which is structureless to the naked eye and has been designated as pinite. It occurs only at the base of the Hardyston. Under the microscope it is found to be composed mainly of sericite mica but with smaller amounts of quartz, epidote and chlorite. In a few places it has been colored red by iron oxide. Fragments of quartz and a lamination parallel to the contact with the surface of the underlying gneiss are occasionally noted, both of which were probably developed by slipping during periods of folding. Rarely the pinite contains some rounded water-worn pebbles. This type of rock has not been seen at any other horizon. It is believed to have been made by the metamorphism of an old residual gneiss so that was formed before the deposition of the Hardyston and not destroyed by the waves of the advancing sea at the time of submergence of the region in Lower Cambrian time.

**Palaeontologic characteristics.**—The arkosic quartzitic phase contains the only fossil record yet described in the Hardyston of eastern Pennsylvania. *Olenellus* has been found in the New Jersey Hardyston, but thus far no trilobites have been discovered locally. The only feature that may be ascribed to marine life is *Scolithus linearis*, or "worm borings." Throughout a thickness of a few feet, and occurring rather widely as a distinct layer, there is a quartzite which contains long narrow cylinders, filled with material of a different color from that of the bed. Some of these tubes are a foot in length. They range in width from about one-eighth to half an inch. There seem to be two distinct sizes, of the dimensions just mentioned. They were recognized by the first geologists of the region as distinctive of the Hardyston (Potsdam of that time) formation. The tremendous number of tubes makes it a bit difficult to believe that they could have been formed by worms and then be filled uniformly with a different colored sand. However, the worm burrow theory is the only one that seems at all plausible.

**Thickness.**—The thickness of the Hardyston is extremely variable. East of Freemansburg it is apparently not more than 25 feet. This suggests the explanation of its absence between the gneiss and the Tomstown in some places as due to non-deposition. In other localities in the county the Hardyston appears to be as much as 200 feet thick. A short distance east of the Delaware River, two miles south of New Village, sandy and calcareous shales referred to the formation give a total thickness of 325 feet. To the southwest, through Lehigh and Berks Counties, the formation thickens to more than 400 feet. The lack of exposures at the top of the formation prevents exact determinations of thickness.

**Name and correlation.**—In the Second Annual Report of Rogers in