represented primarily by numerous well-preserved *Sphagnum* specimens; in the lower part of the core, grains of *Polypodium vulgare* occur. This fern species is frequently found in European late Quaternary deposits (*2*).

The genera occurring most frequently in the Mesozoic are *Classopollis, Cicatricosisporites, Gleicheniidites, Klukisporites*, and *Leptolepidites*. Nearly all Mesozoic genera found in the core have been reported from Jurassic and Lower Cretaceous beds in England (*3*). The genus that is represented by the greatest number of specimens is *Classopollis*, which is extremely abundant in the Purbeck beds (uppermost Jurassic). The specimens of *Cicatricosisporites* belong mostly to *C. dorogensis*, reported from Purbeck, Wealden, and Aptian deposits; *Gleicheniidites* was found in the Middle and Upper Jurassic and the Wealden; *Klukisporites*, represented mostly by *K. pseudoreticulatus*, occurs in the Purbeck and Wealden, and *Leptolepidites* in the Middle Jurassic of Great Britain (*3*). A few specimens of genera occurring in Upper Cretaceous deposits were also found. They are *Trudopollis* and *Plicapollis*. However, it is clear that nearly all reworked Mesozoic plant microfossils were derived from Jurassic and Lower Cretaceous sediments.

Pollen- and spore-bearing beds of this age occur in southern England, and are well exposed along the Channel coast. The Wealden crops out along the southwest coast of the Isle of Wight and in the Hastings area (the Fairlight Clay), and covers an area of many square miles around Tunbridge Wells. Jurassic sediments known to contain abundant *Classopollis* grains occur at Portland near Weymouth, Dorset; other Jurassic fossiliferous outcrops are found further to the northeast, in Northhamptonshire and Yorkshire.

Aptian and Albian sediments containing abundant *Classopollis* occur also along the coast of Portugal, in the vicinity of Obidos and to the west of Lisbon (*4*). This genus has also been reported from the Jurassic of continental Europe (*5*).

Among the most common of the Paleozoic spores in the core are *Anulatisporites* and *Densosporites*, known from European Namurian and Westphalian deposits (*6, 7*). *Granulatisporites, Punctatisporites*, and *Triquitrites* occur through most of Late Carboniferous time (*6*). Of interest also is the presence of the genus *Vittatina* which has been reported, for instance, from the Permian of the Urals (*8*) and from Oklahoma (*9*). Since many Permian pollen genera have a wide geographic distribution (*9*), *Vittatina* may occur in the Permian of England or France, although it has not been reported so far.

Now some consideration should be given to the possible source areas of the reworked fossils. Two possibilities come to mind:

1) Outcrop areas along or adjacent to the English Channel and the Bristol Channel. In these areas Upper Carboniferous, Permian, Jurassic, and Wealden sedimentary rocks occur, capable of delivering large numbers of plant microfossils. Paleozoic and younger rocks are known to occur also on the bottom of the English Channel and the Western Approaches (*10*).

2) If Paleozoic and Mesozoic rocks crop out on the continental slope, as suggested by Day *et al.* (*11*), and if these rocks were of such facies as to contain numerous pollen and spores, they would be the closest possible source of reworked fossils. So far, only Eocene and younger rocks have been dredged from the upper part of the slope, near the shelf-break (*10*), but it is quite possible that older rocks are present at greater depth.

The first possibility requires westward currents, which do not occur at the surface. However, bottom currents may differ in direction, and in this respect it is interesting to note that Cooper and Vaux (*12*) described "cascading" of cold and relatively dense water over the continental slope west of the entrance to the English Channel and the Irish Sea. Such water movement might well be capable of carrying plant microfossils, which can be as easily transported as fine silt and clay particles, to the Biscay Abyssal Plain.

The second possibility is attractive because of the short distance of transportation involved, and because slumping could deliver large quantities of sediment and their contained fossils to the abyssal plain. However, the core does not contain turbidity deposits and even if Mesozoic and Paleozoic rocks crop out on the slope we would need a mechanism for the transport of reworked pollen and spores (*13*).

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Ice Movement of Valley Glaciers Flowing into the Ross Ice Shelf, Antarctica

Abstract. *Seven glaciers from 9 to 26 kilometers in width move 0.3 to 2.3 meters per day. Byrd Glacier is the fastest moving of the known valley glaciers in Antarctica.*

The Ross Ice Shelf is the largest floating ice sheet in the world. Into it flow valley glaciers of unparalleled size (Fig. 1). Surface movement measurements were made during the years 1960–62 to assess the contribution made by valley glaciers to the overall regime of the ice shelf. A line of survey markers was erected across seven of the principal glaciers. Each marker consisted of a 3-m length of 0.1-m aluminum pipe drilled 1 m into the

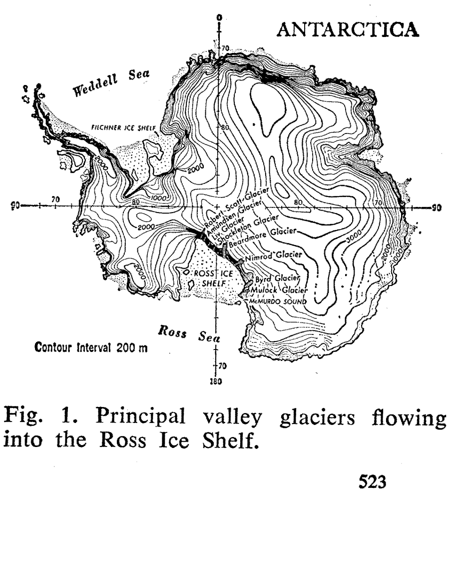

Fig. 1. Principal valley glaciers flowing into the Ross Ice Shelf.

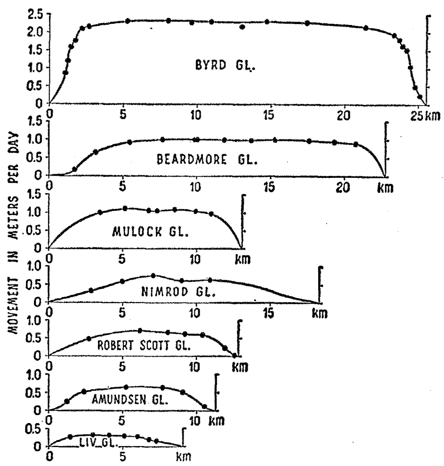

Fig. 2. Observed horizontal displacement expressed as rate of movement.

ice and topped with a red flag. Severe crevassing on Mulock and Byrd glaciers made it necessary to lower a man to the ice by means of the sea rescue winch of a hovering helicopter. Conspicuous crevasses and seracs were sometimes used instead of specially erected survey markers. The position of each marker was established by conventional triangulation, by using a theodolite at each end of a base line measured on mountains overlooking the glacier. A second set of measurements on a subsequent visit to the glacier gave the horizontal component of ice movement during the intervening period. In addition, the movement of Byrd Glacier was determined by aerial triangulation from two sets of vertical air photographs taken 11 months apart (*1*). The thickness of the glaciers is unknown. Ice discharge can therefore be reported only in units of glacier surface area.

The results are shown in Fig. 2. The accuracy varies, depending chiefly on the length of the period available for observing the glacier (Table 1). The most significant discovery is the overwhelming contribution of Byrd Glacier, which adds 19 km^2/year to the ice shelf, equivalent to the combined contribution of the other six glaciers. Byrd Glacier is so little known as a geographical feature that it was named only in 1960, whereas some of the other glaciers were named and mapped 50 years ago. Though a few ice streams (*2*) may move faster (*3*), Byrd Glacier is now the fastest known valley glacier in Antarctica. Several large Greenland glaciers move faster (*4*), but probably only Jakobshavns Isbrae discharges more ice down a single valley (*5*). The most recently published contours of the neighboring ice plateau (*6*) indicate a drainage basin centered on Byrd Glacier and extending several hundred kilometers inland. The drainage basins of the other major glaciers are relatively small. Though the total ice discharge of the seven glaciers studied—38 km^2/year —is greater than earlier observations (*7*) led me to expect, it is probably small compared with the discharge from the unexplored southeastern borderlands of the ice shelf. While flying down the eastern margin on 21 October 1961, I saw what is virtually a single, 200-km-wide ice stream south of latitude 83°S.

Table 1. Observed horizontal displacement and probable error (P.E.) of measurement in middle of glacier.

Glacier	Observing period (days)	Total movement (m)	P.E. (%)
Byrd	348	803.3	± 1.0
Beardmore	332	331.5	± 0.4
Mulock	446	473.9	± 0.8
Nimrod	296	183.5	± 0.8
Robert Scott	7	4.9	± 3.4
Amundsen	5	3.2	± 4.8
Liv	5	1.5	± 8.4

Measurements across Beardmore Glacier over a 14-day period in summer (December) gave the same rates of movement as for the long period. A 2-percent difference would have been measurable. The observations suggest that in high latitudes where there is no surface melting, there may be no seasonal variations in the rate of glacier movement (*8*).

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Reduced Incidence of Persistent Chromosome Aberrations in Mice Irradiated at Low Dose Rates

Abstract. *A marked difference was observed between the effectiveness of high and low dose rates of ionizing radiation in producing persistent chromosome aberrations in the marrow cells of mice. Clones of cells with chromosome abnormalities were present in the marrow of all the mice previously exposed to single or fractionated doses of x-rays given at a rate of 30 rad/min. The frequency of chromosome aberrations in these mice varied from 14 to 72 percent of the cells examined. By contrast, none of the mice exposed to continuous gamma radiation at a low dose rate (1.45 rad/hour) showed definite clones of abnormal marrow cells, and the frequency of persistent chromosome aberrations varied from zero to 8 percent in this group.*

The importance of dose rate in the delayed and late effects of ionizing radiation has been demonstrated, both with respect to genetic effects (mutations) in mice (*1*, *2*), and in studies of life span (*3*). However, since there are no results available of observations on persistent radiation-induced chromosome abnormalities relative to dose rate, we were interested in obtaining such data, and in correlating them with late pathological changes after irradiation at high and low dose rates.

We studied the chromosomes of bone marrow cells from three groups of female LAf_1 mice irradiated at 2 to 3 months of age. Group I received a single dose of 500 rad of x-rays, at a rate of 30 rad/min as measured in air. Group II received fractionated doses of x-rays, 100 rad given on 9 of 11 successive days, for a total dose of 900 rad, at a rate of 30 rad/min. Group III received Co^{60} γ-radiation, given continuously at a rate of 1.45 rad/hr, the dose totaling either 935 rad (*a*) or 926 rad (*b*) (see Table 1).

The radiation factors for the x-radiation were: 250 kv; 15 ma; half-value layer, 1.5 mm Cu; filter, 0.5 mm Cu