THE PRODUCTION OF A THELYTOKOUS HYBRID IN AN INTERSPECIFIC CROSS BETWEEN TWO SPECIES OF *TRICHOGRAMMA* (HYM. : TRICHOGRAMMATIDAE)*

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AS discussed by Mayr (1963), the occurrence of animal hybrids in nature is relatively rare, but in the laboratory where isolating mechanisms can sometimes be overcome, two species which normally do not hybridize in nature can be induced to do so. Most interspecific hybridization studies involving insects have dealt with *Drosophila* (*e.g.*, Patterson and Stone, 1952) or mosquitoes (*e.g.*, Laven, 1959), while some work has also been done with Coleoptera (Smith, 1959 and 1962).

Recent work done with *Aphytis* spp. (Hymenoptera, Aphelinidæ) by Rao and DeBach (1969 *a*, 1969 b) has shown some interesting possibilities in parasitic Hymenoptera, including the production of substantial degrees of reproductive isolation in a single step between hybrids in certain interspecific crosses and the parental species (Rao and DeBach, 1969 *c*). These authors have suggested that such hybrids could be considered to be semispecies, in view of their being partially reproductively isolated from their parent species and further that if *complete reproductive isolation* had been encountered, the hybrids would then qualify for species status. The production of such "laboratory-created species" of parasitic insects would be of special interest to biological control workers, since introduction of such a "species" having an altogether different genotype and possibly also different biological characteristics would be equivalent to introducing an exotic species.

During the course of interspecific hybridization experiments with egg parasites of the genus *Trichogramma*, a single "hybrid" was obtained which seemed to be unique. The two species used in this particular cross were biparental and arrhenotokous, so that any females in the F_1 generation were believed to be unquestionably hybrid. (The possibilities of these *not* being hybrids is discussed later.) The cross involved females of *T. perkinsi* Gir., a parasite of *Diatræa saccharalis* (F.) in Colombia (South America) and males of *T.* D-67, a parasite of *Hemerocampa pseudotsugota* McD. in north-eastern California. The identity of the latter is not quite clear as yet, hence a code name is being used. Five vials, each with 5 virgin females of *T. perkinsi* and 2-3 males of *T.* D-67 were prepared for mating. Extreme care was taken to see that the cultures were pure and that no *perkinsi* males had access to the *perkinsi* females used in the experiment. To ensure their virginity, females from individually isolated parasitized eggs of the laboratory host, *Corcyra cephalonica* Staint., were used. The cross was set up in the manner described by Nagarkatti and Nagaraja (1968), the progeny being isolated after eggs of *Corcyra* had been parasitized.

A total of 17 females ("hybrids") were obtained in the F_1 generation. As had been standard practice, a single virgin "hybrid" female was given host eggs for parasitization with a view to obtaining hybrid males, while the remaining "hybrid" females were kept separately. Surprisingly, all the progeny produced by the single virgin female proved to be *females* and not males as had been expected. The F_2 progeny and the offspring in each subsequent generation of this single individual have all demonstrated thelytoky, whereas all the remaining 7 F_1 females (9 females out of the 17, died before they could be tested) proved to be arrhenotokous.

Amongst possible explanations which can be proposed for this phenomenon, are the following :

1. That thelytoky was produced as a result of hybridization. Certain genetic changes, as yet undetermined, may have been responsible for the development of thelytoky in the F_1 female.

2. That the female was not really a hybrid, but an impaternate female that was produced from patches of tetraploid ovarian tissue in the parental *T. perkinsi* female. This phenomenon has been reported by Speicher and Speicher (1938) in the F_1 from crosses between certain mutants of *Habrobracon juglandis* (Ashmead). In *Habrobracon*, the F_1 females apparently produce a small proportion of females regularly, which originate from tetraploid tissue in the parental female.

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3. That other mechanisms were responsible for restoration of diploidy, such as, fusion of products of meiosis or fusion of cleavage nuclei.

It is not known whether there occur in the ovaries of any species of *Trichogramma*, much less of *T. perkinsi*, patches of tetraploid tissue, which could possibly have given rise to the single thelytokous female. This will have to be determined by isolating very large numbers of *T. perkinsi* and checking the progeny of unmated (virgin) females for any rare parthenogenetically-produced females. On the basis of past experience, however, this seems very unlikely. The cytology of these insects is also poorly understood, and since the chromosomes are extremely small, detection of any genetic changes becomes difficult. Preliminary studies to see whether the hybrids are polyploids have indicated that they are not. At present, therefore, the alternative explanations given above seem equally probable and there could very well be others.

The interesting fact, *if* the thelytokous female is indeed of hybrid origin, is that, a line derived from this female would be equivalent to a "laboratory-created species", as the individuals would then obviously have a genetic make-up quite unlike that of either of the parent species, although phenotypically they may be identical to their maternal parent (as has been found to be true of all *Trichogramma* hybrids hitherto observed by the author). Being thelytokous, any beneficial gene combinations would be reproduced faithfully generation after generation. This statement would, of course, also hold true for any deleterious gene combinations, but if such should be present, the ill-adapted line would peter out in any event. As pointed out by Rollins (1967), although apomixis confers certain advantages on a species, its evolutionary future is pretty well thwarted.

Flanders (1945) has stated that thelytoky may occur in any species of *Trichogramma* and its occurrence in some species may be sporadic and conditioned by undetermined environmental factors. But we do not really know how frequently a biparental species produces uniparental clones. Attempts are being made by the author to determine this in the case of *T. perkinsi*. The 5,932 progeny of 101 virgin (unmated) *perkinsi* females have, however, proved to be exclusively male. If the number is as rare as one in ten million or even one in a million, it would scarcely be feasible to determine this.

Records of sporadic production of thelytokous individuals in species of arrhenotokous Hymenoptera appear to be few and far between. Webster and Phillips (1912) have reported the work of Messrs. Kelly and Urbahns on *Lysiphlebus* (*Aphidius*) *testaceipes* Cress. in which females were produced parthenogenetically by the normally biparental species. The progeny of a single mated female were isolated by them in the pupal stage. From these, 48 virgin females were selected for study. The progeny of 44 of these proved to be entirely male, but 3 of the remaining 4 virgin females produced a small proportion of (10) females amongst the otherwise predominantly male progeny (238). Of these three cases, the offspring from one female were not checked further; the offspring of the second female became all males in the second generation, all eventually becoming males in the third generation. It, therefore, appears that the ability to reproduce female offspring parthenogenetically did not last for more than one or two generations, as it did in the case of the *Trichogramma*. Commenting on these results, Webster and Phillips say that, "While the conditions under which these experiments were conducted would not obtain under ordinary field conditions where the infestation was great, it could very easily occur where there are very few aphids present. This apparently abnormal feature, then, would greatly assist the species in tiding over periods of scarcity of plant-lice."

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PSEUDODIAPTOMUS JONESI, A NEW CALANOID COPEPOD FROM INDIAN WATERS*

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INVESTIGATIONS carried out on the Calanoid Copepoda of the family Pseudodiaptomidæ of the Indian Ocean reveal that so far twenty-one species and one sub-species have been described or recorded from this area (Sewell[1,2]; Brehm[3-5]; Nicholls[6]; Tanaka[7]; Ummerkutty[8]; Desai and Bal[9]; Grindley[10]; Wellershaus[11]; Grice[12]). These are : *Pseudodiaptomus annandalei* Sewell (= *P. dubius* Kiefer ; = *P. nostradamus* Brehm) ; *P. aurivillii* Cleve ; *P. ardjuna* Brehm ; *P. binghami* Sewell ; *P. binghami malayalus* Wellershaus ; *P. batillipes* Brehm ; *P. burckhardti* Sewell ; *P. clevei* A. Scott ; *P. charteri* Grindley ; *P. cornutus* Nicholls ; *P. dauglishi* Sewell ; *P. heterothrix* Brehm ; *P. hickmani* Sewell ; *P. lobipes* Gurney ; *P. masoni* Sewell ; *P. marinus* Sato ; *P. mertoni* Fruchtl ; *P. pauliani* Brehm ; *P. salinus* (Giesbrecht); *P. serricaudatus* (T. Scott) (= *P. nudus* Tanaka); *P. stuhlmanni* (Poppe and Mrazeck) and *P. tollingeræ* Sewell. While examining material of Pseudodiaptomidæ from Indian waters a hitherto undescribed species has been encountered in the samples collected from Cochin Backwaters and Palk Bay and this paper embodies a description of the new species.

Pseudodiaptomus jonesi Sp. Nov.
(Fig. 1 *a-l*)

Pseudodiaptomus ardjuna (*nec.* Brehm, 1953) Wellershaus, 1969, pp. 259, 262 ; Fig. 24.

Material.—Collections obtained by horizontal tows along surface by 50 cm. diameter conical net as follows : (1) *Cochin Backwaters* : 17–12–1968, between 07·50–08·00 hr. (4 M, 12 F); 21–1–1969, between 08·03–08·13 hr. (6 F); 4–2–1969, between 07·40–07·50 hr. (1 M); 11–2–1969, between 08·10–08·20 hr. (6 M, 4 F); 18–3–-969, between 08·00–08·10 hr. (6 M, 6 F); 11–3–1969, between 08·00–08·10 hr. (1 M, 1 F): (2) *Palk Bay* : 22–6–1959, between 06·00–06·15 hr. (10 M, 20 F).

Type material.—Holotype, C.M.F.R.I. No. 151. Female, 1·180 mm., and *Allotype*, C.M.F.R.I. No. 152. Male, 0·968 mm., both from Cochin Backwaters collected on 18–2–1969 from surface. *Paratypes* C.M.F.R.I. No. 153, include 55 adults (31 F, 24 M) collected on 4, 11 and 18 February and 11 March 1969 from Cochin Backwaters and on 22 May 1969 from Palk Bay as listed above. Type specimens are deposited in the Research Collections of Central Marine Fisheries Research Institute, Mandapam Camp.

Description.—Female : Total length for 33 adults range 1·14–1·18 mm., with mean length 1·16 mm. ; Cephalon distinct from T-I and is

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