

Forensic Entomology

An Introduction

Dorothy E. Gennard

University of Lincoln, UK



Forensic Entomology

Forensic Entomology

An Introduction

Dorothy E. Gennard

University of Lincoln, UK



Copyright © 2007 John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester,
West Sussex PO19 8SQ, England

Telephone (+44) 1243 779777

Email (for orders and customer service enquiries): cs-books@wiley.co.uk

Visit our Home Page on www.wiley.com

All Rights Reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning or otherwise, except under the terms of the Copyright, Designs and Patents Act 1988 or under the terms of a licence issued by the Copyright Licensing Agency Ltd, 90 Tottenham Court Road, London W1T 4LP, UK, without the permission in writing of the Publisher. Requests to the Publisher should be addressed to the Permissions Department, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England, or emailed to permreq@wiley.co.uk, or faxed to (+44) 1243 770620.

Designations used by companies to distinguish their products are often claimed as trademarks. All brand names and product names used in this book are trade names, service marks, trademarks or registered trademarks of their respective owners. The Publisher is not associated with any product or vendor mentioned in this book.

This publication is designed to provide accurate and authoritative information in regard to the subject matter covered. It is sold on the understanding that the Publisher is not engaged in rendering professional services. If professional advice or other expert assistance is required, the services of a competent professional should be sought.

Other Wiley Editorial Offices

John Wiley & Sons Inc., 111 River Street, Hoboken, NJ 07030, USA

Jossey-Bass, 989 Market Street, San Francisco, CA 94103-1741, USA

Wiley-VCH Verlag GmbH, Boschstr. 12, D-69469 Weinheim, Germany

John Wiley & Sons Australia Ltd, 33 Park Road, Milton, Queensland 4064, Australia

John Wiley & Sons (Asia) Pte Ltd, 2 Clementi Loop #02-01, Jin Xing Distripark, Singapore 129809

John Wiley & Sons Canada Ltd, 22 Worcester Road, Etobicoke, Ontario, Canada M9W 1L1

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Anniversary Logo Design: Richard J. Pacifico

Library of Congress Cataloging in Publication Data

Gennard, Dorothy E.

Forensic entomology : an introduction / Dorothy E. Gennard.

p. cm.

Includes bibliographical references.

ISBN: 978-0-470-01478-3 (cloth : alk. paper)

ISBN: 978-0-470-01479-0 (pbk. : alk. paper)

1. Forensic entomology. I. Title.

RA1063.45.G46 2006

614'.1—dc22

2006032094

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

ISBN 978-0-470-01478-3 (HB) 978-0-470-01479-0 (PR)

Typeset in 10.5/12.5pt Times by Integra Software Services Pvt. Ltd, Pondicherry, India

Printed and bound in Great Britain by Antony Rowe Ltd, Chippenham, Wiltshire

This book is printed on acid-free paper responsibly manufactured from sustainable forestry in which at least two trees are planted for each one used for paper production.

Contents

List of figures	ix
List of tables	xiii
Preface	xv
Acknowledgements	xvii
1 The breadth of forensic entomology	1
1.1 History of forensic entomology	1
1.2 Indicators of time of death	3
1.3 Stages of decomposition of a body	3
1.4 Indicators of physical abuse	13
1.5 Insect larvae: a resource for investigating drug consumption	14
1.6 Insect contamination of food	15
1.7 Further reading	17
2 Identifying flies that are important in forensic entomology	19
2.1 What is a fly and how do I spot one?	23
2.2 Forensically important families of flies	29
2.3 DNA identification of forensically important fly species	43
2.4 Further reading	50
3 Identifying beetles that are important in forensic entomology	53
3.1 What do beetles look like?	53
3.2 Features used in identifying forensically important beetle families	61
3.3 Identification of beetle families using DNA	69
3.4 Further reading	70
4 The life cycles of flies and beetles	73
4.1 The life stages of the fly	73
4.2 The life stages of the beetle	80
4.3 The influence of the environment on specific insect species	82
4.4 Succession of insect species on the corpse and its role in post mortem estimation	84

4.5	Review technique: preparing slides of larval spiracles or mouthparts – preparation of whole slide mounts	87
4.6	Further reading	89
5	Sampling at the crime scene	91
5.1	Entomological equipment needed to sample from a corpse	91
5.2	The sampling strategy for eggs	95
5.3	Catching adult flying insects at the crime scene	97
5.4	Catching adult crawling insects at the crime scene	98
5.5	Obtaining meteorological data at the crime scene	99
5.6	Review technique: investigating the influence of larval location	100
5.7	Further reading	101
6	Breeding entomological specimens from the crime scene	103
6.1	Returning to the laboratory with the entomological evidence	103
6.2	Fly-rearing conditions in the laboratory	104
6.3	Conditions for successful rearing to the adult (imago) fly stage	108
6.4	Beetle rearing in the laboratory	108
6.5	Dietary requirements of insects reared in the laboratory	110
6.6	Review technique: preserving and mounting insect specimens	110
6.7	Further reading	113
7	Calculating the post mortem interval	115
7.1	Working out the base temperature	117
7.2	Accumulated degree data	118
7.3	Calculation of accumulated degree hours (or days) from crime scene data	121
7.4	Sources of error	124
7.5	Use of larval growth in length to determine post mortem interval (isomegalen and isomorphen diagrams)	125
7.6	Calculating the post mortem interval using succession	125
7.7	Review technique: interpretation of data from a crime scene case study	126
7.8	Further reading	129
8	Ecology of forensically important flies	131
8.1	Ecological features of bluebottles (Calliphoridae)	131
8.2	Greenbottles – <i>Lucilia</i> spp.	136
8.3	Ecological associations with living organisms	138
8.4	Further reading	141
9	Ecology of selected forensically important beetles	143
9.1	Categories of feeding relationship on a corpse	143
9.2	Ecology of carrion beetles (Silphidae)	146
9.3	Ecology of skin, hide and larder beetles (Dermestidae)	147

9.4	Ecology of clown beetles (Histeridae)	151
9.5	Ecology of checkered or bone beetles (Cleridae)	152
9.6	Ecology of rove beetles (Staphylinidae)	154
9.7	Ecology of dung beetles (Scarabaeidae)	154
9.8	Ecology of trogid beetles (Trogidae)	155
9.9	Ecology of ground beetles (Carabidae)	155
9.10	Review technique: determination of succession and PMI	156
9.11	Further reading	158
10	The forensic entomologist in court	161
10.1	The Statement of Witness	162
10.2	Council for the Registration of Forensic Practitioners	169
10.3	Communicating entomological facts in court	171
10.4	Physical evidence: its continuity and integrity	172
10.5	Review technique: writing a Statement of Witness using the post mortem calculations determined from details given in Chapter 7	173
10.6	Further reading	174
11	The role of professional associations for forensic entomologists	175
11.1	Professional organizations	175
11.2	Forensic entomology protocols	176
11.3	Areas for future research	177
11.4	Further reading	178
	Appendices	181
	Appendix 1: Form for forensic entomology questions to be asked at the crime scene	181
	Appendix 2: Answers to the calculation of the post mortem interval for the body at the Pleasure Gardens, Wingsea	183
	Appendix 3: UK list of Calliphoridae (2006)	185
	Appendix 4: UK checklists for Coleoptera	187
	Appendix 5: List of relevant UK legal acts and orders	191
	Appendix 6: Selected sources of entomological equipment	193
	Appendix 7: Legal information relevant to giving testimony as a forensic entomologist in the USA	195
	Glossary	197
	References	205
	Index	221

List of figures

1.1–1.7	Artistic impressions of stages of decomposition of the body (Morishige, 1673–1680). The nine contemplations of the impurity of the human body, stage 1–9.	7
1.8	Last stage of decomposition of a human body	7
1.9	Body in bloat	9
1.10	Post-decay stage of human decomposition. The breakdown material was retained within the polythene	10
1.11	Rabbit exhibiting myiasis	12
1.12	A tequila bottle label illustrating the Maguey worm, <i>Aegiale hesperiatris</i> Walker (Lepidoptera), which authenticates the drink	16
2.1	Structure of (a) the insect and (b) the leg	20
2.2	The structure of the insect wing	22
2.3	Examples of some of the forms of antennae found in insects	23
2.4	Classification hierarchy	24
2.5	(a) A nematoceran fly, a member of the Tipulidae; note the halteres, or balancers, and the pendulous mouthparts. (b) Nematoceran wing showing the complexity of wing venation	25
2.6	An example of a member of the Brachycera; a tabanid or horse fly	26
2.7	The wing of a member of the infraorder Muscomorpha Aschiza, illustrating the long anal cell	27
2.8	The wing calypter (squama)	27
2.9	The face of a fly. The remains of the ptilinum is present as a ptilinal suture above the antennae	28
2.10	The occipital dilation present in <i>Calliphora uralensis</i> Villeneuve	29
2.11	The insect thorax showing the rows of acrostichal bristles down the centre of the thorax	30
2.12	The tessellation (chequer-board effect) on the abdomen of such flies as <i>Calliphora vicina</i> Meigen	31
2.13	The black basicosta of <i>Calliphora vomitoria</i> (L.)	31
2.14	The bare subcosta (stem vein) in <i>Lucilia</i> and <i>Calliphora</i> spp. distinguishes them from <i>Phormia</i> spp. where the subcosta upper surface is hairy	32
2.15	(a) An example of the head skeleton and (b) the tubercles and spiracles at the posterior region of the larva	33
2.16	(a) <i>Lucilia illustris</i> Meigen surstyli. (b) <i>Lucilia caesar</i> (L.) surstyli	34

2.17	<i>Lucilia richardsi</i> Collin	35
2.18	<i>Protophormia terraenovae</i> (Robineau-Desvoidy)	36
2.19	<i>Cynomya mortuorum</i> (L.), illustrating its yellow parafrontal region	37
2.20	A fly showing the characteristic features of the Sarcophagidae	38
2.21	A pair of piophilids taken 'in cop'	39
2.22	Head of <i>Piophilidae casei</i> (L.) to show the cheek region	40
2.23	The sigmoid spiracle slit shapes characteristic of Muscidae	42
2.24	An example of an electropherogram	45
2.25	Electrophoresis gel from RAPD analysis of fly DNA	46
3.1	Generalized morphology of a beetle, dorsal view	54
3.2	Structure of a beetle thorax; (a) dorsal view and (b) ventral view	55
3.3	Insect front legs modified for digging (<i>Geotrupes</i> sp.)	56
3.4	Examples of the shapes of beetle larvae	58
3.5	The types of pupae and puparia illustrate the relationship of appendages to the body	59
3.6	The distinction between the Polyphaga (a) and the Adephaga (b), ventral view	60
3.7	A silphid, <i>Nicrophorus humator</i> Gleditsch	62
3.8	An example of the Staphylinae	63
3.9	A hispid beetle	64
3.10	A trogid beetle	65
3.11	<i>Dermestes lardarius</i> (L.)	65
3.12	The front coxa of the dermestid projects from the coxal cavity	66
3.13	Life cycle of <i>Dermestes maculatus</i> DeGeer	67
3.14	Clerid beetle	67
3.15	An example of a nitidulid beetle	68
3.16	Carabid beetle, illustrating the striations on the elytra	69
3.17	Profile of the RAPDs of a silphid beetle in comparison to a calliphorid fly	70
4.1	Clump of eggs laid inside the ear of a pig	74
4.2	The plastron runs the length of the egg	74
4.3	Life cycle of the blowfly	75
4.4	(a) Posterior section of the larva, showing tubercles and posterior spiracles. (b) Transition from larval stage 2 to larval stage 3, showing emerging spiracle slits	76
4.5	Example of the anterior spiracle of the larva. The shapes can vary and can be used for identification purposes	77
4.6	Puparial colour changes of <i>Calliphora vomitoria</i> (L.) up to 25 hours after the onset of pupariation	78
4.7	Adult fly emerging from the puparial case	79
4.8	Generalized insect growth curve	80
4.9	A flea, an ectoparasite which may be alive on a submerged body for up to 24 hours	81
4.10	The human louse, an indicator of recent death if still alive on a corpse	82

5.1	The contents of an entomological scene-of-crime case, with equipment	92
5.2	Sealed, labelled bag containing specimens of insects collected from the crime scene	94
5.3	Body wrapped in black polythene	94
5.4	A label containing information about the scene, date, collector, the crime number and item number used at a crime scene	95
5.5	Retrieving a flying insect from the net	98
5.6	A commercial Tulgren funnel for extracting live insects from soil	99
6.1	Larvae collected from the crime scene are reared in a controlled environment cabinet	104
6.2	Large cage for emerging adult flies	105
6.3	Container with liver provided as an oviposition site so that the larvae can be grown through to the stage recovered from the body at the crime scene	106
6.4	Examples of styles of mounting insects	111
7.1	Insect growth in relation to upper and lower temperature thresholds	116
7.2	Base temperature determination, using the linear approximation method	118
7.3	Graph to show the justification for using accumulation of averaged temperatures over time	119
7.4	Regression of crime scene data against meteorological station temperature data	122
9.1	Dermestid damage of (a) the leg and (b) the foot of a 'mummy'	148
9.2	Faecal remains (frass) from dermestids	149
9.3	The shrubbery at the field station where the rabbit carcass was located	157
10.1	A specimen first page from a Statement of Witness for a criminal case	168

List of tables

2.1	Examples of primers for cytochrome oxidase investigation of calliphorid identity	44
4.1	Succession of insects on buried bodies	85
4.2	Seasonal distribution of European insect species on a body	86
6.1	Average minimum life cycle duration (hours) of a selection of dipteran species at fixed temperatures	107
7.1	Lower development thresholds	120
7.2	An example of the headings and completed spreadsheet to calculate ADD for <i>Calliphora vicina</i> (Robineau-Desvoidy)	122
7.3	Temperature readings from the meteorological station for the period 14–20 April	128
8.1	Succession of Diptera on carrion in the open in the UK	132
9.1	Generalized coleopteran succession on carrion in relation to stage of decomposition	144
9.2	Daily field station collections of insect species on a dead rabbit	158
10.1	Suggested headings for a forensic entomology Statement of Witness	162

Preface

This book is an introduction to forensic entomology for undergraduates, particularly those studying for a degree in forensic science. Responding to comments over the past 6 years from students studying forensic entomology, this book provides a basic entomological background, with descriptions of practical techniques and the legal aspects of using insects to estimate the time since death and help solve crime. I have included sections on the ecological implications of the presence of some of the more frequent insect visitors to a corpse (human and non-human). I have also included information from a range of countries to broaden the application of the textbook, as students travel widely and may go on to find employment across the world.

I hope that, by using *Forensic Entomology: An Introduction*, students will find studying entomology interesting and its role and application as a forensic tool to solve crime scenarios a fascination, irrespective of any fears about the smell!

Dorothy Gennard

Acknowledgements

I am grateful to the following for permission to reproduce illustrations, or quote from publications:

The Amateur Entomologists' Society, for permission to quote from Dear J. P. Carrion (1978). In Stubbs A. and Chandler P. *A Dipterist's Handbook*. The Amateur Entomologist 15. The Amateur Entomologists' Society: London (1978).

Dr Mark Benecke, for providing a copy of his RAPD profile of *Oiceophoma thoracicum* L. and *Calliphora vicina* (Robineau-Desvoidy).

Professor Michael Claridge, the Royal Entomological Society of London and Dr B. R. Laurence, for permission to reproduce his photograph of the tequila bottle from *Antenna* 6(3) (1982).

Dr Jonathan Cooter, Hereford Museum, for permission to quote his comments about the distribution of *Necrobia ruficollis* in the UK.

The Etnografisch Museum of Antwerp, for providing a CD of photographs of the paintings by Morishige (1673–1680) entitled 'The nine contemplations of the impurity of the human body' (Figures 1.1–1.7) and for permission to reproduce them.

Dr Sharon Erzinçlioğlu, for permission to quote the case of Mike Evans and Zoë, from Erzinçlioğlu Y. Z. *Maggots, Murder and Men*. Harley Books: Colchester (2000).

Elsevier, for permission to quote details of lower temperature limits, published in Marchenko M. L. Medico-legal relevance of cadaver entomofauna for the determination of the time of death. *Forensic Science International* 120(1–2): 89–109 (2001) and a section of *Forensic Science International* 98.

Benecke M., Random amplified polymorphic DNA (RAPD) typing of necrophagous insects (Diptera: Coleoptera) in criminal forensic science: validation and use in practice (Figure 4) p. 164 © (1998) with permission from Elsevier (presented in this book as Figure 3.17).

Dr Susan Giles, Curator, Bristol Museums, Galleries and Archives, Bristol City Council, for the opportunity to photograph the Bristol Mummy.

Dr Martin Hall, British Museum, Natural History, for permission to quote his comments on the species of fly recovered from the bodies of two children murdered in Soham, Cambridgeshire.

Frances Harcourt-Brown, for permission to reproduce her photograph (Figure 1.11) of a rabbit exhibiting myiasis.

Dr Kate Horne, Secretary of the Council for the Registration of Forensic Practitioners, for permission to reproduce the tenets of the Council for the Forensic Practitioner.

The Regents of the University of California, for permission to reproduce a modification of Figure 4A from Wilson L. T. and Barnett W. W. Degree-days: an aid in crop and pest management. *California Agriculture (January–February)*: 4–7 (1983). TM©1983 Regents, University of California (presented in this book as Figure 7.3).

John Newton and Rentokil Initial plc, for permission to reproduce diagrams of antennae, insect larvae and pupae (Figures 2.3, 3.4 and 3.5), from Munro J. W. *Pests of Stored Products*. The Rentokil Library. Benham and Co: Colchester (1965).

Tecknica Ltd, for providing the 2006 MapMate data and for permission to reproduce the Checklist of UK Recorded Calliphoridae, 2006, and also selected families of the Checklist of UK Coleoptera.

Dr Chris Pamplin, Editor, UK Register of Expert Witnesses, for permission to reproduce a section of *Taking Experts out of Court*, citing evidence for the Daubert test of evidence.

Warrant Officer Thierry Pasquerault Colonel J. Hebfard, of the Criminal Research Institute of the French and National Gendarmerie, for permission to use his photograph of packaging of entomological specimens recovered from a crime scene.

I would like to thank the following people for their comments, discussion and advice:

Mr Bill Barnett; Dr Trevor Crosby, Curator NZ Arthropod Collection, Landcare Research, University of Auckland; Keith Butterfield, University of Lincoln; Mr Lindsay Cutts; Dr John Esser; Susan Giles, Curator, Bristol Museums, Galleries and Archives, Bristol City Council; Katrina Hanley; Lorna Hanley; Karen Inckle; Mr Simon Jelf, Bond Solon Training Ltd; Helen Joiner; Mark Lawton; Helen Lonsdale; Dr Robert Nash, Ulster Museum; Professor Brian McGaw, University of Lincoln; Dr Brett Ratcliffe, Curator and Professor, Systematics Research Collections, University of Nebraska, Lincoln, NE, USA; Sean Riches, CAB Product Manager, Novartis Ltd, Paula Saward, formerly of Centrex; Kate Stafford; Dr J. Van Alphen, Etnografisch Museum of Antwerp, Belgium; Arpad Vass, Oakridge National Laboratory, TN, USA; Janet L. White,

Executive Editor, *California Agriculture*; Dr Lloyd T. Wilson, Texas A&M University; Laura Woodcock and Dr Frank Zalom, University of California.

I am most grateful to Rachael Ballard and Elizabeth Kingston, of John Wiley & Sons Ltd, for their help, encouragement and support; especially to Elizabeth Kingston and Lesley Winchester (Freelance Editor) for their editing assistance in the production of this manuscript.

I am grateful to Dr Darren Mann and Mr James Hogan of the Hope Entomological Collections, Oxford University Museum of Natural History, for providing, on extended loan, dipteran specimens for photography.

I am especially grateful to Mr David Padley, formerly police photographer with the Lincolnshire Police, for his excellent photography of the entomological specimens.

1

The breadth of forensic entomology

Forensic entomology is the branch of forensic science in which information about insects is used to draw conclusions when investigating legal cases relating to both humans and wildlife, although on occasion the term may be expanded to include other arthropods. Insects can be used in the investigation of a crime scene both on land and in water (Anderson, 1995; Erzinçlioğlu, 2000; Keiper and Casamatta, 2001; Hobischak and Anderson, 2002; Oliveira-Costa and de Mello-Patiu, 2004). The majority of cases where entomological evidence has been used are concerned with illegal activities which take place on land and are discovered within a short time of being committed. Gaudry *et al.* (2004) commented that in France 70 % of cadavers were found outdoors and of these 60 % were less than 1 month old.

The insects that can assist in forensic entomological investigations include blowflies, flesh flies, cheese skippers, hide and skin beetles, rove beetles and clown beetles. In some of these families only the juvenile stages are carrion feeders and consume a dead body. In others both the juvenile stages and the adults will eat the body (are necrophages). Yet other families of insects are attracted to the body solely because they feed on the necrophagous insects that are present.

1.1 History of forensic entomology

Insects are known to have been used in the detection of crimes for a long time and a number of researchers have written about the history of forensic entomology (Benecke, 2001; Greenberg and Kunich, 2002). The Chinese used the presence of flies and other insects as part of their investigative armoury for crime scene investigation and instances of their use are recorded as early as the mid-tenth century (Cheng, 1890; cited in Greenberg and Kunich, 2002). Indeed, such was the importance of insects in crime scene investigation that in 1235, a training manual on investigating death, *Washing Away of Wrongs*, was written by Sung Tz'u. In this medico-legal book it is recorded that the landing of a number of blowflies on a particular sickle caused a murderer to confess to murdering a fellow Chinese farm worker with that sickle.

Between the thirteenth and the nineteenth century, a number of developments in biology laid the foundation for forensic entomology to become a branch of scientific study. The two most notable were, perhaps, experiments in Italy by Redi (1668) using the flesh of a number of different animal species, in which he demonstrated that larvae developed from eggs laid by flies, and the work by Linnaeus (1775) in developing a system of classification. In so doing, Linnaeus provided a means of insect identification, including identifying such forensically important flies as *Calliphora vomitoria* (Linnaeus). These developments formed foundations from which determination of the length of the stages in the insect's life cycle could be worked out and indicators of time since death could be developed.

A particularly significant legal case, which helped establish forensic entomology as a recognized tool for investigating crime scenes, was that of a murdered newborn baby. The baby's mummified body, encased in a chimney, was revealed behind a mantelpiece in a boarding house when renovation work was being undertaken in 1850. Dr Marcel Bergeret carried out an autopsy on the body and discovered larvae of a fleshfly, *Sarcophaga carnaria* (Linnaeus), and some moths. He concluded that the baby's body had been sealed up in 1848 and that the moths had gained access in 1849. As a result of this estimation of post mortem interval, occupiers of the house previous to 1848 were accused and the current occupiers exonerated (Bergeret, 1855).

The next significant point in the history of forensic entomology resulted from observations and conclusions made by Mégnin (1894). He related eight stages of human decomposition to the succession of insects colonizing the body after death. He published his findings in *La Faune des Cadavres: Application de l'Entomologie à la Médecine Légale*. These stages of decomposition were subsequently shown to vary in speed and to be dependent upon environmental conditions, including temperature and, for example, whether or not the corpse was clothed. However, the similarity in overall decomposition sequence and the value of the association of insects has been demonstrated for decomposition of the bodies of a number of animal species. This knowledge about insect succession on a corpse became the basis for forensic entomologists' estimations of the time since death of the corpse.

In the twentieth century insects were shown to be of value in court cases involving insect colonization of body parts recovered from water and not just whole corpses found on land. On 29 September 1935, several body parts, later identified as originating from two females, were recovered from a Scottish river near Edinburgh. The identities of the deceased were determined and the women were named as Mrs Ruxton and Mary Rogerson, 'nanny' for the family. The presence of larvae of the blowfly *Calliphora vicina* Robineau-Desvoidy, in their third larval instar, indicated that the eggs had been laid prior to the bodies being dumped in the river. This information, combined with other evidence, resulted in the husband, Dr Ruxton, being convicted of the murder of his wife and Mary Rogerson.

The acceptance of forensic entomology has depended upon both academics and practitioners working alongside the police and legal authorities, to refine and develop forensic entomology as a scientific study in the late twentieth and early twenty-first centuries. A list of forensic entomologists, who are members of the American Board of Forensic Entomology, the European Association for Forensic Entomology and other professional entomological and medical organizations, can be found on the website: http://folk.uio.no/mostarke/forensic_entomologists.html

1.2 Indicators of time of death

In the first 72 hours after death, the pathologist is usually considered to be able to provide a reasonably accurate determination of the time of death. Historically, this has been based upon the condition of the body itself and such features as the fall in body temperature. Beyond this time, there is less medical information with which to correlate post mortem interval (PMI). So another area of expertise is required to clarify time of death. The forensic entomologist can provide a measure of the possible post mortem interval, based upon the life cycle stages of particular fly species recovered from the corpse, or from the succession of insects present on the body. This estimate can be given over a period of hours, weeks or years. The start of the post mortem interval is considered to coincide with the point when the fly first laid its eggs on the body, and its end to be the discovery of the body and the recognition of life stage of the oldest colonizing species infesting it. The duration of this stage, in relation to the particular stage of decay, gives an accurate measure of the probable length of time the person has been dead and may be the best estimate that is available.

1.3 Stages of decomposition of a body

The stages of decomposition of a body have been a topic of interest for both artists and scientists over a long period of time (Figures 1.1–1.8). There are three recognizable processes in corpse decomposition. These are autolysis, putrefaction and skeletal bone decomposition (diagenesis). In autolysis, a process of natural breakdown, the cells of the body are digested by enzymes, including lipases, proteases and carbohydrases. This process can be most rapid in organs such as the brain and liver (Vass, 2001). A ‘soup’ of nutrients is released which forms a food source for bacteria. Putrefaction is the breakdown of tissues by bacteria. As a result, gases such as hydrogen sulphide, sulphur dioxide, carbon dioxide, methane, ammonia, hydrogen and carbon dioxide are released. Alongside this, anaerobic fermentation takes place when the volatiles propionic and butyric acid are formed. The body undergoes active decay, in which protein sources are broken