

---

*The Hot-Blooded Insects*

---



---

# *The Hot-Blooded Insects*

---

STRATEGIES AND  
MECHANISMS OF  
THERMOREGULATION

---

BERND HEINRICH



SPRINGER-VERLAG BERLIN HEIDELBERG GMBH

Copyright © 1993 by Bernd Heinrich  
Originally published by Springer-Verlag Berlin Heidelberg in 1993  
Softcover reprint of the hardcover 1st edition 1993

All rights reserved

10 9 8 7 6 5 4 3 2 1

ISBN 978-3-662-10342-5 ISBN 978-3-662-10340-1 (eBook)  
DOI 10.1007/978-3-662-10340-1

This book is printed on acid-free paper and its binding  
materials have been chosen for strength and  
durability.

Designed by Gwen Frankfeldt

---

# *Contents*

---

Prologue	1
1 Night-Flying Moths	17
2 Butterflies and Wings	76
3 Dragonflies Now and Then	117
4 Grasshoppers and Other Orthoptera	143
5 Beetles Large and Small	191
6 Bumblebees Out in the Cold	227
7 Tropical Bees	277
8 Hot-Headed Honeybees	292
9 The Tolerance of Ants	323
10 Wasps and the Heat of Battle	334
11 Flies of All Kinds	343
12 Sweating Cicadas	369
13 Warm Caterpillars and Hot Maggots	382
14 Fever	411
15 Cold Jumpers	422
16 Social Thermoregulation	447
Summary	510
<i>References</i>	525
<i>Acknowledgments</i>	585
<i>Index of Authors Cited</i>	590
<i>General Index</i>	598