylinder, sometimes from near the bases of the petiolar bundles; these probably supplied rootlets. The author points out that this fern, along with the *Anachoropteris Decaisnii* and the *Zygopteris Brongniarti* of M. Renault, constitute a group of ferns having a very distinct type of stem-structure different from what is found in the rhizomes of recent ferns, and which approximates to the lower Lepidodendroid stems as represented by *L. Harcourtii*.

Two kinds of sporangia of ferns are described. One of these has a perfectly vertical annulus, such as is common amongst the Polypodiaceæ. A second has a large, horizontal, subterminal annulus, approaching closely to the form seen in the recent Gleicheniaceæ and Schizæaceæ, especially resembling the latter type. Both these sporangia contained spores; in the first mentioned these were numerous and small; in the latter they are fewer in number, but of larger dimensions. The Gymnospermous stems of the Coal-measures are next examined. The small branch of *Dadoxylon* from Coalbrook Dale, described by the author many years ago in the Transactions of the Manchester Literary and Philosophical Society, is first restudied. Its pith is Sternbergian; its ligneous zone has a medullary sheath of barred vessels, whilst its woody zone is composed of wedges of discigerous fibres arranged exogenously and separated by mural medullary rays. The disks of the fibres lack the central perforations seen in those of recent conifers. The bark is exactly like that of a young shoot of a *Taxus*, consisting of an inner liber, the tissues of which are arranged compactly in lines running parallel to each other and to the surface of the wood; whilst the outer layer consists of large parenchymatous cells, which in the living plant doubtless contained chlorophyl. It appears to correspond to the phelloderm, no true phellein layer being present. Other branches, especially from the Ganister beds near Oldham and Halifax, are also described. Many of these are of much larger size, but all have Sternbergian piths, with the exception of one in which the parenchymatous medulla is not disciform, but like that of living conifers. The chief peculiarity in the majority of these latter fossil branches and twigs is that they give off small twin vascular bundles from the innermost surface of the ligneous cylinder. These pass outwards side by side through the smaller branches, but can only be traced in the innermost portions of the larger ones; hence it is probable that they either supplied leaves arranged in pairs (not distichously), or that they went to a binerved leaf, the latter being most likely to have been their real destination. The bark is rarely preserved in these larger specimens from the Ganister ironstones, in which they are associated with myriads of *Goniatites*, an indication that they have been drifted from a distance and long exposed to water—conditions very different from those characterizing the origin of the coal in which most of the Oldham plants have been obtained.

The author discusses the claim set up by M. Brongniart and Professor Newberry for the admission of *Sigillaria* amongst the Gymnospermous exogens, as well as Dr. Dawson's opinion that some of them, at least, have decided Gymnospermous affinities: but still believes that this determination is not justified by the facts. All the additional observations which he has made since the publication of his second and third memoirs confirm his original conclusion that no true distinction can be demonstrated to exist between the *Sigillariæ* and the higher forms of *Lepidodendra*, in

which the vascular cylinder assumes the exogenous Diploxyloid organization. All the plants of which stems and branches have been found displaying an organization corresponding to that of living Gymnosperms are still comprehended within Endlicher's genus *Dadoxylon*. On the other hand, recognizing in *Trigonocarpum* all the external features of a true seed, the author cannot admit the probability of its having belonged to the Lycopodiaceous *Sigillariæ*.

Gymnospermous Seeds.—Attention is next directed to the curious seeds discovered in America, and published in Professor Newberry's 'Geological Survey of Ohio.' These, however, merely display external forms. Still more remarkable is the collection of such seeds found by M. Grand-Eury at St. Etienne in France. These exhibit their internal structure in a wonderful manner, as is shown by M. Brongniart's brief memoir published in the 'Annales des Sciences Naturelles.' M. Brongniart called attention, in that memoir, to a remarkable organization of the micropylar extremity of many of these seeds, where a peculiar cavity existed, between the micropyle and the apex of the nucleus, into which the pollen-grains obtained entrance through the micropyle, and were thus brought into contact with the nucleus. In a more recent memoir on the fertilization of the ovules of some species of recent Cycads (*Ceratozamiæ*), M. Brongniart showed that a mammillar prolongation of the apex of the nucleus projected into the micropyle, which it filled; but that during fertilization the cells of this prolongation became disorganized, and a cavity was produced into which the pollen-grains found their way, the apex of the nucleus below this cavity becoming covered over by true perispermic membrane. These structural peculiarities so far accord with what he observed in M. Grand-Eury's seeds, as to lead him to surmise that the latter had Cycadean rather than Coniferous affinities.

The author has found a number of remarkable seeds of a similar type to those from St. Etienne in the Oldham nodules, and he has been indebted to his friends Mr. Butterworth and Mr. Nield, of Oldham, and to Captain Aitken, of Bacup, for a few others.

The first of these is a very small, nearly spherical seed, which the author names *Lagenostoma ovoides*, about ·16 of an inch in length and ·1 in breadth. It has a solid testa, within which can be recognized two distinct membranes—an inner or "perispermic" one, which has enclosed the endosperm, and an outer or "nucular" one, which has been in close contact with the perispermic one throughout the greater part of the seed, but which splits up at its apex into two portions, the inner one of which forms a remarkable flask-shaped cavity, which the author designates the lagenostome. Its base has rested upon the apex of the perisperm, and its upper extremity has been continuous with the micropyle. Within this lagenostome is a little delicate parenchyma, which has shrunk up towards the centre of the cavity, leaving a surrounding space in which, in some examples, the author has found the objects regarded by

M. Brongniart as pollen-grains—an opinion in which the author concurs. External to the lagenostome the second or outer division of the nucular membrane forms a remarkable "canopy," which hangs down from the micropyle, enclosing the lagenostome within ten sharply defined and regular crescentic folds, the concavities of which are directed outwards. The walls of this lagenostome and of the "canopy" correspond with the nucular membrane in consisting of flattened prosenchymatous cells. The perispermic membrane, on the other hand, looks structureless, save that it appears to have had imbedded in it an innumerable multitude of minute crystals, like those observed by Dr. Hooker on the spicular cells of *Welwitschia*.

A second species the author designates *Lagenostoma physoides*. In this the apex of the endospermic sac contracts into a mammilliform prolongation, overlapped by the base of the lagenostome, which overhangs it as a bladder half-full of water might be made to overhang the neck of a soda-water bottle upon which it rested. This species has other distinctive structural peculiarities.

For a second genus of new seeds the author proposes the name of *Conostoma*. *C. oblonga* from Oldham is about ·18 of an inch in length. Here, again, we have an endosperm enclosed in a perispermic membrane, and this in turn is encased within a nucular one, the whole being invested by a dense testa. The lagenostome is again formed out of divisions of the apical part of the nucular membrane; but it assumes a funnel-shape at its base, whilst its upper extremity is continuous with the micropyle. A second species, named *C. ovalis*, is from the Burntisland deposit, and is more ovate than *C. oblonga*. In it the lagenostome assumes a remarkably funnel-shaped contour. The same deposit has furnished a third species, *C. intermedia*. To another remarkable seed from Oldham the author gives the name of *Malacotesta oblonga*, of which the maximum length, exclusive of its funiculus, has been about ·25. Its exotesta has been soft and parenchymatous, with a prosenchymatous inner (nucular?) membrane. The micropyle has been remarkably wide with incurved margins at the exostome, and enclosing a mass of delicate parenchyma through which a canal passed.

The author has obtained a fine series both of longitudinal and transverse sections of *Trigonocarpum olivæforme*, the seed long ago made the subject of a valuable memoir by Dr. Hooker and Mr. Binney. So far as the longitudinal sections are concerned, the results obtained correspond closely with those already arrived at by these two authors, except that a modified form of lagenostome is shown to have existed at the apex of the nucleus. The transverse sections show that the two layers of the testa, an outer soft parenchymatous exotesta and an inner sclerotesta, present some striking features. The exterior of the latter has exhibited three principal, acute, prominent, longitudinal ridges, between each two of which are three intermediate ones, the centre of these three being

rounded, and the two flanking ones acute. The internal cavity of the endotesta is prolonged like a narrow fissure only into each of the three principal ridges. The ordinary sandstone specimens of *Trigonocarpum olivæforme* commonly seen in cabinets do *not* represent, as has hitherto been supposed, the *exterior* of these seeds, but are casts of the *interior* of the sclerenchymatous endotesta, the three thin, longitudinal, wing-like appendages being merely casts of the three slit-like extensions of that interior just referred to. These slits extend upwards into the prolonged micropyle, the interior of which displays a triangular section, each of the sides of which is convex, the convexity projecting inwards.

The nomenclature of this type of seed is in great confusion, owing to specific differences being based on mere differences of size, many of which are probably nothing more than varieties due to age and development.

Casts of seeds with six longitudinal wings are described, corresponding with Brongniart's genus *Hexapterospermum*. They are more oblong than *Trigonocarpum olivæforme*, but apparently identical with the *T. Nöggerathi* of the 'Fossil Flora.' The author doubts the wisdom of Brongniart's establishment of a separate genus for these seeds.

Several species of the important genus *Cardiocarpum* have been obtained displaying the internal organization of these remarkable seeds. They all agree in possessing a central endosperm which is remarkable for the very large size of its conspicuous parenchymatous cells. This is invested by a perispermic membrane, the whole being enclosed within a testa composed of two very distinct and separate layers. A thin inner one, which may be identical with the nucular membrane of other seeds, is entirely composed of delicate prosenchymatous cells, and is prolonged into an elongated micropyle, into which the endosperm is not prolonged. Externally to this is an exotesta composed of a denser parenchyma. In some species this latter tissue is uniform throughout, in others it is separable into a dense endotesta and a more lax parenchymatous exotesta. The first species described is apparently identical with the *C. anomalum* of Carruthers, and has a trigonous endosperm invested by the two layers of testa(?), both of which are prolonged into a slender tapering beak, half the entire length of the seed, and which contains the elongated micropyle. Another species, designated *C. compressum*, has its apparent testa composed (as just described) of two continuous layers. In it the micropyle is comparatively short, and its apical extremity is patulous or trumpet-shaped. To a third very beautiful little cordato-lanceolate species with a peduncle or funiculus equal in length to the seed, the author gives the name of *Cardiocarpum Butterworthii*, after its discoverer. These seeds exhibit no specialized organ corresponding to the lagenostome of *Lagenostoma* and other seeds described. The pollen has passed down the long narrow micropyle into the triangular space at its inner extremity, where it came into direct contact with the endospermic membrane. It thus appears that the seeds known by the name of *Cardiocarpum* have a very

simple organization, approximating somewhat closely to that of the ovules of *Juniperus*, *Callitris*, and *Welwitschia*.

Some small seeds, which appear to be identical with the *Cardiocarpum tenellum* of Dawson, found in great numbers on slabs of shale by Mr. John Smith, of Kilwinning, in Ayrshire, are described. They were found in the upper Coal-measures near Stonehouse in Lanarkshire.

The last form noticed is a very curious winged seed from the uppermost Coal-measures of Ardwick, at Manchester, and which appears to have been a double seed, resembling in general form the samara of an ash. It belongs to Brongniart's genus *Polypterospermum*.

The fact that large numbers of seeds of unmistakable flowering plants exhibit very close resemblance to the *ovules* of Gymnospermous seeds is a very important one. Prof. Newberry has obtained such seeds in America; M. Grand-Eury has done the same thing in France; and it now appears that, though attention has but very recently been drawn to the existence of the smaller forms now described in the British Coal-measures, the discovery of a considerable variety has already rewarded the researches of the author and his auxiliary friends. There is no doubt that further research will materially increase that number. The question naturally arises, where are the Gymnospermous plants to which these seeds belonged? Finding the latter in the thin "upper-foot" coal-seam suggests that other remains of their parent stems should also be found there. The Dadoxylons are the only ones which exhibit any probability of such relationship. But these have chiefly been found in the marine Ganister bed, which underlies the upper-foot coal from which the majority of the seeds have been derived, indicating that the Dadoxylons grew apart from the Calamites and Lycopods abounding in the coal side by side with the seeds. Time alone can solve these problems, as well as others relating to the true homologies of some of the structures contained within these seeds.

V. "On Stratified Discharges.—II. Observations with a Revolving Mirror." By William Spottiswoode, M.A., Treas. R.S. Received May 3, 1876.

In a paper published in Poggendorff's 'Annalen,' Jubelband, p. 32, A. Wüllner has described a series of observations made, by means of a revolving mirror, upon the discharge of a large induction-coil through tubes containing ordinary atmospheric air at various degrees of pressure. When, as is generally the case with an induction-spark, the discharge occupies an appreciable interval of time, the image in the mirror appears spread out to a breadth proportional to the duration and to the velocity of rotation. The successive phases of the phenomena then appear, as usual, arranged in successive positions, and may be studied separately, even when too rapid to be disentangled by the unassisted eye.