

THE SPERM CELL

**fertilizing power
surface properties
motility
nucleus & acrosome
evolutionary aspects**

edited by Jean André

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FERTILIZING POWER, SURFACE PROPERTIES, MOTILITY,
NUCLEUS AND ACROSOME, EVOLUTIONARY ASPECTS

Proceedings of the Fourth International Symposium on Spermatology,
Seillac, France, 27 June-1 July 1982

edited by

JEAN ANDRÉ

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D. Schwartz (Villejuif) and Ch. Thibault (Paris) were honorary presidents.

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PREFACE

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Sperm cells have long been considered as the most highly specialized of all living cells. They surely are, being very diverse, very complex, containing organelles which do not exist in any other cell -such as acrosome or crystallized mitochondria- and being endowed with a very unique behaviour, that is to meet and recognize the ovum, pierce its protective envelopes and inject into its cytoplasm a most precious deposit, the haploid genome of the species.

It is Baccio Baccetti's merit to have felt the need for a confrontation of the scientists working on sperm in order to clarify the apparent complexity of the enormous amount of knowledge accumulated on the subject. Thus, he successfully inaugurated the series of the *International Symposia on Spermatology*. The Seillac edition is the fourth in the series. After an initial stage during which morphology was predominant, our meetings have turned more and more towards function. It has been the will of the French Organizing Committee to devote this meeting mainly to Eutherians, and, among those, to man, in connection with the conflicting necessities to help the sterile couples and to control the population explosion at the surface of the world.

The papers have been presented under six main headings which constitute the six chapters of this book. Each one begins by one or two invited papers which review the actual state of knowledge ; then contributed papers follow, which present the original works of the participant laboratories.

The first chapter deals with *Evaluation and control of the fertilizing power of sperm*. The extensive use of artificial insemination and of storage of sperm would benefit greatly of such an evaluation. To this aim, new techniques have been developed, *in vitro* fertilization, rapid measure of sperm motility and mathematical analysis, among others. They have brought already a great deal of scientific and clinical data which are a good promise of improvements in diagnosis and therapeutics. For the time being however, due to the great complexity of gamete biology, the significance of the results obtained at the laboratory on a semen sample in terms of its fertilizing ability is not yet clear.

The second chapter deals with the *Surface properties of sperm cells*. The explosive development, during the last decade, of knowledge on molecular aspects of membranes has been of great benefit to the study of sperm cells. Membranes are now thought of as bidimensional spaces paved with a multitude of specific antennas. The use of advanced techniques, such as that of hybridoma antibodies, can disclose these receptors precisely and lead to an understanding at the molecular level of the unique behaviour of the male cell as it unites with the female cell.

The third chapter deals with the *Nucleus*, a topic which happened to be almost overlooked at the preceding three Symposia. The dramatic condensation of the haploid genome at the time of spermiogenesis, paralleled by its complete functional occultation, and its decondensation immediately after fertilization are followed in terms of the succession of basic proteins interacting with the DNA molecules. The amino acid sequence of several of these arginine-rich proteins is now known and shows an unexpected diversity, which contrasts with the uniformity of histones.

The fourth chapter concerns the most typical organelle of sperm cells, the *Acrosome*. In spite of the facts that it has been known for a long time and that the acrosomal reaction has been thoroughly scrutinized over the past decades for a number of species, the functions of the acrosomal

enzymes, the locus and the timing of their deployment are questions still not clearly settled, so we felt that a general survey of the subject should be made.

Sperm motility is the subject of the fifth chapter. Two extreme, but complementary points of view on sperm motility are in rapid progress : at the molecular level and at the population level. At the molecular level, work has been initiated by Björn Afzelius and Ian Gibbons. The spatial arrangement and functioning of the major macromolecules that constitute a flagellum have now been extensively studied so that the dynamics and regulation of flagellar beat are beginning to be well understood at the molecular level. As far as the population level is concerned, a new, very ingenious tool, has radically changed the situation. This is the laser doppler velocimeter, which measures almost instantaneously a number of parameters of sperm motility in such a way that a semen sample can be characterized objectively. Also, the reaction of sperm cells to various media, to various metabolites or other active molecules can be measured rapidly with great accuracy. It can be augured that the data obtained will soon become precious to sperm banks.

The sixth and last chapter emerges from a long heritage : *Sperm structure in relation to function and phylogeny*. The basic approach of all the great problems in biology is comparison. Comparison of shape, dimensions, mass, and the series of the so-called physical parameters, comparison of composition, functioning, origin, and others. This is so at all levels of observation, from populations of individuals to molecules. Since sperm cells are so diverse, such comparisons are especially exciting and fruitful. They lead to an easier comprehension of general phenomena. A striking example is that of the quasi-universality of flagellar structure and function. Another benefit from extensive comparisons comes from the fact that evolution has sometimes masked in some species a structural or functional trait which has been kept conspicuous in others. An example of this