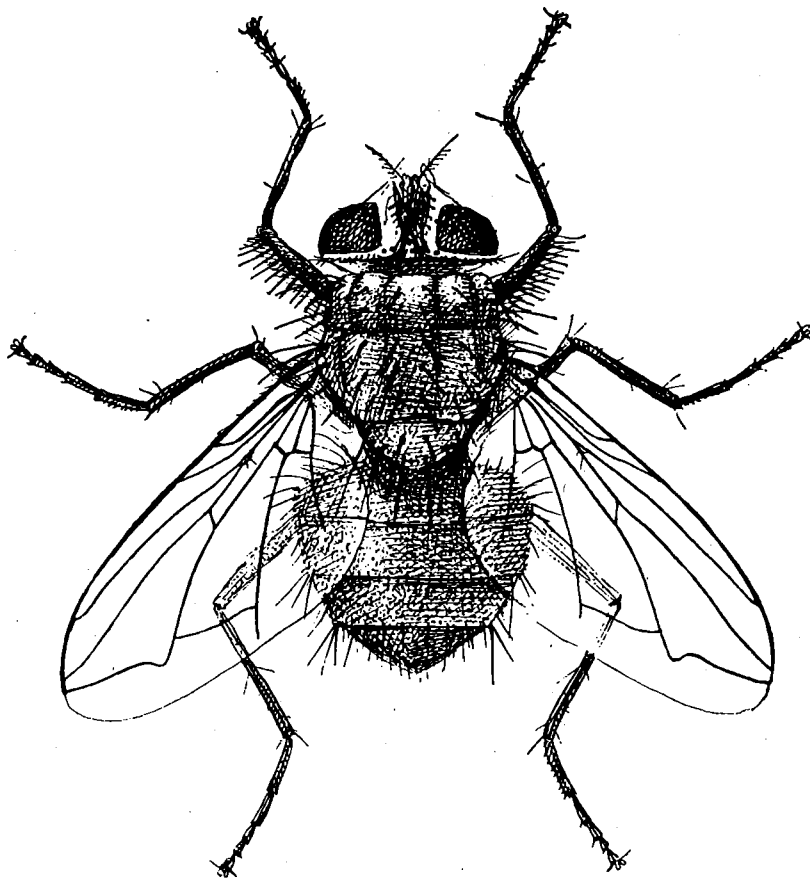


# ISRAEL JOURNAL OF ENTOMOLOGY

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THE ENTOMOLOGICAL SOCIETY  
OF ISRAEL

The figure on the front page depicts the adult of *Calliphora erythrocephala*, the larva of which was used by Professor Gottfried S. Fraenkel to prove for the first time the occurrence of a pupating hormone in insects.

## ISRAEL JOURNAL OF ENTOMOLOGY

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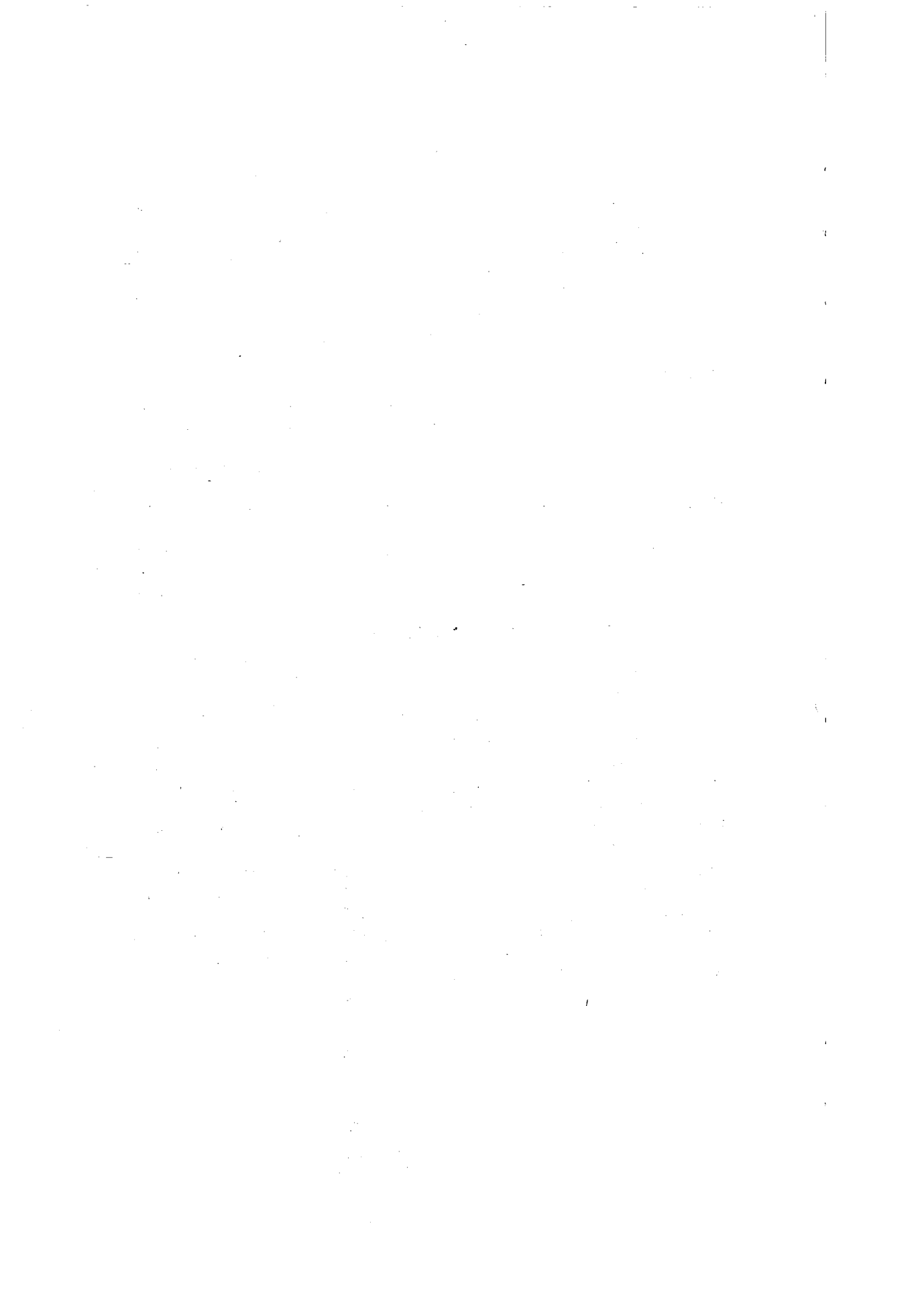
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PROFESSOR GOTTFRIED S. FRAENKEL

On the occasion of the 70th birthday of Professor G.S. Fraenkel, the Israel Entomological Society decided to dedicate the 1972 issue of the Journal of the Israel Entomological Society to him.

Professor G.S. Fraenkel started his academic career as an assistant in the Department of Zoology at the Hebrew University, Jerusalem, in 1928-30. In those years massive outbreaks of the migratory locust occurred in the country, and Professor Fraenkel's classic papers on locust migration and behaviour laid the cornerstone to extensive studies with this insect in the years to come.

The limited possibilities of those years did not allow Professor Fraenkel to continue his work in this country, but he maintained his friendships with his colleagues and his ties to the country remained strong. In the last twenty years he spent many of his vacations and sabbaticals in Israel, doing research and teaching at the Israel Institute for Biological Research, Ness-Ziona and at the Hebrew University, Jerusalem. Several publications, in the fields of insect respiration, insect nutrition, behaviour of mosquitoes, effects of various venoms on pupation, and ecological studies of local snails, resulted from Professor Fraenkel's collaboration with Israeli scientists.

The Department of Entomology at the University of Illinois at Urbana dedicated its annual Entomology Newsletter to Professor Fraenkel on his recent retirement after 24 years. That issue contained a tribute to Professor Fraenkel by his colleague Prof. S. Friedman. Because we felt that this article summarizes Professor Fraenkel's many-sided interests in an admirable way, we reprint it here in full with the kind permission of the author.

The Editors are very thankful to the many colleagues, friends and former students of Prof. Fraenkel, who contributed to this Festschrift, and also thank the Israel Foundation Trustees for generous financial support.

*The Editors*

#### TRIBUTE TO G.S. FRAENKEL

Professor Gottfried S. Fraenkel takes up the position of Professor Emeritus in Entomology at the end of this academic year. In recognition of his achievements and the time and effort he has given to our department the decision has been made to dedicate to him this issue of the Newsletter. I am both pleased and grateful to have been chosen to write this dedication, pleased because it gives me an opportunity to share with you some of the contributions he has made to entomology over his long career and grateful because it provides me with an occasion to publicly mark the affection I hold for my colleague and friend of these many years. I hope that by taking you through a very abbreviated review of his work you will be as impressed as I by the enormous breadth of intellectual activity he has demonstrated throughout his career.

Fraenkel's early work (1925-1932)<sup>1</sup> on the orientation reactions of invertebrates provides no clue to the directions he was subsequently to take in research, but it does give us an indication that his future was to be bound up in an analytic rather than integrative approach to science. His intelligent extension and clarification of the mechanistic ideas of Loeb and Kühn was first impressed upon me when in 1958, trying to work out a simple method of increasing the flight range of tethered *Phormia*, I went back to the literature and read his lovely (1932) description of flight reflexes in insects.<sup>2</sup> From this I was drawn to his book with Gunn, entitled, *The Orientation of Animals*,<sup>3</sup> probably the best effort extant which brings together and makes sense of the early experiments of kineses and more complex orientation reactions in animals.

This first phase of his career ended in 1932 (long before publication of the book), with a massive work on insect migration,<sup>4</sup> and by 1934 his love affair with the cyclorrhaphous Diptera had begun. This has continued off and on for 28 years. It is of special interest to note that his first paper on these animals, entitled "Pupation of flies initiated by a hormone,"<sup>5</sup> and published on a single page in *Nature* in 1934, is not only a classic in insect endocrinology, providing us with one of the earliest evidences of the hormonal control of metamorphosis, but also contains the bio-assay used in the 1960's by Karlson's group to follow the purification and finally crystallization of the moulting hormone, ecdysone.

From 1935 through 1940 Fraenkel was consolidating his and our knowledge of blowflies, and out of those five years two important papers appear: one, with Pringle, establishing the function of halteres in the flight orientation of Diptera<sup>6,7</sup> and the second, with Rudall, a quantitative study of cuticle structure.<sup>8</sup> This latter continues to be a mine of information for more recent investigations on the same subject at the University of Illinois and by others.

In 1940, under pressure of England's wartime restrictions Fraenkel moved in a different direction, opening an entirely new field of insect physiology, that of insect nutrition. The general similarities between insect and mammalian requirements were established in his laboratory<sup>9</sup> as were the absolute sterol requirements for all insects<sup>10</sup> and the long chain unsaturated fatty acid requirements for certain species.<sup>11</sup> He arrived at the University of Illinois in 1948, and in the same year he announced a new insect vitamin, B<sub>1</sub>, required by a single family of beetles.<sup>12</sup> This compound, later identified by a group of Illinois chemists as carnitine, was shown by Fraenkel to be distributed across the entire animal kingdom,<sup>13</sup> and his laboratory established its involvement in acyl transfer reactions.<sup>14</sup> It has recently been found to be of general importance in animals in the transport of fatty acids across mitochondrial membranes. His studies on insect nutrition also led, in 1956, to a theory concerning host preferences based on secondary plant compounds<sup>15</sup> which has, in effect, kept Fraenkel in the center of an ongoing debate concerning the evolution of defense mechanisms in plants.

By 1962, his contributions had so established the field of insect nutrition that with the exception of investigations concerned with examining the validity of some of the ideas set forth in his host selection papers<sup>16</sup> he once again looked elsewhere for his primary research effort. Turning back to his flies, he immediately discovered a hormone involved with adult tanning<sup>17</sup> which he named Bursicon, and to which he attributed a significance extending beyond the Diptera.<sup>18</sup> Work continued for five years with some success in establishing the locus of action of the hormone,<sup>19</sup> and recently other laboratories have taken it up, demonstrating the correctness of his interpretation by showing its importance in the darkening of cockroach and locust cuticle after ecdysis. Most recently (1969-present) he has undertaken studies on other aspects of hormone action. These investigations already appear to have borne fruit, complicating the simplistic views we have had concerning the action of ecdysone in puparium formation.<sup>20</sup>

In this short review I could not hope to do justice to the content of those contributions I had space to mention, nor could I touch on many of the less well known but equally interesting investigations into such phenomena as salivary secretion,<sup>21</sup> respiration,<sup>22</sup> symbiosis,<sup>23</sup> cuticular calcification<sup>24</sup> and temperature adaptation in marine invertebrates.<sup>25</sup> However, in spite of the shortcomings of the survey, the use of any of the usual criteria for success in science would establish the very high degree of

professional competence exhibited by Professor Fraenkel. Yet, I do not think that this judgment would completely satisfy most of us who have seen him in action. It is not the quantity or variety of work which so overwhelms us, but rather the exquisite simplicity of the initial experiments in so many areas which have led so directly to the breakthroughs. For those of you who have never had the opportunity to read them, I recommend a perusal of some of the papers listed below. They reveal much better than I could the general features of the research strategy which Fraenkel has practiced with such great success for so long.

I cannot close this without a more personal indication of the high esteem in which he is held by his colleagues and especially myself. He is always available for conversation, a good story teller, a better listener, a loyal friend, and a man with interests which transcend science; knowledgeable in art and literature, an accomplished amateur musician and musicologist,<sup>26,27</sup> he is a true Renaissance man. I, and all of us in the department, look forward to the pleasure of his company for many years to come.

Stanley Friedman

#### Bibliography

- (1) G. Fraenkel. 1925. Der statische Sinn der Medusen. *Zeitschr. vergl. Physiol.* 2:658-690.
- (2) G. Fraenkel. 1932. Untersuchungen über die Koordination von Reflexen und automatisch-nervösen Rhythmen bei Insekten. I. Die Flugreflexe der Insekten und ihre Koordination. *Zeitschr. vergl. Physiol.* 16:371-393.
- (3) G. Fraenkel and D.L. Gunn. 1940. The Orientation of Animals. Kineses, Taxes, and Compass Reactions, Oxford, Clarendon Press, 135 Fig. pp. 352.
- (4) G. Fraenkel. 1932. Die Wanderungen der Insekten. *Ergebnisse der Biologie* 6:1-238.
- (5) G. Fraenkel. 1934. Pupation of flies initiated by a hormone. *Nature* 133:834.
- (6) G. Fraenkel and J.W.S. Pringle. 1938. Halteres of flies as gyroskopische organs of equilibrium. *Nature* 141:919.
- (7) G. Fraenkel. 1939. The function of the halteres of flies (Diptera). *Proc. Zool. Soc. London (A)* 109:69-78.
- (8) G. Fraenkel and K.M. Rudall. 1940. A study of the physical and chemical properties of the insect cuticle. *Proc. Roy. Soc. London (B)* No. 854, 129:1-35.
- (9) G. Fraenkel and M. Blewett. 1943. The Vitamin B-complex requirements of several insects. *Biochem. J.* 37:686-692.
- (10) G. Fraenkel and M. Blewett. 1943. The sterol requirements of several insects. *Biochem. J.* 37:692-695.
- (11) G. Fraenkel and M. Blewett. 1946. Linoleic acid, vitamin E and other fat-soluble substances in the nutrition of certain insects (*Ephesia kuehniella*, *E. elutella*, *E. cautella* and *Plodia interpunctella*.) *J. exp. Biol.* 22:172-190.



- (12) G. Fraenkel. 1948. B<sub>t</sub>, a new vitamin of the B-group and its relation to the folic acid group and other anti-anaemia factors. *Nature* 161:981-983.
- (13) G. Fraenkel. 1953. Studies on the distribution of vitamin B<sub>t</sub> (carnitine). *Biol. Bull.* 104:359-371.
- (14) S. Friedman and G. Fraenkel. 1955. Reversible enzymatic acetylation of carnitine. *Arch. Biochem. Biophys.* 59:491-501.
- (15) G. Fraenkel. 1956. Insects and Plant Biochemistry. The specificity of food plants for insects. *Proc. XIV Intern. Congr. Zoology Copenhagen*, 5.-12. August 1953. 383-7.
- (16) G. Fraenkel, J. Nayar, O. Nalbandov and R.T. Yamamoto. 1962. Further investigations into the chemical basis of the insect-host plant relationship. XI. Intern. Congr. Entomology, Vienna. 1960. *Verhandlungen*, Bd. III. 122-126.
- (17) G. Fraenkel and C. Hsiao. 1963. Tanning in the adult fly. A new function of neurosecretion in the brain. *Science* 141:1057-1058.
- (18) G. Fraenkel and C. Hsiao. 1965. Bursicon, a hormone which mediates tanning of the cuticle in the adult fly and other insects. *J. Insect Physiol.* 11:513-556.
- (19) M. Seligman, S. Friedman and G. Fraenkel. 1969. Bursicon mediation of tyrosine hydroxylation during tanning of the adult cuticle of the fly, *Sarcophaga bullata*. *J. Insect Physiol.* 15:553-562.
- (20) J. Zdarek and G. Fraenkel. 1971. Neurosecretory control of ecdysone release during puparium formation of flies. *Gen. Comp. Endocrin.* 17:483-489.
- (21) G. Fraenkel and V.J. Brookes. 1953. The process by which the puparia of many species of flies become fixed to a substrate. *Biol. Bull.* 105:442-449.
- (22) G. Fraenkel and R.A. Davis. 1940. The oxygen consumption of flies during flight. *J. exp. Biol.* 17:402-407.
- (23) N.C. Pant and G. Fraenkel. 1943. Studies on the symbiotic yeasts of two insect species, *Lasioderma sericorne* F. and *Stegobium paniceum*. *Biol. Bull.* 107:420-432.
- (24) G. Fraenkel and C. Hsiao. 1967. Calcification, tanning, and the role of ecdyson in the formation of the puparium of the facefly, *Musca autumnalis*. *J. Insect Physiol.* 13:1387-1394.
- (25) G. Fraenkel. 1968. The heat resistance of intertidal snails at Bimini, Bahamas; Ocean Springs, Mississippi; and Woods Hole, Massachusetts. *Physiol. Zool.* 41:1-13.
- (26) G. Fraenkel. 1963. Berlioz, the Princess and "Les Troyens". *Music and Letters.* 44:249-256.
- (27) G. Fraenkel. 1968. *Decorative Music Title Pages*. 201 examples from 1500-1800. Dover Publications, N.Y. pp. 230.