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SUGAR FROM SUNFLOWERS

By Dr. Edwin E. Slosson.

A new sort of sugar may soon be on the market that is sweeter and better and possibly cheaper than common sugar. I call it "new" because it is unfamiliar and not yet for sale in the shops, but as a matter of fact it forms a large part of our daily food already. The reader, if he be an ordinary person - though no one will admit that he is - is now consuming the new sugar at the rate of a pound a week and gets from it some six per cent of his muscular energy.

The chemist knows of scores of different kinds of sugars but the public knows only two, beet sugar and cane sugar, and these two are really one, sucrose, the chemist calls it. When we eat this sugar it is split up into two equal parts, one of which is known as "glucose" and the other as "fructose".

The chemist, who analyzes sugars by passing a ray of polarized light through their solutions, calls the former "dextrose", or the right-handed sugar, because it rotates the ray to the right, and the latter "levulose", or the left-handed sugar, because it rotates the ray to the left.

Now glucose or dextrose made from cornstarch has in recent years come into common use as a syrup for making certain kinds of candy, and can now be prepared as a pure white powder. But it cannot completely replace cane sugar because it is not nearly so sweet.

The other sugar, fructose or levulose, has a sweeter disposition than either its twin, glucose, or its mother, sucrose. In fact, two pounds of levulose would go as far as three pounds of cane or beet sugar in sweetening food. It is also much more soluble than common sugar and so can make a sweeter syrup. A spoonful taken on the tongue vanishes like snowflakes in the sun.

Levulose gets its other names of fructose or fruit sugar because it occurs commonly in sweet fruits, as it does also in honey. But it has never been prepared in commercial quantities because of the difficulty of purifying it. This difficulty has at last been overcome by the researches of Jackson, Silsbee and Proffitt at the Bureau of Standards who have worked out a process of producing it by the ton in a pure white, crystalline form. This may make levulose a formidable rival of common sugar, since it may be made from a plant that is tougher, wider spread and more prolific than either beet or cane.

This is the Jerusalem artichoke. The tubers of the artichoke are similar in composition to potatoes but, instead of the starch of potatoes, they contain a similar substance, known to chemists aa "inulin". Starch, digested in warm acidified water, turns into the right-handed sugar, dextrose. Inulin, treated in the same way, turns into the left-handed sugar, levulose.

It seems that we can get more sweetness from an acre of soil by growing artichokes than any other crop. The average yield of potatoes in the United States is three tons per acre. In England this is doubled. But fifteen tons per acre of artichokes have been raised in Pennsylvania, using the strain known as the Mammoth White French Jerusalem Artichoke.

In the midst of the Great War when England seemed in imminent danger of starvation through the cutting off of her shipping by U-boats, the British Government set the Royal Society to finding what crop would produce the largest amount of food on this limited land. The War Food Committee reported, in "private and confidential circular No. 46", that the Jerusalem artichoke was better than potatoes, for it could be grown on waste land without preparation and with little cultivation, and that the yield in gardens ran up to 20 or 22 tons per acre.

Unlike the sugar beet, the artichoke is not impaired in sugar content by freezing, so the tubers can be kept in storage or left in the ground until it is convenient to work them up in the factory. The factory can therefore be kept running for eight months in the year instead of three with consequent reduction of overhead and investment.

The tubers yield ten to twelve per cent of levulose. Formerly crystallized levulose was sold, or rather quoted in the catalogs of rare chemicals, at over a hundred dollars a pound. The new process may reduce the price to that of common sugar, or cheaper considering its superior sweetening power. It has one disadvantage that may interfere with its table use; that is, it absorbs water from moist air more readily than salt, and so is apt to deliquesce into a syrup.

So it seems that we need not depend upon imported sources for our sugar, the tropical cane or the European beet. The Jerusalem artichoke does not come to us from Palestine, but is a native weed, one of our wild sunflowers, that means that it is immune from destructive insects and diseases and needs little encouragement to make a good crop.

WOULD USE CHEMISTRY TO CLASSIFY PLANTS

That the natural relationships of plants may be learned from a study of their chemical composition, and the knowledge thus gained of chemical kinships can be put to practical use in the search for useful chemicals of plant origin, is the idea advanced by Dr. Raphael Zon of the U. S. Forest Service.

Dr. Zon states that related plants resemble each other not only in structure and arrangement of parts, but also in the chemical substances which they contain. As an example he cites the presence of a certain class of fatty acids in the higher groups, which are absent among algae and other lower plants. Mr. Zon goes on to say that once we have built up a sufficient array of knowledge of the chemical relationships among plants it will be possible to save a great deal of time now lost in haphazard investigations to find new foods, oils, drugs and other plant materials, for then it will be known definitely in what plant families the desired substances can most probably be found.

CANADIAN HELP NEEDED IN SUPER POWER DEVELOPMENT

Because of Canadian governmental policy against exporting power it is probable that the St. Lawrence River project and the Carillon project, an undertaking larger than Muscle Shoals and requiring the exporting of power from the Ottawa river, will be blocked indefinitely, according to information reaching the U.S. Department of Commerce.

With the completion of these plans, power would have been furnished the manufacturing districts in New England at a figure below the present cost. Only one-third of the expense of the St. Lawrence plan could be borne by the United States, however, as not more than sixty miles of the mileage of the proposed development are a part of the international boundary line.

The St. Lawrence project is a combined waterway and power development plan worked out by a group of American and Canadian financiers. For power development a super power plant would be built at the base of Lake Ontario. This super power plant would have to produce 300,000 kilowatts per hour or one-half of the power produced on both sides of Niagara Falls. The waterway plan would, by deepening the channel of the St. Lawrence, link the Great Lakes with the sea.

Closely allied to, and almost a part of, the St. Lawrence scheme is the Carillon project. A huge power plant would be built at the small town of Carillon on the Ottawa river. Power from this plant could supply not only prospective Canadian needs but most of the eastern United States as well. The Ottawa river flows between the provinces of Quebec and Ontario, and the premiers of these two provinces are bitterly opposed to the plan. Since the money for the initial payments on the work has been raised and since the project is so large it is probable that the Dominion Government will make the final decision.

An important step in super power that seems likely to materialize is the ratification of a power treaty contracted by New Jersey, New York and Delaware. These states have agreed among themselves to share the power of the Delaware river, and it remains for the legislature to ratify the agreement. Metropolitan New York will benefit most from the plan, as extra power will come in from the Delaware watershed.

"Water power, developed in small companies, is not cheap power but requires an enormous outlay for power houses and coal," said Paul S. Clapp, secretary to the Northeastern Super Power Committee. "By concentrating these power houses at a number of centers much of this expense will be eliminated, as coal can be bought in large quantities and stored, larger and more efficient machinery can be used, and arrangements can be made for transferring the amount of energy needed for peak loads from one plant to another."

The Northeastern Super-Power Committee, organized by Herbert Hoover, secretary of commerce, in the interest of eliminating waste, consists of representatives from New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and Maryland. Investigations were made as to the feasibility of a power system connecting these states in an interlocking system. The northeastern part of the United States was chosen as a field for investigation because sixty per cent. of the manufacturing is carried on in them and they have forty per cent. of the population.

"The United States naturlly divides itself up into power areas," Mr. Clapp continued," and will have to be developed as such. We chose the northeastern part of the United States to make our survey because of its industrial importance. We

found that about thirty-eight per cent. of the water supply had already been developed and that not more than twenty-five per cent. of the total supply could come from water alone.

"Water is not a constant thing; varying with the weather, it is sometimes impossible to carry out the power contracts undertaken by the companies. Undoubtedly most of the future power development rests with steam.

"Power at the mines, however, is not the answer to the question as it is usually impossible to get water in sufficient amounts to condense the steam. Experiments with super power in Germany have attempted the use of the power at the mines plan but it was found that pumping the water and forcing it down water towers was an overwhelmingly expensive process.

"Super power or giant power means interconnection and consolidation of stations and is necessary in all areas of the country."

CRYING HARD LABOR FOR BABIES

When a baby cries it means hard labor for himself as well as for his afflicted parent. Drs. J.R. Murlin, R.E. Conklin and M.E. Marsh, of the University of Rochester, have been conducting careful measurements of the energy used up by crying babies and they find that the metabolism, or rate of food-use, by crying babies is markedly higher than that of infants contentedly cooing or sleeping in their cribs. Crying one per cent. of the time increases the use of energy one per cent; so that if a baby cried all the time it would double its energy requirements and hence the amount of food it would need.

Assuming that a child could keep up such a distressing performance for a day and a night, and assuming further that one-fifth of the energy could be transferred into muscular work, the doctors calculated that on this basis this imaginary long-time squaller could develop enough power to lift himself to the top of the Washington monument.

Just how far the harassed father would walk in that time, or how much energy he would use up in the process, the doctors do not state. They do, however, draw the practical conclusion that crying is a very wasteful process as well as an annoying one, and that economy as well as comfort requires that babies be so cared for that they have little occasion to cry.

EGYPTIAN BARLEY IS CALIFORNIA SUCCESS

A barley from old Egypt is proving a precious gift to the western part of the United States, according to the Office of Cereal Investigations, U. S. Department of Agriculture. In the past season in California, Club Mariout barley successfully survived an exceptionally dry year that did damage to many other barleys and other cereals.

Club Mariout barley was brought from the Nile Delta by Dr. Harry V. Harlan, in his African agricultural explorations. It has just been well established and has now proved its splendid resistance to severe drought in the west. At all times it is preferred on the market.

COAL, JEWEL AND FUEL

By Dr. David White,

Chairman of Division of Geology and Geography,
National Research Council

Coal is like character; the deeper you go into it the more interesting it becomes, and there is much in it that, unsuspected, is beautiful. Ordinary bituminous coal is dirty, black and uncouth, and anthracite is none too clean; but if you cut from a lump of coal a slice thin enough to be translucent and examine it under a microscope you will see what beautiful things coal is made of.

The preparation of such a thin section is a most delicate task. First a thin flat piece from a lump is sawed out and then ground down smoothly until it is reduced nearly to a film - that is, until it averages about 2/10,000ths of an inch in thickness. This thickness - or rather thinness - would correspond to the leaves of a book in which 14,000 pages make a volume only one inch in thickness.

Seen through the microscope such slices of coal are found to be translucent, and if treated with certain chemicals before grinding they will be so beautifully translucent that they may be examined by a microscope which magnifies them more than 1800 times.

Under the microscope the coal is no longer dark as night, or sooty or forbidding. In the cross section of that dirty lump one beholds a landscape in brown and gold. Golden links in serried chains bound in filigreee fill portions of the view.

The links are the cross sections of the cells of pieces of wood of twig, branch or log that enter into the product we call coal. Each cell in the wood is a jewel box of gold. In the hollow interior where once were protoplasm, starch, and other substances embracing the very life of the plant, we find a transparent amber-like substance clouded with sepia and containing clusters of shining crystals of utmost minuteness, together, perhaps, with tiny glistening globules of gas. Stem of leaf and fern, and scale of catkin or cone, are seen in tissues traced in saffron and orange, straw-color and russet. Scattered here and there are a thousand spores of club moss, fern or fungus, and pollen of many kinds of flowers, now appearing as ovals, clasps, and crescents of luminescent brass or antique gold. Festooning skeins in brown, knit with silver representing cross sections of fragments of inner tissue of leaf or bud are perhaps present; and resins of different kinds, brownish, amber, yellow, or red, stud the pattern like precious stones. Real amber used in jewelry is, you know, a fossil resin. Yonder mesh of old gold sealed over with a mosaic in glistening topaz-yellow is a piece of the outer wall of a leaf. The fragile labyrinths traced in pale yellow and silver are the cross sections of fragments of "mineral charcoal", the so-called "mother of coal". The scene changes from area to area and from specimen to specimen.

All these details of tracery and mosaic are set in a background - the ground mass - of cinnamon verging into sepia and brownish black, which fills the spaces. This composes the dark shadows of the picture.

Geological as well as the microscopical study of coals proves that all the ordinary kinds of coal, including anthracite, began their existence as peats deposited in vast swamps that once spread back of the low coasts, or in the interior lowlands basins of the continents in ancient geological times. The wood fragments, t

twigs, leaves, seed coats, spore cases, now chemically transformed in colors of gold and brown, are the plant debris that was saved from decay by the germ-poisonous product developed by bacteria at or near the surface of the peat on which this debfis was deposited. However, the great chemical and physical transformations by which the peats were changed to lignite, subbituminous, bituminous, semibituminous coals, and anthracites have been brought about by geological processes instead of by bacterial action. The principal agents in this geological transformation are pressure, heat, and time.

The pressures taking part in the conversion of peats to coals of different ranks are, first, the downward pressure of weight of hundreds - perhaps many thousand of feet of beds of sand, mud, limestone, etc., piled on top of the peat bed as the region was sinking or the basin was filling. Second, and far more effective, however are the horizontal pressures which build mountains by causing great wrinkles in the earth's crust.

Most earthquake zones are the scenes of compression and mountain building, though the movement is invisibly slow. The coals have progressed farthest on the road to anthracite and graphite in those regions where the greatest actual horizontal compression of the peat containing strata has taken place.

The temperatures developed in the process are those due to depth of buial of the deposit. This amounts to about a degree Fahrenheit to each 80 feet downward through depths averaging about 2,000 feet. Added to this is the heat generated by friction due to the compression, through millions of years, of the rocks as just described, and also the heat caused by chemical action in the buried strata. Altogether, however, the temperatures in the coal beds were probably less than 300 degrees Fahrenheit in most coal regions. Lowness of temperature is, however, compensated by great length of geologic time, time and temperature being, in fact, partially interchangeable in the geological transformation of coals.

Coal is still the world's greatest source of industrial power and it will remain so for a long time, for the coal reserves of the world probably exceed 10,000 billion tons. Our portion, over 3,500 billion tons, of these vast supplies, should last us many centuries in spite of increasing population and expanding industries, though our coal exportation probably will not grow correspondingly. The actually depressing feature is that we are rapidly mining our limited reserves of best and most valuable coals first. It will be no long period before our so-called smokeless or Navy coals will be largely consumed, and we shall be using inferior and generally dirtier coals mined from thinner beds, at greater depth and at greater cost.

SECRET BAIT DESTROYS SUGAR BEET PESTS

Nematodes, the wiliest enemy of the sugar-beet, are destroyed by Drs. Baunacher and Rensch, working for a large chemical company at Halle, Germany, by a strategy new in the war on crop pests. A chemical formula, kept secret by the Germans, lures to their death the ravenous earth-dwelling worms which by an organ analogous to the tongue can detect their food at a distance of many yards.

Nematodes have been impossible to eradicate because of the heavy cyst or shell in which the eggs are encased, highly resistant to the most powerful destructive fluids. Moreover, the eggs remain alive as long as eight years.

But when, after harvest when the eggs have been laid, the beet field is saturated with the potent chemicals, the larvae are lured forth by the bait and by the lingering warmth in the soil. Then winter comes and the entire nematode population is killed.

SKIES ALTHOUGH GRAY, BRIGHTER THAN SNOW

Physicists and opticians from all parts of the United States at the recent New York meeting of the American Physical Society and the Optical Society of America heard Irwin G. Priest, of the Bureau of Standards, describe paradoxical effects observed when the ground is covered with a layer of snow. By means of experiments, Mr. Priest, demonstrated that such snow covered ground may appear white and that the sky will appear gray, even though the latter is much brighter. This may be important in painting, said the speaker, and "to give a faithful rendition of the visual effect the artist may be obliged to make the relative brightnesses on his canvas in reverse order."

Methods by which the structure of atoms are analyzed by passing X-rays through crystals, thus forming X-ray spectra, and how such spectra compare with those produced when light is passed through a prism, were describedby Prof. M. Siegbahn, of Upsala, Sweden. The work of Professor Sieghahn was based in part upon experiments made by Prof. Bergen Davis at Columbia University, who made accurate measurements of the extent to which crystals deflect the X-rays.

SEEDS STILL LIVE AFTER 20 YEARS SLEEP

Why war against weeds? Experiments just completed by E. Brown of the U. S. Department of Agriculture's seed laboratory show that of 100 species of seeds buried for twenty years, weed seed showed the highest per cent. of germination when planted

According to Mr. Brown, however, twenty years is as but a night to a seed as numbers of successful experiments have been made in germinating seed which has been buried forty years. Reports from Japanese investigators in Manchuria indicate that seed buried for about four hundred years has been grown successfully.

How long seed can live is not definitely known, but it is known that seed taken from Egyptian and prehistoric tombs willnot grow. Mr. Brown characterized as impossible the often recurring stories of wheat from Egyptian tombsthat has sprouted and borne fruitfully after several thousands of years of storage.

SCIENCE AIDS IN DETECTING BOOTLEGGERS

Bootleggers may be clever enough to fool "John Law", but they come to grief when they run afoul of the paper-and-ink experts of the U. S. Government Printing Office. In a recent report Edward O1 Reed, chemist of the testing section of this office, relates how a number of bogus permits for the release of liquor from bonded warehouses were detected.

More than 300 suspected permits were examined, and most of them were found to be counterfeit. The detection was easy in most cases; gross differences in typography betrayed them to the printers. But some of them had been reproduced by photoengraving processes, and these called for more careful methods.

It was the paper the false permits were printed on that finally gave them away. Government permits are printed on a fiffy per cent. rag paper, that is, a half-and-half mixture of wood pulp and rag stock, with the watermark running

lengthwise of the sheet. The counterfeit permits were printed on a wide variety of papers, some of them of very poor grade and some of much better quality than the government uses, ranging as high as ninety-five per cent. rag stock. In many cases also the watermark ran crosswise of the paper.

As a result of this piece of chemical detective work, thirteen alleged violators of the Federal law were indicted in the western district of Pennsylvania, and after the longest trial on record in that court seven of them were convicted.

SPEECH DEFECTS CURED BY EXERCISE

Between 90 and 99 per cent. of speech defects are curable by proper exercise, says Samuel Robbins, director of the Boston Stammerers' Institute.

"Persons who have impediments in speech earn at least ten dollars a week less than the average person. Since there are a half million persons in the United States with such defects the loss to them yearly is $250,000,000," Mr. Robbins continued.

5 Most of these defects can be cured by proper exercises like those taken in voice culture. If the parents of a child who has such an affliction are always careful to speak distinctly defects will pass without the child being conscious he has them. It is particularly hard for stammerers to correct their speech if they play with children who mock them, however; so they should be kept away from such a possibility for at least a month. Stammering is easily spread from ome child to another and unless it is cured one child may be responsible for the stammering of his friends.

PACIFIC STATES OPERATE LARGE SCALE GAME FARMS

Washington and Oregon have become Edens for sportsmen through the operation of large farms for breeding and introducing game birds for many lands. California is watching with the interested eye of a possible competitor, and contemplating like action in the near future. This is the gist of a report to the California Board of Fish and Game Commissioners by Executive Officer George Neale, who has just returned from a tour of inspection of the game farms of the northern coast states.

Oregon has three state game farms, maintained out of hunters' license fees, from which nearly 22,000 pheasants were set free during the two-year period 1923-24, and where breeding stocks of several thousands of Chinese and Mongolian pheasants and Hungarian partridges are constantly maintained. Washington has two game farms, which propagate not only the pheasants but also grouse, two species of partridge, and the eastern bob-white. One unique feature of the Washington farms is the fact that one of them is maintained by the labor of convict "trusties", and the other by the more competent inmates of the state institutions for the mentally afflicted. Good results are claimed in both places.

"A peculiar situation now exists in both of these states," concludes Mr. Neale, "inasmuch as some native game birds are strongly recommended to be placed on the protected list for a number of years, while nearly all of the introduced game birds, domestically raised and liberated, are now on the open list and furnish the sportsmen ninety per cent. of the upland bird shooting."

PROTECTION OF DUCKS BRINGS BIG INCREASE

"The biggest bag of game birds in a quarter of a century" is what verteran hunters are calling the result of the prohibition of shooting during the spring mating and nesting season.

Reports from 28 states, received by the Biological Survey of the U. S. Department of Agriculture, show that for the season which has just closed unprecedented flocks of ducks, swans, and wild geese are crowding every lake and river. An official of the Biological Survey who went down the Potomac recently reports "floating islands" of ducks a mile long; they were mostly canvas-backs.

Results of the Migratory Bird Treaty between the United States and Canada, enacted in 1916, at first showed only meager results. It was not until the last season that a bound in reproduction among game birds was observed which surpassed the hopes of the framers of the law. More game birds than have been seen in the memory of any living hunter are reported from the unrivalled shooting districts of Carritick and Pamlico Sounds, North Carolina.

The Biological Survey is working to bring before Congress a bill to provide for the reservation of swamps and lakes in the track of migratory game birds, to be supported by the federal hunting tax of a dollar a head. Sportsmen all over the country are said to be strongly in favor of the bill.

TO CLIMB MT. LOGAN IN THE SPRING

Attempts will be made to scale Mount Logan, second highest peak in North America, by a party composed jointly from the American Alpine Club and the Alpine Club of Canada. The party will leave Vancouver in April.

Mount Logan is in the southwestern corner of the Yukon Territory almost on the border line of Alaska. Although this mountain is only 761 feet lower than Mount McKinley in Alaska, no expedition has ever explored its summit. Its height has been estimated for anumber of years at 19,539 feet.

Over seventeen years elapsed after the discovery of Mount McKinley by W. A. Dickey in 1896 to its successful exploration by Archdeacon Hudson Stuck, in 1913. Mount McKinley at its highest point is 20,300 feet. Only the northern side has been climbed as many efforts to reach the top from the west failed.

The noise of atoms moving about in a piece of iron, stirred with a magnet, has been detected by sensitive amplifiers.

The first stamp issued by the government of the United States in 1847 bore the likeness of Benjamin Franklin.

METAL SHIELDS STOP WHITE ANTS

Buildings may be rendered secure against the ravages of the wild-eating termites or white ants, by a method described by Prof. S. F. Light, of the University of Amoy. Prof. Light's method depends on the fact that some termites require constant access to the earth to carry on their operations, either through galleries which the bore through the wood or through covered ways which they construct over the faces of brick or stone foundations. He simply cuts off all chances for this communication by inserting a sheet of galvanized iron, or "termite shield" as he calls it, into the masonry and turning the projecting edges downward at an angle. A variation of the method, which he states has been used in Africa, consists in placing metal caps over the tops of construction pilings.

SEEK TO SAVE INDIAN RELICS

Hundreds of precious specimens of prehistoric art and craft are annually lost to science by illegal excavations of Indian ruins, according to Dr. Neil M. Judd, archaeologist of the U. S. National Museum. Dr. Judd states that the committe on illegal investigations of the American Anthropological Association, on which he is chairman, is now working towards a program for the enforcement of the Antiquities Act which Congress passed in 1906. The law has never been properly enforced because the act did not provide who should bring offenders to justice.

Indian traders are the chief offenders, Dr. Judd stated, for they either encourgage Indians to dig the ruins, or themselves excavate and peddle what they find. One Indian trader is now offering for sale two hundred specimens for $5000 which he rifled from a Navaho reservation in eastern Arizona. Yet, though he is well known to the Archaeological Association, there is no way to bring him to count because witnesses did not see him in the act, though hislist is an admission of his guilt. Agents of the Bureau of Indian Affairs have been instructed by the Secretary of the Interior to report cases of violation.

TABLOID BOOK REVIEW

SHRUBS OF INDIANA. By Charles C. Deam. 351 pages; 148 plates. Indianapolis: The Department of Conservation, State of Indiana, 1924.

This is a very worthy companion volume to the author's "Trees of Indiana", published a few years ago. Though professing competence only for the state of Indiana, its usefulness extends far beyond this restricted range. Indiana, lying between thehighest development of the northeastern deciduous forest area and the beginnings of the prairie, with the high-northern disjuncts of the lake dune area on its northern boundary and the outposts of the South along the lower Wabash, probably contains more species of plants, especially of trees and shrubs, than any area of similar size elsewhere on this continent; and in this volume as in its prececessor Mr. Deam has shown himself worthy of his opportunity.

To protect the pearl banks around the Sulu archipelago, Philippine Islands, and to allow for a recouping of the pearl industry, the Government has ordered the banks closed for a period of three years.
