

THREE PHILOSOPHICAL APPROACHES TO ENTOMOLOGY

ABSTRACT

The first philosophical approach to entomology deals with insects as small animals. Due to the physical differences linked with the difference of scale, small animals seem to live in another world. The second approach deals with nomenclature and classification. It shows the progressive making of the concept of insect. In this process, groups like the crustaceans or the spiders were split off from the insects. The third approach deals with the interpretation of insect societies. – Insects can offer to philosophy a set of thought experiments, which have not been fully exploited.

1. INTRODUCTION

The phrase “a philosophical approach to entomology” sounds slightly paradoxical. Many philosophers would agree with Buffon saying in the *Discours sur la nature des animaux*, published in 1753, that a fly must not take more space in a naturalist’s mind than it takes in Nature.¹ This spiteful remark was aimed at Réaumur, Buffon’s main rival. Réaumur was the author of the celebrated *Mémoires pour servir à l’histoire des insectes*, in six volumes (1734–1742).² Peculiarly, Buffon despised Réaumur’s admiration of the architecture of the bee’s cells; he stated, as a principle, that the less one reasons, the more one admires. Buffon considered the shape of the bees’ cell as the mechanical result of the forces of a huge number of bees. By taking into account the distance between insects’ behaviour and man’s behaviour, Buffon avoided one anthropomorphist bias. But he did not avoid the anthropocentric bias of placing the human species at the centre of nature. Anthropocentrism and anthropomorphism look like the Charybdis and Scylla of natural history, but while anthropocentrism is a metaphysical and ethical point of view, anthropomorphism can offer a useful metaphor. For instance when the French entomologist Jean-Henri Fabre described an insect as a craftsman he did it to express

1 Georges-Louis Leclerc Comte de Buffon, *Histoire naturelle, générale et particulière*, vol. IV. Paris: Imprimerie Royale 1753, p. 92. (See also a web edition, <www.buffon.cnrs.fr>)

2 René Antoine Ferchault de Réaumur, *Mémoires pour servir à l’histoire des insectes*. Paris: Imprimerie Royale, 6 vol.1734-1742.

what we nowadays call the ecological function of this insect and to vividly depict the succession of gestures necessary to perform its task.³

Despite its importance, the controversial problem of anthropomorphism is not the only one. The current paper will be devoted to three other approaches to insects. These approaches are termed “philosophical” because they represent broad motifs of inquiry that set its scene by determining what type of observation or distinction is deemed worthy of note.

2. THE SIZE OF INSECTS

The first philosophical approach to entomology deals with insects as small animals. Michelet, for instance, in *L’Insecte* – one of the popular books of natural history, which the French historian wrote in co-operation with his wife Athénaïs Mialaret – depicts beetles wearing their heavy carapace as an armour of the Middle Ages and fancies that it is proportionally like a man bearing the obelisk of Luxor.⁴ Popular science often explains that a flea, if it had the same size as a man, could jump on the top of the Eiffel Tower. Many authors have shown, from a mathematical point of view, the fallacy of this kind of comparison. The strength of an animal is as the square of its length, while the weight is proportioned to the cube of its length. But the computation cannot refute the dream and the miniature world of insects still strongly appeals to the imagination.

Due to the physical differences linked with the difference in size, small animals seem to live in another world.

The problem was known by Galileo, but it has been forgotten by metaphysicians.⁵ Hence, the famous meditation by Pascal, who, in the *Pensées*, after depicting the earth lost in the universe, focussed on a “ciron” (a cheese mite) and

3 Jean-Henri Fabre, *Souvenirs entomologiques*. Paris: Delagrave, 10 vol. 1925. See for instance the case of the Dung Beetle, VI, 13, p. 243. On Fabre, see: Yves Cambefort. *L’œuvre de Jean-Henri Fabre*. Paris: Delagrave 1999; Patrick Tort, *Fabre. Le miroir aux insectes*. Paris: Vuibert/ADAPT 2002.

4 Jules Michelet, *L’Insecte*. Paris: Hachette 1857, p. 133. See also the new edition by Paule Petitier, *Sainte-Marguerite sur Mer*: Edition des Equateurs 2011. The other naturalist books by Michelet are: *L’Oiseau* 1856; *La Mer* 1861; *La Montagne* 1868.

5 Galileo Galilei, *Discorsi e dimostrazioni matematiche, intorno a due nuove scienze [Discourses and Mathematical Demonstrations Relating to Two New Sciences]*. Leiden: Louis Elsevier 1638. See also John Burdon Sanderson Haldane, “On Being the Right Size”, in: John Maynard Smith (Ed.), *On Being the Right Size and other Essays*. Oxford: Oxford University Press, [1927] 1985, pp. 1-8. See also Augustin Cournot *Matérialisme. Vitalisme. Rationalisme. Etudes sur l’emploi des données de la science en philosophie*. Paris: Hachette 1875. Reissue by Claire Salomon-Bayet: Paris, Vrin 1987. See also Jean-Marc Drouin, “Quelle dimension pour le vivant ?”, in: Thierry Martin (Ed.), *Le tout et les parties dans les systèmes naturels*. Paris: Vuibert, pp. 107-114.

imagined a universe in the “ciron”...⁶ The first chapter of *On Growth and Form*, the masterpiece of D’Arcy Thompson (first published in 1917) is an answer to this kind of meditation.⁷ As Stephen Jay Gould says in his preface to a recent reissue: “the author descends from the ordinary gravitational world of our own species through the realm of surface forces inhabited by insects, to the utterly unfamiliar domain of bacterium”.⁸

It has often been stated that nothing is small or large *per se*. D’Arcy Thompson analyses and refutes this commonplace:

We are accustomed to think of magnitude as a purely relative matter ... and we are apt accordingly to suppose that size makes no other or more essential difference, and that Lilliput [the country of the little people in Gullivers’ travel] and Brobdingnag [the country of the giants] are all alike, according as we look at them through one end of the glass or the other.⁹

3. NOMENCLATURE AND CLASSIFICATION

The second philosophical approach to entomology deals with nomenclature and classification.

To classify can just be to set things in an order (for instance the alphabetical order) which makes it easy to find them. It can be sorting things according to their real, or supposed, utility or harmfulness. But the entomologists, like all other naturalists, did not content themselves with those practical classifications, they looked for a classification which caught something of the order of nature. The history of entomology shows the progressive making of the concept of insect. In Linnaeus’ work, the group of the insects included butterflies, moths, flies, mosquitoes, bugs, bees, ants, wasps, beetles, fleas, grasshoppers, dragonflies, and all kinds of animals which are still considered as insects, but it also included crabs, shrimps, lobsters, crayfishes, woodlice, spiders, scorpions, mites, centipedes, and all kinds of animals, which are no longer considered as Insects.¹⁰ In the second half or the 18th century and the first half of the 19th century, many groups were excluded from the insects. For instance, all the species which do not have six legs. All these efforts of classification resulted in a phylum, the arthropods, divided in several classes: insects, arachnids, crustaceans, centipedes.

6 Blaise Pascal, *Pensées*, in: *Œuvres complètes*, Jacques Chevalier (Ed.), Paris: Gallimard 1954.

7 D’Arcy Wentworth Thompson, *On Growth and Form*. Cambridge: Cambridge University Press 1961, pp. 15-48 [posthumous and abridged edition by John T. Bonner]. Reissued with a preface by Stephen Jay Gould, Cambridge: Canto Editions 1992.

8 Stephen Jay Gould, Preface to Thompson, *On Growth and Form*, *op. cit.*, p. x.

9 D’Arcy Wentworth Thompson, *On Growth and Form*, *op. cit.*, pp. 16-17.

10 Carl von Linné, *Systema naturae*, 10th issue, Stockholm: 1758. See also Mary P. Windsor, “The Development of the Linnean Insect Classification”, in: *Taxon* 25, 1, 1976, pp. 57-67.

The entomologists also dealt with the “orders” into which they divided the class of insects: for instance, coleoptera (beetles) or lepidoptera (moths and butterflies). The orders are divided into families, the families into genera, the genera into species. The Linnean nomenclature, still in use nowadays, names each species by its generic name completed by a specific attribute.

In order to construct all these classifications, the entomologists tried to use the natural method of classification, taking into account several characteristics of different organs. This method was initiated by the French botanists. It was introduced in entomology circa 1800, by Pierre-André Latreille.¹¹

At first, the Darwinian revolution was chiefly a reinterpretation of the natural classification. In the *Origin of Species* Darwin argues that the descent with modification is the principle which can justify the rules which the naturalists obey in their day to day work. For instance the importance for classification of rudimentary organs is explained by a comparison “with the letters in a word still retained in the spelling, but become useless in the pronunciation, but which serve as a clue in seeking for its derivation”.¹²

In the late 20th century a new trend in classification, cladistics, was proposed by the German entomologist Willi Hennig. The principle is to construct a strictly and only genealogical classification.¹³

4. POLITICAL DEBATES ON INSECT SOCIETIES

The third philosophical approach to entomology deals with the interpretation of insect societies.

4.1 Kings or queens?

During many centuries, the main question was whether the ant colonies or the beehives are ruled by kings or by queens. One of the more significant texts from this point of view is *The Feminine Monarchie or the History of Bees* by Charles Butler. First issued in 1609, the book was often republished.¹⁴ It is a genuine guide of beekeeping, which also contains political views. The hive is pictured as an Amazonian kingdom and the drone “is but an idle companion, living by the sweat

11 Pierre-André Latreille, *Considérations générales sur l'ordre naturel concernant les classes des crustacés, des arachnides et des insectes*. Paris: Schoell 1810.

12 Charles Darwin, *On the Origin of Species*. London: John Murray 1859. Reprint, Cambridge (Mass.): Harvard University Press 1964, p. 455.

13 Willi Hennig, “Phylogenetic Systematics”, in: *Annual Review of Entomology*, vol. X, 1965, pp. 97-116. French Translation by Daniel Gouget et al., published in: *Biosystema*, 2, 1987, pp. 1-30.

14 Charles Butler, *The Feminine Monarchie or the History of Bees*. London: John Havi-land 1623 (first published 1609).

of others brows".¹⁵ Butler warned the reader that things are different in the human species. Anyway the issue of the gender of the leader of insect societies was settled when the Dutch naturalist and physician, Jan Swammerdam, observed with a microscope the genital organs of bees and ants.¹⁶

4.2 Monarchy or republic?

Not a hint of this entomological knowledge can be found in Bernard Mandeville's famous political writing, *The Fable of the bees or private vices, public benefits*. Published in 1714, Mandeville's fiction showed a hive whose bees having decided to be virtuous became so poor that they "flew in a hollow tree".¹⁷ Mandeville's hive was just an image of a rich city, whose economical activity is founded on greed and fraud.

The image of insect societies has often been controversial.¹⁸ But during the French Revolution, the controversies gained a great importance because of the political debates about monarchy and republic and because of the economical need to produce wax and honey. In any case, it can be said that the entomologists em-

15 Butler, *op. cit.*, first page of chapter IV. On Butler and the gender issue, see: Frederick R. Prete, "Can Female Rule the Hive? The Controversy over Honey Bee Gender Roles in British Beekeeping Texts of the Sixteenth-Eighteenth Centuries", in: *Journal of the History of Biology*, XXIV (1), 1991, pp. 113-144.

16 Jan Swammerdam, *Histoire naturelle des insectes*. Utrecht: Ribbuis 1685 (French translation).

17 Bernard Mandeville, *The Fable of the Bees or Private Vices, Publick Benefits*. With a Commentary Critical, Historical and Explanatory by F.B. Kaye. Oxford: Clarendon Press 1924 (Reprint; Indianapolis: Liberty Classics 1988).

18 Several publications deal with the controversies about Insect Societies. See for instance: Perru, "La problématique des insectes sociaux: ses origines au XVIIIe siècle et l'œuvre de Pierre-André Latreille", in: *Bulletin d'histoire et d'épistémologie des sciences de la vie*, vol. X, 1, 2003, pp. 9-38; Marc Ratcliff, "Naturalisme méthodologique et science des mœurs animales au XVIIIe siècle", in: *Bulletin d'histoire et d'épistémologie des sciences de la vie*, vol. III, 1, 1996, pp. 17-29; Jean-Marc Drouin, "L'image des sociétés d'insectes en France à l'époque de la Révolution", in: *Revue de Synthèse*, vol. IV, 1992, pp. 333-345; Jean-Marc Drouin, "Ants and Bees between the French and the Darwinian Revolution", in: *Ludus Vitalis*, vol. XII, 24, 2005, pp. 3-14; Sarah Jansen, "Ameisenhügel, Irenhaus und Bordell: Insektenkunde und Degenerationdiskurs bei August Forel (1848-1931). Entomologe. Psychiater und Sexualreformer", in: Norbert Haas, Rainer Nägele and Hans-Jörg Rheinberger (Eds.), *Kontamination*. Eggingen: Edition Isele 2001, pp. 141-184; Abigail Lustig, "Ants and the nature of nature in August Forel, Erich Wasmann and William Morton Wheeler", in: Lorraine Daston and Fernando Vidal (Eds.), *The Moral Authority of Nature*. Chicago: The Chicago University Press 2004, pp. 282-307; Charlotte Sleight, *Ant*. Chicago: The University of Chicago Press 2003; John F. M. Clark, "A Little People but Exceedingly Wise? Taming the Ant and the Savage in Nineteenth-Century England", in: *La Lettre de la Maison Française*, Oxford, VII, 1997, pp. 65-83.

phasized the philosophical aspects of their science as well as the practical ones in order to show its usefulness.

4.3 *On the origin of inequality among social insects*

The main political themes concerning the insect societies are presented with a strong dramatization in *L'Insecte*, by Jules Michelet. The scholars who studied the work of Michelet took his naturalist books into account.¹⁹ Michelet observed in his garden a “civil war” between large ants and small ones and was horrified by the cruel revenge of the small ones. But the greatest moral problem is slavery. In Michelet’s eyes, rearing aphids is fair: it is like cattle breeding. But, the problem is different when ants capture the pupae of another species of ants, and carry them to their own nest, where the new born ants will work for them during their whole lives. This phenomenon of social parasitism was discovered by Pierre Huber, and named by him *slavery*.²⁰ Pierre Huber was the son of François Huber.²¹ To put it in a nutshell, the father studied the bees and the son observed the ants. Though it is still used in entomological text-books, the word *slave* is questionable as far as the slaves and their masters belong to the same family – the formicidae – but not to the same species: the slave makers observed by Pierre Huber, are Amazon ants (*Polyergus rufescens*) while their so-called slaves belong to another species: ash-coloured ants (*Formica rufa*). In this case, such a taxonomical point of view is not taken into account, and all authors use the word *slave* without considering it metaphoric. If they agree on the name and the description of the phenomenon, authors differ in their moral judgment. Pierre Huber considers that these slaves have no memories of their motherland and he is convinced that they are happy in their new colony.²² Michelet, on the opposite side, is depressed to see Nature setting a bad example of injustice and servitude.

What! I turn aside from the history of men in search of innocence; I hope at least to discover among beasts the evenhanded justice of Nature, the primitive rectitude of the plan of Creation. I seek in this people whom I had previously loved and esteemed for their laboriousness and temperateness, the severe and touching image of republican virtue ... and I find this indescribable horror!²³

19 Roland Barthes, *Michelet*. Paris: Seuil 1954; Linda Orr, *Jules Michelet, Nature, History and Language*. Ithaca: Cornell University Press 1976; Edward K. Kaplan, *Michelet’s Poetic Vision. A Romantic Philosophy of Nature, Man, & Woman*. Amherst: University of Massachusetts Press 1977; Georges Gusdorf, *Le Savoir romantique de la Nature*. Paris: Payot 1985.

20 Pierre Huber, *Recherches sur les mœurs des fourmis indigènes*. Paris et Genève: Paschoud 1810. (Translated into English in 1820 under the title *The Natural History of Ants*.)

21 See François Huber, *Nouvelles observations sur les Abeilles*. Genève: Barde, Manget 1792.

22 Pierre Huber, *Recherches*, *op. cit.*, p. 210.

23 See Michelet, *L’Insecte*, *op. cit.*, pp. 259-260. English translation quoted in Kaplan, *op.*

4.4 Social insects and evolution

Depressed by this treason of nature, Michelet seeks some relief in an evolutionistic approach. He suggests that slave maker colonies are monstrous societies, deprived of the working part of the people. So nature, far from legitimating injustice, reveals it as degeneration. As Roland Barthes says in his essay: “Michelet does not naturalize morality, he moralizes nature.”²⁴

An opposite phrase can be used to epitomize the point of view expressed by Marcelin Berthelot, the famous French chemist and politician, who observed ants as a hobby. He published in 1886 under the title *Science et philosophie* a book collecting several essays. One of them is called “Les cités animales et leur évolution”.²⁵ Berthelot stated that the subject was always in the mind of savants and philosophers, because of the analogies between animal societies and human ones. He was convinced that the same instinct of sociability was active among human races and among animal ones. He considered the hypothesis of the social contract as a chimerical one. Berthelot knew the classical objection of the stability of animal societies contrasting with the historical change undergone by human societies, but he dismissed it, opposing the vicissitudes of an ant colony, which he observed in a wood near Paris. Ten years later, in another collection of essays called *Science et morale*, Berthelot devoted a paper to ant invasions.²⁶ He considered that it is more useful to compare human societies with ant colonies than with beehives, because while in the latter laws are uniform, in the former there is a place for the individual initiatives. In 1903, Marcelin Berthelot, in a commentary on Michelet’s *L’Insecte*, suggested that Michelet, in his books on natural history, searched the symbolism of his own thought.²⁷

Charles Darwin was keenly interested in entomology.²⁸ An entire chapter of the *Origin of Species*, chapter 7 in the first edition, is devoted to instinct structure for “the welfare of each species, under its present conditions of life”.²⁹ Among the examples of instincts analyzed by Darwin, “the slave-making instinct of certain ants” and “the comb-making power of the hive bee”, are borrowed from the study of social insects.³⁰ Darwin proposed to explain them as complications of simpler instincts by natural selection. The ancestors of the slave-making ants might have

cit., p. 87.

24 Barthes, *Michelet*, *op. cit.*, p. 35.

25 Marcelin Berthelot, “Les cités animales et leur evolution”, in: *Science et philosophie*. Paris: Calman-Lévy 1886, pp. 172-184. (I wish to thank Annie Petit for this reference.)

26 Marcelin Berthelot, “Les sociétés animales. Les invasions des fourmis; le potentiel moral”, in: *Science et morale*. Paris: Calman-Lévy 1897, pp. 313-331. (I wish to thank Annie Petit for this reference.)

27 Marcelin Berthelot, “Etude. Lettre à monsieur Ludovic Halévy”, in: Jules Michelet, *L’Insecte*. Paris: Calman-Lévy 1903, pp. 1-39.

28 Yves Carton, *Entomologie, Darwin et Darwinisme*. Paris: Hermann 2011.

29 Darwin, *On the Origin of Species*, *op. cit.*, p. 209.

30 Darwin, *ibid.*, p. 216.

just displayed the instinct of stealing and storing the pupae of other species of ants as a source of food. Some of the pupae, which were stored, might have developed into workers. These workers might have followed “their proper instincts, and do what work they could”.³¹ Their work being useful, the natural selection gradually complicated the instinct of making raids on nests of other species of ants, and transformed this instinct into the habit of capturing workers. Concerning the comb-making power of the hive bee, the explanation rests upon a gradual process from humble-bees “using the old cocoons to hold honey”, to the hive-bee, *Apis mellifera* constructing hexagonal prisms with bases made of three rhombs.³² In this gradual process, the Mexican bee, *Melipona domestica*, with its cylindrical cells plays the role of an intermediate stage. Darwin reports on some experiments he performed with ants and bees. He also thanked several naturalists for their advice, and among them, a specialist of crystallography, William Miller (for the geometrical approach of the comb of the Bees).

The first issue in 1874 of *Les Fourmis de la Suisse* by Auguste Forel, the publication in 1877 of the doctoral dissertation of Alfred Espinas, *Les sociétés animales*, and the popular success of Maurice Maeterlinck’s *Vie des Abeilles* – followed in 1926 by *La Vie des Termites*, and in 1930 by *La Vie des Fourmis* – are evidences of the importance of the Insect societies as a matter of reflection for scientists and philosophers in the second half of the 19th century and the beginning of the 20th century.³³ The celebrated *Mémoires entomologiques* of Jean-Henri Fabre, despite the few pages devoted to ants and bees, can be taken into account to assess the place of entomology in the early 1900.³⁴

A contrast between the evolution of insects and the evolution of humans was suggested by Henri Bergson in *L’Évolution créatrice* (1907). Bergson presented the history of life as a road with two major bifurcations. The first one separates vegetables from animals, the second one separates arthropods from vertebrates. The first line, the arthropods’ one, goes toward instinct, its climax being the Hymenoptera, which is the order of insects to which belong Ants and Bees. The second line, the vertebrates one, goes toward intelligence, its climax being man.³⁵ So, Bergson’s view of evolution of life avoided the myth of a linear progress, as far as he took into account insect societies.

31 Darwin, *ibid.*, p. 223.

32 Darwin, *ibid.*, p. 225.

33 Auguste Forel, *Les Fourmis de la Suisse*. Bâle, Genève, Lyon: Georg 1874; Alfred Espinas, *Des Sociétés animales*, 2nd ed. Paris: Germer, Baillièrre et Cie, 1878. [Reprint: New-York: Arno Press 1977]; Maurice Maeterlinck, *La vie des Abeilles*. Paris: Fasquelle, 1901; *La vie des Termites*. Paris: Fasquelle 1926; *La vie des Fourmis*. Paris: Fasquelle 1930.

34 Fabre, *op. cit.* See also Fabre, *Souvenirs entomologiques*. Yves Delange (Ed.). Paris: Robert Laffont, 2 vol. 1989 (coll. Bouquins).

35 Henri Bergson, *L’Évolution créatrice*. Paris: PUF 1907. New issue: 1962, ch. II, p. 135.

4.5 Sociobiology vs. swarm intelligence

A conflicting view on insects and human evolution occurred with the debate on socio-biology. The starting point looks like a strict question of biomathematics. In 1964, William Hamilton, a British biologist, published, in two issues of the *Journal of Theoretical Biology*, a paper entitled “The genetical evolution of social behaviour”. Hamilton outlined a hypothesis connecting the social behaviour in the hymenoptera with the number of chromosomes. Among ants and bees, females are diploid, which means they have $2n$ chromosomes like any animal, while the males are haploid, which means they only have n chromosomes. The theory of probabilities predicts that in this case, a female can have three quarters of her genes in common with any of her sisters, but only half of her genes with an offspring. So from the point of view of the genes, an ant must prefer nursing her sisters to having a daughter. Of course this can be applied also to the bees, which belong to the hymenoptera.³⁶ The difficulties arose when one postulated that every social behaviour in any animal species – including *Homo sapiens* – can be linked with a genetic fact in a similar manner. Edward Wilson, an entomologist and theoretician of scientific ecology, specialized in the study of ants, claimed for a larger extension of socio-biology. He did it in a provocative way stating, in 1976, that “the division between biology, particularly population biology, and social sciences, no longer exists”.³⁷ Such a claim needs an epistemological discussion. Stated as a fact, it appeared, to social scientists, at least, like a threat of annexation of their discipline. The controversy took a political turn: a biological theory of social behaviour being *a priori* suspected of legitimating inequalities.

Wilson’s view looks reductionist. Not surprisingly, a view, more in harmony with the cultural atmosphere of the seventies, has been launched. The works of Pierre-Paul Grassé (at the end of the 1950s) on the construction of a nest by the termites, a paper of Remy Chauvin (1974), opened a route to Jean-Louis Deneubourg and several other scholars.³⁸ The beehive or the ant colony offer striking examples of collective intelligence. An ant colony grouping a great number of individuals with very simple behaviour can solve complex problems, like finding the shortest way between several points: the salesman problem.

36 William Hamilton, “The Genetical Evolution of Social Behaviour”, in: *Journal of Theoretical Biology*, 7, 1964, pp. 1-16 and pp. 17-52.

37 Edward O. Wilson, “The Central Problem of Socio-biology”, in: Robert May (Ed.), *Theoretical Ecology: Principles and Applications*. Oxford: Blackwell, pp. 205-217 (quotation, p. 217).

38 Pierre-Paul Grassé, “La reconstruction du nid et les coordinations inter-individuelles chez *Belliocsternes natalensi* et *Cubitermes sp.*: la théorie de la stigmergie: essai d’interprétation des termites constructeurs”, in: *Insectes sociaux*, 6, 1959, pp. 41-83; Rémy Chauvin, “Les sociétés les plus complexes chez les Insectes”, *Communications*, 22, 1974, pp. 63-71; Jean-Louis Deneubourg et al., “The Dynamic of Collective Sorting. Robot-like Ants and Ant-like Robots”, in: J. A. Meyer and S. Wilson (Eds.), *From Animals to Animats*. Cambridge (Mass.): The MIT Press, pp. 346-354.

5. CONCLUSION

First, Insects do not *look* small, they *are* small. Second, the works of the entomologists have resulted in a distinction between insects and crustaceans, arachnids, centipedes, as well as the definition of division in several orders of insects. This classification is a social construction, in the sense of the sociology of scientific knowledge, but it is a construction, which, far from being just more or less convenient, can be more or less realistic for theoretical reasons. Third, an ant colony or a beehive is a society, which can be thought of as analogous to a great city or to a brain. Entomology offers to philosophy many stimulating problems, which have not been fully exploited.³⁹

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