Semiochemistry, flavours and pheromones (Proceedings of the American Chemical Society Symposium, Washington D C., U.S.A., August 1983) edited by Terry E. Acree and David M. Soderlund. Walter de Gruyter, Berlin, 1985, pp. x+289, DM 160.

It was not very long ago that animals were considered deaf, dumb and virtually blind. Karl von Frisch, the discoverer of the honey bee dance language shook us out of this megalomania when, not willing to believe that flowers were exquisitely coloured merely for the aesthetic pleasure of human beings, showed that honey bees not only had colour vision but that they could also sense colours such as ultraviolet to which we humans are blind. Frisch along with Niko Tinbergen and Konrad Lorenz went on to develop the science of animal behaviour called *Ethology*. A major triumph of modern ethology has been to show that much of animal behaviour can be broken down into *fixed action patterns* that are predictably evoked by extraordinarily simple *releaser* stimuli. Egg retrieving behaviour in geese which is normally triggered by a real egg lying outside but near the nest will also be released by beer cans, light bulbs, smooth stones or any object ever so vaguely resembling an egg. Herring gull chicks which normally begin to beg at the approach of their mother can be induced to show the same response by appropriately vibrating a pencil as long as it has a bright red spot at its tip like the mother's beak. Male sticklebacks which develop a bright red belly during the reproductive period not only attack their red-bellied neighbours but anything that is red, not sparing even the reflection of passing red postal trucks! The simplicity of the releasers is a matter of great satisfaction because we now know that even single nerve cells are capable of responding to these stimuli. The neurophysiological basis of a great deal of behaviour is thus stripped of mystery[1].

As a young student. the now famous sociobiologist, Edward O. Wilson listened to Konrad Lorenz lecture about releasers and wondered that "If birds and fish were guided to such a remarkable extent by auditary and visual releasers, ants and other social insects must be guided to an even greater degree by chemical releasers"[2]. It is a matter of history that among other things Wilson went on to demonstrate chemical releasers of many complex behaviours in ants such as trail following behaviour, alarm behaviour and even the behaviour of detecting and disposing off corpses so that even live ants could be converted into 'corpses' when applied with the chemical in question and would be "carried to the refuse live and kicking". Such chemicals that are produced by one individual but elicit a response in another of the same species have been called *pheromones* ever since Peter Karlson and Adolf Butenandt[3] first used the term. When they elicit a response in an individual of another species they are called *allomones* or *kairomones* depending on whether they benefit the producer or the receiver. *Semiochemical* is a more recent but composite term that includes chemicals used in communication both within and between species[4]. As explained by the editors of this book in their introduction, "*Semiochemistry* is the isolation, chemical characterization, synthesis, and bioassay of such chemicals".

Being the proceedings of an American Chemical Society symposium entitled "The isolation and characterization of biologically active natural products" held in Washington D.C. in August 1983 and augmented by additional invited chapters, this book. in the words of the editors, "like semiochemicals themselves, ... is intended to stimulate". The intention of the editors I think will be largely fulfilled. The contents, depth of treatment, general interest and quality of the 16 chapters which comprise this book are however highly variable. The book does well to begin with a chapter "Viewing behaviour-modifying chemicals in the context of behaviour: Lessons from the onion fly" by J. R. Miller and M. O. Harris of Michigan State University. This chapter is a paragon of virtues. For the manner in which their study was planned and executed, for the style of their writing and above all for the communicative power of their graphs I unhesitatingly vote this chapter as the best research report I have read in some years. It deserves to be made compulsory reading for all graduate students as it has been in my lab. Miller and Harris begin their chapter by describing their frustration in being unable to establish good laboratory cultures of the onion fly *Delia antiqua*, a serious pest of onion fields, in spite of meticulously following all details of published procedures. Their highly emulation-worthy method of meeting this challenge and even more so their attitude to science is best summed up in their own charming words.

"In desperation we visited the laboratory of Dr. Freeman McEwen (University of Guelph, Ontario), which was rearing massive numbers of *D. antiqua* for release of sterile males. We were taken step by step through their rearing procedures and found most of our methods were very similar, except for one seemingly minor exception. In obtaining eggs, the Guelph researchers followed a practice that had never been reported in the literature. In addition to moist sand and chopped onion, their oviposition dishes were routinely provisioned with a spring of onion foliage about 6 cm tall and standing upright in the sand over the chemical stimulus. When queried on the rationale of the 'stems' the technician who spent considerable time overseeing egg collections insisted that they improved egg production. However, no quantitative data were available on the effect of the onion stems, and furthermore, we received the impression that the degree of belief in effectiveness onion stems was inversely correlated with extent of formal education in entomology. Upon returning to our laboratory, one of us (MOH, graduate student) was enthusiastic about incorporating onion stems into our rearing procedures, suggesting that the additional visual/physical stimuli might have a major impact on behaviour. The other (JRM, major professor) was very skeptical, finding it hard to believe that important determinants of oviposition would have gone unnoticed in the previous classic studies on host colonization by *D. antiqua*. More fundamentally, the skeptic was a proponent of notions prevalent among those schooled in insect chemical ecology that: 1) insect behaviour results from a series of simple reactions, and 2) that chemicals are without question the primary regulators of insect behaviour, particularly in host-plant colonization by insects. Fortunately, the 'less informed' junior author did not share these assumptions." (References to literature given as serial numbers in brackets at various points in this paragraph have been omitted).

From here Miller and Harris go on to conduct an immaculate series of experiments to show that 1) the onion stem indeed has a profound impact on oviposition, 2) a vertical glass tube with yellow paper is almost as effective as the real onion stem, 3) chemical stimuli from the chopped onion and the visual stimulus of the vertical yellow real or surrogate stem act synergistically, 4) yellow colour of the surrogate stem is far more effective than other colours, 5) heaviest egg deposition occurs when the surrogate stem is in the shape of a narrow cylinder, 6) with an optimum diameter of 4–6 mm, 7) an optimum height of 10 or more cm, 8) and an optimum angle of 90° to the soil surface and so on until they go on to fly watching and discover the optimal stimuli for each step in the fly's ovipostition behaviour and finally cap it all by presenting a neurophysiological model for stimulus summation across different sensory modalities. The result is not only a package of efficient methods for culturing the onion fly but a *tour-de-force* in insect behaviour providing the much needed emphasis on well designed experiments and an open mindedness about a multiplicity of releasers acting simultaneously or synergistically. I have referred to the effectiveness of their data presentation before. As can be seen from a sample reproduced (fig. 1), their graphs can be almost completely understood without reference to the text. How much faster would scientific progress be, and how much easier and error-free would reading of scientific papers be if their approach and style became more popular!

Most of the remaining chapters are more technical reports of less interest to anyone other than those working in fields such as chiral semiochemistry, microanalytical methods for structure determination of pheromones, etc. Conspicuous exceptions to this are a study of the pheromone of a true bug by J. R. Aldrich and a masterly review, with much useful advice, of behavioural analysis of pheromones by T. C. Baker. In summary, I feel that this collection of papers would be useful to anyone working in the area of

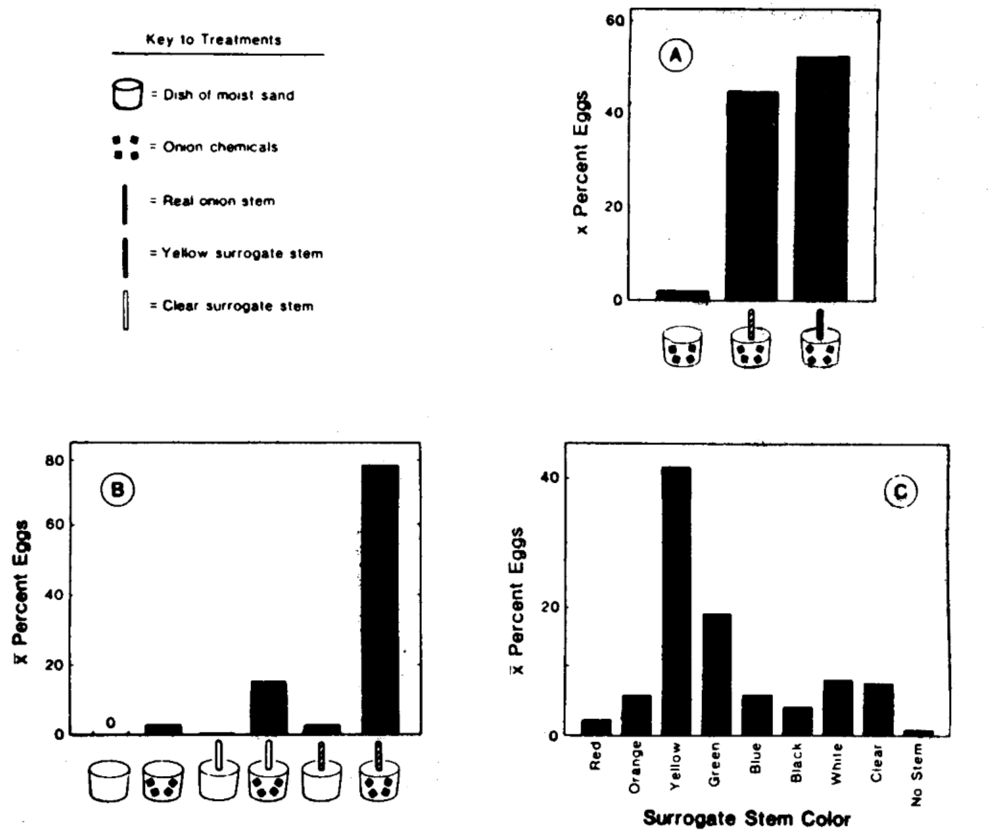

Fig. 1. Patterns of onion fly egg deposition in "choice tests" with dishes containing various combinations of chemical and visual/physical stimuli. For statistical assignments, see original research papers cited in text. (Reproduced with permission.)

natural product chemistry and recommend that the chapter by Miller and Harris be read by anyone interested in animal behaviour or even merely interested in some tips on effective communication in science.

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