

Imre FOLDI

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The Advisory Committee of the XIIIth International Symposium on Scale Insect Studies (ISSIS), held in Sofia, Bulgaria, has agreed unanimously to honour Imre Foldi for his outstanding contributions to coccidology in the fields of anatomy, morphology and systematics, particularly on Margarodidae *sensu lato* (the archaeococcoids). Imre began his studies of entomology in the 1950s in his home country, Hungary, and then, after he moved to France, he acquired special knowledge of scale insect ultrastructure and its function, particularly the wax gland system. Later he developed wide expertise in all aspects of systematic studies, from field collection to inventory and taxonomic revisions. He has published nearly 80 scientific papers, including several substantial monographs on diverse archaeococcoid groups, including Margarodidae *sensu stricto*, Matsucoccidae and Monophlebidae.

The following account is a summary of Imre's career, explaining the significant achievements and major directions of his research. Here some of his papers are mentioned by year of publication only, but a full list is available from ScaleNet (<http://www.sel.barc.usda.gov/scalenet/scalenet.htm>).

Imre Foldi was born in Hungary in 1933. From a young age, he was fascinated by the natural world. After he obtained his baccalauréat (1952) at a high school in the town of Eger, he was directed to the Agricultural University in Budapest, where he participated in many entomological activities, especially

field projects. Following the occupation of Hungary, Imre succeeded in leaving in 1957 and, after a period of displacement as a refugee, settled in France. Imre worked hard in various jobs and continued to study French. His efforts led to his acceptance into the laboratory of Professor Paul Pesson in Zoology-Ecology at the Institut National Agronomique, Paris. Then in 1961, Imre was introduced at the National Centre for Scientific Research (CNRS) and began work on scale insects. This connection was important because it allowed him to complete his studies in the Faculty of Sciences of Paris in animal biology, in histology and ultrastructural cytology, and finally in entomology.

Period of research on ultrastructure and function

The early period of Imre's studies of scale insects corresponded to the dominant influence in entomology at that time of elucidating structures and explaining their functions. Thus Imre qualified as Ingenieur-Docteur (1972) with a thesis on the ultrastructure and histochemistry of the digestive tract, particularly of the filter chambers of *Icerya purchasi* and *Planococcus citri*, obtained from the Faculty of Sciences, Paris. He published his first paper on scale insects on the ultrastructure of the filter chamber of *Planococcus citri* (1973). This was followed by two papers published (1978) with P. Pesson – one on the spermiogenesis of *Aonidiella aurantii* and the sec-

ond on the fine structure of integumentary glands of *A. aurantii*.

In 1983, Imre obtained the highest academic level possible in France, Docteur ès Sciences, for his thesis on the comparative ultrastructure and evolution of the wax glands of scale insects. As a result of this research, he published on the wax gland systems in Coccidae (1978), subterranean Margarodidae (1981), Pseudococcidae (1983) and Diaspididae (1983), as well as other publications. Subsequent work contributed to an important synthesis: “The wax glands in scale insects: comparative ultrastructure, secretion, function and evolution”, published in 1991. In addition, Imre diversified his research by experimental studies.

Imre has authored chapters on the internal and external anatomy of scale insects in two important books on Diaspididae and Coccidae. For the book on Diaspididae (edited by Rosen, 1990), Imre produced four informative chapters and, in the book on Coccidae (edited by Ben-Dov & Hodgson, 1997), Imre wrote a detailed chapter on the internal anatomy of the adult female and another on the ultrastructure of the wax glands.

Period of systematic research

Following the years of intensive laboratory work, Imre’s career underwent a major reorientation. He became more interested in field expeditions and wanted a more holistic approach to coccidology, including inventory/collecting, identification, taxonomic revision, and generating hypotheses of evolution. He left the Institut National Agronomique and moved in 1999 to the Entomology laboratory of Museum national d’Histoire naturelle, Paris, where there were two coccidologist colleagues, Alfred S. Balachowsky and Danièle Matile-Ferrero.

Imre’s contributions to scale insect taxonomy consisted of both regional studies and worldwide revisions, including cataloguing and description of new taxa, leading to 13 new genera and 54 new species (belonging to 14 families) from many regions of the world. In 2001, Imre published a world list of extant and fossil species of Margarodidae *sensu lato* and also a list of scale insects of France, as well as inventories of several natural areas. For his systematics research, Imre travelled widely, collecting all scale insect groups, particularly in France, the Mediterranean Basin and also in Brazil, Colombia, Ecuador, Mexico, Venezuela and the USA. From Brazil and Venezuela he described four palm pests

of the genus *Limacoccus* (Beesoniidae) (1995), and from Brazil *Stigmacoccus paranaensis* (2006) and also species of other families (1988). Imre developed a special interest in archaeococcoids, especially the Neotropical taxa. He considers knowledge of archaeococcoids to be fundamental to understanding the evolution of scale insects because of the diverse morphology, biology, life histories and reproductive systems of archaeococcoid groups. He has had a long-term interest in the phylogeny of scale insects. For archaeococcoids, Imre has described and illustrated seven new genera and 30 new species as well as redescribing several other species, in more than 20 publications including major ones on:

- the new genus *Laurencella*, based on *L. marikana*, and other new species, *Stigmacoccus garmilleri*, *Cryptokermes mimosae* and *Llaveiella dugmilleri* (1995) and *C. oaxacaensis* (2011), all from Mexico;
- a world revision of the ground pearl genera, Margarodidae *sensu stricto* (2005);
- a revision of the Matsucoccidae of the Mediterranean Basin (2005);
- archaeococcoids from the tropical high mountains of the Andean Cordillera, including two new genera and five new species (2009).

Imre’s work to revise the archaeococcoid groups continues actively.

Collaborations

During his career, Imre has travelled to meet and work with many coccidologist colleagues and collaborators worldwide and has visited the major museums in the UK and USA. He has enjoyed productive collaborations (with publications listed by year) with many people, including with: Y. Waku on the ultrastructure of wax-secreting glands (1984), Saulo Soria on South American vineyard scale insects (1989, 1990), Paris Lambdin on wax glands in pit scales (1995), Jenny Cox on mealybugs (1989), Gillian Watson on *Laurencella colombiana*, a pest of avocado trees in Colombia (2001) and a sugarcane coccid in Egypt (2002), Antonius van Harten on archaeococcoids in Yemen (2004), Chris Hodgson on adult male coccoids (2005, 2006), Ferenc Kozár on many new species of various families (2000, 2001, 2002, 2004, 2006, 2007), Doug Williams on *L. jonmartini* (2013), and most recently with Penny Gullan on Neotropical archaeococcoids. Imre is well respected by his colleagues, several of whom have named new taxa in his honour. These names include

new genera (*Foldicoccus* and *Foldilecanium*) and several new species.

Conclusion

Scale insects have been Imre's life-long passion. His research contributions on ultrastructure and systematics of many taxa, but especially archaeococcoids, are very important to scale insect science. In addition, in 2000 and 2001, he was President of the Entomological Society of France and, during this

period, he organised a large meeting on classical and modern approaches to the study of insects. Imre also very much appreciates his family, friends and colleagues, and quality of life. He loves music, several hobbies (e.g. space and the universe), and takes great pleasure in gastronomy and good wines. In 1998, he retired from the CNRS but he continues to work each day in Entomology, and is linked to the Museum as an Attachée of Museum national d'Histoire naturelle, Paris. The ISSIS community thanks him for many scientific contributions and his friendship.

