teris, one of which bears both fertile and vegetative pinnae (*6*).

The great significance of this specimen becomes apparent when one realizes that the two organ genera, now known to represent one plant, have been widely accepted as having close affinity with members of different classes of the plant kingdom, *Archaeopteris* frequently being classified with the ferns and *Callixylon* conceded by most to be a gymnosperm. This plant, which according to the rule of priority must be called *Archaeopteris*, is unique among known vascular plants. It was a tall, straight, forest tree, with branches bearing large, pinnately-compound leaves. In size, excurrent habit, and wood anatomy it had the appearance of a conifer. Its pycnoxylic secondary xylem, containing tracheids with alternate, round-bordered pits restricted to radial walls, and narrow rays containing ray tracheids, is of a relatively advanced type, and appears to have been more highly specialized than that of some modern conifers. Its leaves, however, were unlike those of any known coniferophyte (that is, cordaite, ginkgo, taxad, or conifer), and although, in gross form, they were fernlike, they were no more similar to those of the ferns than to those of another gymnosperm group, the pteridosperms. All positive evidence indicates that this extraordinary plant reproduced pteridophytically. Significantly, at least one species of *Archaeopteris* had evolved to the level of heterospory (*7*), and it is very probable that the genus is one of a group of Devonian and Lower Carboniferous plants which was directly ancestral to some of the late Paleozoic seed-bearing plants.

Archaeopteris, which 300 million years ago formed extensive forests of tall, graceful, trees over large parts of the earth, now becomes one of the best known Devonian plants.

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6. The identifications of the stem of this specimen as *Callixylon* and the foliage as *Archaeopteris* have been verified by Prof. C. A. Arnold. His interest and assistance are greatly appreciated.
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Numerical Comparison of Geomorphic Samples

Abstract. The distribution of elevations representing a region can be shown as a cumulative frequency curve plotted on probability paper. Many elevation distributions are "zig-zag" curves which can be represented conveniently by measures of skewness and kurtosis. A plot of skewness versus kurtosis permits the recognition of six major, non-Gaussian forms, with countless gradations.

Skewness and kurtosis, computed from elevation or relief data, can be used to characterize various geomorphic regions (*1*). This is true because, for most areas, the distribution of elevation data is not Gaussian, nor can it be made to appear Gaussian by any standard transformation. The departure from the normal (or log-normal) curve commonly depends on the fact that most such relief distributions contain three major components: uplands, slopes, and lowlands. These three components can be combined in various distinctive ways. Seven examples, six of which are non-Gaussian, are given as insets in Fig. 1. The upper right inset, showing much upland, little slope, and no lowland, can be taken as representative of Davisian youth. The upper left inset, showing a little slope and much lowland, can be taken as Davisian old age. The concept of maturity (all slope; a Guassian distribution) is shown by the middle inset. The other four insets show departures from the ideal Davis cycle.

The insets are not only illustrative. They are also plotted, individually, to scale. For each inset, the vertical ordinate is percent of relief (from 0, at the bottom, to 100 percent, at the top). The horizontal ordinate is the common probability scale, ranging from 1 percent at the right end, to 99 percent at the left end. The curve that is shown in each inset is a cumulated frequency curve.

It is obvious that the departures of the outer six insets from the central inset can be represented by moment measures, specifically, skewness and kurtosis. The "maturity" inset, having a true Gaussian distribution, has a skewness value of 0 and a kurtosis of 3.

The small circles represent actual areas studied. For each area, a sample of elevations (generally some multiple of 100 measurements) has been taken, and converted to percent relief. From the classified cumulated data, skewness and kurtosis were obtained. Actual areas fall in many parts of the chart except in the vicinity of "youth." Absolute relief, or absolute elevation, does not show in any way.

Two points need to be made clear about this diagram. First, the chart, as a whole, cannot be taken to indicate the relative number of areas which are in youth, maturity, old age, or off the Davis sequence. The choice of study areas has been influenced by the availability of detailed maps. Furthermore, no effort has been made to randomize the choice of study localities (although actual sample points have been randomized). On the other hand, a wide variety of areas is shown. Oklahoma and Alabama are represented by eight areas each; Arizona and Arkansas, by six each; and Kentucky, Tennessee, Pennsylvania, North Dakota, South Dakota, California, Minnesota and Maine, by one or two each. Ten areas are from Asia and Africa. The lack of true randomization of study areas does not detract from the basic purpose.

The second problem, a more serious matter, involves the definition of a sample or study area. It has been suggested by some that the river basin (outlined by divides) is the only natural unit of study. This notion ignores large portions of the earth's surface, where no good, continuous divides exist. In sand hills, karst plains, swamps, deserts, tundra, and glaciated regions one may find that he must choose his study area arbitrarily. His decision may be forced by the realities of map availability. And if he chooses limits other than the edges of the map, he may find that his work is not closely reproducible.

Computation of skewness and kurtosis measures, for a given area, allows an investigator to make a reasonably objective analysis. Furthermore, examination of the probability plot itself (such as the insets in Fig. 1), permits an esti-

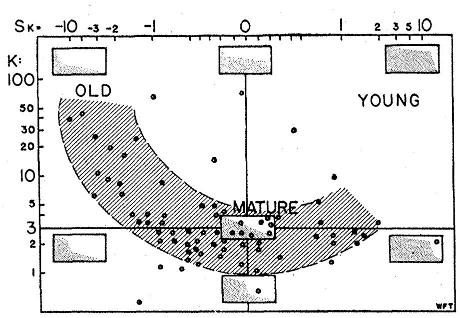

Fig. 1. Plot of skewness (horizontal ordinate; modified tangent scale) versus kurtosis (vertical ordinate; log scale), for geomorphic relief data for 75 selected areas (small circles). Stippled insets are representative cumulative relief plots, made on a horizontal probability scale. The labels "young," "mature," and "old" refer to Davisian concepts. The shaded area shows that most samples (about 85 percent) represent mature or old regions, some samples (about 15 percent) are non-Davisian, and few or none represent regions in youth.

mation of the relative proportions of upland, slope, and lowland. By means of studies of this type, one can compare regions, evaluate various distinctive land forms, and in some cases even determine the extent to which structural control has influenced geomorphic development.

Because the work is fairly quick and simple (a typical analysis takes about an hour), computation of skewness and kurtosis measures does not appreciably increase the amount of time and effort necessary to study a given area. When these measures are coupled with altitude and relief values (such as means and standard deviations), the geologist can list absolute, rather than merely relative, figures to denote degree and kind of geomorphic expression.

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Role of Olfactory Sense in Pregnancy Block by Strange Males

Abstract. Pregnancy is blocked in a high proportion of recently mated female mice exposed to strange males. This reaction is virtually abolished by the prior removal of the olfactory bulbs of the female. The smell of the strange male appears to be the primary stimulus in the exteroceptive block to pregnancy in mice.

An exteroceptive block to pregnancy in mice associated with the presence or proximity of strange males has recently been described (*1*, *2*). If the newly mated females are placed with or near strange males, particularly males of a different strain from the stud male, pregnancy and pseudopregnancy both fail in a high proportion of mice. The development of the corpora lutea is inadequate, implantation does not take place, and, typically oestrus returns 4 to 5 days after the stud mating in more than 90 percent of the females in which pregnancy is blocked. Fertile mating takes place at this time if the strange male has access to the female. (Atypically, oestrus may return on day 6 or 7).

A high degree of discrimination is shown by the female because if she is returned to her original stud male 24 hours after separation from him, her pregnancy is carried to term. The primary stimulus initiating the reaction is almost certainly olfactory, but direct proof of this assumption has so far been lacking. Experiments have now been carried out with female mice in which the sense of smell has been destroyed.

The operation of removing the olfactory bulbs was performed under Avertin anesthesia. A hole was drilled between the eyes of the mouse and the olfactory bulbs were separated from the cribriform plate with a metal probe and removed by suction, as described by Whitten (*3*). The mice used were of the same strain as those initially observed. All the females and the stud males were albino, from a closed colony randomly mated, the P strain, bred in this institute. Mice of the G substrain of CBA (*4*) were used as pregnancy blocking agents. To induce pregnancy block the mated female was removed from the stud male when the vaginal plug was found, housed alone for 24 hours after separation from him, her inside a stock box containing males, or in a basket suspended from the lid of the box, for 3 or 4 days. Both situations have proved satisfactory for the manifestation of the block to pregnancy. Vaginal smears were examined daily. Females in which pregnancy was blocked and those which became pseudopregnant were again paired with a stud male and allowed another mating. Only those which then became pregnant have been included in the results. Altogether, tests were completed on 22 anosmic females. The results are summarized in Table 1.

Table 1. Effect of the removal of the olfactory bulbs on the incidence of pregnancy block in mice.

Mated females		Blocked pregnancies*	
		No.	Percent
Anosmic females			
Parous†	10	2	14
Nonparous‡	12	1	
Normal females tested concurrently			
Parous	9	6	78
Nonparous	49	39	

* ♀ returns to oestrus within 7 days of mating.
† Stud mating 8 to 17 weeks after operation.
‡ Stud mating 2 to 4 weeks after operation.

In marked contrast to intact females the majority of anosmic females remained pregnant or pseudopregnant in the test situation. None of the three females in which pregnancy was blocked showed the typical response, since oestrus returned only on day 6 (in two females) or on day 7 (in one female) after the stud mating. An unusually high pseudopregnancy rate (five out of 22) was shown by the anosmic females. Among the intact females tested concurrently, only one became pseudopregnant. It is therefore most unlikely that the increase in the number of pseudopregnancies among the anosmic females is related to the presence of strange males. Removal of the olfactory bulbs in female mice leads to regression of the ovaries and uteri, to alterations in mating behavior (*3*), and to disturbances of reproduction often more profound than can be explained by ablation of the olfactory bulbs alone (*5*). Much variation in reproductive behavior is therefore to be expected among anosmic females.

The results of these tests emphasize the primary function of olfaction in pregnancy block of exteroceptive origin, since the recently mated females in which the sense of smell had been destroyed were virtually immune to the effects of the presence of strange males. In this respect pregnancy block is reminiscent of other social effects in mice. When females are housed together, instead of singly, oestrus is partially suppressed. In small groups there is such an increase in the number of pseudopregnancies that the latter may account for over 25 percent of the cycles (*6*). In large groups of females, oestrus and ovulation occur only infrequently (*7*). But if such females are paired with males, oestrus returns promptly, and the incidence of mating greatly exceeds expectation (on the basis of a 5-day cycle) on the third day after pairing (*8*). By contrast, stimulation resulting from the presence or proximity of strange males inhibits the establishment of pregnancy in the recently mated female (*1*). These effects are abolished in mice from which the olfactory bulbs have been removed (*3*, *9*).

Other experiments have shown that successive pregnancies in the same female can be blocked. Whitten (*7*) has suggested that the exteroceptive control of the oestrous cycle might to some extent regulate cycles of population density among colonies of wild mice. In the same way the exteroceptive block to pregnancy associated with the smell of strange males might be held to favor exogamy among wild mice.

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