D'après cela il est toujours possible de déterminer le nombre et l'espèce des points multiples de la courbe inverse et aussi l'ordre de la courbe (a_2) ou la classe de la courbe (A_2).

Supposons que la courbe inverse (a_2) d'une courbe L par rapport à une autre courbe D comme directrice soit construite; la courbe inverse (α_2) de la courbe (a_2) par rapport à L se décompose en la courbe D et, une autre courbe, dont l'ordre est déterminé, ou réciproquement la courbe (a_2) a pour courbe inverse par rapport à la courbe D directrice une courbe qui se décompose en la courbe L et en une autre courbe, dont l'ordre est connu.

4. Le point a de la courbe proposée L a une tangente A' a cette courbe; cette tangente coupe la conique fondamentale C en deux points t, u. La polaire A du point a coupe la courbe directrice D en n points. La tangente B' en un de ces points b rencontre C en deux points x, y, et la droite polaire B du point b coupe la droite A en un point a_2 qui est un point de la courbe inverse (a_2). Considérons le point de contact a comme deux points infiniment voisins; la même chose a lieu au point b. A ces points infiniment voisins correspondent aussi tels points dans la courbe inverse.

Ainsi la courbe inverse de l'une des droites A', B' par rapport à l'autre, qui est une conique E, a avec la courbe (a_2) deux points infiniment voisins communs. Ces deux courbes ont par conséquent une tangente commune en ce point a_2. La conique E est plus que déterminée par les points t, u, x, y et par a_2. Quand les points t, u ou x, y sont imaginaires, ils sont remplacés par la tangente et son point de contact, ou respectivement par deux tangentes et leurs points de contact et par le point a_2.

Le point a_2 sur la courbe inverse (α_2) étant donné nous construisons sa droite polaire par rapport à la conique fondamentale C et cherchons le point a sur L et b sur D qui correspondent au point a_2. La conique E est alors déterminée et par conséquent aussi la tangente en a_2.

II. "On the Organisation of the Fossil Plants of the Coal-measures. Part XII." By Professor W. C. WILLIAMSON, F.R.S. Received May 4, 1882.

(Abstract.)

At the recent meeting of the British Association at York, Messrs. Cash and Hick read a memoir, since published in Part IV of vol. vii of the "Proceedings of the Yorkshire Geological and Polytechnic Society," in which they described a stem from the Halifax Carboniferous deposits characterised by a form of bark hitherto unobserved in those rocks. To this plant they gave the name of Myriophylloides William-

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sonis. It was characterised by having a large cellular medulla, surrounded by a thin vascular zone composed of short radiating lamellæ. This, in turn, was invested by a cylinder of cortical parenchyma from which radiated a number of thin cellular laminæ, like the spokes of a wheel, separating large lacunæ. Each lamina generally consisted of a single series of cells. At their peripheral end, these laminæ merged in a thick, large-celled, cortical parenchyma. The generic name, Myriophylloides, was given to the plant because of the resemblance between sections of its cortical tissues and those of the recent Myriophyllum. Two reasons induced the author to object to this name ("Nature," December 8, 1881, p. 124), and to propose the substitution of that of Helophyton. Such substitution, however, was rendered unnecessary by the discovery, by Mr. Spencer, of Halifax, of some additional specimens which indicate that the supposed new plant was merely the corticated state of the Astromyelon, described by the author in his Memoir, Part IX.* These specimens showed that the plant was more complex than had been supposed, different ramifications of it having individual peculiarities.

In some of the new specimens the vasculo-medullary axes present no differences from those of the Astromyelon already described. The radiating lines of cells separating the lacunæ prove to be transverse sections of elongated vertical laminæ composed of cells with a mural arrangement, and which separate large vertical lacunæ of varying lengths; a type of cortical tissue clearly indicating a plant of aquatic habits. So far as this bark is concerned, all the ramifications of the plant display similar features, but several of the specimens exhibit important variations in the structure of the vasculo-medullary axis. In them the central cellular medulla is replaced by an axial vascular bundle, which has little, or in some examples apparently no, cellular element intermingled with the vascular portions. In some examples this axial bundle is invested by the thick exogenous zone seen in Astromyelon. In others that zone is wholly wanting. Yet there appears to be no reason for doubting that these are but varied states of the same plant which branched freely, the differentiated branches having, doubtless, some morphological significances, as yet incapable of being explained. That the plant was a Phanerogam allied to Myriophyllum is most improbable. It has several features of resemblance to the Cryptogamic Marsileæ, from which it does not differ more widely than the fossil Lepidodendra do from the living Lycopodiaceæ.

The author describes a new specimen of Psaronius Renaultii, found by Mr. Wild, of Ashton-under-Lyne. Those previously described consisted almost entirely of fragments of the bark and its ærial rootlets. The present specimen contains a perfect C-shaped fibro-vascular bundle and a portion of a second one, resembling some of those

* "Phil. Trans.," 1878.

described by Corda, and which leave no room for doubting that our British Coal-measures contain at least one arborescent fern, equal in magnitude to those obtained from the deposits at Autun.

In his Memoir, Parts IX and X, the author described under the provisional generic name of Zygosporites, some small spherical bodies with furcate peripheral projections. Similar bodies had been met with in France, and were regarded by some of the French palæontologists as true Carboniferous representatives of the Desmidiaceæ. The author was unable to accept this conclusion, deeming it much more probable that they would prove to be spores of a different kind. Mr. Spencer exhibited the specimen now described at the York meeting. It is a true sporangium, containing a cluster of these Zygosporites. Though they undoubtedly bear a close superficial resemblance to the zygospores of the Desmidiæ, their enclosure within a common sporangium demonstrates them to be something very different. There is now no doubt but that they are the spores of the strobilus described by the author in his Memoir, Part V, under the name of Volkmannia Dawsoni. Hence the genus Zygosporites may be cancelled.

Another interesting specimen found by Mr. Wild is a young Calamite, with a more curiously differentiated bark than any that has hitherto been discovered. The structure of the vascular cylinder and of the innermost layer of the bark differs in no essential respect from those previously described; but the outermost portion displays an entirely new feature. It consists of a narrow zone of small longitudinal prosenchymatous bundles, each one having a triangular section, the apex of each section being directed inwards, whilst their contiguous bases are in contact with what appears to be a thin epidermal layer. As in every previously discovered Calamite in which the cortex is preserved, the peripheral surface of this specimen is perfectly smooth or "entire." It displays no trace of the longitudinal ridges and furrows seen in nearly all the traditional representations of Calamites figured in our text-books.

It has long been seen that the medullary cells of the Lepidodendra, as well as the vessels of their non-exogenous medullary sheaths, steadily increased in number as these two organs increased in size correlatively with the corresponding general growth of the plants. But the way in which that increase was brought about has continued to be a mystery. The author now describes a Lepidodendron of the type of L. Harcourtii in which nearly every medullary cell is subdivided into two or more younger cells, showing that, when originally entombed, the pith was an extremely active form of meristem, though the branch itself had attained to a diameter of at least two inches. The numerous small young cells are of irregular form. Their development by further growth into a *regular* parenchyma would inevitably necessitate a corresponding increase in the diameter of the branch as a whole;

and it must have been from these newly-formed cells that the medullary cylinder obtained the elements out of which to construct the additional vessels, the increase of which has been shown to be the invariable accompaniment of the growth of the branch. As might be expected, the growth of the vascular cylinder or medullary sheath could only have been a centripetal one.

A new form of Halonia from Arran is described. Instead of its central portion consisting, as in previously described examples, of the usual Lepidodendroid medulla, surrounded by a vascular cylinder, it consists of a solid axis of vessels, resembling in this respect all the very young Lepidodendroid twigs previously described from the same locality. Many recently obtained specimens of Lepidodendroid branches sustain the author's previous observations that all examples from Arran having less than a certain diameter have the solid axial bundle; whilst all above that diameter have a cylindrical vascular bundle enclosing a cellular medulla. The first type commences with the smallest twigs, and is found increasing gradually up to the diameter referred to. The second type begins where the other ends, and increases in diameter until attaining the dimensions of the largest stems, in none of which does the solid bundle reappear. Halonial branches have not hitherto been described attached to the branches of any true Lepidodendron, though, in 1871 (Memoir, Part II), the author gave reasons, based upon organisation, for insisting that Halonia was a fruit-bearing branch of a Lepidodendroid tree. This conclusion was sustained by Mr. Carruthers in 1873 in his description of a branch belonging to a Lepidophloios. The author now figures a magnificent example, from the museum of the Leeds Philosophical Society, of a dichotomous branch of a true Lepidodendron of the type of L. elegans and L. Selaginoides. In this specimen every one of the several terminal branches bears the characteristic Halonial tubercles. The leaf-scars of these latter branches have the rhomboid form once deemed characteristic of the genus Bergeria, whilst those of the lower part of the specimen are elongated as in L. elegans, &c. These differences are not due to their appearance in separate cortical layers of the branch, but to the more rapid growth in length of its lower part compared with its transverse growth.

The author throws some additional light upon the structure of Sporocarpum ornatum described in Memoir, Part X, as also upon the nature of the development of the double leaf-bundles seen in transverse sections of the British Dadoxylons, described in Memoir IX. After a prolonged but vain search for a similar structure amongst the twigs of the recent Conifers, the author has at length found them in the young twigs of the Salisburia Adiantifolia. Sections of these twigs made immediately below their terminal buds exhibit this geminal arrangement in the most exact manner. Pairs of foliar bundles are

given off from the thin, exogenous, Xylem zone which encloses the medulla, whilst at the same points the continuity of the Xylem ring is interrupted, as was also the case with the Dadoxylons, by an extension of the medullary cells into the primitive cortex. Sections of the petiolar bases of the leaf-scales of the bud show that these bundles enter each petiole in parallel pairs, subsequently subdividing and ramifying in the Adiantiform leaf. This curious resemblance between Salisburia and Dadoxylon, accompanied as it is by other resemblances in the structure of the wood, bark, and medulla, suggest the probability that our British Dadoxylon was a Carboniferous plant of Salisburian type, of which Trigonocarpum may well have been the fruit. If so, the further possibility suggests itself that this plant may have been the ancestral form whence sprang the Baieras of the Oolites, and, through them, the true Salisburias of Cretaceous and of recent times.

The Society adjourned over Ascension Day to Thursday, May 25.

May 25, 1882.

THE PRESIDENT in the Chair.

The Presents received were laid on the table and thanks ordered for them.

Mr. Bindon Blood Stoney was admitted into the Society.

The following Papers were read :—

I. "On certain Geometrical Theorems. No. 2." By W. H. L. RUSSELL, F.R.S. Received May 10, 1882.

(4.) The following is a short method of determining the conic of 5 pointic-contact with a given curve. Write the conic

$$\alpha y+\beta xy=y^2+\mu x^2+\nu x+\rho \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1),$$

then differentiating four times and writing D for $\frac{d}{dx}$, we have, remembering that the four first differential coefficients of the two curves coincide,—

$$\alpha Dy+\beta D(xy)=Dy^2+2\mu x+\nu \quad . \quad . \quad . \quad . \quad . \quad . \quad (2),$$

$$\alpha D^2y+\beta D^2(xy)=D^2y^2+2\mu \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3),$$

$$\alpha D^3y+\beta D^3(xy)=D^3y^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4),$$

$$\alpha D^4y+\beta D^4(xy)=D^4y^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5),$$