BOOK REVIEWS

Birds in the Field

Ecological Isolation of Birds. By David Lack. Pp. xi+404. (Blackwell Scientific: Oxford and Edinburgh, 1971.) £4.25.

THIS book sets out to provide detailed evidence for the hypothesis, formulated by the author 25 years ago, that ecological isolation exists between bird species in nature. At the time, the view was hardly accepted, the chief criticism being that many closely related species were known to share the same habitat and were thought to have similar ecology. Recent research, however, has established "competitive exclusion" as a fundamental biological principle, and food has been shown to be the limiting factor in the widest variety of cases.

Dr Lack's introduction includes a particularly interesting historical review. The next twelve chapters examine ecological isolation in a number of related, and usually sympatric, forms (especially titmice and finches) or the avifauna of circumscribed areas (especially islands). A final chapter summarizes the important points that have emerged and considers such problems as the acquisition of segregation by feeding, and the consequences for species' origins and diversity. A quarter of the book consists of appendices tabulating in fuller detail the ranges, habitats, feeding stations and food of bird groups that have been subjected to field research.

One value of the text lies in having so much material synthesized in readable form. It is, indeed, extremely readable and is much enhanced by Robert Gillmor's delightful drawings. The gaps in our knowledge are now more evident. It is obvious that certain avian groups require further study and that new approaches—such as the mathematical considerations of MacArthur—may be helpful. The trends, usually referred to as Bergmann's and Allen's rules, of increasing body size and smaller appendages in colder regions are so widespread that they are firmly accepted as adaptive, although, as Dr Lack points out, it is not clear precisely what they are adaptations for. The trends were formulated for races of the same warm-blooded species but they seem to apply also within genera. Dr Lack suggests that it may be doubted whether climatic factors ever limit the ranges of birds directly. In support, it could be said that many tropical species are, with adequate food supplies, kept healthy in temperate "wildlife parks". Intraspecific differences become apparent, however; tropical water birds with long legs and broad feet commonly suffer frostbite in severe weather and lose their toes, a situation which might well impair feeding efficiency in the wild. Koskimies also showed differences between species of day-old ducklings in their ability to maintain normal body temperature in cold surroundings, and inferred that climate placed limits on their typical ranges. Further investigation along these lines seems to be required.

The influence of Dr Lack's work on a generation of ornithological research has been enormous. His latest book is a timely and succinct examination of field studies largely generated by his own earlier ideas. JANET KEAR

Thermodynamic History

From Watt to Clausius: The Rise of Thermodynamics in the Early Industrial Age. By D. S. L. Cardwell. Pp. xv+336. (Heinemann: London, October 1971.) £5.00.

DONALD CARDWELL describes his book as follows: "This, then, is an account of a scientific revolution (thermodynamics) that took place between about 1790 and 1865, one of whose root causes was the rapid progress made in power technology during this period. It is not a general history of theories of heat". Unfortunately, the focus on thermodynamics is blurred by the intrusion of too much general history.

Thus, the early chapters are confusing fragmented compilations of ideas, observations and experiments regarding the diverse phenomena of heat. Cardwell readily admits the confusion but attributes it to the failure of contemporary scientists to see the emerging new cosmology of the universe as a cosmic heat machine, a view supposedly only attained in the 19th century. He has therefore included discussions of meteorology, radiation and conduction even though he never shows in what way thermodynamics brought unity to this diverse collection. His treatment of the culmination of thermodynamics with Kelvin and Clausius, for example, includes no significant analysis of any of these phenomena, and, in order to consider the winds in relation to thermodynamics, a leap well beyond 1865 to Napier Shaw's *Manual of Meteorology* must be made. The scientific revolution in thermodynamics arose within a far more restricted province in the theory of heat, namely, the fruitful interaction between steam power technology and scientific interest in the thermal properties of gases, vapours and liquids. It would therefore have been far more appropriate to discuss Lavoisier's caloric model of a liquid and its vapour than to review Rumford's work on conduction and convection.

When Cardwell does turn to the interaction between technological reality and scientific ideas, we are treated to a brilliant analysis of how water power technology contributed to Carnot's stunning achievement. His use of the waterfall analogy for the temperature fall of caloric from boiler to condenser, for example, an image made possible only with Watt's engine and the separate condenser, seems a quite natural step when viewed with high pressure water piston engines operating so similarly to their steaming counterparts in the background. Moreover, Carnot's introduction of a reversed steam engine functioning as a refrigerator is shown to have a corresponding conceptual precedent in 18th century thought experiments which reversed waterwheels to perform as pumps. Thus, Cardwell demonstrates that there was a natural flow of ideas from a realm of technology that was well understood, water power, to one that represented a persistent puzzle, namely, the overwhelming superiority of high pressure over low pressure steam engines. Carnot's unique insight that it is the higher temperature rather than the higher pressure which really rules steam power is seen as a watershed in the science of thermodynamics.

Following his illuminating discussion of Carnot's thought, however, Cardwell becomes more routine in his outlining of the contents of major thermodynamic papers by Clapeyron, Clausius and Kelvin. Rankine, although mentioned in a chapter title, is dismissed as somewhat incomprehensible and as one who addressed himself primarily to engineers. But if engineers managed to understand him (and they did), he could not have been all that incomprehensible; and if thermodynamics resulted from the interaction of science and technology, why should the one thermodynamicist who made a concerted effort to cover the whole gamut of heat behaviour, from a vortex atom that could account for radiation to detailed analysis of engine behaviour, from the graphical portrayal of thermodynamic concepts to the highly abstract symbolism of energetics, be excluded?