

The European lynx is shown in its last stronghold in the Carpathians. Closer to our own Arctic home, "the walrus . . . has been almost exterminated around Spitsbergen. It may still be found at Novaya Zemlya, but is otherwise rare in Europe". The polar bear, on the other hand, is reported as doing fairly well in the European Arctic — but the slaughter at present going on off the Alaskan coast will no doubt soon have its effects upon the whole circumpolar distribution. "The wolf . . . is now ruthlessly hunted from helicopters and snow scooters. Only about twenty to forty of these animals remain in Sweden." This means extinction. There are happier moments: the bison, finally extinguished in the wild state in 1921 in Poland and in 1925 in the Caucasus, has been reintroduced successfully to its natural habitat from an extremely tenuous thread of bison DNA remaining in zoological gardens. The numbers are still small, but they are growing.

As the landscape goes, so goes the fauna. Pollution of fresh water is another specialty of man. To quote again: "The brown trout was for a time widely distributed in Europe but increasing water pollution has restricted its range. It now occurs chiefly in streams in such mountainous country as Bohemia, Czechoslovakia." The author does not mention that the brown trout is still abundant in Scotland and in Ireland, although threatened there too, but the message is nevertheless well taken. Man is the most corrosive force in nature.

The author does not talk down to his audience. The text is straightforward and without nonsense, and although we are brought face to face with the unpalatable facts of our own follies, we are also inspired by the unusual and the beautiful. Place-names have often been collected in euphonic anthologies, but what about plants and animals? Here is talk of suslik, saiga, crake, moufflin, ibex, hellebore; amphipod, dotterel, garganey and natterjack.

We ought, I suppose, to stick to our last in this journal and consider the North. The final three chapters are entitled: "the great taiga"; "the frozen

tundra"; "polar bears and arctic seas". Here we meet landscape at its best, perhaps because it is newest, and northern biogeography, because of its simplicity, is all the more intriguing. "Each night, over head . . . birds spread out over the land. Then, even the wings of ducks seem to sing, the widgeon whistle; the teal sound like flutes; the wings of the goldeneyes make a musical noise." Oddly enough, in these last three chapters the quality of the photographs falls off a little, with a few exceptions. The Arctic fjords provide some of the finest scenery in the world, but they do not appear here. Is there a shortage of European Arctic photographers? They have done well in Greenland.

The book as a whole, however, fully makes up for this partisan criticism. It is beautiful, thoughtful, provoking. Buy it.

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TRAITÉ DE GLACIOLOGIE. TOME I. GLACE — NEIGE — HYDROLOGIE NIVALE. By LOUIS LLIBOUTRY. Paris: Masson & C^{ie}. 1964. 10 x 7¼ inches, vi + 428 pages, 36 plates, numerous tables and diagrams. 140 F.f.

This is the first of two volumes of a monumental text on glaciology. In this volume the emphasis is more on the physical side for which the author has special qualifications. Each chapter contains an extensive bibliography; it is, however, awkward that full references are lacking for a considerable number of the publications discussed in the text. An introduction defines and delimitates glaciology as a special branch of science and gives a brief history of the subject. The latter is undoubtedly the weakest part of the book as it contains a considerable number of errors.

Chapter I deals with the physics of pure ice, its molecular and crystalline structure, its optical and electrical properties and particularly the changes between the solid and fluid states. The

treatment of the mechanics of ice in chapter II takes no less than 50 pages. The author discusses in great detail the theory of stress, particularly shearing stress, and strain as applied to ice. This chapter contains considerable original work on the rheology of ice. Here, as in other parts, theory and experimental verification are efficiently blended. The deformation of ice samples which is closely connected with the movement of ice in glaciers, finds full theoretical treatment, first for monocrystals and then for polycrystalline aggregates. This leads in chapter III to the petrography of ice, one of the most widely spread and until recently most neglected rocks. A clear distinction has to be made between the crystals and the grains of ice. In this connection the role and distribution of the air bubbles enclosed in much natural ice is discussed. The direction of the optical axes of the ice crystals in glaciers is of particular interest as it indicates movements and modifications within the ice body.

This more purely physical treatment which is to a large extent based upon laboratory experiments, is followed by the consideration of ice as it occurs in nature. The author deals in chapter IV rather briefly with ice forming on sweet water of rivers and lakes and with sea ice, particularly its load-carrying capacity.

In chapter V, as an introduction to the deposition of ice substance on the surface of the earth, the conditions of its formation from water vapor in the atmosphere are briefly shown, the different types of solid precipitation are described and their formation is discussed. A short discussion of the measurement of the snow cover is followed by a review of the stable isotopes of hydrogen and oxygen in precipitation.

The formation and evolution of the snow cover and of its stratigraphy under mechanical and thermal influences with and without melting is described in chapter VI. The mechanical properties of the snow cover lead to movements, from slow creep to the different types of avalanches. The author gives in chapter VII a detailed discussion of the

forces involved in the motion and arrest of avalanches according to a recently developed theory.

Chapter VIII deals with different aspects of the connection between snow cover and problems in engineering, as protection against avalanches, snow-drifts, rime and glaze and the movement of vehicles and skis over different types of snow.

In chapter IX we find an extensive treatment of the heat exchange at the surface of ice and snow and of the run-off of meltwater. Chapter X deals with the formations caused by ablation and refreezing, in particular with the occurrence and distribution of penitentes which the author has extensively studied, with cryconite holes and wave ogives on glaciers.

This first volume concludes in chapter XI with a discussion of the temperature distribution inside snow cover and glaciers; first according to theoretical considerations, then as actually found in the field. In this connection Lliboutry develops an original theory of the temperature at the base of ice caps. The "paradoxical" decrease of temperature with depth in a number of bore holes in ice caps would merit a more extensive treatment.

Lliboutry's book takes a very broad view of its subject. It stands out from most earlier texts on glaciology by its extensive treatment of the underlying physical principles. It is as a whole clearly written and well produced. The number of errors and omissions which the reviewer noticed, is small. There are a considerable number of well chosen and produced illustrations. After the impending publication of the second volume which will deal with actual glaciers, permafrost and variations of climate, Lliboutry's work will constitute the most comprehensive and modern treatment, particularly on the theoretical side, of the occurrence of water in the solid state on earth.

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