puzzle solving within an organised structure of theoretical commitments and experimental techniques. Since tobacco mosaic virus is constituted of 95% protein and since protein was regarded as the material basis of biological specificity, Stanley looked upon the 5% phosphorus discovered by Bawden and Pirie as an impurity. When attempts to alter the protein by oxidation, methylation and decarboxylation failed to destroy infectivity or yield mutants, it was simply concluded that such chemical changes were not sufficient to alter the biological specificity of the virus particle. This view was taken despite the fact that treatments specific for nucleic acids—deamination with nitrous acid and irradiation with ultraviolet light in the region 2,600 Å both inactivated the virus. Moreover, viral protein on its own failed to show infectivity. These 'anomalies' in the virus research programme of the protein chemists were accommodated by the introduction of accessory hypotheses — the energy transfer hypothesis for ultraviolet light and the integrity of the entire nucleoprotein virus particle as essential to infectivity. H. Frankel-Conrat, in his masterly survey of the early work on the chemistry of plant viruses, responded to Seymour Cohen's question: why did those in virus laboratories where relatively undegraded viral RNA had been isolated in the 1940s not test the RNA for infectivity at the time? They had been impressed by the fact that nearly all the virus particle was made of protein, and that the amino acid composition of this protein showed differences in different taxonomic forms. No parallel evidence of nucleotide differences was evident at that time in the nucleic acid portion of the particle. There was no positive motive to test the infectivity of viral nucleic acid. Whether the protein had shown infectivity or not however, it would surely have been standard procedure to test the nucleic acid as a control, an action all the more to be expected when the protein fragment proved negative. Failure to test, even as a control, the infectivity of the viral nucleic acid may be seen as an expression of commitment to the paradigm of the protein theory of specificity.

In the round-table discussion and in questions put to the contributors, there was evidence of different emphases and aims. Scientists' questions were largely, though not entirely, devoted to the clarification of the course of intellectual and experimental developments in the science, whereas historians were asking questions about the extent of contact between laboratory groups and disciplines, the causes of discipline insularity and the means of communication. To the scientists the value of history of science in teaching was seen largely in its power to clarify the nature of scientific concepts. Young aspiring scientists often expressed little interest in the history of their subject. This attitude tended to change once they became established in the profession and had made a contribution to the discipline. Historians wanted to emphasise the wider educative role of their subject as a contribution to an education in our cultural heritage. As such it is concerned not only with 'internal' conceptual and technical developments but with the interface between science and society—the reasons for

Robert Olby is in the Division of History and Philosophy of Science, Department of Philosophy at the University of Leeds.

Monkeys prefer kin

from John Krebs

It is perhaps not surprising that in many higher vertebrates parents and young can recognise each other as individuals. In a busy, crowded colony of guillemots (*Uria aalge*) newborn chicks respond by approaching only to the calls of their own parents, ignoring the hundreds of other similar calls in the close vicinity. The parents too respond to the calls of their own young but ignore other young in the colony (Tschanz *Z. Tierpsychol. Beiheft* **4**, 1; 1968). In most cases, this sort of individual recognition comes about through learning: young guillemots learn their parents' calls while in the egg, and to quote another example, female goats learn the individually characteristic scent of their own offspring during the first few minutes after giving birth (Klopfer & Klopfer 1966. *Z. Tierpsychol.* **23**, 588; 1966).

A much more startling (or "incredulous" as one delegate put it) result, was reported by H. Wu and G. Sackett (University of Washington) at the 1978 annual conference of the (American) Animal Behaviour Society*. They described an experiment showing that young rhesus monkeys (*Maccaca nemestrina*) can recognise their half-brothers or half-sisters without any previous contact with them. The 16 test monkeys were related to their half-siblings only through their fathers, thus neatly eliminating the possibility that some family-specific cue such as odour might have been acquired *in utero* from the mother. The young monkeys were reared in strictly controlled, semi-isolated conditions and given just enough daily contact with unrelated peers to ensure normal social development. They were tested once at ages ranging from 44 to 344 days in a choice apparatus in which they were offered the chance to face towards, and later to enter, three compartments containing respectively a caged half-sib, a caged non-relative and an empty cage. The test monkeys had never had any previous contact with any of the stimulus monkeys. Thirteen of the sixteen spent more time in the half-sib compartment than in the non-kin section, while eleven out of the sixteen showed a similar preference in the initial part of the experiment where they simply faced one or other compartment. The results were not influenced by age or sex of the test monkeys. The remarkable conclusion is that rhesus monkeys have an inborn ability to recognise half-siblings, and presumably other close relatives. At the same conference, W. Holmes (University of Washington) showed that a similar sort of kin recognition may occur in Arctic ground squirrels (*Spermophilus parryii*). Holme's results were based on cross-fostering siblings starting at the age of 3 to 7 days, so although they demonstrated kin recognition, they did not distinguish between an inborn discrimination and one based on early learning.

How does a monkey recognise its half-sib? The obvious possibility is by comparison with itself, an idea suggested some years ago in an experiment with day-old chicks by E. Salzen and J. M. Cornell (*Behaviour*, **30**, 44; 1968). They dyed isolated chicks different colours, and found that they subsequently tended to prefer to join groups with feathers dyed the same colour as their own. Wu and Sackett are now in the process of trying to find out if rhesus monkeys have similar but more sophisticated narcissistic tendencies as young chicks.

The theory that social cooperation evolved through kin selection has been remarkably successful in predicting details of social behaviour in animals ranging from bees to lions. Wu's and Sackett's results suggest that the possibilities of kin recognition, and therefore of kin-directed cooperative behaviour which might be favoured by selection, are far greater than previously supposed.

John Krebs is a Lecturer in Zoology at the Edward Grey Institute of Field Ornithology, University of Oxford.

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