in part to the movement of the particles themselves, though this general view is not so much in favor at present. Nevertheless, it is certain that these particles exhibit Brownian movement and, were they electrically charged, more or less of their motion might in this sense be ascribed to them directly. Because of the uncertainty of this whole question it seems best to designate the various states of chromatophore pigment in as non-committal terms as possible.

Sumner's suggestion of a chromatosome, melanosome, etc., seems to me artificial, for there is really no such single body of pigment particles as these terms imply. In many melanophores, after most of the melanin particles have been drawn toward the center of the cell, groups of particles may often be seen stranded in the cell processes, showing that no such unity as is suggested in the idea of the chromatosome really exists. I am therefore not inclined to use this term and to speak of the chromatosome as expanding and contracting. I am more in favor of describing the several states of the pigment-cell in terms of its colored particles as one of dispersion of these particles or of concentration of them. In this respect I come nearer in agreement with Mast, who has suggested distribution and aggregation for the corresponding conditions. According to what I have suggested, a chromatophore might then be described as having dispersed or concentrated pigment. If, as seems probable, certain vertebrate chromatophores are provided with double innervation, the two sets of nerve-fibers may be designated as dispersing fibers and concentrating fibers. Neurohumors, if present, may be similarly designated. No writer can dictate a phraseology for another. The terms I suggest are to all intents synonyms of those proposed by Mast, but as every one knows synonyms are often very useful and if they are at the same time a means of avoiding an old difficulty, they may be doubly worth while.

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FOLIAR DETERMINATION IN ANGIOSPERMS

THE diversity of foliar structures formed during the development of the shoot in angiosperms represents a problem which has attracted considerable interest from both morphologists and physiologists in the past. The morphological view-point is well illustrated by Potonié,[1] who maintains that such vegetative organs as cotyledons, foliage leaves, cataphylls and bracts are leaf types which have all evolved from a common ancestral assimilatory leaf or "Trophophylle." The floral organs, according to this author, have developed more or less independently from a primitive type of "Sporophylle." In contrast, the physiological view-point, as typified by Klebs,[2] Pfeffer,[3] Jost[4] and Goebel[5] is primarily concerned with the influence of external and internal factors on the differentiation of the foliar anlagen of the shoot. This "causal" outlook has resulted in considerable speculation as to the inherent potentialities of foliar initials. Pfeffer (*l.c.*, p. 143), for example, holds that all foliar primordia are equipotential. Klebs (*l.c.*, pp. 4–6) likewise assumes that leaf primordia are characterized by a wide range of developmental potentialities. Klebs believes that during the development of a primordium many potentialities remain latent in favor of the realization of a dominant or "prospective" potentiality. Often, however, several potentialities may be expressed in varying degrees, resulting in organs which are intermediate in character. Goebel (*l.c.*, pp. 1603–1616), however, attempts to reconcile the morphological and physiological view-points by assuming that the plant forms but one type of leaf initial, *viz.*, the foliage-leaf primordium. Such organs as cataphylls, bracts and the floral structures result, in his view, from the transformation (*Umbildung*) of morphologically identical anlagen.

In the writer's opinion, the problem of foliar determination, as outlined above, raises many fundamental questions which warrant careful examination in the light of modern botanical technique and theory. More exact information is particularly needed as to the cytological and histogenetic processes which accompany the early stages of foliar specialization. In an effort to secure such data, a detailed study has been made of the comparative histogenesis of cataphyll and foliage leaf in *Carya Buckleyi var. arkansana*, Sarg., a species which the writer has already found suitable for morphogenetic analysis.[6] Some of the general results of this investigation seem of sufficient importance to justify a preliminary statement at this time. A detailed report will be published *in extenso* in the near future.

Clear evidence of a profoundly divergent histogenesis between cataphyll and foliage leaf appears when their respective primordia are 90–100 microns in height. This is shown in the cataphyll initial (1) by the rapid vacuolation of many cells in its median

[1] H. Potonié, "Grundlinien der Pflanzen-Morphologie," Jena, 1912.

[2] G. Klebs, *Abhandl. d. Naturforsch. Gesell. Halle*, 25: 1–162, 1903.

[3] W. Pfeffer, "The Physiology of Plants," Vol. 2. Ed. and transl. by A. J. Ewart. Oxford, 1903.

[4] L. Jost, "Pflanzenphysiologie," Bd. 2, Jena, 1923.

[5] K. Goebel, "Organographie der Pflanzen," 3 Teil, Samenpflanzen, Jena, 1932.

[6] A. S. Foster, *Am. Jour. Bot.*, 18: 864–887, 1931; *ibid.*, 19: 75–99, 1932; *ibid.*, 19: 710–728, 1932.

region, and (2) by the rapid acceleration of growth at its margins. The latter process is associated with the extremely rapid formation and vacuolation of irregular groups of genetically related cells and soon results in the typical vaginate form of the cataphyll initial. In contrast, the cells of a young foliage-leaf primordium are more meristematic in staining reaction, and prominent vacuoles are absent from the cytoplasm. The basic histogenetic divergence in such a primordium is evidenced by its early and rapid increase in radial thickness. This type of growth results primarily from the cambial-like activity of a vertical strip of cells beneath the adaxial epidermis and leads to the typical semi-terete form of the foliage-leaf initial. Following this critical period of histogenetic divergence between cataphyll and foliage leaf, rapid morphological and anatomical specialization occurs. Marginal growth continues actively in the scale primordium and is accompanied by the rapid centrifugal and acropetal maturation of a simple type of mesophyll traversed by palmately-branching procambial strands. Conversely, the continued increase in radial thickness of the foliage-leaf initial results in the gradual differentiation of an anatomically complex leaf axis or phyllopodium from the adaxial margins of which two or three pairs of lateral leaflet primordia arise in acropetal succession, the terminal portion of the primordium differentiating into the terminal leaflet.

In conclusion, it must be stated that the early conditioning histogenetic stages in both cataphyll and foliage leaf are preceded by a formative phase in which little or no cytological differences can be detected between their respective primordia. Whether such anlagen are "indifferent" or "determinate" in potentiality remains the central unanswered question in the problem of foliar determination. From this standpoint the problem is not necessarily morphological in appeal. In reality, it challenges, in theory as well as technique, modern genetics and physiology.

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MULTIPLE BIRTHS IN ANTHROPOID APES

SUCH meager information as is available indicates that the frequency of multiple births diminishes in the order primates from the Prosimiae to man. It is reported that twins and triplets may be borne by lemurs, although single births are the rule. The occurrence of twins has been observed also in marmosets and baboons, less certainly in gibbons, and there is high probability that multiple births occasionally occur in many, if not all, of the New and Old World monkeys. For the great apes (orang-outan, chimpanzee and gorilla) we have discovered no published accounts of multiple births. This is not at all surprising in view of the following facts: (1) When a wild female ape carries two infants there ordinarily is no assurance whatever that she bore either, still less both, of them; (2) there have been relatively few anthropoid births in captivity, and of those less than a score have been reliably observed and reported; (3) the frequency of multiple births in man is known to be low, ranging from 1.1 to 1.2 per cent. Our experience in breeding chimpanzees in captivity justifies the surmise that the lack of records of multiple births in captive primates is due primarily to the unfavorableness of nutritional, hygienic and social conditions to normal reproductive process.

Because of the facts which we have presented and our desire to supplement our present information by accumulating all pertinent observations, we wish to report the birth of chimpanzee twins in our laboratories.

Between September 11, 1930, and November 21, 1933, ten seemingly normal births occurred in the chimpanzee colony at the Anthropoid Experiment Station of Yale University, Orange Park, Florida. Of these infants all except one, which died within twenty-four hours after birth, are living at the date of writing. With one exception, the births were single. Fraternal twins, a male and a female, were born on June 26, 1933, after an estimated gestational period of 210 ± 5 days. Although somewhat prematurely born, they were normal and their development has proceeded typically and uneventfully.

The father of the twins has been in these laboratories since September 15, 1925. He was purchased from a ship's officer on arrival in Boston Harbor from Africa. The mother was received as a gift from Mr. Pierre S. Abreu on May 13, 1931. Previously she had been kept for approximately fifteen years in the primate collection of Mrs. Rosalia Abreu in Havana. The estimated age of the father at the date of birth of the twins is eleven years, that of the mother twenty years. She is known to have borne three infants previously. A daughter, born March 24, 1926, now in our colony, is the first chimpanzee of dated birth and positively known parentage and life-history to mature sexually in captivity, so far as we have been able to discover from the pertinent literature. She matured during her eighth year.

The chimpanzee twin birth here recorded is the first to come to our knowledge. True, we have seen chimpanzee infants which were exhibited by showmen as twins. Assertion, however, does not establish fact, and in the only instance in which we were able to make direct inquiry it was promptly admitted, after the nature of our interest had been explained, that the animals were not twins.