the production of $^{14}CO_2$ by rabbit sperm or by kidney cells obtained from rat, boar or rabbit.

Discussion. The isolation of β-chlorolactaldehyde (**III**), by means of its 2,4-DNP derivative, as a primary metabolite of α-chlorohydrin indicates that rat and boar sperm are capable of oxidatively metabolizing α-chlorohydrin via the aldehyde (**III**) to β-chlorolactate (**IV**). That rabbit sperm and isolated kidney tubules of the rat, boar or rabbit do not carry out this conversion is interesting since there is a direct correlation with the ability to oxidize α-chlorohydrin and an inhibitory effect on glycolysis.

We propose that the metabolite of α-chlorohydrin which inhibits glycolysis is not α-chlorohydrin-1-phosphate (**II**) but is β-chlorolactaldehyde (**III**), produced by an enzyme with α-chlorohydrin dehydrogenase activity. If this enzyme is present in certain cells (such as rat or boar sperm) it would explain why α-chlorohydrin is not a general inhibitor of glycolysis and why it has species-specificity as an antifertility agent. (α-Chlorohydrin has antifertility activity in the rat and the boar but is ineffective in the rabbit[3]). Mechanistic considerations also favour the presence of an aldehyde group in an inhibitor of glyceraldehyde-3-phosphate dehydrogenase and triosephosphate isomerase as both enzymes require this functional group for active site attachment[13]. The α-chlorohydrin dehydrogenase activity of boar sperm and the synthesis of β-chlorolactaldehyde are being investigated.

1 This work was supported by The National Health and Medical Research Council of Australia.
2 Present address: Department of Biochemistry, School of Life Sciences, N.S.W. Institute of Technology, Gore Hill, N.S.W. 2065, Australia.
3 A.R. Jones, Life Sci. *23*, 1625 (1978).
4 P.M. Mashford and A.R. Jones, Experientia *34*, 1267 (1978).
5 The pure enzyme was obtained commercially, isolated from *Candida mycoderma*.
6 D.E. Brooks, J. Reprod. Fert. *56*, 593 (1979).
7 P.D.C. Brown-Woodman, H. Mohri, T. Mohri, D.A.I. Suter and I.G. White, Biochem. J. *170*, 23 (1978).
8 A.G. Dawson, Biochim. biophys. Acta *499*, 85 (1977).
9 A.R. Jones, Xenobiotica *5*, 155 (1975).
10 A.R. Jones, D.H. Milton and C. Murcott, Xenobiotica *8*, 573 (1978).
11 A.I. Vogel, in: Practical Organic Chemistry, 3rd edn. p. 1067. Longmans, London 1957.
12 A.G. Dawson, Biochem. J. *130*, 525 (1972).
13 C. Walsh, in: Enzymatic Reaction Mechanisms, pp. 322, 593. Freeman, San Francisco 1979.

An unusual case of a complex heterozygote presenting no taxonomical problem in *Chelidonium majus* L. (Papaveraceae)

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Summary. Chelidonium majus shows a closed ring of 12 chromosomes at meiosis. The maintenance of this translocation heterozygosity is assured by a balanced combination of lethal alleles. The fertility is estimated to be 60–70%. In spite of its genetic system and its wide distribution, the genus is monospecific.

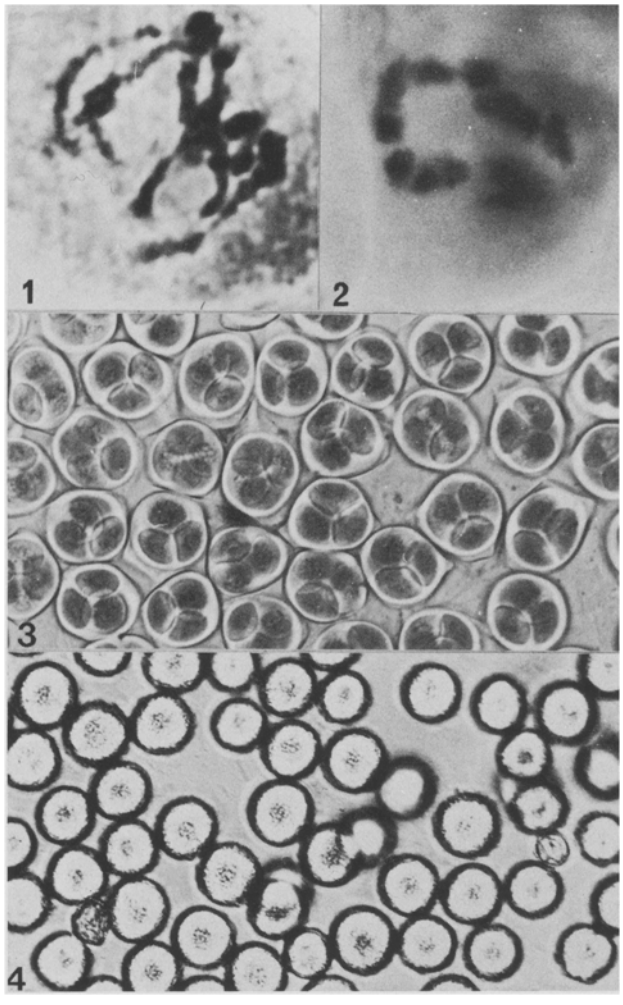
Permanent translocation heterozygosity is rather rare, being well known especially in *Rhoeo spathacea*[1] and in a few diverse genera of the family Onagraceae[2]. In some of these genera, namely *Calylophus, Gaura, Gayophytum* and *Oenothera* and in *Rhoeo* also, all the chromosomes are united at meiosis in one giant circle[3]. In some species, entire populations consist of permanent, true-breeding hybrids, since balanced lethal combinations of alleles have been developed which inhibit the union of similar gametes. Another way in which translocation heterozygosity is maintained was recently described: a sex-linked translocation system in Viscaceae[4] and in termites[5–7].

Here, we report a case of permanent translocation heterozygosity involving the entire chromosome set in *Chelidonium majus* L. (Papaveraceae). This plant is widespread (Asia, Europe and North Africa). It is used in traditional medicine against warts. Nagao and Sakai[8] observed in this species from Japan a closed ring of 10 chromosomes (2n = 10). The arrangement on the meiotic metaphase plate was usually zig-zag. They also observed 68.9% of empty pollen and 71.8% of empty seeds. They explained this sterility by the aberrations occurring in meiotic divisions, but gave no information on the breeding behavior.

In our case, the plants studied (from 2 Belgian populations, collected at Thon and Marche-les-Dames in the Meuse valley-Vouchers at the national herbarium of Bruxelles-BR-Tilquin, 421 and 422) are cleistogamous, the anthers bursting over the receptive stigma as much as 24 h or more before the flower opens (anthesis). The dehiscence of the buds is stimulated by the growth of the fertilized ovary.

Furthermore, our observations are quite different. The somatic chromosome number is 2n = 12 instead of 10. All the chromosomes are also united at meiosis in one ring (figure, 1 and 2). At metaphase I, the ring shows a regular alternate orientation. Counts in anaphase I and telophase I confirm the regular numerical disjunction. Occasionally a laggard is visible in telophase I, but this is probably due to the squash technique.

All the products of male meiosis seem to develop into normal pollen grains (figure, 3 and 4) instead of 69% of empty pollen. Furthermore, we did not observe empty seeds. The mature capsules are well filled, given the appearance of full fertility. But in examining the young capsules, we could nevertheless observe aborted ovules distributed at random among the developing ovules. The fertility is now estimated at 60–70%. We plan extensive further analyses of the fertility. Indeed, the maintenance of heterozygosity must be assured by a balanced lethal system which involves a 50% reduction in seed set. 2 kinds of lethality are possible: the zygotic and the gametic. If the departure from 50% fertility is significant and confirmed, then lethality should be of the gametic type, probably associated with a system of megaspore competition known as the Renner effect[3] and found in some *Oenothera*. This system is the more elaborate one and restores full fertility. Basically, the functional megaspore in each ovule is that



containing the pollen lethal and so the selective system can operate while full fertility is maintained. Either the system in *Chelidonium majus* does not operate perfectly or the observed sterility is attributable to the greenhouse conditions. Further studies on fertilization and embryology are necessary to anwer this question.

Such a genetic system tends to lead to a diversified taxon with series of smaller populations and subpopulations sometimes referred to as demes, as in *Oenothera.* But in this case, the situation is drastically different and thus unique; in spite of its large distribution and its genetic system, the genus is monospecific with but one rare variety *(laciniatus).* The case of *Rhoeo,* also a monospecific genus, is rather different; indeed, its distribution is limited to the tropical forest of America, a stable environment. Furthermore, *Rhoeo* is a long-lived perennial with an active vegetative reproduction and a poor sexual reproduction.

1 C.D. Darlington, J. Genet. *21,* 207 (1929).
2 R.E. Cleland, Oenothera, Cytogenetics and Evolution. Academic Press, London and New York 1972.
3 B. John and K.R. Lewis, Chromosome Hierarchy. Clarendon Press, Oxford 1975.
4 D. Wiens and B.A. Barlow, Nature New Biol. *243,* 93 (1973); B.A. Barlow and D. Wiens, Chromosoma *53,* 265 (1975); B.A. Barlow, D. Wiens, C. Wiens, W.H. Busby and C. Brighton, Herdity *40,* 33 (1978).
5 R.M. Syren and P. Luyks, Nature *266,* 167 (1977).
6 P.P. Vincke and J.P. Tilquin, Chromosoma *67,* 151 (1978).
7 F. Fontana and M. Amorelli, Experientia *34,* 708 (1978).
8 S. Nagao and K. Sakai, Jap. J. Gent. *15,* 23 (1939).

1 Meiotic prophase showing the multiple association of chromosomes. × 350. *2* Polar view of metaphase I. × 900. *3* Regular tetrads. × 130. *4* Mature pollen. × 130.

Absence of recombination in the male of *Ceratitis capitata*[1]

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Summary. The linkage relationship between a morphological and a biochemical locus was studied. Results suggest that recombination does not occur in the male of the Mediterrannean fruit fly although its meiosis is typically chiasmatic.

The male *Drosophila* and the female *Bombyx mori* are typical of organisms in which crossing over does not occur in the meiotic cells of the heterogametic sex. Early observations were interpreted as a cytological basis for the absence of crossing over in *Drosophila*[3]. Later on it was established that chiasmata regularly occur during meiosis in the bivalents of this species at an incidence of at least 1-7.6%[4]. This fact casts doubt on the 1:1 correspondence between chiasmata and crossing over.

The Mediterrannean fruit fly *Ceratitis capitata* shows a typically chiasmatic meiosis[5]. In reference to this, it was suggested that in contrast with most other higher diptera, recombination occurs in the male spermatocyte[5]. It has previously been impossible to test this hypothesis either because the known genes were located in different recombination groups[6,7] or their linkage relationships had not yet been tested[8-10].

The existence of 2 codominant alleles in the pupal enzyme esterase, referred to as *Est-1a* and *Est-1b*[11], was recently detected through electrophoresis. This communication reports on the study of the relationship between the gene Est-1 and the autosomal recessive gene *niger* (*nig*/*nig* = black pupa)[8].

The flies used here belong to a laboratory strain obtained at the Department of Genetics, INTA, Castelar, Argentina. Previously-reported breeding methods and electrophoretic technique[11] were used.

The $\frac{nig\ Est\text{-}1a}{nig\ Est\text{-}1a}$ females and $\frac{+\ Est\text{-}1b}{+\ Est\text{-}1b}$ males were crossed, and the pupal esterase pattern in the 1st generation (F_1), in the 2nd generation (F_2) and in both backcrosses were studied. All the F_1 pupae were wild brown. 13 F_1 individuals were electrophoretically analyzed and all of them were heterozygotes for the gene *Est-1 (1a/1b).*