base from which to depart with restorations of Hercynian movements in Europe. Figure 2 was intended to depict essentially Late Caledonian and Late Acadian conditions in the vicinity of the wrench-faulted and rifted area, but it still represents post-Hercynian relations in southern Britain and the European mainland, as no attempt was made to include European Hercynian movements in the restoration. Thus the relation of the proposed rift to the Iberian Peninsula and other parts of the mainland of Europe is especially uncertain. Nor are the Appalachian and Caledonian portions of Fig. 2 entirely compatible; in the sense of age, the British wrench faults were already in motion while the Appalachian area was still in the throes of Acadian orogeny, which included widespread intrusions and metamorphism. Thus the Caledonian belt in Britain is mapped for pre-Middle Devonian, post-Silurian, while the Appalachian belt is mapped as pre-Middle Carboniferous, post-Middle Devonian. The internally somewhat anachronous restoration proposed in Fig. 2 should be considered only as a first and incomplete approximation in the process of unraveling the record of crustal movements in the North Atlantic region.

The proposed rift hypothesis would have certain other ramifications. Wilson (*19*) has emphasized that the Mesozoic rift, which initiated the present Atlantic Ocean, split off a portion of the Europe-Africa block and left it as the part of North America that extends southwestward along the present coast from eastern Newfoundland, the block originally having been part of the eastern side of the Appalachian belt, itself of oceanic origin. Newfoundland in particular demonstrates the presence of the eastern flank of the geosyncline (*20*). Likewise, the Mesozoic rifting detached the Lewisean basement of the Hebrides from the Greenland portion of the old Laurentia and left it as a part of Europe. Therefore the postulated Late Paleozoic rifting appears to have predetermined the part of the Mesozoic oceanic rift that cuts across the grain of the Appalachian-Caledonian geosynclinal belt, the oceanic split following one or perhaps both of the northeasterly trending transform boundary faults as well (see Figs. 1 and 2). Likewise, the two distal extensions have predetermined location of the present Labrador Strait and Bay of Biscay. All three segments seem to have functioned as true rifts, but presumably the center portion first opened in one or two stages during the Late Paleozoic; the remaining segments, during the Middle Mesozoic. The ultimate origin of the proposed line of weakness is of course obscure, but its great length and relatively straight trace may suggest an earlier wrench-fault history.

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Hydration Rind Dates Rhyolite Flows

Abstract. *Hydration of obsidian has been used to date rhyolite flows, containing obsidian or porphyritic glass, at Glass Mountain (Medicine Lake Highlands) and Mono Lake, California. The method is simple and rapid and can be used to date flows that erupted between 200 and approximately 200,000 years ago.*

In 1960 Friedman and Smith (*1*) described a technique for dating obsidian artifacts; it was based on the fact that the artifact maker, in chipping or flaking the artifact, exposed a fresh surface of the volcanic glass to the atmosphere; water vapor was adsorbed on the surface, and slowly diffused into the body of the artifact, producing a hydrated layer or rind. The hydrated glass has a higher refractive index than does unhydrated material, and the boundary between is sharp; one can observe this boundary optically on thin sections of the artifact cut normal to the water-diffusion front (Fig. 1). Rates of diffusion were derived by measuring hydration rinds on artifacts of known age, or on artifacts whose ages could be inferred by C^{14} dating of associated carbonaceous material. The rates were shown to be independent of relative humidity, but dependent on the temperature of hydration. The hydration rates varied from 0.36 μ^2/1000 years for the Arctic to 11 μ^2/1000 years for the tropics.

It occurred to Friedman and Smith that this method of dating might be used to date rhyolitic flows also. However, the problem of the large amount of hydration that may have occurred, as the flow cooled from its high original temperature, deferred a test of this method on flows.

Several samples of trees burned by the composite rhyolite-dacite flow at Glass Mountain, Medicine Lake, California, recently yielded C^{14} ages of 390, 380, 190, and 130 years, all $\pm$ 200 years (*2*). These ages are much younger than the 1360 $\pm$ 240 years obtained by Chesterman (*3*) on a tree buried by airfall pumice that was erupted before the glass flow. Since Glass Mountain was erupted recently (less than 500 years ago) and since the date of eruption was known reasonably well from C^{14} measurements, this flow seemed suitable for checking the importance of hydration of the glass during cooling. Accordingly I set up a saw, lap, and microscope at Glass Mountain and examined the hydration layers on original surfaces from various parts of the flow.

Original surfaces, created when the flow was still in motion, are found in tension cracks (Fig. 2) in the glass outcrops; they are usually duller than freshly chipped surfaces, probably because of deposition of small amounts of silica on the surfaces by steam as the flow cooled. Samples were collected from obsidian spires pushed above the flow surface during flow, and from obsidian outcrops along the margin of the flow. The hydration thickness of 1.3 ± 0.2 μ proved to be uniform on all samples measured. Negligible hydration occurs during cooling.

For a further check on the usefulness and accuracy of this method of dating I moved the equipment to Mono Craters, California, where K-Ar dating by Evernden and Curtis (*4*) had given ages of from about 5000 years for a dome in the central part of the chain to less than 60,000 years for the flow at the south end of the craters. Recently Dalrymple (*5*), using K-Ar dating, obtained the following ages for samples from Mono Craters: (from the caldera) sample 6G007, 6200 $\pm$ 3100 years, 4700 $\pm$ 3400 years, 12,400 $\pm$ 3900 years; sample 5G202, 6800 $\pm$ 1400 years, 6100 $\pm$ 1200 years; sample 5G204, 6900 $\pm$ 1600 years, 6300 $\pm$ 1400 years; (from Devil's Punch Bowl) sample 5G201, 7700 $\pm$ 400 years, 6900 $\pm$ 1000 years; sample 6G005, 8700 $\pm$ 1400 years. Applying the Glass Mountain hydration rate of 5 μ^2/1000 years to the Mono Craters rhyolite, I derive ages of 1300 years (2.5 μ) for Panum (north) Dome, 1800 years (3.0 μ) for Northern Coulee (flow), 2500 years (3.5 μ) for Southern Coulee, and 5800 years (5.4 μ) for the caldera just north of Devil's Punch Bowl; and ages ranging from 8700 (6.6 μ) to 31,000 years (12.4 μ) for four samples collected from the east rim of Devil's Punch Bowl.

One should note that this technique of dating by hydration measures the time since the obsidian surface or crack was made; where any one of many events could have created the surface that is measured, care must be taken to correlate the correct event with the hydration date. For example, in the case of the caldera at Mono Craters, any of at least three events could have created surfaces on the obsidian: extrusion of the flow, subsequent collapse of part of the flow creating the depression or caldera, or the explosion in the west wall of the caldera. The surfaces that I measured may be related either to the original flow or, more probably, to the collapse; if to the latter, the indication is that the samples dated by Dalrymple may have been material intruded at about the time of either the collapse or the explosion, rather than the material from the original flow. In the case of Devil's Punch Bowl there is the possibility of an explosion in an old flow, followed by extrusion of the rhyolite plug in the center of the explosion crater. The greater age of 31,000 years may be related to material associated with the old flow; the 8700-year age, to the time of explosion, and extrusion of the plug. In the case of simple or single events, such as are apparently represented by Panum Dome and by Northern and Southern coulees, identification of the event that is being dated is less difficult.

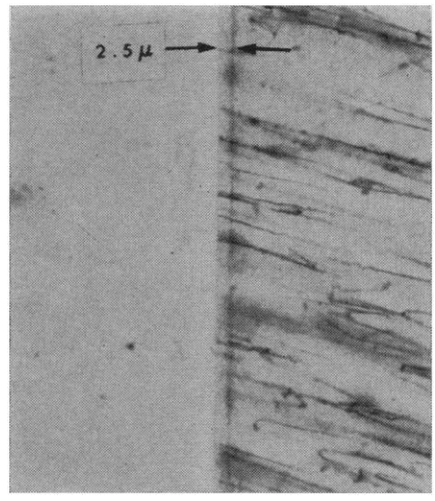

Fig. 1. Thin section of obsidian from Panum Dome, showing 2.5-μ hydration layer.

Dating of obsidian by hydration can be used to date flows aged between approximately 200 years and 200,000 years. The minimum age is determined by the minimum thickness that can be measured; the maximum, by the fact that the hydration layer spalls from the glass after reaching a thickness of approximately 20 μ. The limits of usefulness therefore vary with rate of hydration.

An individual measurement of thickness of hydration is precise within about 0.2 μ; measurement of the rind at several points on a single thin section, plus measurements of several sections, can improve the precision. The probable error in age due to uncertainties regarding the rate of hydration is about $\pm$ 20 percent of the calculated age. Since the rate of hydration is controlled by temperature (but not humidity), a change in climate may affect the rate; thus the dating of older flows in areas in which glaciers may have been subsequently active may be complicated by the change in hydration rate by glaciation. Future refinements of rates of hydration will probably allow overall accuracy within 10 percent. Comparisons of ages are obviously more precise between flows in the same

Fig. 2. Obsidian outcrop on side of Glass Mountain flow. Note tension cracks near hammer.

climatic region than between flows in different climates.

The technique, applicable to porphyritic glass also, is inexpensive and rapid; one person can make and measure about six thin sections (0.051 to 1.016 mm in thickness) per hour.

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Immunosuppressant from Group A Streptococci

Abstract. *A cytoplasmic component of group A streptococci suppresses both 19S and 7S antibody responses of mice to sheep erythrocytes. Partial purification is achieved by differential centrifugation and gel filtration. When the direct and indirect hemolytic plaque techniques are used, a single injection of this group A material given before injection of erythrocytes produces more than 90-percent suppression of either primary or secondary immune response.*

A potent immunosuppressant has been derived from a microorganism which is very common in our environment and which is a natural pathogen for man. Unlike most other immunosuppressants, a single injection of this material, when given before antigen, can produce significant suppression of the immune response, in doses far smaller than the usual lethal dose.

The immune response of mice to sheep erythrocytes was studied by the direct and indirect hemolytic plaque techniques to measure cells that produce 19*S* and 7*S* (*1*) antibody in the primary and secondary responses (*2*, *3*). Injections of streptococcal fractions and sheep erythrocytes (5×10^8) were given intraperitoneally. Each experimental group consisted of eight to ten mice; an equal number of control animals injected with saline and with sheep erythrocytes was included with every experimental group. All mice, 10 to 12 weeks of age, were either of Swiss-Webster strain (Carworth Farms) or from a closed-colony strain bred for 20 years at the University of North Carolina. Although most unsensitized adult mice show a background of antibody-forming cells in the spleen and probably have had previous contact with antigens cross-reactive with sheep erythrocytes, the terms primary and secondary indicate immune response after first and subsequent injections of antigen, respectively. The two responses are clearly distinguishable with regard to relative numbers of cells producing 19*S* and 7*S* antibody, as well as in the time required for the maximum increase of these cell types. In addition, there has been evidence that background antibody-forming cells are not related to the antigen-sensitive precursor cells of the primary response (*4*). The active streptococcal fraction described below increased the number of background plaque-forming cells (PFC) about tenfold. This stimulation, rather than suppression, of background is similar to that reported for phytohemagglutinin (*4*).

Group A, type 3, strain D-58 streptococci were cultured in Todd-Hewitt broth (*5*), washed three times with saline, disrupted in the Braun shaker, and subjected to differential centrifugation (*6*). Samples of supernatant and sediment were obtained after serial centrifugation for 45 minutes at 12,000, 37,000, and 100,000*g*. Mucopeptide extracted from the cell-wall fraction (*7*) was also prepared. The sedimentable fractions were washed twice with buffer and three times with distilled water. All fractions were dialyzed against distilled water and freeze-dried. These fractions were compared for their immunosuppressive effect by intraperitoneal injection of 5 mg into mice (groups of ten) 24 hours before injection of sheep erythrocytes. Spleen cells were obtained from the mice 4 days after erythrocyte injection and suspended in Hanks's solution for hemolytic plaque counts.

Only the soluble material in the supernatant fractions from centrifugation at 37,000 or 100,000*g* gave more than 50-percent suppression of 19*S* PFC. The supernatant from centrifugation at 37,000*g* was fractionated by ascending gel filtration on Sepharose 2B (*5*). Material was eluted from the column with pyrogen-free 0.15*M* NaCl at a flow rate of 10 to 12 ml/hr. The second fraction, designated SF-II, constituted 30 percent of the starting material, and 400 μg or more produced nearly complete suppression of the 19*S* PFC (97 percent); 200 μg produced 71-percent suppression. These observations were made 4 days after erythrocyte injection. The suppressive effect of the SF-II fraction on the primary 19*S* response was also studied after an 8-day interval to determine whether the 19*S* response had been delayed rather than suppressed. At this interval, the 19*S* PFC count was suppressed 60 percent. Although the SF-II cannot be considered a homogeneous fraction, it does represent considerable purification in that an antiserum to the soluble component of group A streptococcus which showed six precipitin lines in immunodiffusion with the crude supernatant after centrifugation at 37,000*g*, gave no precipitin lines with SF-II.

Although 1 mg of SF-II produced complete suppression when it was given 1 day before the erythrocytes, partial

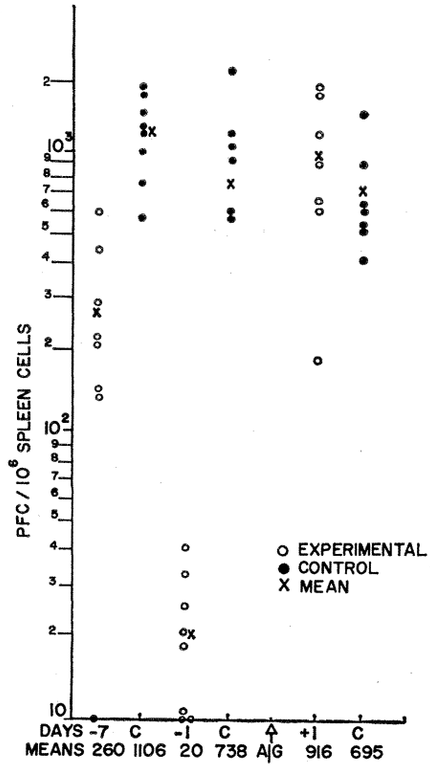

Fig. 1. Effect of interval between intraperitoneal injections of 1 mg of SF-II and of erythrocyte antigen on 19*S* PFC. Erythrocytes were injected at day 0 (A↑G), and spleen cell suspensions were prepared 4 days later. Each point represents one mouse.