DISCUSSION

EXCURRENT CONES

ANOMALOUS cone growth in the conifers must yet prove to yield facts of value in simpler textual discussion. Many isolated notes and also illustrated articles have appeared in the course of the years, though all such had to await the acuter study of the fossil record and the cone organogeny of just the past twenty years. While the great cone dispute of a hundred years seems settled in favor of an inflorescent view, the unusual axial growths in the cones may now be viewed in far clearer light, meriting close study. The near certainty that the angiosperms are in their defined origin very old in geologic time adds a splendid evolutionary interest here.

A brief note in SCIENCE[1] last year calls attention to the very handsome excurrent cones of *Sciadopitys verticillata,* the Japanese "umbrella pine." Single terminal tines were first seen, and then later in the 1939 cone series whorls of three and four tines appeared. Now, however, some of these axes have again grown forward. During the past summer (1940) about a half dozen of the cones with the terminal whorls have grown a second such whorl, so that the full-grown seed cone as seen just now (midwinter) bears from seven to nine of the apical, normal foliar tines. Further growth of these axes seems likely. The late May, 1940, condition of the tree (about 30 feet high, but topped by a storm) was looked over by the senior class in botany at the Hunter College.

Also what appears to be the most instructive parallel to the renewed vegetative growth in the "umbrella pine" is found in *Cunninghamia sinensis.* Professor Medsger, of the Pennsylvania State College, has called my attention to the striking excurrent cone growth he found in this species planted as an ornamental in Charleston, South Carolina. The cuttings sent show forward growth of the cone axes to lengths of a foot or more bearing the handsome spiral set leaves, and secondary cone growth occurs too. As in other instances these fine variations from the norm seem partly dependent on some new or exotic factor in the environment, and even suggest experimental study.

Another fine example of excurrent growth was noted in *Cryptomeria.* All in all, these growths must occur far more widely than has been either recorded or suspected. They seem to fail in the short-shoot types—pines. Nevertheless the observed facts must have sound evidential value in the attack on that defyingly difficult problem of the morphogenesis of cone and flower. If, in let us say some really far back course of origin, the doubled or fused tines of the umbrella pine have a certain equivalence to the short shoot in the pines, then proof that the cone axis generally is neither simply floral nor of limited growth, is a point nearer. In either case easy transition from seed cones into such a superinflorescent condition as may be found in the Chinese "black pine" must mean something in the evolution of cone and flower as well as conifer origin. The greater subject is much nearer to sound discussion as said above than only a few years ago. More evidence from the fossil side is certain to appear. Seed fern antecedents of the conifers, and maybe dicots, too, are not too darkly suggested by the monocarpic and other Mesozoic cycadeoids.

G. R. WIELAND

YALE UNIVERSITY

[1] SCIENCE, 91: 2359, 262–263.

KIDNEY STONES IN RANA PIPIENS TADPOLES REARED ON SPINACH

DURING recent years a number of papers have appeared containing the statement that tadpoles reared for experimental purposes were fed a diet containing boiled spinach. Recently the writer has reared *Rana pipiens* tadpoles for various purposes on a diet made up of (1) a dried food consisting of liver, pablum, milk and (2) boiled spinach. The animals were fed two or three times each week on the dried food and usually twice each week on spinach. Growth was fairly rapid. The tadpoles attained a length of approximately 60 mm and began to metamorphose at an age of about three months. Two hundred and fifty-two of these animals were autopsied at the time of metamorphosis. Of these two hundred and twenty-seven were found to contain numerous large kidney stones. These were hard, transparent or translucent, and slightly yellow in color. They were of elongated cylindrical shape and appeared to be deposited in the tubules. A second group of tadpoles has been reared on a diet made up of the dried food listed above but with lettuce replacing the spinach. Seventy-four of these have been autopsied approximately at the time of metamorphosis. In two cases there were a few minute opaque crystalline deposits in the tubules, but in the remaining 72 animals the kidneys were well formed and contained no stones.

The explanation for the deposition of crystalline stones in tadpole kidneys may be found in the high oxalic acid content of spinach recently reported by Kohman.[1] Kohman found that rats given a diet containing spinach grew poorly and deposited much less

[1] E. F. Kohman, *Jour. of Nutrition,* 18: 233, 1939.