number being the same for both. Hence the sex determining mechanism is of the XY/XX type. The possession by *T. robustula* of 7 extra pairs of large meta/submeta-centric autosomes, with a corresponding reduction of 14 pairs of acrocentrics, can be explained by Robertsonian-type translocations, resulting in differences in chromosome number but maintaining the same total number of chromosomal arms (fundamental number) in the complement. A parallel case has been reported in the tobacco mouse (*Mus poschiavinus*) and the house/laboratory mouse (*Mus musculus*) with 26 and 40 chromosomes respectively[7,8]. Similar examples have also been described in other vespertilionid bats[6].

On karyological grounds, the 2 species of *Tylonycteris* can be said to be closely related, and their karyological difference is most likely the result of Robertsonian-type translocations. The present finding also throws more light on the karyotypes of closely related mammalian species and their importance as isolating mechanism. In the present case, these sympatric bat spedies exhibit great differences in chromosome number (46 in *T. pachypus* and 32 in *T. robustula*), which probably effectively maintain the 2 species distinct despite their occupying the same ecological niche. Although there is no direct evidence, the assumption is supported by a parallel situation found in 2 species of mice. In the tobacco mouse and the laboratory mouse, experimental evidence indicated marked reduction of fertility in the F_1 hybrids and the subsequent generations[7,8]. Furthermore, no intermediate karyotype has been found in the present materials of *T. pachypus* and *robustula* although they were collected from the same locality. The same mechanism probably also operates in 2 sibling rat species, *Rattus rajah* and *R. surifer*, with $2n = 36$ and $2n = 52$ respectively[9,10]. On the other hand, closely related rat species such as *Rattus edwardsi* and *R. sabanus*, which are normally non-sympatric, have the same diploid number[11,12]. The hypothesis that sympatric closely related species possess markedly different karyotype while allopatric closely related species possess rather similar karyotype is under investigation.

Zusammenfassung. Zwei sympatrische, nahverwandte Fledermausarten, *Tylonycteris pachypus* (Temminck) und *T. robustula* Thomas, besitzen 46 beziehungsweise 32 Chromosomen, was offenbar den Robertson'schen Translokationen zuzuschreiben ist.

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Inherited Semisterility for Control of Harmful Insects. III. A First Field Experiment

Several authors have suggested chromosomal aberrations (translocations, pericentric inversions) and the ensuing semisterility of heterozygotes as a means for control of harmful insects[1,2]. Mosquitoes seem to be very suitable for such an approach because translocations can be induced in this group in high yield[3] and with all degrees of sterility[4].

In a cage experiment in which semisterile males of *Culex pipiens* were released into a stable population, eradication could be achieved in 4 to 5 generations[5]. This theoretical success has led us to try a first small scale field experiment against the same species. That experiment was supported by the Entente Interdépartementale pour la Démoustication du Litoral Méditerranéen and took place during the summer and fall 1970.

In the experiment to be described here we used a laboratory strain with a translocation between the male-determining sex chromosome and an autosome giving a semisterility of about 50%. In such a case all males are semisterile and the translocation is inherited to all male offspring. That might not be the most effective type of translocation for control but it has the big advantage that it can hardly become homozygous. Therefore males of this kind can be released in any number into a natural population without fear that the translocation could become homozygous in the population and could cancel the temporary influence of heterozygosity.

The experiment was conducted in a small village 16 km north of Montpellier (Southern France). There a big abandoned well showed heavy breeding of *Culex pipiens*. Other potential breeding places were most of the time without larvae. The well was chosen because of its relative isolation and because of the fact that the daily production of adult mosquitoes in it could easily be measured. Mosquitoes ready for oviposition could only enter the well through 2 subsoil channels leading waste water into the well. Otherwise the well was totally closed. The top had a manhole which was normally also tightly closed. We opened this manhole and put a trap on it. In this way we could catch all new born mosquitoes leaving the well during the night for feeding.

As can be seen from Figure 1 the population in the well increased from a few hundred animals borne per day early in July towards middle of July to a peak of 2,400 per day. At the end of July the production was up to about 3,700 new adults per day. During the night 26/27th of July the trap had been turned over by storm, therefore the night-catch was suddenly interrupted (hatched part of the curve in Figure 1). But the opening of this easier access to the well had obviously attracted many more gravid females

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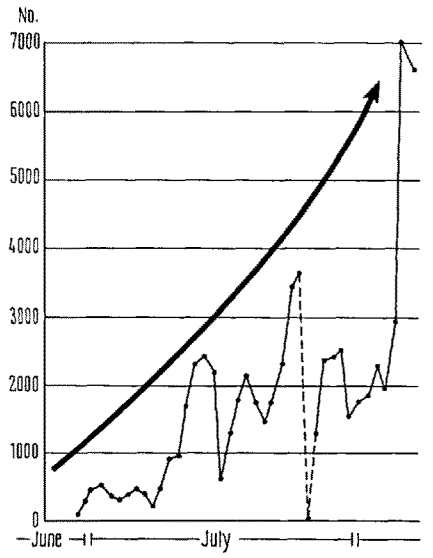

Fig. 1. Daily production of adult mosquitoes *Culex pipiens* in an isolated breeding place (well) in Southern France during June, July and early August.

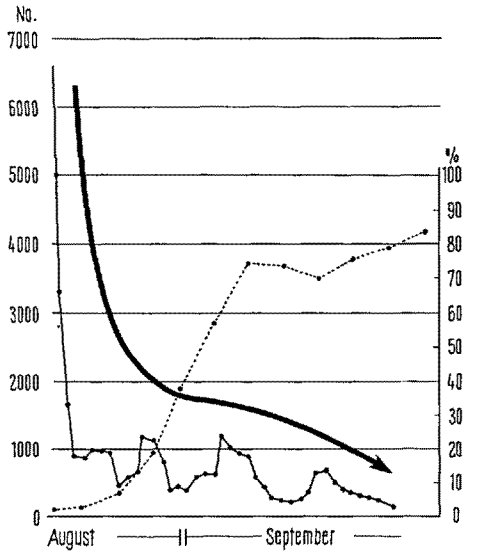

Fig. 3. Daily production of adult mosquitoes after continous release of translocation males. Full line, production; hatched line, percentage of egg rafts with semisterility.

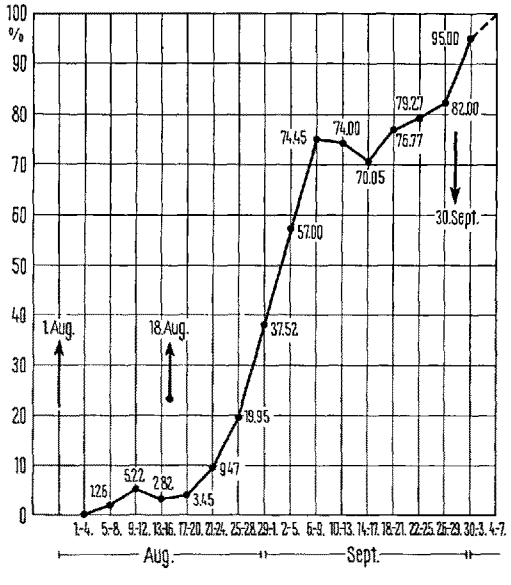

Fig. 2. Percentage of egg rafts with semisterility after release of translocation males. Begin of releases August 1st, releases in sufficient numbers August 18th, end of releases September 30th.

during that night than naturally would have entered through the more difficult subterraneous channels. As a consequence of this very much higher influx of gravid females, the production in the well increased to a maximum of about 21,000 animals per day on August 11th and 12th (not shown in Figure 1).

These figures show clearly the increase of an isolated population as it can be expected after the end of hibernation and during the first spring and summer generations. There seem to be 2 waves of generations, about 4–5 days apart, manifested in the double peaks at the end of June, in the middle and at the end of July. The next double peaks are obscured by the accidental population explosion mentioned above. If the interpretation of the different peaks as separate generations is correct, a natural factor for increase can be deduced. In the beginning there was an increase of 4.7 and 4.8 fold, the following generation was 1.4 and 1.5 times bigger than the preceding. The final increase had been about 2 fold. It seems to us to be adequate to point to this natural increase of the population for a better comparison with the later events after the release of translocation males. Due to technical reasons the first males could only be released on 1. August. So the conditions for control were rather unfavorable (high number of production, constant increase). Furthermore the numbers of released males were for about 3 weeks inadequate, i.e. the ratio of naturally born males and translocation males did not reach equality. Only on August 18th was the ratio 1:1 attained. Considering the late start of the experiment, all available translocation males were released from August 18th. The average release ratio for the remaining part of August and for the month of Sepember was about 5 translocation males against 1 natural male. The releases were stopped on September 30th.

Three questions can be asked in such an experiment and the figures obtained in our experiment will give the answer to at least part of them. The questions are: 1. Will translocation heterozygotes, in this case males, copulate in the field with normal females? 2. Is it possible to introduce a translocation into a natural population up to the point that all members of the population, in our case all males, become translocation heterozygotes? 3. What influence will have the inherited semisterility on the reproductive potential of the population?

The answer to the first question was obtained very soon after the first releases of the translocation males. Already on August 6th, i.e. on the 5th day after release of the first 200 males into the natural population, containing at that time approximately 1,000 new-born normal males, the first egg rafts were found with reduced hatching due to the translocation semisterility. Therefore we had proof that there did not exist any isolation mechanism between our laboratory strain and the natural population. This population was a mixture of autogenous and anautogenous biotypes. Our translocation strain was a pure autogenous type. It has been claimed by several authors that there is

isolation between the 2 types. But the fact that natural populations in the southern parts of the distribution area of *Culex pipiens* (Mediterranean area) show varying degrees of autogeny, does not support this view. Our experiment weakens it still more.

We are convinced that our released males were equal in competitiveness to the natural males or still better. Before the translocation strain was built up for mass production it had been subjected to a rigorous selection by overpopulation in the rearing containers. Furthermore, the translocation males were outcrossed to normal females from wild populations. In this way the fitness of the males intended for the releases was still more enhanced due to hybrid vigour.

The second question, whether the translocation could be introduced into the population to the saturation point, could also be answered in the positive. Figure 2 shows the percentage of egg rafts with reduced hatching due to copulations of wild females with translocation males. The percentage remains low during the first 3 weeks. However, after releases in a ratio of 1:1 and up to an average of 5:1 from on August 18th, the percentage rises very quickly to about 75% in the course of 3 weeks. At that point a cold spell did bring about a stagnation of the percentage. Newborn females were entering into hibernation after they had copulated and were therefore no longer contributing to the percentage figures. But after a stagnation period of somewhat more than 1 week, the percentage was again increasing and went up to 95% or more at the end of September. At that time the number of egg rafts in the open was rapidly decreasing and releases were terminated on September 30th.

It is obvious from the figures presented in Figure 2 that the translocation had been introduced into the population. In fact the saturation point had already been attained before the stagnation period. The saturation point is that percentage of semisterile crosses, that produces more semisterile offspring than normal ones. With the translocation used in the present experiment, giving 50% semisterility, the saturation is obtained with 66% semisterile egg rafts. In this situation equal numbers of normal and semisterile males are produced. When more than 66% of egg rafts show the semisterility, the semisterile males will be more numerous. If both types of males, normal and semisterile ones, have the same reproductive capacity and if the population is totally isolated, the semisterile ones will increase automatically and the normal ones decrease. Normal males will finally disappear and the population will reproduce on the decreased level imposed by the translocation semisterility.

The third question, whether our measures had an influence on the population size, can also be answered, although not in such convincing way as the former questions because comparative data from similar populations without treatment are not available. It can only be stated in a general way that breeding of *Culex* in other villages was still going on without obvious decrease or stagnation at least to the second part of September. Our treated population, however, revealed a decrease in production (Figure 3) parallel to the release of translocation males. After the highest peak in the middle of August there appear still 2 minor peaks towards end of August and early in September. The last peak after the middle of September is already lower and afterwards the production is tapering off. Under normal conditions the population density would at least have remained on the level of early August, but would most probably have still increased. Our releases had the effect that the production did decrease in about 2 months' to a level of about 10% or less of the normal potential.

The present experiment of releases of translocation animals into a natural population is the first of its kind. Considering the late beginning of the releases under difficult conditions, it has nevertheless proved that semisterility can be used with success for control. With the translocation applied here, giving only 50% sterility, it is definitely not possible to eradicate a population. But is total eradication really the ideal goal that should be attained by all means? Depression of the reproductive potential of a population of harmful insects to a level which will, for example, make disease transmission no longer possible, or will minimize economic losses to a bearable extent, seems for various reasons to be more desirable than eradication. With the development of strains with two or more translocations, presently undertaken and already accomplished to some extent, the depression level can be fixed at any point, with other word, we impose birth control on natural populations. The results in producing translocation systems in other insects besides mosquitoes leads us to expect that the translocation method could be developed and applied with the same result against all harmful insects.

Zusammenfassung. Fortlaufende Freilassung von semisterilen Männchen in eine isolierte Freilandpopulation von *Culex pipiens* führte zu einer Verminderung dieser Population auf 10% der maximalen Populationsgrösse.

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On the Relative Position of the Centromere of Chromosome 3 in *Drosophila melanogaster*

According to Lindsley and Grell[1], the chromosome region with the locus Kinked (Ki 3-47.6) in *D. melanogaster* is located on the left arm of chromosome 3, proximal to the centromere. This is a contradiction to the following results, which indicate that the Kinked-region is localized close to the centromere on the right chromosome arm.

The large autosomes, chromosomes 2 and 3 of *Drosophila* are metacentric with a left and a right arm (2L *2R; 3L *3R, asterisks symbolize the centromere). In the laboboratory of E. B. Lewis[2] compound autosomes, sometimes called isochromosomes, with 2 equilateral arms attached to 1 centromere, were constructed (2L *2L and 2R *2R; 3L *3L and 3R *3R).

If virgin females, carrying standard chromosomes, are crossed with males from a compound stock, most of the

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