

The circulatory system of cephalopods

Hans Mislin – A dedication on the occasion of his 80th birthday

EADEM MUTATA RESURGO – the eternal recurrence in changed form – this epitaph symbolizing the archimedian spiral on the tomb of the great mathematician from Basel, Jakob Bernoulli, fascinated the young student Mislin when walking round the cloisters of the Basel Cathedral. In the foreword to the catalogue of a recent exhibition in Basel successfully and ingeniously organized by him and entitled, typically, ‘The spiral in human life and in nature’, he wrote: ‘Zugleich stieg in mir der “Urgedanke” aus der Tiefe stets sich wiederholender Pulsation, Rhythmik, Periodik aller Lebensstufen und Weltalter nach einer denkbaren und möglichen “Spiral-tendenz”, eines sich selbst verwirklichenden “Welt-Organismus” oder “biotischen Kosmos”’. I am nearly sure that it was this fascination with the rhythmical and cyclical elements of natural phenomena that led Hans Mislin to biology, nor was it a coincidence that the topic of his thesis was the baffling life cycle of the River Rhine salmon. In view of the threatening biological death of this river – salmon in the river have been non-existent for decades – this same subject matter inspires him again now – with sorrow but also with a determination to fight in order to preserve the basis of human life. Nor is it a coincidence that the theme of the following multi-author review in EXPERIENTIA deals with the circulatory system of cephalopods; as the main theme of his later scientific work was the comparative physiology of the circulatory system in which cycles and rhythms fascinated him once again. It is especially the pulsative dynamic of the ‘autonomous autochthon pulse’ of blood vessels and lymphatics, and their relative dependence on the changing hydrostatic pressure and temperature as well as electrical and pharmacological parameters that has captivated him for the whole of his life.

In the following review we shall report more closely on his basic works which are still valid today, concentrating on his investigation into the isolated arm veins of octopods that reveal a vascular endogenous myogenic automatism, or his ingenious method to demonstrate a relative coordination between heart activity and respiratory movements, by using ECG recordings through implanted electrodes on the freely swimming Sepia.

His extensive electro-physiological research on the pulsatile veins in the bat wing are of equal significance. Using an isolated perfused vessel segment he was successful in demonstrating for the first time in vertebrates that this pulsatile activity, analogous to the pacemaker system of the systemic heart is a myoendogenic characteristic of such vessels, independent of the CNS, and therefore a myogenic ubiquitary automatism is present. He was also able to obtain corresponding results for the considerably more subtle lacteals within the mesentery of the guinea pig and other mammals. These are lymph vessels, seg-

mentally organized by valves whose single segments, that he called ‘lymphangions’, which can be regarded as autonomous ‘minihearts’ according to Mislin’s electrovasogram (EVG) recordings from in vitro perfused preparations, in which the spontaneous rate of the action potential primarily represents a nerve independent phenomenon of the smooth vascular cell.

On a later occasion in the mid sixties, I vividly remember how he reported on the results of his electrophysiological experiments on the heart of the tunicate *Ciona intestinalis* in a fascinating lecture at the University of Mainz. In the course of the lecture he proceeded to completely refute the old v. Skramlik’s two-center-theory of the phenomenon of the pulse reversal. Even today I’m afraid that this antiquated concept still haunts many textbooks and the minds of colleagues. We are indebted to Mislin for a great number of other studies in the specialized field of circulatory physiology in vertebrates and invertebrates (lumbricides, crustacea, insects), which undoubtedly helped to found a new, comparative view of the vascular physiology. – Noteworthy, too, are his many far more broadly-based textbook articles, reviews and book publications aimed at a larger, less specialized readership.

It is not easy to give due respect to all the important dates and events of such a full life as we only have a few lines in this dedication. But here are a few milestones in the life of ‘homo faber’ Hans Mislin: He was born on 24th May 1907, in Basel where he first studied medicine, then switched to biology and right from the start sought the proximity of philosophy. After successfully completing his thesis on nutritional biology and the problem of physiological hunger in the cycle of Rhine salmon, in 1939 he began several semesters of study abroad at the universities of Prague, Vienna and Königsberg. War-time troubles and, I think, experiences in the Germany of this era which were not always pleasant brought him back to Switzerland where he worked as an assistant at the Physiological Institute in Bern under A. v. Muralt performing the already mentioned angiological studies on the vessels of the chiroptera wing. At the Zoology Institute of Basel headed by A. Portman, he was awarded in 1943 the *venia legendi* (Habilitation) in zoology and offered a lectureship in comparative physiology.

In 1945, in the aftermath of the war, a time of change and transition, EXPERIENTIA was first issued. Initially conceived as an international ‘monthly journal for pure and applied sciences’, it later became an interdisciplinary journal for life sciences thanks to Mislin, who after founding the journal, then became its chief editor. It soon became internationally recognized, and Mislin’s successful endeavor to achieve interdisciplinary open-mindedness, high standards and topical quality of the contributions was consequently given deserved recognition in the

Marzotti gold medal for excellent editorial work in 1965. In the meantime Mislin was appointed to a lectureship (1949) and then to a chair (1954) at the Institute of Zoology at the J. Gutenberg University Mainz (later renamed Institute for Physiological Zoology) and he was the head of this department from 1954–1977, succeeding W. v. Buddenbrock. Lectures and courses in general zoology and comparative physiology, and courses and many study stays in the French marine biological stations Banyuls s. M., Villefranche s. M., and Arcachon as well as the 'Stazione Zoologica' in Naples and in the Ivory Coast are some of the things he focussed on during his time as 'ordinarius' there. These activities also paved the way very rapidly for German biology students to work at these institutions despite the obstacles posed by the post-war situation. Thus, in a very concrete way German-French cooperation was encouraged.

Mislin was never the retiring research scientist, withdrawn in his study. Being aware of his responsibility as an informed scientist who can comprehend the far-reaching implications of a subject – like the cogent recognition that protecting nature does not only entail preserving individual species of plants and animals but the foundation of human life – he founded the colloquium for human ecology (1964) during his time in Mainz. Competent scientists, politicians and industrial managers were invited to join in discussion at a time when industry was expanding rapidly and the belief in progress was accepted uncritically. Even then Mislin argued for a comprehensive concept of a 'biopolicy' and pointed to the future, and this is now gradually being put into general practice on account of the pressure exerted by recent catastrophic events.

On this path, he proceeded unswervingly, and still today he continues with his own fighting spirit. Many committees and boards interested in ecopolitics have asked his advice and are still very appreciative of his valuable and dedicated cooperation. He is or was a member of: the Department of Environment in the Council of Europe in Strasbourg (consultative member until 1972); the 'Eidgenössische Kommission für eine Gesamtenergiekonzeption', section: energy and environment (1968–1973); the 'Akademie für Umweltfragen in Tübingen', Chairman of 'Schweizerische Arbeitsgemeinschaft für Umweltforschung' (SAGUF), General Secretary of 'Internationale Arbeitsgemeinschaft für Radioökologie Bern' (IAR), Senate president of the 'Alpine Akademie für Integrale

Medizin Vulpera' (Unterengadin), president of the 'von Keyserling Gesellschaft Wiesbaden'.

In 1980 he was awarded an honorary membership of the 'Deutsche Gesellschaft für Lymphologie' in recognition of his extraordinary contributions to lymph-vessel research; a little later, in 1983, he was granted a similar honor by the 'Sokratische Gesellschaft Mannheim' which acclaimed his synthesiological universal mind, his interdisciplinary approach and his untiring struggle for international understanding. In March 1986 finally, he became an honorary member of the 'Schweizerische Gesellschaft für Physiologie' an honor that attests to his success as a scientist and his 41 years as the editor of EXPERIENTIA.

In recent years Mislin has turned his attention more intensively to the life and works of Francis of Assisi, still indebted to the philosophy of v. Keyserling and Leopold Ziegler who regarded Mislin as his 'Wahlsohn' and for whom the methods of scientific insight 'die Verwissenschaftlichung des Geistes' were only a part of human cognitive faculty. Mislin picked up the example set by Assisi's partnership with nature and confronted the purely 'usurpatorial' ideas of modern civilization, thus giving impulses for a new ecumenically and ecologically based partnership between man and nature. The international congress on the causes of the 'Waldsterben' under the patronage of the 'Schweizer Hochschulrektorenkonferenz' planned for January 1988 in Basel and initiated by Mislin, as well as the international symposium planned for the same year in Zürich, focussing on health responsibility and industrial catastrophes are examples of his continuing intensive efforts in this area. His recently published book containing correspondence with the French Germanist Sophie Latour reveals more of this philosophy.

Mislin has remained a man with a good sense of humor and splendid irony; an avid communicator with both the young and the old, he has never been one to avoid heated discussions about urgent matters of current importance. Of course this often provoked resistance and criticism – though that is the way it should be!

We congratulate Hans Mislin on his 80th birthday and hope that he may continue to thrive with his youthful energy.

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General morphological and functional characteristics of the cephalopod circulatory system. An introduction

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When comparing the organization and biology of recent cephalopods with that of other invertebrates, e.g. arthropods or especially developed species of other mollusc groups, we keep arriving at the conclusion – not only as somewhat biased teuthologists – that the representatives

of this group have attained a particularly high level of evolution. Thus it seems justified to accord them a particular status among the other molluscs and invertebrates^{17, 31, 37}.

A comparison with vertebrates suggests itself with re-