the temperature 1170° absolute. Actually this radiator is very far from gray and has the temperature 1400° absolute.

Using the valuable method of isochromatics and considering the constant p of equation (4) the writers hope to present later experimental data on the emissivity of carbon. It may be remarked that the intersections used directly give simply the temperature at which a color match is obtained. It is also interesting to note that a non-black material may show the energy distribution of a gray body and still not be gray. That is, it is theoretically possible to obtain a color match against a black body with *certain* materials which have an emissivity coefficient varying greatly with the wave length. It is theoretically possible to have two radiators at different temperatures, one gray and the other far from gray, giving an exact color match, and an exact intensity match at every wave length.

BOTANY.—*Rolliniopsis, a new genus of Annonaceae from Brazil.* W. E. Safford, Bureau of Plant Industry.[1]

Among the plants collected by Messrs. Dorsett, Shamel, and Popenoe while on their mission of agricultural exploration in Brazil, in 1914, there is one of peculiar interest, belonging to the Annonaceae, with 3-winged flowers resembling those of a Rollinia but with clusters of small, one-seeded, orange-colored fruits very much like those of a Guatteria or Aberemoa. A photograph of the flower and fruit was taken in the field, and plants propagated from the seeds were distributed by the Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry, bearing the label "Guatteria sp., S. P. I. No. 37902."

A second species having the same botanical features was brought back from Brazil more recently by Dr. J. N. Rose and Mr. P. G. Russell, who collected it in the state of Bahia, in the summer of 1915, while carrying on botanical exploration under the auspices of the Carnegie Institution of Washington.

For these and two allied plants hitherto assigned to the genus Rollinia (*R. parviflora* St. Hil. and *R. leptopetala* R. E. Fries) must be created a new genus, for which I here propose the name Rolliniopsis.

[1] Published with the permission of the Secretary of Agriculture.

Rolliniopsis Safford, gen. nov.

Flowers resembling those of Rollinia, solitary or in clusters of 2 or 3. Calyx gamosepalous, 3-lobed. Corolla gamopetalous, the lobes corresponding to the outer petals of other Annonaceae produced into three spreading obtuse spurs or compressed rounded wings, the three alternate inner lobes connivent in such a way as to leave only a very small opening above the gynœcium. Stamens minute, numerous, closely crowded on the torus, the connective produced into a thin transverse shield above the pollen sacs, these linear, parallel, and contiguous, opening extrorsely by a longitudinal fissure. Carpels several to many, forming a cluster (gynœcium) in the center of the mass of stamens just below the opening of the corolla; ovaries 1-ovuled. Receptacle (torus) at length indurated and bearing a cluster of distinct fruits, these closely crowded but not concrescent nor compressed into prisms or angular pyramids. Fruits small, pyriform or ovoid, containing a single seed surrounded by a thin layer of aromatic pulp (mesocarp), very much as in the genus Guatteria. Seeds pyriform, obovoid, or ovoid, the thin testa somewhat wrinkled by the inclosed ruminate endosperm and marked by a longitudinal line from the small basal hilum to the rounded apex.

Type species: *Rolliniopsis discreta* Safford.

Geographical range: Brazil, from the State of Bahia to Minas Geraës.

This genus is separated sharply from Guatteria by its 3-winged flowers. From Rollinia[2] it differs chiefly in its fruits, which consist of a cluster of separate, or discrete, carpels instead of a fleshy Annona-like syncarpium. Its relation to Rollinia is very much the same as that of Aberemoa or Duguetia to the genus Annona. The seeds differ from those of a typical Rollinia in their minute hilum; and the fruits, instead of having a sugary, juicy pulp like that of the commercial custard-apples, possess a thin aromatic mesocarp surrounding the seed, very much like that of certain species of Xylopia known in Brazil as "monkey peppers" and in Panama as "*malaguetas*," suggesting also the flavor of the Mexican *xochinacaztli*, or "ear-flower" (*Cymbopetalum penduliflorum*), whose petals were used by the Aztecs as an ingredient of their chocolate.

KEY TO THE SPECIES

Leaf blades oblong-elliptical or oblong-lanceolate.
Nerves 7 to 9 on each side.....1. *R. discreta.*
Nerves 9 to 13 on each side.....2. *R. simiarum.*

[2] Prantl, in an analytical key of the section Xylopieae, briefly distinguishes the genus Rollinia as follows: "Kronenb. über dem holen Grunde seitlich zusammengedrückt; Fr. verschmolzen." Nat. Pflanzenfam. **3**[2]: 35. 1891.

Leaf blades broadly elliptical
Flowers minute; young branches ferruginous-tomentose; leaf blades acute.....3. *R. parviflora.*
Flowers medium-sized (winged petals about 1 cm. long); young branches fulvous-tomentose; leaf blades round-tipped.....4. *R. leptopetala.*

1. **Rolliniopsis discreta** Safford, sp. nov.

A small tree, 6 to 9 meters high. Vegetative branches not observed; flowering branches slender, grayish brown, thickly dotted with gray lenticels and bearing prominent leaf scars. Leaf blades oblong-elliptical, rounded or obtuse at the base, usually rounded or obtuse or sometimes slightly retuse at the apex, variable in size, when normal 7 to 8 cm. long, 2.5 to 3 cm. broad, with 7 to 9 nerves on each side; smaller blades near extremities of branchlets 5 cm. long, 1.5 cm. broad; petioles 5 to 7 mm. long, often recurved, broadly grooved above, clothed with fine grayish tomentum; blades membranaceous but firm, minutely tomentose with short whitish hairs on both surfaces, more densely so beneath; midrib impressed above, prominent beneath and tomentose like the petiole. Flowers (fig. 1) solitary or in 2's or 3's; peduncles extra-axillary or opposite a leaf, straight or curved and wirelike, 10 to 17 mm. long, clothed with minute reddish brown tomentum, subtended at the base by a small sessile tomentose bracteole and usually bearing a second minute clasping bracteole at or below the middle; calyx 3-lobed, clothed outside with reddish tomentum like that of the peduncle, the divisions broadly triangular, 5 mm. broad, 3 mm. high; corolla reddish brown, the 3 lobes corresponding to outer petals compressed laterally into thin orbicular vertical wings 11 to 12 mm. in diameter, minutely tomentellous (as seen under the microscope), the 3 lobes corresponding to inner petals minute, grayish-puberulent, connivent. Stamens numerous, minute (0.6 mm. long, 0.2 mm. broad), with the reddish brown connective expanded above the two straw-colored parallel pollen sacs. Gynœcium composed of about 50 carpels, these remaining distinct and developing into a cluster of small drupes. Mature fruit cluster 4 cm. in diameter; indurated receptacle 8 to 12 mm. in diameter; drupes pyriform, sessile, often somewhat oblique, 12 to 14 mm. long, 7 to 8 mm. in diameter, rounded at the apex and terminating in a short oblique point, gradually narrowing toward the base; pericarp bright orange, turning dark brown in drying; seeds pyriform or obovoid, enveloped in a thin layer of aromatic pulp, 9 to 10 mm. long, 4 to 5 mm. in diameter, the testa light brown, slightly wrinkled by

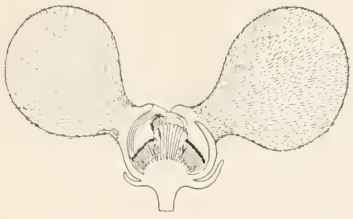

Fig. 1. Flower of *Rolliniopsis discreta*, with portion removed to show crowded stamens surrounding the central gynœcium. Scale about 1.5.

Fig. 2. *Rolliniopsis discreta* Safford.

the corrugations of the enclosed ruminate endosperm, marked on one side by a longitudinal line extending from the small basal hilum to the rounded apex.

Type in the U. S. National Herbarium, No. 865593, collected and photographed at Januaria, State of Minas Geraës, Brazil, February 15, 1914, by Messrs. Dorsett, Shamel, and Popenoe (No. 371 b; photograph, Field No. 1855, File No. 15508; seeds, No. 125a). "A small tree 20 to 25 feet high, common between Januaria and Brejo, 4 miles back from the river. Fruits bright orange; called '*fruta de macaco*' [monkey-fruit]."

EXPLANATION OF FIG. 2.

The type specimen of *Rolliniopsis discreta*, showing flowering branches with leaves, flower, and fruits both immature and mature; *a*, stamen, dorsal view; *b*, stamen, ventral view; *c*, two mature carpels which have fallen from the receptacle; *d*, seed. Branches with flower and fruits, and detached carpels and seed, *c*, *d*, natural size; *a*, *b*, scale 10.

2. **Rolliniopsis simiarum** Safford, sp. nov.

A small irregularly branching tree with small narrow round-pointed leaf blades, 3-winged flowers, and dense clusters of small yellow aromatic berries. Young growth grayish-tomentulose, the branchlets soon becoming glabrous, those of the vegetative growth slender, zigzag, with reddish brown bark sparsely dotted with lenticels, those terminating the limbs often irregular, with grayish bark, short internodes, and prominent leaf scars. Leaf blades variable in shape, those at the base of the branchlets smaller and relatively broader than the succeeding ones; normal leaf blades oblong-lanceolate, rounded or very slightly retuse at the apex, rounded at the base, 8 to 10 cm. long, 2.8 to 3.5 cm. broad, with 9 to 13 nerves on each side, membranaceous, deep green above, paler beneath, yellowish green or olivaceous when dry, apparently glabrous on both faces but as seen under the microscope clothed with scattered minute curved whitish hairs; midrib impressed above, prominent beneath, reddish brown, sparsely clothed with grayish hairs; parenchyma between the lateral nerves divided into polygonal areoles by fine reticulating veins; petioles broadly grooved above, clothed at first with grayish tomentellum, those of the normal leaves 6 to 8 mm. long, of the smaller leaves 3 to 5 mm. long. Flowers (only the detached petals of one flower observed) reddish brown when dry; petals laterally compressed, winglike, suborbicular, abruptly contracted at the base, 11 mm. long, 9 mm. broad; calyx persistent (observed only on dry fruits), 3-lobed, the divisions rounded or obtuse at the apex, 2 mm. broad, 1.8 mm. high; peduncles (only those of fruit observed) at length woody, 12 to 21 mm. long. Fruit a cluster of small distinct sessile carpels borne on the indurated receptacle; mature carpels aromatic, pyriform or obovoid, 8 to 12 mm. long, 5 to 6 mm. in diameter, rounded or abruptly beaked at the apex, gradually narrowed at the base; pericarp glabrous, yellow when fresh, dark brown or blackish when dry; seed solitary, obovoid or pyriform,

sometimes slightly compressed, 7 to 10 mm. long, 4 to 5 mm. in diameter, the testa light brown, slightly wrinkled by the corrugations of the inclosed ruminate endosperm, the hilum basal, small, and inconspicuous.

Type in the U. S. National Herbarium, No. 762291, collected in the vicinity of Machado Portella, State of Bahia, Brazil, June 19–23, 1915, by J. N. Rose and P. G. Russell (No. 19963).

The specific name chosen for this plant was suggested by its Portuguese vernacular name, *fruta de macaco* [monkey fruit].

3. **Rolliniopsis parviflora** (St. Hil.) Safford.

Rollinia parviflora St. Hil. Fl. Bras. Merid. **1**: 30. 1825.

A small tree with rufous-pubescent branchlets. Leaf blades 4 to 6.4 cm. long, 1.8 to 2.5 cm. broad, oblong, acuminate at the apex, acute at the base, glabrous above, puberulous beneath, the midrib prominent, ferruginous-pubescent, the lateral nerves parallel; petioles about 4 mm. long, nearly terete, ferruginous-pubescent. Flowers small, the peduncles solitary, 4 to 6 mm. long, recurved, slightly thickened at the apex, ferruginous-villous. Calyx ferruginous-villous, 3-lobed, the divisions broadly ovate, acute. Corolla 3 to 5 mm. long and broad, villous, green to rufescent, 6-lobed; lobes thick and obtuse, horizontally spreading, those corresponding to the inner petals of other Annonaceae a little narrower than the others, nearly orbicular. Torus convex on top, bearing a cluster of about 15 carpels at its apex and below these a mass of minute, closely crowded stamens (about 1 mm. long). Fruit a cluster of small oblong-ovoid sessile drupes, these 1 cm. long, 5 mm. in diameter, closely crowded on the indurated receptacle, but quite distinct and falling off separately when mature, like those of Guatteria.

Type collected by Augustin St. Hilaire "in sylvis primaevis montis *Tejuca* propè Sebastianopolim [Rio de Janeiro]. Florebat Novembre."

Rolliniopsis parviflora can readily be distinguished from the two preceding species as well as from *R. leptopetala* by the minute size of its flowers and the relatively short and thick lobes of the corolla.

In the type material collected and described by St. Hilaire there were no specimens of fruit and the fruit remained unknown until 1905, when R. E. Fries described it from specimens collected by Riedel in the vicinity of Rio de Janeiro.[3] In the amended description of this

[3] "Die Früchte, die für diese Art bisher nicht bekannt sind, bieten ein sehr eigenthümliches Aussehen dar. Die Einzelfrüchte sind nicht in einem Syncarpium vereint; sie sind länglich eiförmig . . . und sitzen ungestielt auf dem Receptaculum dicht zusammen, unter einander jedoch frei; sie fallen auch von einander getrennt ab, wie z. B. bei den Guatterien. Hierin weicht *R. parviflora* von den allermeisten übrigen *Rollinia*-Arten ab, von denen man Früchte kennt; nur *R. leptopetala* R. E. Fr. hat die Frucht auf ähnliche Weise gebaut."—R. E. Fries, in Arkiv för Botanik, **5**[4]: 20. 1905.

species by Martius[4] the leaves are described as "ovate, ovate-lanceolate, or lanceolate," and two varieties are indicated: var. *α latifolia* and var. *β angustifolia*. Whatever varieties may be established, that which corresponds with the original description of the species must be regarded as the type form ("Rollinia foliis oblongis, acuminatis, basi acutis"). A specimen in the U. S. National Herbarium (No. 703471), collected by Riedel "in sylvis montosis propè Rio Janeiro, 1829," with most of the leaf blades broadly elliptical or oval and acuminate, belongs undoubtedly to the variety *latifolia*. The blades of the smaller leaves at the base of the flowering branchlets of this specimen are orbicular. It is quite possible that the leaves of vegetative branches would be relatively narrower, like those of the type described by St. Hilaire.

DISTRIBUTION: Known only from Brazil. Primeval forests of Mount Tejuca, vicinity of Rio de Janeiro, *St. Hilaire* (type, as cited above); *Glaziou* 6077; Mount Gabia and neighboring hills, *Martius*, *Sellow*, and *Lhotzky;* Serra Tinguá, *Schott;* Rio de Janeiro, without definite locality, *Sellow*, *Riedel;* "Versant de Copacabana," January 26, 1870, *Glaziou* 3859; without definite locality, *Glaziou* 2120.

4. **Rolliniopsis leptopetala** (R. E. Fries) Safford.

Rollinia leptopetala R. E. Fries, Kongl. Sv. Vet. Handl. **34**[5]: 50. *pl. 7, f. 3, 4.* 1900.

A tree or shrub, with gray to blackish gray bark, that of the young branches dotted with numerous light-colored lenticels; young branchlets, petioles, and peduncles tomentose with projecting yellowish hairs. Leaf blades broadly elliptical, rounded at the base and rounded or subemarginate at the apex, variable in size, reaching the dimensions of 8 cm. in length and 4.5 cm. in breadth, membranaceous, clothed on the upper surface more or less densely with short white hairs, at length glossy though still bearing scattered hairs; on the lower surface clothed with a uniform tomentellum of yellowish white hairs; midrib impressed above, beneath prominent, reddish brown like the principal lateral nerves (6 to 8 on each side); petioles 5 to 8 mm. long, narrowly grooved above. Peduncles 1 to 1.5 cm. long, bearing at the base and at the middle two small acute hairy bracteoles (1 mm. long). Flowers red, fragrant. Calyx lobes 2 mm. long, 2.5 mm. broad, rounded and abruptly acuminate at the apex, united at the base, clothed outside with reddish hairs, glabrous within. Outer petals obtuse, each bearing a thin ferruginous-pilose, rounded or cuneate wing 8 to 11 mm. long and, near the rounded apex, 6 to 8 mm. broad; inner petals (corolla lobes) 2.5 mm. long, 3 mm. broad, suborbicular, obtuse, clothed outside with minute grayish hairs, glabrous within. Stamens scarcely 1 mm. in length. Fruit (observed only on 1 specimen) spheroidal, 1.5 cm. in

[4] Fl. Bras. **13**[1]: 19. 1872.

diameter, composed of a few smooth ovoid carpels 8 mm. by 6 mm. in size, borne on the indurated receptacle. Seeds oval, 7 mm. long, 5 mm. in diameter, light yellow, smooth.

Type in the Berlin Botanical Museum, collected in the state of Piauhy, Brazil, in 1840, by George Gardner (No. 2033).

Fries compares the leaves of this species to those of *Rollinia longifolia*, which, however, are relatively narrower and are not rounded at the apex. He says that the flowers and fruit are more like those of *Rollinia emarginata*, but specimens of the latter in the U. S. National Herbarium show its fruit to be a solid syncarpium. To this species he assigns as a variety, *angustifolia*, a plant in the Berlin Botanical Museum collected at Rio de Janeiro by Glaziou, No. 13508, but of this he figures only a single leaf and gives no account of the flower or fruit. In his figure of the type[5] the wings of the corolla are shown as different from those of *Rolliniopsis discreta* in size and form, and the mature carpels as ovoid instead of pyriform as in the latter species; moreover he describes *R. leptopetala* as a tree or shrub with "ramulis, petiolis, pedunculisque fulvo-tomentosis" . . . . and its "jüngsten Sprosse von abstehenden gelblichen Haaren wollig." These characters readily serve to disinguish his species from both *R. discreta* and *R. simiarum*, as well as from the ferruginous-tomentose *R. parvifolia*.

PLANT PHYSIOLOGY.—*A field auxanometer.* G. N. Collins and J. H. Kempton, Bureau of Plant Industry.

In studying the effect of different environmental factors, such as light, temperature, and water supply, on the rate of growth of maize varieties, the lack of some means of measuring the elongation of plants growing naturally in the field has for several years been recognized as a serious obstacle. There are two principal requirements in securing satisfactory measurements: (1) In order to ascribe any observed difference in the behavior of two varieties to its environmental cause it is necessary to make the measurements at short intervals; (2) that due allowance may be made for individual diversity, it is essential to make simultaneous measurements of a number of plants. These conditions have been met by devising a form of auxanometer well adapted to

[5] Op. cit. *pl. 7, f. 3, 4.*