3. *The Biology and Pathology of the Twinning Phenomenon*

BIOLOGY OF THE TWINNING PHENOMENON: EMBRYOGENESIS AND TERATOGENESIS

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The twinning phenomenon has always interested the great public, the artists, and naturally the scientists. Isidore Geoffroy St. Hilaire has established a classification still now valid. This classification considers the different types of double monsters, which are found in nature in all classes of vertebrates, including man.

To explain the twinning phenomenon, the experimental realizations have progressed by successive bounds after the preliminary attemps of different authors. Now, when it is question of experimental duplication, anybody thinks of H. Speeman for the amphibians, of H. Lutz for the birds, of F. Seidel for the rabbit, and of A. Tarkowsky for the mouse. Now, it is possible to conceive a twinning resulting from the separation of the first blastomeres (amphibian, rabbit, mouse) and a twinning whose origin consists in the fissuration of the blastoderm (bird, mammal). All these experiments confirm the unicist theory. If a total or partial regulation of the excedents may be experimentally realized, no argument can however support this theory in the realization of the double monstrosity.

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MONOZYGOTIC HETEROCARYOTIC TWINNING

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Since the first publication in 1961, cases of monozygotic heterocaryotic twinning have been repeatedly found and a total of 14 observations can now be analysed.

The mechanism involved in this type of twinning is yet uncertain and eventually is not identical in each case, the main uncertainty being to decide whether the chromosomal error affecting one of the twins is related, directly or indirectly, to the process of monozygotic twinning per se.

Regarding the time of occurrence, the error seems to occur at few days of development at the most and, in one case at least, was contemporary to the first division cleavage.

Considering the possibility of twins of different sex (e.g., one XY and one XO) the monozygotic heterocaryotic twinning could be considered as a potential equivalent of a fecundation in species in which the XO is a fertile female.

Evolutive implications shall be discussed.

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CONJOINED (SIAMESE) TWINS: REMEDIABLE CONGENITAL HANDICAP

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Two decades of surgical advances have given successful safe deliveries and restorative separation procedures for these malformations. Softening of earlier more awesome terms of definition has been greatly influenced by the lovely living examples from the abovementioned measures in uninjured mothers and children once joined, now healthy individuals. *Siamese Twins* are now defined " Twins born with their bodies joined together in any manner ". *Human Teratology*, " The study of (unnatural, strange, extraordinary in a way to excite wonder), serious malformations, or marked deviations from normal type of structure, esp. in man ", remains of world interest today and man now looks for repair of any handicap and promotion of normal activities by the indi-

vidual twin. While congenital junction has had different theories for its origin (one factor, anoxia in the embryo) as described by Gedda in one of his books and by Luow in his masterly paper in Vienna, it now gets the sanction of world-wide visitors studying a scientific exhibit with these data included (Callahan 1965-1974).

Types that confirm these observations include *Xipho-Omphalopagus* — one unseparated set being Eng and Chang one hundred years ago, 1811-74, with 277 descendants in 1974. Likewise, a living 26-year-old set still united. Similarly joined were other now separated sets with healthy normal survivors. Next, *Craniopagus* — the oldest known living ones, recorded by Todorov, now healthy and living. Other sets, now separated, are also living as individuals. Finally come *Pygopagus*, appearing most extangled at birth, but of a pleasing appearance when separated, and *Manuopagus*, joined at their hands.

Studies in genetics, fertility, and sterility, will be made in twins, siblings, and parents, as these sets mature, marry, and reproduce or not.

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FREQUENCY OF THORACO-OMPHALOPAGUS CONJOINED TWINS

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A review of literature shows that MZ twinning has low heritability and little racial variation. In Thailand, however, almost every case of conjoined twins is of the thoraco-omphalopagus type. It is recessive and not sex-limited.

The survey includes over 200 twin pairs. Each pair had a common heart and a common liver, and was connected at the xiphoid cartilage down to the level of the umbilicus. Different feelings and marked differences in personality are stressed. Every pair has been successfully separated.

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MORPHOLOGIC AND CYTOGENETIC STUDIES ON CONJOINED TWINS

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Two sets of male conjoined twins have been observed. Both were born at term and after a normal pregnancy. The first was a *bicephalus* born to an epileptic mother, a primipara aged 18 who suffered from a severe flue during the first two months of pregnancy. The second was a *pygothoracopagus* born to a 23-year-old mother with a living normal child.

The bicephalus showed four normally formed extremities, atresia of ampula recti, two hearts, both connected. The left heart had multiple malformations. All the left-side internal organs (kidneys, gonads, and others) were not fully developed. The left umbilical artery was missing.

In the pygothoracopagus, one of the twins was well developed, while the other one, the " parasite ", was without head, joined with the abdominal and thoracic parts of the developed twin, and with less developed body and extremities; the abdominal cavity of the parasite was quite slightly developed; in fact it presented one heart of the abdominal cavity of the developed twin and it contained a big kidney with the shape of a horseshoe. The left eye was double in size as compared to the right one, consisting of one formed and one rudimentary eyeball; on the same side a rudimentary second mouth could be seen. The umbilical cord had five blood vessels (four umbilical arteries and one umbilical vein): it is evident that the twins had a common blood circulation for all their organs.

The cytogenetic study of the organs of the parasite showed high aneuploidy, which was not revealed in the normally developed twin.

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