purity attained is unknown; experiments on modern life may possibly lead to some reasonable estimate. This much is certain: that the waters were sufficiently pure for the development of a great diversity, as has been shown, of aquatic life. The types of the early Cambrian are mostly identical with those now represented in existing seas, and although inferior in general as to grade, they bear no marks of imperfect or stunted growth from unfit or foul surroundings. How the purification was made so complete by the beginning of Paleozoic time has not been explained.

The following observations have an important bearing on this subject, although falling short of the needed explanation: —

If the carbonic acid in the limestones of the world and other carbonates, and the carbon of the coal and carbonaceous products in the rocks were originally, as is believed, in the air and waters, the amount of these carbonates and carbonaceous products in the formations of the Cambrian and all later periods would afford a basis for estimating approximately the amount of available carbonic acid existing at the beginning of these periods.

For the estimation there are the following data. A cubic foot of pure limestone which is half calcite and half dolomite, and has the normal specific gravity 2·75, weighs 171·4 pounds; and this, allowing for $\frac{1}{12}$ impurity, becomes 157 pounds, and corresponds to 72 pounds of carbonic acid. A cubic foot is equal to an inch-square column 144 feet in height. Since 72 is half of 144, each foot of the column of such limestone contains half a pound of carbonic acid. Hence a layer of the limestone 1 foot thick would give to the atmosphere, on decomposition, half a pound of carbonic acid for each square inch of surface.

A foot layer of good bituminous coal containing 80 per cent of carbon, $G = 1{\cdot}5$, will give to the atmosphere, by oxidation, 1·9 pounds of carbonic acid per square inch of surface.

If the mean thickness of the limestone over the whole earth's surface, that of the oceans included, reckoned on a basis of $\frac{1}{12}$ impurity, is 1000 feet, the contained carbonic acid amounts, according to the above, to 500 pounds per square inch, or 34 atmospheres (of $14\frac{3}{4}$ pounds), and if the mean thickness of the coal is 1 foot, the carbonic acid it could contribute would be 1·9 pounds per square inch. Adding these amounts to the carbonic acid corresponding to the carbon in the mineral oil and gas and other carbonaceous products of the rocks and organic life, supposing it to be 6 times that of the coal, the total is 513·5 pounds, or 35 atmospheres. The mean thickness of Archæan calcium, magnesium, and iron carbonate is not a fourth of that of post-Archæan. Estimating the carbonic acid they contain and that corresponding to the graphite of the rocks at 10 atmospheres, the whole amount becomes 45 atmospheres.

It has been suggested by some writers that the total amount of carbonic acid in the early Archæan was equivalent in pressure to 200 atmospheres. But this would require that the mean thickness of the limestone for Archæan and post-Archæan time should have been nearly 6000 feet.

Part of the limestone of post-Archæan terranes was derived from the wear and solution of Archæan limestones, iron carbonate, etc., and hence all the 35 atmospheres to the square inch were not in the atmosphere at the commencement of the Paleozoic. But if we reduce the 35 atmospheres, on this account, to 25 atmospheres, it is still an enormous amount beyond what ordinary life, even aquatic life, will endure. Reducing the estimated mean thickness for the limestone layer over the globe from 1000 to 500 feet would make the amount less by nearly one half. But with all the reductions that can be explained, the excess is still very large. It has been proved by experiment that an excess also of oxygen diminishes the deleterious influence of carbonic acid on plants; and that if the