

ing its physical and chemical constitution, its palæontology, geological occurrence, and geographical distribution, was published by C. F. Zincken in 1865.

Fossil peat-deposits occur, so far as at present known, only in the post-Tertiary or Quaternary formation. The black-coal deposits of the old formations were frequently compared in geological literature with brown-coal, but the homogeneous structure and the rarity of good plant-remains in black coal, threw great doubt upon this explanation of its origin. Agricola, in 1544, explained it as condensed petroleum, and his opinion still found favour with Voigt in his special work on Coal-deposits (1802) and with Buckland (1822).

Kirwan, the opponent of Hutton, even explained coal as a product of the chemical decomposition of Archæan rock, while Andreas Wagner supposed it to represent condensed and de-oxidised carbonic acid derived from an atmosphere supersaturated with carbon dioxide. Many of the geologists in the eighteenth century upheld the correct explanation; amongst others Scheuchzer in 1706, Beroldingen in his work on *Controversial Points in Mineralogy* (1778), and James Hutton in Great Britain (1785). But it was not until the microscope was applied to its investigation that the origin of coal from plant-growth *in situ* was securely established. In 1848, the German botanist, Dr. Heinrich Goeppert, proved that the vascular cryptogams and conifers whose remains accompany coal-formations had supplied the material of the deposit. His results were corroborated by Dawson in 1859; but even after this date erroneous conceptions from time to time were advanced with regard to the kinds of vegetation which had given origin to the coal-deposits. A decisive paper on the subject was contributed by Gumbel to the Bavarian Academy of Sciences in 1883, wherein he gave microscopic sections showing the fine textures of the various plant-remains in peat, brown coal, black coal, and anthracite.

The transformation of decayed plant-remains into coal takes place under the fundamental condition of limited access of air, and is promoted by heat and pressure. There is little doubt that all three factors have contributed to the origin of the deposits of black coal, and Bischof suggested that the characteristic chemical and physical constitution of the varieties of coal had been determined by definite relations in the amount of air admitted and in the accompanying heat and