

A Beetle's Eye View of the Ice Age

Dr. Russell Coope¹

COOPE, R. (1984). A Beetle's Eye View of the Ice Age. *Proceedings of the Shropshire Geological Society*, 4, 7-8. After describing the traditional view of ice ages and evolution, attention was drawn to the situation within ice ages where populations are driven into refuges capable of sustaining only a small population, therefore the selection pressures must be very great. Thus ice ages are likely to produce new, novel species, to speed up the process of evolution. Furthermore, when the ice retreats, vast areas of the country become available for colonisation, isolated small populations spread out and in so doing, atypical populations become established. These compete with one another; many will survive to produce new species, and other will become extinct.

A correlation was then shown between beetle species and average July temperatures to describe palaeoclimates. The beetles indicate that climatic change can be very sudden and that the intensity of change is enormous. These changes can be correlated with changes in the position of the Gulf Stream North Atlantic Drift.

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Dr. Coope began by describing the traditional view of ice ages and evolution. In ice ages, populations are driven into refuges capable of sustaining only a small population, therefore the selection pressures must be very great. Thus ice ages are likely to produce new, novel species, to speed up the process of evolution. Furthermore, when the ice retreats, vast areas of the country become available for colonisation, isolated small populations spread out and in so doing, atypical populations become established. These compete with one another; many will survive to produce new species, and other will become extinct.

When he began to study beetles, he found that some species were totally unfamiliar; other were very similar to present day species. The differences between fossils and modern animals were in fact less than the differences between individuals living at the present time. So in the time he has been investigating, some 40,000 years, evolution has not happened, yet there had been a whole ice advance episode during this time.

More than a quarter of the known animals and plants are beetles. They are therefore a very important group. The number of fossil beetle species is between one and two thousand. During the last million years, there is no evidence of evolution amongst them, neither is there any extinction. Yet this is contrary to the traditional view of speciation and the destructive effects of ice ages, which certainly wiped out a great many vertebrate species.

Beetles are entomological tanks and, being so strongly built, makes them unique among insects

in forming good fossils. An entomologist identifies species on the basis of the exoskeleton. In the case of beetles, the palaeontologist can use exactly the same criteria for differentiating and describing species as the present day biologist. To prove this point, Dr. Coope showed two slides of *Carabus nitens*, one modern, the other 12,000 years old, and both identical, with the latter perfectly preserved. This high degree of preservation is vital, since beetle species can only be identified with recognised certainty by the size and structure of the male genitalia and these are also preserved in the fossils.

Referring to two species with different ranges, one appearing in warm periods the other in colder times during the last glaciation of Britain, yet this disposition has no relationship to where they originated. Much time is spent trying to interpret evolutionary history by looking at the distributions of animals today and saying those distributions betray their evolutionary history, yet they need not. Ice ages have caused huge changes in geographical ranges. The different types of animal (in this case beetles) indicate different types of climate and their comings and goings in Britain will be an indication of climatic conditions in this very recent geological period.

Being deliberately contrary, Dr. Coope proceeded to give us the conclusions next to be followed by the evidence, on the grounds that it was more interesting that way.

Using average July temperatures, together with the fossil beetles present, it is possible to show that the period between the last interglacial and the

present one, i.e. a glacial period, was subject to numerous climatic variations, including short, "warm" periods. The beetles were very quick in responding to these climatic changes. In the middle of the last ice age, a beetle with a present range of high arctic tundra, was a common species in central England. This is not just an oddity.

Another species now found in the Russian steppes, was here in profusion during the glacial maxima. There are many other such examples, including present-day southern species, present in the warm periods. High mountain species were very common in Britain at the height of the last ice age. Two high Tibetan plateau species (*Khnzoriani*) were the commonest dung beetles in Britain during the last glacial period.

The missing piece of the puzzle in the traditional view mentioned earlier is that the response of most animals to climatic change is to move. If the climate is changing, an animal can do one of three things - evolve, move or die. To move so that the environment remains constant is the easiest and preferable option. This then is the reason why we see no speciation, no evolution or any extinction. It is therefore possible to put together a synoptic picture.

Using biogeographic ranges of different species found in Midland sites, it was shown that 44,000 BP the fauna was dominated by arctic types, but no continental species occur. These are replaced by southern species in the middle of the glacial period and these in turn become replaced by continental species indicating a return to colder, but not arctic,

conditions, but the record does end with an impoverished northern fauna. Thus, the fossil beetle record shows the changing climate as being polar 50-45,000 years BP; oceanic with temperatures at least as warm as at present 45-40,000 BP; continental with cold dry summers 40-25,000 years BP, then polar again with maximum ice extension at 18,000 years BP.

Using a computer program it is possible to show a correlation between beetle species and average July temperatures to describe palaeoclimates. For example, 14,500 years BP, the average July temperature was not more than 10°C, i.e. too cold for trees to grow. At 13,000 years BP, there was a very rapid (70 years) change to temperatures of 17°C, i.e. from glacial to interglacial mode, but still no trees were present because trees take much longer to respond to climatic change than mobile carnivorous beetles, for example.

Average February temperatures also indicate a similarly rapid change from -20°C to 0°C. The beetles therefore indicate that climatic change can be very sudden and that the intensity of change is enormous. These changes can be correlated with changes in the position of the Gulf Stream North Atlantic Drift.

A lecture delivered to the Society by Dr. Russell Coope on 16th November 1983.

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