Considering the three items above, the period of time from June 20 to July 9 showed fairly high consistency of daily insolation with a high percent chance of days of maximum insolation and the highest average insolation. Albedo reduction treatments would be most effective during this time. Lesser, but still relatively large, treatment effects can be expected during the remainder of the snowmelt season.

**General Conclusions**

Albedo reducing materials definitely increase the rate of melt of ripe snow packs. Melt rates can be expected to reach a value of from 2.5 to 2.8 times that of untreated snow, depending on the kind and amount of treatment materials used.

Treatment effects increase by a simple linear relationship as the incoming short-wave radiation increases only if the time duration of measurement is short. There is a positive treatment effect when net, all-wave radiation on untreated snow is zero or even negative. Treatments are effective with up to two inches of new snow overlying the treated surface.

Treatment effects decrease with time. Significant time trends over periods as long as ten days were found. The reduction of treatment effect with time was most rapid during the first day following treatment; the time effect lessened as elapsed time increased.

Carbon black treatments give much better results per unit weight than non-carbon black treatments. For both carbon black and non-carbon black treatments, the treatment effect tends to increase inversely with mean particle size and tends to approach a limit as the treatment weights increase.
Variations in snow conditions, especially in late-lying snow-fields, provide an important source of variation in treatment results, and may preclude differences that would normally be expected to occur on the basis of more rigorously controlled experiments.

Based on the frequency of occurrence of daily insolation, the maximum and most consistent treatment effects can be expected during the period from June 20 to July 9.

The approximate purchase cost of fluid coke, coke, and coal is $1.00, $1.25, and $0.85 per 100 pounds respectively (Appendix Table A). The coke and coal used were both available in chunks and had to be crushed. Fluid coke is available as small spherical beads with 80 percent of the material less than .18 mm. in size. Fluid coke is easily crushed, and the amount of crushing required is very small compared to that required for the other materials. Also, fluid coke is much more easily sieved due to its spherical form. Thus, the purchase and preparation costs for fluid coke are less than for the other two materials. The application costs would probably be the same for all three for a given weight of application. In summary, it appears that fluid coke of less than .18 mm. size applied at the rate of about 23 grams per plot or 690 pounds per acre is the best of the non-carbon black materials.

Aqua Nuchar "A" was by far the cheapest of the carbon black materials used (Appendix Table A). The Nuchar did not cause as large, first-day increases in net, all-wave radiation as did some of the more expensive carbon blacks. However, over time periods up to ten days there was no significant difference between it and other carbon blacks.
There was no difference in the application cost of the various carbon blacks. For most of them, including Nuchar, the optimum weight of application was found to be about 3.2 grams per square foot or 300 pounds per acre.

Based on the studies made, and considering material purchase cost and ease of application, it is concluded that spray application of Nuchar at a rate of 300 pounds per acre is the best treatment to use for snowmelt acceleration.
SNOW HYDROLOGY Acceleration of snowmelt by reducing the albedo of the snow surface is being investigated by watershed management researchers. These plots on Mines Peak were used to test various kinds and amounts of materials. Based on the results from these plot studies together with information from earlier experiments on energy exchange at the snow surface, the final phase of the research will involve treating a large permanent snowfield in the Little South Poudre Watershed.

RANGE ECOLOGY Six million acres of land in Colorado are dominated by sagebrush-grass cover. This land has variable potential for recreation, watershed and production of forage for domestic livestock and wildlife. Suitability of these ranges for various uses depends upon soil-vegetation-environment relationships on these lands in order to obtain information for making sound management decisions.

FISHERIES SCIENCE Black Canyon of the Gunnison is one of the deepest, narrowest, canyons extant. Because of difficult access the fishes present were unknown. A portable electrofishing apparatus is used to collect fishes in the swift river between the nearly vertical canyon walls. Eight species are present. The turbulent canyon area is a barrier to many species common to the lower reaches of the Colorado River. The Curecanti River Development Project that is under construction immediately upstream from the canyon will alter the river flow and temperature and subsequently influence the fishes.

WATERSHED MANAGEMENT A severe burn covering about 600 acres occurred near Comanche Reservoir in late August 1966. During the summer of 1967, the rate of soil particle movement and the effect of the burn on hydrologic properties of the soil were studied. Although all litter and humus were destroyed on the burn, infiltration rates were not materially affected. Soil erosion was not a problem except during intense summer thunder storms when soil particles would become entrained and moved considerable distance downslope.
FOREIGN TRAVEL

In tune with the times, faculty members in the College continue to participate in selected foreign activities in forestry and natural resources.

Dr. Bertram C. Goodell, Research Professor of Watershed Management and U.S.F.S. Cooperator, represented the College at the 14th Congress of the International Union of Forest Research Organizations in Munich in September. Dr. Goodell presented a paper describing our efforts in the development of dye-dilution techniques for measuring streamflow. He also visited watershed and hydrology research centers in England, Switzerland, and Germany.

Dr. R. E. Dils, Associate Dean, will be in Argentina for two months starting in mid-January for the Food and Agriculture Organization of the United Nations. Dr. Dils will be lecturing on watershed management and torrent control at the University of La Plata and will work with Argentine and United Nations personnel in the development of new undergraduate and graduate curricula in watershed management.

The College will be represented by Dr. Gilbert H. Ehren, Professor of Forestry, at a two-month institute for tropical forestry to be held in Honduras and Costa Rica during February and March. The institute is being sponsored by the Organization for Tropical Studies and the National Science Foundation. Dr. Stephen B. Preston (CSU 1946), Professor of Wood Technology at the University of Michigan, is Executive Director of the Organization for Tropical Studies.

Dr. Gustav A. Swanson, Head of the Department of Fishery and Wildlife Biology, will be on special leave from June to December, 1968, to accept a Fulbright Award to Australia. Dr. Swanson will be associated with the University of New England at Armidale in New South Wales. He will assist the University in the planning and development of a new school of natural resources, and will give some lectures in wildlife management and ecology.

ENROLLMENTS CONTINUE UPWARD

Fall quarter 1967 enrollments as in the past seven years show large increases in students within the College. The largest increases are in entering freshmen (311) and in graduate students (25). Total College enrollment is up 9.1 percent, graduate student enrollment is up 17.5 percent. Enrollments by departments are:

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<th>Department</th>
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*Excludes freshmen

COOK NAMED HEAD OF RANGE SCIENCE DEPARTMENT

Dr. C. Wayne Cook, currently Assistant Dean of the College of Natural Resources and Professor of Range Science at Utah State University, will assume his new position as Head of our Department of Range Science on May 1. Dr. Cook has degrees from Fort Hays Kansas State College, Utah State University and Texas A&M University (Ph.D.). He has been at Utah State University since 1947. Prior to this he served with the Soil Conservation Service, College of South Utah as well as Utah State University. Among many other honors he is presently President of the American Society of Range Management.

Dr. C. Wayne Cook
Mines Peak Plots
June-July 1967
Plot T-3 (Sav-a-pond)
6/27/67

Plot T-4 (NuChar)
6/27/67
Plot M-1 (NuChar+Sav-a-pond)  
6/27/67

Plot M-2 (NuChar)  
6/27/67
General view of Mines Peak Plots from the air  6/29/67

General view of Mines Peak Plots from the air  6/29/67
Plot B-3 (Control)
7/9/67

Plot B-4 (NuChar+Sav-a-pond)
7/9/67
Close-up plot M-3 (Sav-a-pond) 7/9/67

View looking up on plots from bottom of snowfield 7/9/67
General view of drift area east of Mines Peak 7/9/67
Plot T-3 (Sav-a-pond)
7/22/67

Plot T-4 (NuChar)
7/22/67
Plot B-3 (Control)  
7/22/67

Plot B-4 (NuChar+Sav-a-pond)  
7/22/67