

story of his "painful surprise" when Schiller said, "This is not an observation, it is an idea", is interesting to the student of scientific method, the obvious fact being that Goethe reached his conclusion *deductively*, for his mind was full of the evolution idea, and that he tried to verify it *inductively*—a thoroughly sound procedure.

Goethe's theory of the morphological equivalence of appendicular organs was developed in his famous essay *Versuch die Metamorphose der Pflanzen zu erklären*, published in 1790. "In this brilliant essay", Prof. Geddes says, "the doctrine of the fundamental unity of floral and foliar organs is clearly enunciated, and supported by arguments from anatomy, development, and teratology. All the organs of a plant are thus modifications of one fundamental organ—the leaf, and all plants are in like manner to be viewed as modifications of a common type—the *Urpflanze*."

Prof. Vines points out that Goethe's evidence, if strictly considered, was by no means conclusive. He rested his case chiefly on the occurrence of transitional forms which connect different kinds of leaf-organs, and on monstrosities, such as stamens which become petals. But it is possible to find forms at least superficially transitional between leaf and shoot; and to argue from monstrosities is always precarious. The theory lacked, what Wolff had begun to supply, the "embryological criterion of homology". Moreover, as Goethe himself felt keenly, the theory remained vague and unsatisfactory in regard to *what it was* that had been the subject of all the supposed metamorphosis. "What he sought", Prof. Vines says, "was the morphological concept of the leaf; and the reason why he failed to form it was that the morphological botany of his time was too superficial and too physiological to admit of such conception." And as the observed facts of transitions and abnormal changes pointed to both ascending and descending metamorphosis, Goethe was puzzled, as many of us are still, as to the *direction* of the supposed evolution. Is it from vegetative leaf to floral leaf, or *vice versa*? "For", as Goethe said, "we can as well