TO: Sugar Research Foundation, Inc.

FROM: Robert Flaherty

The film we are now undertaking in collaboration with Dr. William J. Robbins, Professor of Botany, Columbia University, and Director of the New York Botanical Garden, and Dr. E.E. Naylor and Miss Carol Woodward, of his staff, and Dr. Hockett, of the Sugar Research Foundation, is based on Dr. Robbins' monograph, "Sugar is the Foundation of All Life." A synopsis of this monograph follows:

"Few of us, occupied as we are with the daily routine of living, realize the true significance of plants and the reasons for it; few of us realize that we are able to live and keep on living only because of the current existence of plants; that if plants were eliminated we and all animal life would disappear in short order.

"Our dependence on plants is because the food we eat,.....comes in the last analysis from plants and, in addition, the oxygen we breathe as well as the vitamins and indispensable amino acids, so essential for our nutrition, are derived from plants. In other words, without plants we would starve to death, die of suffocation and expire from a combination of deficiency diseases.

".....We are so completely dependent upon plants (primarily those which contain the green pigment, chlorophyll) because they alone of all living organisms have the power to make sugar....

"The process by which this is accomplished is called photosynthesis. It occurs in the light in the presence of the green pigment, chlorophyll, so obvious in the leaves of grass or a maple tree. As the result of photosynthesis, water and gaseous carbon dioxide are combined to form sugar.....

".....It occurs only in the light, and part of the energy of the sunlight which falls on a green leaf is stored in the sugar which is made there.....

".....animals use other things than sugar for food ... oils, fats, starch and proteins ... however, all of these substances are made directly or indirectly from the sugar.... In fact, all constituents of the plant body (except those which are purely mineral) are made from this basic compound. The starch in a potato is constructed from the sugar synthesized in the leaf of the potato plant; the cellulose and lignin of wood are built from sugar made in the

leaves of the tree of which the wood is a part; the oil in the peanut or soybean and the protein in wheat grains, the quinine in the bark of a cinchona tree, the digitalis of the foxglove, the opium of the poppy, the perfume given off by a rose and the pigment which colors its petals are all developed from sugar by the alchemy of the plant. Every organic compound in the plant, no matter what, is derived from sugar. So even if the diet of an animal were limited to vegetable foods containing starch, oil and proteins and no sugar, it would still be living at the expense of the substances constructed from sugar.

"It is justifiable, therefore, to refer to sugar as the foundation of life, the substance upon which in the last analysis our existence and the development of modern civilization rests....."

Dr. Hockett, just before his departure for Hawaii, wrote a script based on Dr. Robbins' monograph, and with Dr. Hockett, David Flaherty and I had a conference with Dr. Robbins and his staff, Dr. Naylor and Miss Woodward, out at the Botanical Gardens, and we were all agreed as to the value of the project and the general line the film was to take.

Since then I have had a second conference with Dr. Robbins and several conferences with Dr. Naylor and Miss Woodward, who have made a further compilation of many details, drawings, sketches and plans, etc., which are still going foward. We have also made photographic tests at the Gardens.

The more deeply we have gone into the subject the more fascinating we have found it, and I believe the film, which is to be in color, will be absorbingly interesting. The subject is a "natural" for color. It will be further enhanced by the variety of its photography, which will be a combination of realistic photography, animation, and photomicrographic photography, all in color.

We will begin with the run rising, its rays like gigantic wheel spokes shooting up into the sky; we will show it a boiling, molten, golden mass almost the full size of the screen; we will show it higher in the sky sending its sun-beams streaming through the aisles of a deep, solemn forest of trees; we will show sunlight back-lighting leaves and flowers and glinting on the waters of a

stream. We will talk about the sun, what it is, what it means, and the marvelous alchemy it performs with the green pigment, chlorophyll, to create that miracle without which life could not exist - sugar.

We will show by realistic photography, by photomicrography and by animation how this miracle is done, - the process called photosynthesis which means, literally, putting together with the aid of sunlight.

Two substances or raw materials are necessary for this photosynthesis, both very common. One is the colorless gas, carbon dioxide, which is present in the air, and the other is water which falls from the sky and is present in the soil.

Ordinary air is composed mostly of nitrogen gas with about 20% of oxygen and a bare trace of carbon dioxide. It is this tiny bit of carbon dioxide which is so important in the creation of sugar. Carbon dioxide is the gas of soda water, for instance; it is the product of combustion formed when coal and wood and oil burn. By this burning action carbon dioxide is returned to the atmosphere. It is from this constantly replenished supply of carbon dioxide in the air that green plants obtain this essential gas for their manufacture of sugar.

The other substance, water, enters the plant from the soil through tiny root hairs. These minute hairs are usually not observed when a plant is pulled out of the ground. However, when seeds are germinated in moist air in a dish these delicate white hairs are clearly visible. We will show them by photomicrography, and also show by photomicrography and animation how water passes along the root and up the stem and out into the veins of the leaf.

We will then show how the carbon dioxide reaches the inside of the leaf through tiny holes in the leaf's surface, the stomata. We will show the internal structure of the leaf and its marvelous architecture, and by photomicrography show a cross section of a leaf and how water and the carbon dioxide meet and the

miracle occurs which makes possible all life. We will do this by going from a photomicrograph of a single plant cell to an animation which will give the effect of entering a magical room. In this room, which is in semi-darkness, we see little balls, red, green and blue. The green are chlorophyll, the red carbon dioxide, and the blue water. They are inert and in confusion. Soon, however, beams of sunlight stream in, the room gradually lightens up, the sun breaks in. The little balls pair off in their respective colors, they move faster and faster; they become a kaleidoscope of color. Their whirling increases until at last one color dominates the scene - green. Out of this we see at last a tiny, gleaming crystal - sugar.

During this miracle oxygen is set free. All green plants form oxygen as they stand in sunlight. We cannot see this oxygen gas, but we can demonstrate it if we use a plant such as an Elodea which lives normally in water. We can show oxygen bubbles rising from it to the surface. When we cut off the light these bubbles of oxygen will soon cease.

The oxygen content of the air we need to breathe every day is maintained by this activity - that is, the manufacture of sugar in green plants. Fish can live in a sealed bowl, for instance, so long as green plants are present and light strikes them. But without light, plants cannot make sugar and return oxygen to the water, and without this oxygen the fish soon die. In the same way, man could not live if the green plants of the world did not provide him with oxygen released while the sugar is being manufactured.

We will go on to show the part sugar plays in the development of a plant, how it is required for growth and the formation of the plant's new parts. We will show these new parts down to the minutest detail by close-ups, extreme close-ups and photomicrography. We will show in lapse-time photography examples of seed germination, the opening of the buds of flowers, etc. We will show plants in which sugar is stored both as sugar and fats and oils, as, for instance,

the lily, the hibiscus, the sun-flower, sisal, the bread fruit, the olive, the avocado, the cocoanut, and - of course - the sugarcane and sugar beet. We will show also the plants in which sugar combines with minerals drawn from the soil - the proteins so important to produce the cereals and the leafy vegetables; the plants in which sugar undergoes chemical transformation to produce drugs to treat the ills of man - quinine, belladonna, strychnine, morphine; the plants like brown rice and the citrus fruits in which sugar undergoes still other changes to produce the vitamins.

And then on to flowers, both the rarest and the commonest, and show them in all their beauty in which sugar is combined to make their exquisite pigments and perfumes.

We will show instances of the amazing energy sugar gives to the plant as it grows, - how, for instance, the humblest little plant can overturn a stone.

The energy stored by plants remains in their bodies for ages and is eventually used by man in the form of coal or oil. This energy is set free when coal or oil burns, and man uses it to run the wheels of his industries, - locomotives pulling great trains, ships plowing through the sea, dynamos generating electricity, tractors plowing, airplanes speeding across the sky. We will show detailed close-ups of fossils, of plants and trees which grew millions upon millions of years ago, in which the sunlight was trapped and the miracle of sugar was formed which gives to man today the colossal sources of power upon which he now depends.

We come at last to the greatest of all plants - the still growing four thousand year old Sequoias of California. We will show cross sections of their gigantic girth with the dates marked in their rings beginning with the time of the Pyramids in their centre, on to the time of the Greeks and Romans, William the Conqueror and the Elizabethan Age, the Revolution, and on, etc., to the

present day. We will show, by panning, their towering heights, and then recapitulating briefly the key sequence of the film, the formation in the plant cell of sugar - intercut with quick flashes some of the plants, the leaves, the flowers, and the fossilized plants which we have already seen in the film; intercut to the sun coming out from behind a cloud, glinting on water, streaming through trees, lighting up flowers, lighting up boughs laden with fruit, lighting up leaves, lighting up a single leaf be-diamonded with dew. And finally, fading out, we will fade into a micrographic shot of a gleaming sugar crystal, and - recapitulating our title, "Sugar - the Foundation of all Life", - conclude the film.

Made with the authority of Drs. Robbins and Hockett, this film can be a text book on the subject and be used wherever botany is taught in both schools and colleges because, in the opinion of Dr. Robbins and his staff, it is not only the basic story of sugar but the basic story of botany as well.

To those people who believe that sugar is a pernicious food, the cause of many ills, this film, showing as it does the purity of the alchemy with which sugar is made, might be a revelation.

The film will be two reels in length from which a one reel picture can be edited should the film be accepted for theatrical distribution. The tentative title is "Sugar, the Foundation of all Life" or "The Foundation of all Life."

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