ON A SHORT-LIVED COSMIC RAY DECREASE ON NOVEMBER 13, 1960*†

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On the Chacaltaya mountain in Bolivia (altitude 5,220 meters, magnetic latitude 5°S, geographic longitude 68.1°W), we are operating a cosmic ray neutron monitor designed by the University of Chicago for 12 BF$_3$ counters. Its bihourly counting rate is about one million counts. From the twelfth to the sixteenth of November, 1960, the monitor registered a series of Forbush decreases, the broad characteristics of which have already been described. We are now reporting a very abrupt and short-lived cosmic ray decrease, observed on November 13, 1960, when data are analyzed for short-time intervals.

The total counts of the monitor in each 15-minute interval from 0900 to 2200 UT on November 13, 1960 are shown in Figure 1a. It is seen that immediately after the magnetic storm that commenced suddenly at 10h21m UT the cosmic ray intensity decreased rapidly during the first hour, and more gradually thereafter, following the general pattern of the Forbush decrease.

Shortly after 1300 UT, the cosmic ray intensity at Chacaltaya decreased suddenly, remained 3 to 4 per cent below the former value for about one and a quarter hours, and then jumped suddenly to predrop value. Later it continued to decrease slowly for more than six hours, following the profile of the first decrease.

The neutron monitor at Mina Aguilar, which is located near Chacaltaya, also showed similar results. In Figure 1b are shown cosmic ray data from meson telescopes at M.I.T., and their characteristics agree well with those of Chacaltaya. It appears from these observations that the second decrease was not part of the first, but was superimposed on it temporarily.

In addition, we have examined data of neutron monitors at stations in middle and high latitudes, viz. Ottawa, Durham, Mt. Washington, Ellsworth, and Deep River. The cosmic ray intensity at all these stations had increased on November 12, 1960, due to the solar outburst of cosmic rays, but by 1200 UT on November 13 it had returned to normal. At Deep River it was observed that cosmic ray counts between 1,315 and 1,415 were 8 to 10 per cent below the values of the adjoining hours. This decrease is 2.5 to 3 times greater than at Chacaltaya, M.I.T., and Mina Aguilar, suggesting an energy dependence the same as that of the Forbush effect.

Data from other stations are distributed for total hours only. Since the decrease did not coincide exactly with the hourly intervals, its amount is difficult to
FIG. 1.—Cosmic ray intensity measured by (a) a neutron monitor at Chacaltaya and (b) a meson telescope at M.I.T. on November 13, 1960. Data are corrected for variations of pressure only.

Nevertheless, it is worth noting that the cosmic ray intensity between 1300 and 1400 UT at these stations was 3 to 6 per cent less than that in the adjoining hourly intervals.

Events of this type were first reported by Carmichael and Steljes during the big Forbush effect of July 17, 1959, in the neutron monitor data at Deep River. McCracken noted that Meson telescopes at M.I.T. also showed similar phenomena in association with the magnetic storm of July 15, 1959. These observations together with the results described in this note indicate that the short-lived drop may be present during all big Forbush decreases.

The striking features of these events may be summarized as the very rapid decrease, equally fast recovery, and very short duration. Our analysis of the November event shows, in addition, that it was world-wide in character and had an energy dependence the same as that of the Forbush effect.

Cosmic ray decreases associated with magnetic storms are believed to be caused by a cloud of ionized solar gas with magnetic fields enveloping the earth. On these considerations we suggest that clouds responsible for big magnetic storms contain within them well defined regions, where the magnetic field strength is higher and consequently cosmic ray intensity lower than the rest of the cloud. When such a region is moving past the earth, the cosmic ray intensity decreases even more.
Because of the comparatively small dimensions the decrease lasts for an hour or so, and because of its well-defined limits both the decrease and the recovery occur very quickly.

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3 McCracken, K. G. (personal communication).

VITAMIN C AS A COENZYME: THE HYDROLYSIS OF MUSTARD OIL GLUCOSIDES

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The physiological functions of vitamin C have been obscure and reactions in which it participated as a specific coenzyme unknown. Nagashima and Uchi-yama recently discovered that the rate of cleavage of sinigrin by an enzyme preparation from yellow mustard increased by 260 per cent on addition of 0.001 M L-ascorbate, whereas an equal concentration of the stereoisomeric D-araboascorbate produced a rise of only 50 per cent. With other, crude plant extracts, they found that L-ascorbate could accelerate attack on the same glucoside by factors as large as 100. We came independently to the domain and sketch the result.

Yellow mustard seed (from Sinapis alba) contains at least two enzymes that catalyze the same reaction, hydrolysis of mustard oil glucosides (glucosinolates). One enzyme is, like fungal sinigrinase, indifferent to vitamin C and is the classical myrosin. The other enzyme requires the vitamin as cofactor and will be called an ascorbate-activated glucosinolase. General thioglucosidase activity in mustard 4, 4 against 2,4-dinitrophenyl β-D-1-thioglucopyranoside or desulfoglucocapparin (S-β-D-1-glucopyranosylacetothiohydroximic acid) is ascorbate-independent. Although the enzymes have not to our knowledge been completely separated, their relative proportion varies immensely between mustard flour and different extracts. The cleavage of sinigrin or sinalbin by whole mustard is accelerated with 0.002 M L-ascorbate by a factor of 80. The response from ordinary myrosin preparations is a rate factor of merely four or so, 4, 5 but through a changed procedure an enzyme solution can be obtained with the major properties of the native system and an ascorbate effect of 400. The hydrolysis of glucosinolates can be followed by determination of substrate or any product (isothiocyanate, glucose, sulfate, acid). A convenient method for rate studies is automatic titration with alkali at constant pH.

Defatted yellow mustard flour hydrolyzed sinigrin at zero-order rates on the