

per unit dose was not constant. To understand the various results, each must be considered on the basis of the particular lesions involved.

The present data indicate how varied the life-shortening effects of partial- and whole-body exposure can be and the difficulties in attempting to extrapolate from one to the other. They also indicate how tenuous the quantitative estimates of life shortening in man must be when they are based on the relatively incomplete data currently available for experimental animals.

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#### References and Notes

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### New Marine Horizon in the Conemaugh Formation

In the course of stratigraphic studies of the Pennsylvanian sediments of the Kiskiminetas Valley in western Pennsylvania, I have found a previously unrecognized marine shale in the Conemaugh formation. The name "Carnahan Run shale" is proposed for the new stratum, and the designated type locality is in Parks Township, Armstrong County, Pennsylvania, about 0.7 mile north of North Vandergrift.

The fossiliferous shale is found in an outcrop along a country road on the north slope of the first fork of Carnahan Run, about 0.1 mile southeast of Carnahan Run. At the type locality the shale is 5 feet in thickness, weathers brown, and is dark grey on fracture. The rock is calcareous, with numerous small flecks of mica. The new horizon is separated from the underlying Woods Run limestone of Raymond by 21½ feet of reddish-brown shale that carries fragments of fossil plants. There is no marked break in sedimentation between the Carnahan Run marine bed and the underlying shale. A similar reddish-brown shale is found above the Carnahan Run shale at the type locality, but a layer of yellow clay about 1 inch in thickness intervenes between the two

beds. At the outcrop, in the Carnahan Run shale, the fossils are for the most part preserved as molds; the calcium carbonate of the original shells has been leached out. Recognized species include the brachiopod *Juresania nebrascensis* and a gastropod, *Amphiscapha elli* n. sp.

The Carnahan Run shale has also been noted in roadside exposures adjoining Pennsylvania State Highway Alternate 66 on North Vandergrift Hill, about 0.7 mile northeast of North Vandergrift, and approximately 0.5 mile from the type locality. There the marine shale is 1½ feet in thickness and is separated by 23½ feet of reddish-brown shale from the Woods Run limestone of Raymond, which outcrops below. Three inches of ferruginous clay separates the Carnahan Run shale from the overlying shales. The Ames limestone outcrops 126 feet above the Carnahan Run shale in this section, and the roof of the Upper Freeport coal, which marks the lower limit of the Conemaugh formation, is found 216 feet below the base of the new marine bed. Molds of *Amphiscapha elli* n. sp. are characteristic fossils in the Carnahan Run shale at this locality.

At Gosser Hill, in Westmoreland County, across the river from Leechburg, Pennsylvania, about 2.7 miles west of the type locality, the Carnahan Run bed is 7 feet in thickness. At this place it is found 13½ feet above the Woods Run limestone of Raymond and occurs approximately 226 feet above the Upper Freeport coal. Fossils are numerous and well-preserved in the Carnahan Run shale at this locality; the exposure was found in a recent excavation, and the shells have not been leached out.

Prior to dealing with the Carnahan Run shale in relation to the marine limestones which intervene between it and the underlying Lower Bakerstown coal, I find it necessary to touch upon the nomenclature of the latter marine beds. Two limestones have been distinguished in this interval. One, the original Woods Run limestone, was named by Raymond (1) in 1910, and its type locality was designated as Woods Run, in what is now Pittsburgh, Pennsylvania. In 1929, Johnson (2) described a second limestone which in the Pittsburgh region occurs approximately 8 to 17 feet below the Woods Run limestone, but he did not name the bed or indicate a type locality. Subsequent workers have sometimes referred to the two strata as the Woods Run limestones or have distinguished them as the Upper and Lower Woods Run limestones.

To avoid confusion, I feel that the original name Woods Run should be retained, without modification, for the limestone which Raymond described in 1910, especially since it is now known

that in some localities another marine bed, the Carnahan Run, closely overlies the Woods Run limestone of Raymond. For the limestone described by Johnson, which underlies the Woods Run, I propose the new name "Nadine limestone," and designate as the type locality Nadine, on the Allegheny River east of Pittsburgh, where its occurrence was noted by Johnson. To Johnson's description it may be added that the Nadine limestone carries marine fossils at the type locality, including the distinctive brachiopod *Chonetina flemingi plebia*.

The characteristics and relationships of the Carnahan Run shale, Woods Run limestone, and Nadine limestone in the Kiskiminetas Valley may be summarized as follows:

The Carnahan Run is a calcareous marine shale, 1½ to 7 feet in thickness, which is found about 126 feet below the Ames limestone, 13½ to 23½ feet above the Woods Run limestone, and approximately 216 to 226 feet above the Upper Freeport coal. Marine fossils noted to occur at this horizon include *Juresania nebrascensis*, *Meekospira peracuta*, *Pharkidonotus percarinatus*, *Metoceras* sp., and *Amphiscapha elli* n. sp.; the latter species is abundant and characterizes the stratum.

The Woods Run is an impure, nodular, ferruginous limestone, ½ to 1½ feet thick. It outcrops approximately 151 feet below the Ames limestone, 18 to 20 feet above the Nadine limestone, and about 191 to 212 feet above the Upper Freeport coal. The bed is sparingly fossiliferous, with *Lophophyllidium proliferum* the commonest species, although *Shansiella carbonaria*, *Solenocheilus* sp., and *Ameura* sp. have also been noted at this horizon.

The Nadine is a relatively pure limestone, light to dark grey on fracture, 4 inches to 1½ feet thick. In outcrops in the vicinity of North Vandergrift, Pennsylvania, it occurs approximately 172 feet below the Ames limestone, 32 feet above the Cambridge limestone and 170 feet above the Upper Freeport coal. Marine fossils are not abundant, but *Chonetina flemingi plebia* is the commonest species and has been recognized at all outcrops of the limestone in the Kiskiminetas Valley. Associated forms include *Derbya crassa*, *Punctospirifer kentuckiensis*, *Neospirifer triplicatus*, *Marginitifera splendens*, and *Rhombopora lepidodendroides*.

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