

# A GLACIAL HISTORY OF THE PYRENEES



RESULTS OBTAINED BY CATALAN STUDENTS OF GLACIALISM HAVE BEEN WELL CONSIDERED BY THE INTERNATIONAL SCIENTIFIC COMMUNITY, AND THEIR METHODS HAVE BEEN APPLIED TO OTHER PARTS OF THE WORLD SUCH AS TIERRA DEL FUEGO AND ANTARCTICA.

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**A**t the University of Barcelona, work on Pyrenean glacialism started under Dr. Lluís Solé i Sabarís in the fifties. A summary was then made of the work undertaken, mainly by German and French researchers, as well as a regional geomorphological study and reconnaissance of small areas, in order to discover the number of quaternary glaciations that had affected the range. These results were summed up in publications like Editorial Aedos's *Geografia de Catalunya* and shown to the international scientific community at the INQUA Congress in 1957.

In the last twenty years, as well as carrying out detailed regional geomorphological studies of a large part of the southern slopes of the Pyrenees, new methods have been applied that are based on the sedimentological and stratigraphic study of the glacial sediments and, especially, of the glaciolacustrine deposits that filled in the lakes obstructed by glaciers and some of the more than one thousand lakes that at present occupy the basins left by glacial erosion.

The resulting morphology of the glacial



imprint only allows us to reach conclusions as to the extent of the quaternary glaciers and to establish the length of duration of the ice at specific points, but it has little to say as regards the date of this glacial occupation or other details such as the development of successive glacial phases. However, the detailed regional geomorphological studies have led to the discovery of outstanding sites where the glaciers left deposits whose study has allowed us to enlarge our knowledge of the glacial history of the last quaternary glaciation in the Pyrenees.

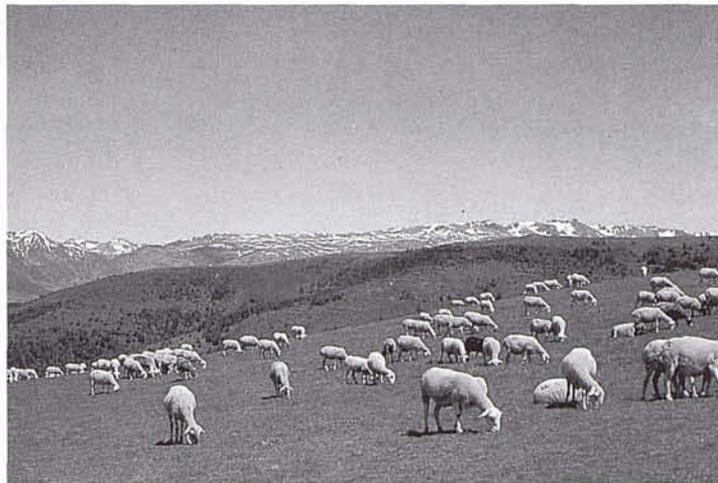
The technologies applied to these deposits come under two main headings:

#### **Field Work:**

- study of sedimentary structures;
- elevation of stratigraphic outlines;
- sampling of different layers;
- geophysics of in-filling without outcrops and mechanical soundings in some cases;

#### **Laboratory Work**

- granulometric analysis;
- study of micro-plaeontological content;



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– absolute datings;

– establishment of stratigraphy.

These studies, carried out mainly by the Department of Dynamic Geology, Geophysics and Palaeontology of the University of Barcelona, with the collaboration of research laboratories in Toulouse, Zurich, Lyons and Jaca, have allowed us to establish the following results:

a) The existence of deposits of glacial origin in areas not affected by the last great glaciation to affect the Pyrenees suggests at least one previous glaciation with an even longer duration in some places. The scarcity and reworking of these deposits does not allow anything other than this simple statement.

b) A last glaciation (Pyrenean), ultimately responsible for the glacial characteristics of the present relief, with features that differentiate it from the last Alpine (Würm) and Scandinavian (Weichsel) glaciation. An initial phase of maximum extension was followed by a clear stabilization phase, which was responsible for most of the obturation lake deposits (La Massana - Valira, Son

del Pi - Noguera Pallaresa, Llestuí - Noguera Ribagorçana, Cerler - Ésera, Linás de Broto - Ara, ...). A rapid final retreat with short recurrences characterizes the final phase, which is broadly contemporary with the peak phase of the Alpine and Scandinavian glaciers. In spite of numerous attempts, we still do not have reliable absolute datings for these phases, and can only situate the stabilization phase at an age of 35,000 years or more.

c) A very cold and arid pulsation, which we call Late glacial, in the Pyrenees, characterized by the rocky glaciers and small cirque glaciers that could correspond to the Dryas of Central Europe. The statistical study of more than one thousand rocky glacier moraines in the Catalan Pyrenees, as well as of associated sediments, will we hope lead us to characterize the two or three phases into which we can divide this Late Glacial period and establish its chronology.

d) After the climatic peak that characterizes the Holocene and that probably caused the disappearance of all the Pyrenean glaciers, the glaciers once more underwent an advance that culmi-

nated in the middle of last century on all the massifs with peaks above 3,000 metres –even in the massifs that no longer have true glaciers (Besiberri, Pica d'Estats,...)– and that corresponds to the Small Ice Age in the Alps.

The rapid retreat of these glaciers at the beginning of this century has reduced today's glacial presence, with small cirque glaciers that could disappear as a result of any small increase in temperature or absence of snow. The photogrammetric register we have been keeping of these glaciers since 1957 shows that in spite of the fact that their fronts are retreating and only advance for short periods of time the total volumes of the Pyrenean ice hardly diminish. These results obtained by Catalan students of the quaternary are felt by the international scientific community to be very positive and their methods have been applied to other parts of the world such as Tierra del Fuego, with advice to the "Centro Austral de Investigación Científica", or even in the Antarctic (Livingston Island), in collaboration with work carried out by the British Antarctic Survey. ■