published in the Publications of the Carnegie Institution of Washington an account of the role of the sex chromosomes in the beetle Tenebrio. She showed that the male had 19 large and 1 small chromosome (the Y), the latter going to half the spermatozoa. She also showed that at the reduction division it (the smaller one) was the mate of one of the large chromosomes. Consequently half the ripe sperm had 10 large chromosomes and half had 9 large and 1 small chromosome. In the oogonial cells there were 20 large chromosomes which would reduce to 10 in the egg after maturation. She pointed out that an egg fertilized by a sperm with 10 large chromosomes would give a female with 20 such chromosomes, and that an egg with 10 large chromosomes fertilized by a sperm with 9 large and 1 small chromosome would restore the number characteristic of the male.

In the same year (1905) Wilson published a similar conclusion in regard to the role of the sex chromosomes in two other insects in which the female has one more chromosome than the male; thus *Anasa tristis* ♀ has 22, and the male 21; and Protenor ♀ has 14, and the ♂ 13. The Stevens type XX-XY and the Wilson type XX-XO are the same in principle. It has turned out that the former is much commoner than the latter as a sex-determining mechanism occurring widely in groups other than insects.

Five years after his appointment at Columbia University he published his book on "The Cell" (1896) which was at once recognized as the outstanding summary of the work in this field. Wilson drew upon his wide experience covering, as it did, the role of the cell in fertilization and development, in experimental embryology, in spermatogenesis, as well as thorough familiarity of the work of his contemporaries dealing with the cell. A third and greatly extended edition appeared in 1925. During the interval between the first and third editions, work in cytology had advanced in many directions and a voluminous literature had grown up. In a masterly way Wilson summarized this literature, separating the wheat from the chaff. I can not do better than quote here the words of Professor E. G. Conklin spoken at the time of the award to Wilson of the Daniel Giraud Elliot Medal (for 1925) by the National Academy,

"The third edition of 'The Cell in Development and Heredity' has been written out of this unique experience; it represents not only the mature point of view of the world's leading student and teacher of cytology, but it is to a large extent the work of its leading investigator in this field. Few other workers are left who were in at the birth of this science and who can speak of its development with the knowledge that comes from intimate contact with persons and problems, and no one could deal with this subject in a more comprehensive and judicial manner."

Wilson was a member of all the leading learned societies of Europe and America. He was a recipient of honorary degrees from the universities of Columbia, Harvard, Yale, Johns Hopkins, Chicago, Louvain, Cambridge (England), Lwow and Leipzig. He was awarded the gold medal of the Linnean Society, London; the Elliot Medal of the National Academy of Sciences; the John J. Carty Medal and Award. He will be lovingly remembered by his many friends as a reserved, cultured gentleman whose sincerity, judgment and breadth of knowledge were shown by the perfection of his lectures and his scientific papers.

WIND-WORN STONES IN GLACIAL DEPOSITS OF THE MIDDLE WEST

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FOR many years the plains of the middle western States have been a classic area for studying deposits formed by the Pleistocene ice sheets. The preliminary work of mapping and distinguishing between sheets of debris spread during each successive episode of the Glacial Period is largely completed. In studies encompassing such vast areas many details will be overlooked, however, and left for the attention of later workers. This is not to the discredit of early investigators, for new data are commonly found each time a particular locality or rock outcrop is revisited.

One detail little noticed until recent years is the association with glacial deposits in central interior States of stones that were shaped, etched, modified or polished through abrasion by wind-driven sand. Such stones are common in modern deserts and have been found in many consolidated aeolian deposits, or "fossil deserts." Bryan[1] proposed the general name "ventifact" for all wind-scoured stones.

Hobbs[2] noted abundant ventifacts on barren plains bordering the Greenland ice-cap, where strong winds generated above the ice drive sand, silt and dust over stones too large for the winds to carry. Ventifacts

[1] K. Bryan, *Rept. Comm. on Sedimentation for 1929–30, Nat. Res. Coun. Cir. No. 98,* 1931, pp. 29–50.

[2] W. H. Hobbs, *Jour. Geol.,* 39: 381–385, 1931.

probably were formed under essentially similar conditions all over the glaciated tracts of the world. Bryan[3] has emphasized that arctic conditions favorable to formation of wind-cut stones must have prevailed during advance and retreat of Pleistocene glaciers in the Middle West. Many writers have described a profusion of wind-cut stones associated with glacial deposits in northern Europe and the northeastern United States, but there are few references to such stones in the north central States, and there is not enough descriptive information in most of these reports to indicate whether sand-blasting occurred during glacial or post-glacial time.

Bryan[4] suggested that ventifacts in glacial deposits of southeastern Massachusetts were formed at the surface and then churned underground by frost action, largely in early post-glacial time. He thinks this explanation may also apply to occurrences of ventifacts in other glaciated areas, in published accounts of which the probable date of sand-blast action[5] has not been indicated. The writer and others[6] reported ventifacts in place in undisturbed till and gravel deposits of the Cape Cod area well below depths affected by frost heaving. These authors consider, moreover, that most of the ventifacts were formed long before all the ice had disappeared from the region

Wentworth and Dickey[7] listed several occurrences of ventifacts associated with glacial and post-glacial deposits of the Middle West, but for most of them it is not specified when the wind-sculpturing occurred. Recently Thiesmeyer and Digman[8] reported wind-cut stones embedded in drift of early (?) Pleistocene age. Previous to publication of that account there were, apparently, only two reports of ventifacts in the central United States known to have been formed *during* the Ice Age.[9]

Three new localities for wind-cut stones in Wisconsin and Michigan have been found during the past year. These are described below to bring the record up to date and to encourage other observers to supplement it. The writer believes systematic search will prove wind-scoured stones as common in glaciated country of the Middle West (and in the Driftless Area) as they are in New England. He suspects that most of them originated while the ice was close at hand, and that their emplacement *within* the deposits will prove related to factors other than frost action in the arctic climate peripheral to the glaciers.

Last spring the writer discovered well-formed ventifacts in a shallow roadcut about three miles east of Crystal Falls, Michigan, on State Highway M 69. The materials underlying this district are glacio-fluvial silts, sands and gravels. Inspection of the sand yielded half a dozen undoubted ventifacts from ¾ to 2 inches in diameter. Quartz, quartzite, granite and several types of porphyritic felsite were represented among the pebbles. It was not possible to determine whether these wind-cut stones had been formed at the surface in post-glacial time, because no clear signs of stratification could be seen in such a shallow roadcut. However, this additional example of ventifacts associated with materials of glacial origin stimulated search for localities where age relationships might be established. In discussion about the stones near Crystal Falls, Professor J Harlen Bretz, of the University of Chicago, disclosed that he had seen many ventifacts in the Baraboo area in Wisconsin. This helpful comment led to the finding of such stones at the third locality, described below.

Later several shallow roadcuts on U. S. Highway 141 four miles southeast of Crystal Falls were examined. Here the highway crosses a broad plain recognized easily as an outwash apron. The material exposed is well washed and sorted, medium to fine sand with occasional streaks of pebbles. Foreset bedding and channeling are evident at several places. A basketful of wind-shaped stones was collected here with little effort. They range in size from ½ inch to approximately 4 inches in diameter. The rock types include quartzite, coarse and fine varieties of granite, diabase, greenstone, red granite gneiss, conglomeratic quartzite and siltstone. Almost every type of wind-sculpturing effect previously observed on ventifacts is represented. Most of the stones were loose upon the slumped surface, but a few were gathered from undisturbed pebble layers several feet beneath the plain surface. This indicates both that they were deposited by glacial meltwaters after shaping in the sand-blast, and that there has been only slight overturning by frost action or plant roots at this locality since the ice disappeared. Some of the ventifacts show modification of their wind-carved features by abrasion during the later water transport.

The third locality is a roadcut 10 to 20 feet deep in till of the Wisconsin terminal moraine on U. S. Highway 12 approximately three fourths of a mile north of its intersection with State Highway 136. Here the moraine rises across a quartzite ridge on the northern boundary of the Baraboo basin. This locality, a scheduled stop on the itinerary of annual field trips to the Baraboo district conducted by several colleges and universities, has been visited by hundreds

[3] K. Bryan, *Am. Jour. Sci.*, 16: 162–164, 1928. (Review and discussion of an article by Paul Kessler.)

[4] K. Bryan, *Bull. Geol. Soc. Amer.*, 44: 176, 1932.

[5] K. Bryan, personal communication.

[6] L. R. Thiesmeyer, K. F. Mather and R. P. Goldthwait, *Bull. Geol. Soc. Amer.*, 50: 1939, 1939; F. E. Matthes, *Jour. Wash. Acad. Sci.*, 24: 195–196, 1934.

[7] C. K. Wentworth and R. T. Dickey, *Jour. Geol.*, 43: 97–104, 1935.

[8] L. R. Thiesmeyer and R. E. Digman, *Jour. Geol.*, 50: 174–188, 1942.

[9] Thiesmeyer and Digman, *op. cit.*, p. 175.

of people trained in geology, including the writer. Yet there is no published record of wind-worn stones here, probably because the visitors' attention was concentrated on more significant details of the deposit.

Close examination of this exposure in April, 1941, by the writer and a class of some thirty Lawrence College students revealed that many of the subangular stones are truly ventifacts. Scores of them were collected in a few minutes, mostly from the slumped surface; but random digging into undisturbed till below a shallow surface zone of weathering produced others. These ventifacts were evidently carried by the glacier in moving to its terminal position and then deposited in the morainic debris that now marks its former margin. Sand-blasting must have occurred earlier while the stones lay in a belt peripheral to advancing ice.

A white quartzite boulder 3½ feet in long diameter, extricated from till just beneath the moraine surface, was taken to the college museum. More than half its surface area bears shallow, subparallel cusps, grooves and flutings characteristic of many ventifacts, and these have a luster like Cellophane. Such surfaces are merely modifications of curving, conchoidal fracture faces commonly found on quartzite. Their arrangement shows clearly that the rock rolled into several positions during sand-blasting. The total amount of material removed by abrasion was apparently not sufficient, however, to give the whole stone a distinctive pyramidal or polygonal shape common among smaller ventifacts.

Most of the wind-carved rocks collected here are fragments of locally abundant Baraboo quartzite; but a few fashioned in coarse granite and felsite porphyry were observed. Consideration of rock types shown on the geologic map of Wisconsin shows that these stones were not transported far from their original positions of outcrop. Fragments of Potsdam sandstone widely distributed north of this did not withstand transportation and weathering sufficiently to retain the evidences of wind-sculpturing they may also originally have displayed.

In a region where surface rocks bordering and beneath the ice were friable quartz sandstones that yielded abundant sand to glacially generated winds conditions must have been especially favorable to formation of ventifacts. Consequently, it seems probable that glacial deposits of the Baraboo region contain a profusion of these curious stones.

The writer will welcome information concerning wind-cut stones at other places in the central States. He urges that the discoverer determine if possible: whether the stones occur within the deposit; at what depth beneath the surface; to what depth the material is stained by weathering; and whether the deposit is unlayered till or stratified sand and gravel.

Since observers trained in any branch of science may encounter these wind-worn stones, it appears worth while to list below other distinguishing characteristics of ventifacts.

(1) The wind-scoured surface is smooth, lustrous and has a rather greasy feel. The polish may vary from a dull mat finish to a gloss like Cellophane.

(2) The surface may be pitted, fluted, cusped or highly irregular through etching out of its less resistant portions. A wind-etched stone is distinguished from one produced by differential solution in weathering by smoothness and high luster of wind-eroded portions. Surfaces developed by solution processes are commonly dull, pitted and "chalky-feeling."

(3) Some ventifacts have distinctive polygonal shapes formed by carving of several rather flat facets across what were originally rounded pebble and cobble surfaces. These stones may be pyramidal, polygonal or shaped somewhat like a brazil nut. The shape attained depends on many factors, including: shape of original fragment, length of exposure to abrasion in one position, constancy of wind direction, resistance and texture of the stone, size of abrasive, mineral composition of stone and abrasive, number of times the stone rolled into new positions during sand-blasting, and amount of surface exposed to abrasion. Consequently, stones of almost any shape may bear evidence of wind-sculpture. Smoothness, greasy feel and high luster are the chief diagnostic things to observe on a surface that one suspects is a wind-cut facet.

OBITUARY

WILLIAM SCHAUS
1858–1942

THE death of Dr. Schaus on June 20 removed one of the last of the elder lepidopterists who have contributed most to our knowledge of the neotropical fauna. For over forty years he labored consistently and with unswerving devotion to one end, the building up of the most complete collection of tropical American Lepidoptera in the world, not for himself nor his personal profit but for the nation. He contributed generously to other institutions, notably the British Museum of Natural History, the Carnegie Museum at Pittsburgh and the American Museum of Natural History; but the bulk of his collection and his valuable library were given to the U. S. National Museum, and there he worked for the last twenty years of his active life. He described over five thousand new species, mostly from tropical America. With few exceptions