organic complexes probably play the predominant role. Once these bonds are disrupted, uranium becomes an exceedingly mobile element in the presence of water containing carbonate and bicarbonate ions.

Based on geologic evidence, the samples that contain U^{234} in excess greater than 10 percent are believed to represent redistributed uranium. Thus a significant portion of U^{234} preferentially leached from other uranium-bearing rocks is subsequently deposited in excess in at least some parts of the redistributed uranium ore bodies *(12)*.

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Weather Control: Use of Asphalt Coatings To Tap Solar Energy

Abstract. *Coating the ground with black asphalt will increase soil temperatures as much as 19°F. On the other hand, if freshly applied asphalt is used as a binder for a white material such as gypsum or lime, subsurface temperatures can be dropped as much as 24°F. The cost and permanence of such coatings might permit their use to cover very large areas of the earth, and the coatings might prove effective in modifying weather.*

The tremendous energy involved in the weather phenomena which affect our planet is derived entirely from the sun. Sunlight, however, is not absorbed directly by the atmosphere except for the absorption of a small amount of ultraviolet light by the ozone at altitudes above the stratosphere. To enter into the earth's atmosphere, the solar energy must first be absorbed at the surface of the earth. This surface acts as a converter to distribute the absorbed energy between the earth and the atmosphere by conduction, radiation, diffusion, and vaporization processes.

It has long been thought that man could control the weather if he could find a practical and inexpensive method for changing the ability of large areas of the earth's surface to absorb and convert solar energy. Methods suggested for accomplishing this were recently reviewed by Wexler (*1*). The most promising suggestion to date has been the spreading of powdered coal, but it has been recognized that the permanence and hence the practicability of such coatings is doubtful. There are also no experimental data on the surface temperature increases which such a procedure might be expected to produce. My report presents evidence which shows that important differences in the ability of the earth's surface to absorb and convert solar radiation can be produced by asphalt coatings, which have been demonstrated to be long-lived and inexpensive to apply.

The absorptivity of sandy soil or most vegetation to solar radiation varies from 70 to 80 percent. By the application of a black asphalt coating, absorptivities of about 95 percent can be achieved. Conversely, if the freshly applied asphalt coating is used as an adhesive for a white reflecting material, such as gypsum or lime, the absorptivity can be reduced to about 25 percent.

The amount of solar energy incident upon the earth on a clear summer day in the temperate zone or almost any sunny day in the tropics is about 500 to 600 cal/cm^2; this amounts to 15,000 to 18,000 Mwatt/mi^2. A 20 percent increase in absorptivity by the surface can, therefore, make enormous amounts of additional energy available for atmospheric effects if the change is effected over a sufficiently large area.

The temperature changes which either a black asphalt coating or a white one covered with gypsum will produce have been evaluated in a field test in Arizona. The coatings were laid down both as 8-inch wide strips and as 10- by 10-foot squares. Thermocouples connected to temperature recorders were buried at various depths below the center of each test patch and also under an uncoated adjacent control area. It was found that the 10-foot-square coatings produced temperature effects which were about twice that recorded under the strips. The data for the square coatings are presented in Table 1. Here it can be seen that the application of a black asphalt coating raised soil temperatures about 19°F ½ inch below the surface when soil temperatures reached a maximum during the afternoon, and that a 4.4°F advantage still persisted at this depth even when the soil was coldest during the night. Conversely, a white coating gave a maximum temperature which was 24°F below that of the control area at ½-inch depth. The actual surface temperature, which controls radiative and convective heat transfer into the atmosphere, would show even greater effects than the ½-inch readings just quoted.

These data appear promising for the initiation of meteorological phenomena. The difference of 43°F between the black and white coated soil temperatures is as large as the difference between average summer and winter temperatures in most temperate zone climates. The difference of 19°F between the black asphalt coated area and the control is enough to cause an increased infrared radiation flux of about 170 Mwatt/mi^2, even assuming that both surfaces have perfect infrared emissivity.

Landsberg (*2*) has stated that the temperature of the surface is undoubtedly directly responsible for the air temperature up to considerable heights, at least for several thousand feet, and that the effect may extend even further aloft. This and other meteorological information gathered to date suggest that the application of asphalt coatings over tens or hundreds of square miles of the earth's surface could produce useful changes in local weather. Relatively thin, inexpensive coatings should prove adequate in respect to permanence since they would not be exposed to traffic or other adverse conditions.

Cumulus cloud formation is frequently induced by differential heating and it has also been suggested that surface heat sources play a significant role in localizing cumulonimbus clouds and

Table 1. Effect of coatings on soil temperatures. Test was performed in Arizona for the period 25–28 October 1960. Average air temperature, 84°F (high) and 48.5°F (low); average insolation, 434 cal/cm^2 daily. Temperatures were recorded beneath center of 10- by 10-foot square coating.

Coating	Temperature (°F) at depths of		
	0.5 inch	1.0 inch	2.0 inch
Average maximum			
Black	114.3	106.5	100.2
Uncoated control	95.7	87.8	83.1
White	71.3	70.5	68.7
Average minimum			
Black	55.0	58.2	61.3
Uncoated control	50.6	53.9	56.2
White	48.2	49.3	52.1

thundershowers. These effects are, of course, achievable only when permitted by the atmospheric stability, humidity, and large scale flow patterns (*3*). One possible application for black petroleum coatings would be for the covering of large areas of arid land near the shoreline of a sea or large lake. This might augment the intensity of the sea breeze circulation, bringing in moist air from over the water, lifting it to its condensation level, and causing cloud formation and subsequent rainfall. Once condensation is initiated, the release of latent heat of condensation will add additional energy to the system to accelerate its operation.

An area where such an experiment might prove effective is the southern coast of the Mediterranean Sea in Libya and Egypt. Here rainfall is very low (2 to 4 inches per year), but in areas where even low hills are effective in physically lifting the air above its condensation level, significant rainfall is produced (for example, in the Bengazi Peninsula where the effect of low hills only 2000 feet high provides 20 to 30 inches rainfall annually). Other interesting areas would be in Australia or in South America at locations such as the Paraguana Peninsula.

This proposal might also have other useful applications, such as relieving smog conditions. Active efforts are under way to calculate the influence which an area coated with asphalt might be expected to have on atmospheric motions and to obtain a better idea of the economics of this technique for the initiation of rainfall (*4*).

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Skin Resistance Levels and Galvanic Skin Response: Unilateral Differences

Abstract. *On five subjects, skin resistance levels and galvanic skin response were recorded unilaterally and simultaneously from each side of the body for between 24 and 36 days. Reliable differences in skin resistance were found in three subjects and in galvanic skin response in two subjects. The magnitude of the skin resistance difference was significantly reduced in four subjects during stimulation.*

The purpose of the present study was to determine whether within a subject there were reliable unilateral differences in skin resistance and galvanic skin responses (GSR's) and the relationship between them.

In research utilizing sudomotor activity, it is common to take unilateral recordings (that is, one palmar area being the active electrode site and some nonpalmar area on the same side of the body being the reference electrode site). It has even been suggested (*1*) that unilateral recordings are preferable to bilateral, palm to palm recordings, at least for measures of skin resistance levels.

On the other hand, there is some evidence indicating that there are unilateral differences in GSR reactivity (*2*) and in skin resistance levels (*3*). If unilateral differences are a consistent characteristic of some subjects, then unilateral recordings may have less validity than bilateral recordings. That is, the degree of a subject's GSR reactivity or the level of a subject's skin resistance would, in part, be a function of the side of the body from which recordings were taken.

As yet, no systematic studies have been undertaken to determine the reliability of such unilateral differences. The present exploratory study was concerned with determining the reliability of unilateral differences in skin resistance level and GSR reactivity within a subject. For this purpose, I used an experimental design for repeated measurements.

Five healthy male Antioch College students served as subjects. They participated in the experiment at the same time each day for between 24 and 36 days.

The electrodes were zinc–zinc sulfate (1¼ inches in diameter) with one on the center of each palm and two mounted in a plastic holder within ½ inch of each other on the midline of the chest. On each day the electrodes were systematically rotated from one position to another. Two Fels dermohmmeters were used. They imposed a constant current of 70 μa. The use of two imposed currents did not create any problems, provided one Dermohmmeter was isolated from ground and no contact was made between either the electrodes or the electrode jelly on the chest.

Prior to electrode placement the skin area was treated with a half-and-half acetone-ether solution to remove dirt and skin oils. On each day of measurement, after a 30-minute hydration period, 10 minutes of recordings were taken while the subject rested with his eyes closed (rest period). After rest, approximately 13 minutes of recordings were taken while the subject performed in a serial learning task (learning period). The task was meant to be an appreciable stress; all subjects were instructed to perform at their best.

Separate measures of skin resistance level and GSR magnitude from both sides of the body for rest and learning were obtained on each day. The measure of skin resistance level was obtained by averaging the lowest point of skin resistance level for each 30-second interval of rest and learning. The GSR magnitude was the mean deflection during rest and learning of all GSR's of 600 ohms or larger. Differences between the right and left side were obtained daily on each subject for both skin resistance level and GSR reactivity. Mean differences for the entire experiment were then obtained for each subject.

Significant ($p < .05$) unilateral differences in levels of skin resistance were found in three subjects with the left side having a higher level of skin resistance in each case. An additional subject, though demonstrating no overall unilateral difference in skin resistance, did show a unilateral effect which