

trisomics. In the trisomics, at division I, the extra chromosome was found to lie outside the metaphase plate, as a univalent (Fig. 4) or was found paired with its homologues forming a trivalent.

The progenies of all these plants will be studied during the next season and a fuller report of the work will be published elsewhere.

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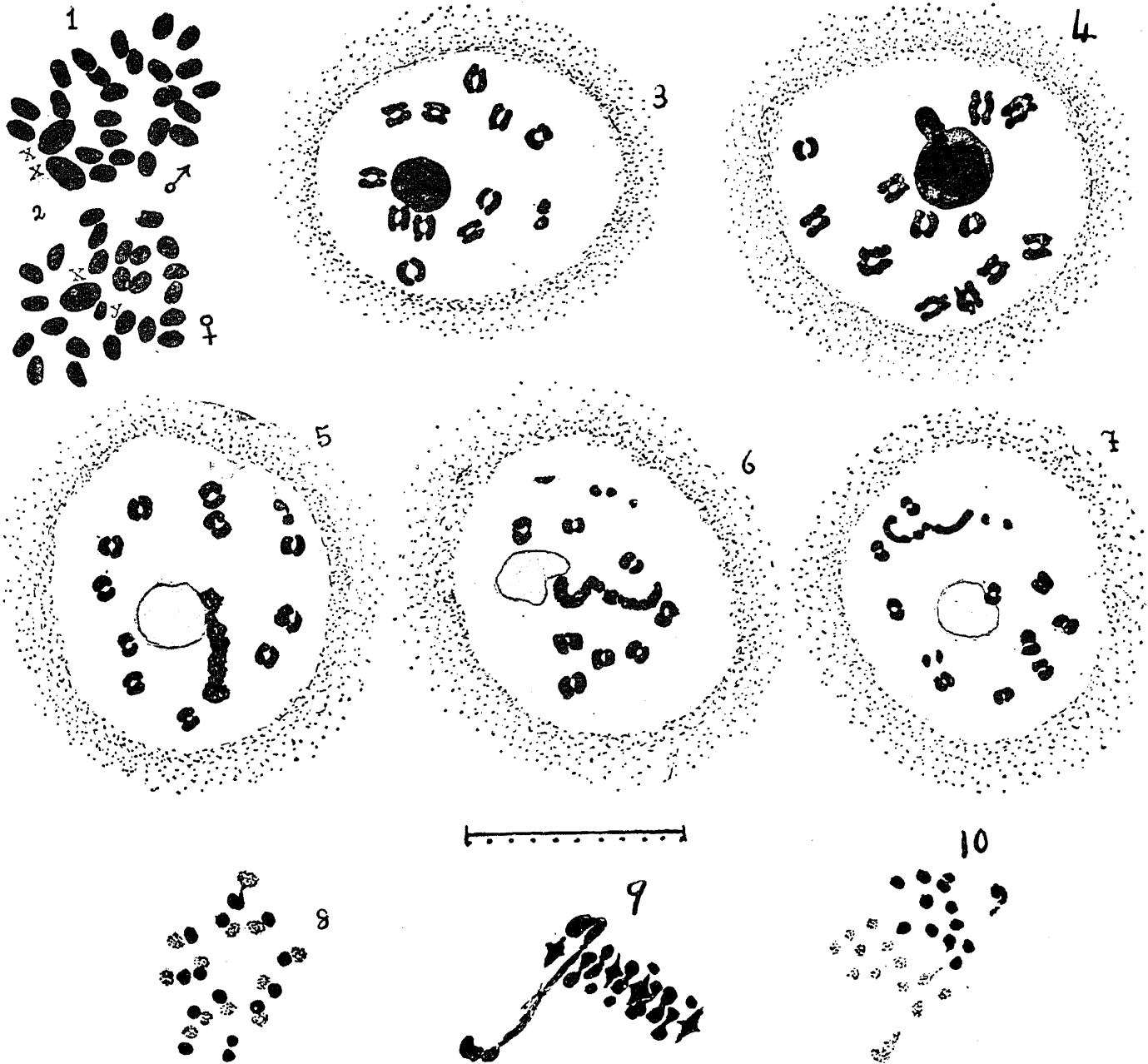
Sex Chromosomes of *Coccinia indica* Wight and Arn.

Coccinia indica Wight and Arn. is a dioecious species belonging to the Natural Order Cucurbitaceæ. Chromosome numbers of *C. hirtella* ($2n = 24$) and *C. indica* ($n = 12$) have been determined by McKay¹ and Sutaria² respectively. In a detailed study of the behaviour of chromosomes during mitosis and meiosis of normal and parthenogenetically developed male and female plants of *C. indica* the authors have observed that thirteen chromosomes in the gametic and twenty-six in the somatic tissues are most frequently met with. Of the twenty-six chromosomes in the female, twelve pairs were of uniform size and the thirteenth was heteromorphic in that one chromosome of the pair was bigger and the other smaller than any of the remaining chromosomes of the complement (Fig. 2). Similarly in the male, twelve pairs were of uniform size and equalled in size the corresponding pairs in the female. The thirteenth pair in the male was homomorphic and consisted of two large chromosomes, which were as large as the large chromosome in the heteromorphic pair of the female (Fig. 1). It was also observed that the largest and smallest chromosome in the female and the two largest ones in the male show somatic association during mitosis (Figs. 1 and 2). The heteromorphic pair (XY) of the female and homomorphic

pair (XX) of the male constitute the sex chromosomes of *Coccinia indica*. This observation was further confirmed by the behaviour of the sex chromosomes during a study of meiosis in microsporogenous tissue.

The chief feature in the development of sex chromosomes during meiosis in *C. indica* is the delay in their origin. They do not appear until the autosomes have undergone considerable longitudinal contraction and have reached the late diplotene stage. Fig. 3 shows the twelve bivalents at diakinesis stage with the pair of sex chromosomes not yet formed. At about this stage from the persistent nucleolus an outgrowth arises which later extends out to form a coiled structure (Figs. 4 and 5). Still later this detaches itself to form the homomorphic pair of sex chromosomes each with a secondary terminal constriction (Fig. 6). From his study of the behaviour of nucleolus Mensinkai³ concludes that there is an exchange of material between nucleolus and chromosome. Gates⁴ in his review of the association of the nucleolus with Sat-chromosomes and chromosomes with secondary terminal constriction brings out the fact that these chromosomes are responsible for the organization of the nucleolus at telophase. The method of formation of sex chromosomes as observed in *C. indica* during prophase appears to show the reverse process of what happens at telophase in other cases. In telophase the chromosome organize the nucleolus and in prophase nucleolus organizes the chromosome from which it had previously arisen.

During microsporogenesis the sex chromosomes of *C. indica* are further characterized by their end association due to the presence of a single terminal chiasma in the shorter arm (Figs. 6 and 7). There is a differential condensation of the longer and the shorter arms and the longer arm shows negative heteropycnosis (Figs. 6 and 7). The non-pairing of the longer arm, differential staining, negative heteropycnosis and complete absence of chiasmata appear to indicate that the longer arm represents a genetically inert region. This inference is also strengthened by the observation of end association between the short arms only. At



metaphase the sex pair invariably orientates itself along the edge of the equatorial plate as in sex chromosomes of rat (Koller and Darlington⁵).

During anaphase the sex chromosome pair shows precocious separation (Figs. 9 and 10) due to the presence of a single terminal chiasma on it and the twelve autosomal pairs having two interstitial chiasmata each, separate subsequently (Figs. 3 and 9). Anaphasic separation of the sex chromosome pair shows a chromatid bridge between the genetically active short arms (Fig. 9). Precocious separation and bridge formation as observed in *C. indica* also appear to be a common feature of the sex chromosomes

of the dioecious species in both dicotyledons and monocotyledons studied by Sinoto.⁶ Occurrence of such a chromatid bridge in the sex chromosomes and their precocious separation, according to Darlington, is better explained due to genetic effect than due to inversion.

Association of sex chromosomes with nucleolus has been observed in insects and in Hepatocæ among the Cryptogam. In Figs. 4-6 the association of sex chromosomes with nucleoli is clearly evident. Such a type of association among higher flowering plants has so far not been reported and the present instance in *C. indica*, therefore, appears to be the first of its kind.

Heterogametic (XY) condition of the female, such as it exists in *C. indica*, is very rare in plants. It has so far been observed in *Fragaria elatior* by Lilienfeld.⁷ In *C. indica* parthenogenetically developed plants in which the male element has been completely excluded have been observed to segregate into male and female individuals during three successive parthenogenetic generations, showing that it is the female which is heterogametic. This is corroborated by the heteromorphic (XY) pair of chromosomes observed during mitosis in cells of the root tip of the female plants. This inference of heterogametic condition of the female is further confirmed by the statistical analysis of the size variation of the pollen grains. Frequency distribution of the pollen-size variation gives a sharp unimodal curve indicating the homogametic condition of the male. In those cases where male is heterogametic such curve is bimodal (Greguss Pal⁸).

From cytological study, segregation of parthenogenetic progenies and pollen analysis, it is clearly evident that the female of *C. indica* is heterogametic and the male homogametic.

L. S. S. KUMAR.

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¹ McKay, J. W., *Bot. Gaz.*, 1939, 89, 416.

² Sutaria, R. N., *Jour. Univ. Bombay*, 1936, 4, 21.

³ Mensinkai, S. W., *Ann. of Bot., N.S.*, 1939, 3, 763.

⁴ Gates, R. R., *Nature*, 1939, 144, 794.

⁵ Koller, P. C., and Darlington, C. D., *J. Genet.*, 1934, 29, 159.

⁶ Yosiro Sinoto, *Proc. Imp. Acad. Tokyo (Japan)*, 1928, 4, 175.

⁷ Lilienfeld, J. A., *Japanese Jour. Bot.*, 1936, 8, 119.

⁸ Greguss Pal, *Mathematische Naturw. Ungarische Akademie*, Budapest (Hungary), 1927, 44, 378.

Macadamia ternifolia F. Muell., the Queensland Nut

THE writer published an account of floral anatomy and embryology in *Macadamia ternifolia* F. Muell. some two years ago¹ and subsequently some further observations about the floral vascular structure were made in the same plant.

These necessitated the publication of a second paper as a supplementary contribution to the subject. After the final preparation of this for the press (the paper has now appeared in the January issue of *Current Science*, 1940),² the writer came across a paper by Hartung and Storey³ on "The Development of the Fruit of *Macadamia ternifolia*" in a recent number of the *Journal of Agricultural Research*. Evidently, these authors have not had any access to the first paper by the writer on *Macadamia*,¹ for they make no reference to it which contains a description of many interesting features in the development of the ovule.

Hartung and Storey³ describe the development of the integuments of the ovule and point out at great length that in the formation of a hard shell in the mature seed it is only the outer integument that takes part, thus contradicting the earlier opinion of Francis¹ who regarded the shell as a combined testa and tegmen. In this connection it must be noted that the present writer had already stated in his first paper on *Macadamia*¹ that the shell is "formed by the outer integument" and that "within this hard coat are the thin and crushed inner integument, a few surviving layers of the peripheral portions of the nucellus and the remnants of the endosperm". He had further remarked that "all these are pressed firmly together and fusing with"—better, clinging to—"the outer hard coat of the seed, form a smooth and shining internal lining for the outer integument." Hartung and Storey³ further discuss the nature of the fruit and remark that during their study "considerable doubt arose as to the accuracy of the generally accepted classification of the fruit as a drupe and of the shell of the nut as an endocarp or putamen". They call attention to the statement by Francis¹ that "A considerable amount of confusion exists in the descriptions of the fruit in systematic, botanical literature" and state that "He advances evidence in support of the fact that the nut is truly a seed and the fruit in which it is contained is not a drupe but a follicle." It is thus clear that the term *nut* may only be retained for common usage and for the purposes