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POLARITY
FROM DIPOLES TO BIOPOLARIZATIONS

II. ADDENDA AND INDEXES

BY

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Polarity is a problem of wide interdisciplinary interest that we have attempted to survey in its widest span from its atomic to its embryogenic, plant and animal levels in the Archives of 1989 reprinted as book **I** (Turian, 1989).

Primeval polarity is bipolar, founded on the separation of two equal but opposite electric charges. Consequently, even apolar molecules are intrinsically electrically polarized but with a symmetrical distribution of their opposite (+ and −) electric charges and therefore they lack in electric polar moment. Similarly, apolar morphological biostructures are examplified by spherical cells (certain eggs, etc.), initially deprived of heterogeneously distributed components, and which being identical with their mirror image can be also considered as achiral.

The whole universe is electrically neutral and, by necessity, contains rigorously equal numbers of opposite electric charges (10^{40} of protons and of electrons, see Souriau in Brack *et al.*, 1989) even though it is filled with electric dipoles from the minute water molecules to giant cosmic dipoles, a basic requirement for its physico-chemical and biological functionings. However, in its wider expression, polarity spans not only pure electric and magnetic phenomena but also chemostructural (chiral), biomolecular (cytoskeletal elements) and spatio-temporal developmental processes. Our survey had therefore to encompass them in their whole span from monopoles to multipoles as following:

1) *monopoles,* electric (+ or −) or magnetic (still elusive north or south isolated poles) as well as homochirals (l- or d-enantiomers) and monopolar, elongating biostructures such as microfilaments (actin), microtubules (tubulins), multinucleate cells such as hyphae and neurites;

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2) *dipoles,* basically electric (+ and −) or magnetic (north and south poles), but also heterochirals (l + d-enantiomers) as well as morphogenetic homodipoles in the twice-budded or -germinated yeasts or fungal spores and heterodipoles in the developing eggs of plants and animals;

3) *tripoles,* electric (+ − + as in thunderclouds, see addendum) or morphogenetic as in iris flowers!

4) *quadrupoles,* electric (radio-frequency electric traps and nuclear coupling, see addendum) or morphogenetic as in four- (multi-) budded yeasts and germinated fungal spores;

5) *multipoles* as exhibited by cells such as amoebae or fungal spores outgrowing n (>4) pseudopodia or germ tubes, respectively.

During the second half of 1989 and first trimester of 1990, we have noticed a few omitted significant papers as well as newly published ones, related to dipoles and biopolarities. We have registered them below by following the sequence of the eight preceding chapters and, parallely, added two subject and taxonomic indexes. Their item entries cover the main book (**I,** 1989) and these first addenda (**II,** 1990).