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THE GREATEST AMERICAN SCIENTIST SINCE FRANKLIN

By Dr. Edwin E. Slosson

Who is the greatest man of science that America has produced in the last hundred years? You may have ten guesses and more if you like for you may need th them. But if you asked any of the three hundred distinguished scientists assembled at Philadelphia to celebrate the centenary of the Franklin Institute you would be apt to get the same reply: "Willard Gibbs."

The genius of the quiet unassuming Yale professor of mathematics was recognized in Europe before it was in his own country and two of the oversea speakers, Professor Fritz Haber of Berlin and Prof. F. G. Donnan of London have citied him as a pioneer in their fields. Prof. Donnan in his address quoted Henry Adams, the historian, in saying that after Benjamin Franklin, Gibbs was the greatest man of science that America has produced and he added "that in the history of the physcial science of the seventeenth, eighteenth and nineteenth centuries, Gibbs ranks with men like Newton, Lagrange, and Hamilton who be sheer force of power of their minds have produced those generalized statements of scientific law which mark epochs in the advance of science. So faithfully and wisely did he use the splendid gifts which Nature bestowed on him that after a half century of time his work remains a potent and living force."

Prof. Donnan told how during the war when it was necessary to make ammonium nitrate in enormous quantities for the British high explosive amatol the munition chemist solved the problem by the use of Gibb's thermodynamic formula. Professor Donnan generously gave credit to Gibbs for the prior discovery of what is known as the "Donnan equilibrium formula" which the late Jacques Loeb made the basis of his theory of colloid chemistry.

Prof. W. D. Bancroft of Cornell in his address on colloid chemistry also called Gibbs an epoch maker in this new and fertile field. He defined colloid chemistry as "the science of bubbles, drops, grains, filaments and films," and showed its practical importance in all the industries dealing with such forms. Bubbles are employed by the makers of carbonated drinks, fluffed ice cream and floating soaps and in the flotation process of ore purification. Drops are the controlling factor in mayonnaise, margarine and milk as well as in the formation of rain clouds. A knowledge of grains is essential in the manufacture of glass, pottery, brick, cement, starch, crayons and photography. Filaments include all the textiles, rubber, asbestos, coke and soap. The science of films covers paints, varnishes, glue, printing, filters, lubrication and oiled roads. The bare list shows what a large part the colloid chemist must play in our daily life.

GENERAL ELECTRIC CHIEF REVIEWS ELECTRICAL AGE

Electricity from Franklin's kite to modern radio - the long list of far-reaching discoveries, prophecies overleaped, and revolutionary applications in the promotion of human welfare were discussed in rapid review by Dr. E. W. Rice, jr., honorary chairman of the board of directors of the General Electric Company, before the centenary celebration of the Franklin Institute in Philadelphia.

Dr. Rice reminded his hearers that in its very infancy electrical research was recognized and rewarded, when the Royal Society elected Benjamin Franklin to membership. Franklin was the first American ever to be thus honored.

The foundations of the modern electrical industry, Dr. Rice stated, were laid many years ago in two discoveries, that of the electric arc by Davy and the phenomemon of electro-magnetic induction by Faraday. From these beginnings the development of the applications of electricity has gone on at such a speed as to keep research workers always on a keen edge to meet the demands of the industry.

As an example, the speaker cited a prophecy made in 1900, that carbon would always be used for the electrode in the arc lamp, for the filament in the incandescent lamp, and for a brush in direct current dynamos. In less than ten years it was displaced, wholly in the incandescent lamp, and partly in the other two uses.

The progress in electro-chemistry, according to Dr. Rice, has been one of the most outstanding of the achievements in the electrical field. The early achievements in the making of aluminum, carborundum, and calcium carbide have been followed by a host of new discoveries. In electro-physics results have been equally noteworthy, the discovery of X-rays and Becquerel rays leading to the researches that gave radium to the world. Research in electricity fathered modern communication, beginning with the telephone and continuing to the radio.

Dr. Rice listed a number of fields that give promise of further fruit when explored by researchers in electricity; among them are vacuum tubes, X-ray tubes, kenetrons, X-ray spectrum analysis, and many others, some of which have hardly even been touched yet. The usefulness of the electrical research worker is only beginning, he said.

MORE POWER IN LIGHTNING FLASH THAN ALL ENGINES IN WORLD

How lightning is made and how to make it, was the topic of the address of F. W. Peek, Jr., at the Centenary of the Franklin Institute. The generator for the production of artificial lightning constructed at the research laboratory of the General Electric Company at Pittsfield, Mass., gives a discharge of 2,000,000 volts, which is about two per cent. of the voltage of natural lightning, and sufficient to afford opportunity for the experimental study of the effects of lightning on buildings and power transmission lines. A thundercloud carrying a charge of say a hundred million volts may, by a flash of lightning to the earth, discharge this burden of electricity within a few millionths of a second in a current of 80,000 amperes. The voltage of the cloud is thus reduced to zero or ir may acquire almost instantly an opposite change. Because the electricity is discharged at such a rapid rate the power developed is enormous, often amounting to several thousand million horsepower, which is more than is developed by all

the steam engines and water wheels of the world. Yet the total energy is not so great as it seems, no more than enough to run an automobile five miles or keep a toaster going all day.

These researches in high voltage will cause a revision of popular ideas of the effects of lightning and give us more exact knowledge on the protective action of rods. Mr. Peek said on this point:

"Researches in the laboratory show that lightning from a cloud over head does not always strike the highest object or rod unless the height of that object is over 2.5 per cent. of the cloud height. The division of hits is about equal between cloud and ground when the rod is 1.1 per cent. of the cloud height. The chance of being hit is less when the cloud is not directly over head. Lightning either strikes the rod or some distance away. There is a protected area around the rod with a radius equal to four times the height of the rod where no ground hits occur.

"These researches show that a man standing directly under the storm center would be hit fifteen times out of a hundred strokes, while a man flat on the ground would be struck about once in one hundred strokes. A 25 foot building would be struck every time. The chance of a thunder cloud of sufficient voltage to cause a discharge being over any particular object is small. The chance of any particular object being struck is thus generally very small indeed.

"The lightning rod seems to be of real value for the protection of buildings. Except for buildings in exposed positions or in special cases, as magazines, the cost of a rod, unless it is quite low, is not warranted from the standpoint of the cost of insurance."

NEW LIGHT EXPECTED ON METAL PROPERTIES

Man's knowledge of the properties and composition of metals, upon which so much of modern industry has been established, will receive important additions in the near future, Dr. C. H. Mathewson, professor of metallurgy at Yale University, declared in an address at the Franklin Institute Centenary.

New discoveries in this important field hitherto have been chemical and have made possible the production of alloys suitable in strength, ductility, rigidity and other properties for the needs of inventors and manufacturers. But chemical researches have not transcended the elemental and it has been possible only to separate different metals and to put them in new combinations.

The new field concerns the internal structure of metals themselves and is a task for the physicist rather than the chemist. Considerable progress has been made at various laboratories in the study of metals by means of the spectroscope.

Dr. Mathewson urged more facilities for students to follow out investigations in these lines.

"The simplest and most direct use of the X-ray spectrograph in physical metallurgy is the examination of pure metals through a suitable range of temperature in order to determine whether one or several crystalline forms occur in the same metal," Dr. Mathewson said. "It has been necessary in the past to argue these questions of polymorphism purely on the basis of continuity or discontinuity

of chosen physical properties through the temperature range in question, although in some cases a pronounced structural change (recrystallization), as in the transformation Alpha to Gamma iron, gave a touch of finality to the argument. The comparatively recent review of the situation in the light of X-ray researches whereby an alleged Beta iron loses its status as a separate crystalline form is fresh in the minds of metallurgists. It is difficult to conceive of any disclosure of theory which will in any way disprove the finality of the X-ray spectrograph, as used at present in proving the presence or absence of different arrangments of atoms in the space lattice, although there may be further advances in determining the particulars of various lattice structures and questions of allotropy as related to changes within or around the atom are ever before physicists. Doubtless much of value to physical metallurgy will come through these agencies, but first we shall have a complete survey of the metals with respect to their habits of crystallinity throughout their entire temperature range of existence."

The most recent contribution in this direction, according to Mr. Mathewson, is the demonstration of the changing nature of zinc under various heat conditions. The New Jersey Zinc Co. laboratory workers studied the metal by use of the spectroscope under five different temperatures. A virtual absence of polymorphism, or various arrangements of atoms in the crystal, was proved.

"It seems inevitable," said Mr. Mathewson, "that the intelligent use of the X-ray spectrometer as an instrument for studying orientational changes will shortly reveal in its innermost mechanism the progression from one structural form to another in the processes of cold working and recrystallization, thus giving us a quantitative picture of these important and baffling structural reorganizations.

WE USE FIVE POUNDS OF EXPLOSIVES APIECE IN PEACE TIME

Last year 530 million pounds of explosives were produced in the United States. Of these, 330 million pounds were high explosives made by the action of nitric acid on glycerine, cotton or such coal-tar compounds as toluene. This shows the peace time importance of the industry dealt with by Dr. Charles L. Reese in his paper on "Twenty-five Years' Progress in Explosives" read at the Franklin Institute Centenary. Glycerine was formerly obtained exclusively from fats but it may be produced by fermentation and Dr. Reese announced a process now being perfected for the large scale production of glycerine from molasses, the cheapest source of sugar.

One of the dangerous defects of nitroglycerine is now in the way of being rectified, that is, its liability to freeze in cold weather and its tendency to explode when carelessly thawed. Many a miner has met his death while thawing his dynamite by the campfire. A stick of frozen dynamite sometimes goes off on being merely broken in two, probably from internal friction between the crystals. Various methods of reducing the freezing point of nitroglycerine have been devised, but the best, according to the speaker's experience, is to condense the glycerine into a double molecule, heating with sodium acetate. The resulting product, known as "di-glycerine", combines with four parts of nitric acid, instead of three as in the case of the single glycerine molecule, and forms a compound much more viscous and therefore harder to freeze. Dissolving some of this in ordinary nitroglycerine protects it from freezing even when stored throughout the winter in the Northwest.

SCIENTIST SAYS PORTUGUESE ADMIRAL DISCOVERED AMERICA BEFORE COLUMBUS

Some one else beat Columbus twenty years in the discovery of the American mainland. Tobacco was not a native product of the American Indians, but had come to them from Africa. These are only two of the startling theories that were advanced and defended at the Twenty-first World Congress of Americanists, which has just been held in Gothenburg, Sweden. An "Americanist" is an expert on any phase of the ancient and primitive civilization in the western hemisphere. There were one hundred and fifty of them assembled from all parts of the world at Gothenburg, and eighty papers in all were presented at the sessions.

Dr. Sophus Larsen, of Copenhagen, was the one who offered evidence that a Portuguese admiral, Joao Vaz Corte-Real, commanded by his king to discover new lands, had in 1474 reached the shores near the mouth of the St. Lawrence River. This region was afterwards called "Stockfishland", and, according to a history of the Azores, Joao Vaz was made viceroy over part of those islands in 1474 as a reward for his discovery. Charts published as early as 1534, says Dr. Larsen, show the names Joao Vaz Bay and Joao Vaz Land in the Labrador region. The lecturer did not state whether Columbus might have had any knowledge of these expeditions or not.

Another lecturer, Prof. Leo Wiener, of Harvard University, presented a theory at Gothenburg which conflicts with the history we learned in our school days. He declared that tobacco was well known in Europe before the discovery of America, and that America herself had got it from Africa. His theory is based on language researches in which he had been able to trace back the use of the word "tobacco", in various spellings, and in many countries, to times long before the voyages of Columbus.

Prof. Franz Boas, of Columbia University, declared that ancient civilization in America, dating back some 10,000 years, had developed independently of other countries. He believed that the people themselves had originated in the old world and migrated to the Western Hemisphere but that their civilization was peculiar to America. Thus their agriculture was based on the growing of maize (Indian corn) which was native in Mexico. The making of pottery also developed without influence from abroad. The use of bronze for weapons, tools, etc., came at a very late period in America, and in the earliest stages copper in natural state was hammered out into the various shapes needed. Here again, Professor Boas saw no influence from abroad. He pointed out further that vehicles with wheels were unknown in America, and that neither horses nor cattle were used to assist man in tilling the soil. The professor concluded from these, and many other evidences, that ancient American culture was of spontaneous development.

Several experts on the Maya civilization, which flourished in Central America hundreds of years before Columbus reached the West Indies, presented papers of unusual interest, in many cases illustrated with stereopticon views. Thus Prof. Sylvanus G. Morley, of the Carnegie Institution, came to Gothenburg fresh from his excavations of the ancient Maya city Chichen Itza in Yucatan. He told of having found remarkable ruins in this, the sacred city of the Mayas, temples with hundreds of stately columns, beautiful graven images of gods, bas-relief sculpture and pictorial designs which prove a high artistic development. Professor Morley drew a smile from his fellow-citizens by announcing that he had also uncovered a well-preserved ball field for public games.

Dr. Joseph Spinden, of Harvard University, reported on the surprisingly accurate astronomical calculations of the Maya scientists, and declared that it

was possible to date back some of their "stone calendars" to the year 3373 B.C. William Gates, president of the American Maya Society, who has classified about 2,000 hieroglyphic characters, and has spent a quarter of a century in trying to discover their meaning, expressed his belief that the key to these Maya writings will soon be found, and that future research would reveal a civilization in Central American fully as fascinating as that of ancient Egypt.

These are only a few samples of the subjects that occupied the attention of the Americanists at Gothenburg, but they serve to illustrate how science is able to turn over page after page of the mysterious forgotten book of humanity's past.

NEW INSTITUTE STUDIES BASIC FOOD PROBLEMS

When the population of the United States reaches 200,000,000, as some authorities claim it will in less than one hundred years, the problem of obtaining sufficient food is going to be severe. Far-sighted scientists are endeavoring to anticipate this, and to answer the question before it becomes acute. The Boyce Thompson Institute for Plant Research, of Yonkers, N. J., the formal opening of which took place recently is an embodiment of this effort.

Human beings, in a savage state, are opportunists. They get their food as chance offers and do without when they must, but civilized man of the twentieth century is beginning to realize that the serious problem of food for the coming generations must be solved in advance and by more scientific methods. The cheap, rich, easily accessible lands of the last century are pretty well occupied now, and the bread for our doubled population of tomorrow will have to come from crops that have been taught to be doubly productive.

Realization of the seriousness of the basic food problem, and appreciation of the steps necessary for its solution, underlie the establishment of the Boyce Thompson Institute. It is the materialization of a dream of an engineer-scientist, and it may become the cradle of a technology as yet unborn.

During the last century great research foundations were established for inquiry into the basic facts of chemistry, electricity, hydraulics, and other non-biological sciences, and in them were bred astonishing advances in material civilization of the past half century. They made the atmosphere, colored the light, in which Col. William Boyce Thompson, mining engineer, the founder of the Institute, was reared. His nickname, "Colonel Facts Thompson", indicates the trend of the past few decades which have changed engineering from a largely empiric art to an exact science, founded on things known and not guessed at.

It was not remarkable then that when Colonel Thompson looked at the looming problem of food for the future he should think in terms of basic research for facts on which a technology could later be established. The remarkable development of the past few decades in agriculture, forestry, and other applied branches of botanical science has been founded on surprisingly little exactly known fact. Present achievement in applied biology shines only by comparison with the dense darkness that preceded it; it is nothing compared with the progress that may be made possible by the acquisition of new basic facts about plants, and the further refinement of basic facts already partly known.

The attack on plant problems in the Boyce Thompson Institute will be fundamentally the same as that on the problems of inorganic matter in the earlier

researches. Chemists and physicists get at the basic facts about iron and clay and electricity by studying their behavior under exactly controlled conditions. Botanists and physiologists will get at the basic facts about plants by controlling their enviromental conditions. The elaborate machinery for controlling the circumstances of the lives of plants at the Institute reflects at once the analytical mind of the botanist and the ingenuity of the engineer.

Plants respond to changes in temperature; therefore automatic devices control the temperature in the rooms and greenhouses within one degree. Plants behave differently under different intensities and colors of light, and with differing lengths of day; therefore color screens and great batteries of thousand-watt lamps enable experimenters to supplement, modify and even replace the light of the sun. Plants must have carbon dioxid from the air; therefore generators make it possible to supply this gas in any concentration desired, or to withhold it altogether.

So it is with other enviromental factors. Every influence in plant life has its set of controls. The plants at the Institute will live in a little universe regulated by science instead of nature.

The Boyce Thompson Institute itself is the result of an interaction of several minds. The chief advisers to Colonel Thompson are Prof. John M. Coulter, head of the botany department at the University of Chicago, Prof. L. R. Jones, head of the department of plant pathology at the University of Wisconsin, and Dr. Raymond F. Bacon, formerly director of the Mellon Insitute of Industrial Research. The active head of the Boyce Thompson Institute and director of research is Dr. William Crocker, formerly in charge of plant physiology at the University of Chicago.

DESERT BELIVED TO BE CLAIMING WHOLE AFRICA

Is Africa going dry? That is a question that is worrying, not "prohisis" and "antis", but sober, serious scientists.

For there seems to be evidence that the great continent is slowly losing all water; that the Sahara and Libyan deserts of the north and the Kalahari of the south are gradually encroaching on the moister and more fertile lands about them.

The evidence comes in from several sources, some modern, some the ancient records of archaeology. In the oases of Kufra and Ouenat, of the Sahara, rock sculptures of unknown age, but certainly dating back to a time earlier than the seventh century, depict ostriches, giraffes and other animals that require grassland and cannot possibly live in the region today. In South Africa there are crude drawings by Bushmen of hippopotamus, rhinoceros, and other animals, in regions now far too dry for them.

Northern Africa used to be the granary of Imperial Rome, and when St. Augustine was Bishop of Hippo, in the early fifth century, the region about the ruins of Carthage was productive farm land.

Today there are evidences of progressive drying up, in the distribution of certain plants. The wine palm has retreated from Egyptian oases to more humid regions farther south. There are still scattering specimens of the yellow-wood tree on the edges of the South African desert, remnants of former forests; and in the same region there exist scattered stands of bamboos, believed to be bits of an ancient jungle.

Scientists are watching new evidence as it turns up with considerable anxiety, for obviously if the continent is slowly drying up it will bring on serious problems in the support and movements of population.

AMERICAN POTATO BEETLE INVADES GERMAN FIELDS

German agriculturists, scientific men, and government authorities are becoming much excited over the threatened danger of the invasion of the potato fields of Germany by the Colorado potato beetle. This destructive insect pest has found a foothold at various times and places in eastern Europe but has hitherto been held in check or driven out by energetic measures. Since the war, however, it has successfully invaded and established itself in a large area in sottheastern France and threatens to extend its invasion into central Europe. Once well established in the potato fields of Germany it would cause great losses to one of Germany's most important food crops.

A German authority, Ernst Janisch of Berlin, claims that the beetle was brought to Bordeaux, France, in ships bringing troops from America. This recalls the fact that American entomologists believe that the Hessian fly, one of the worst pests in America, first came to this country from Germany in the straw brought by Hessian troops with their horses to America during the Revolutionary War.

HEDGE MAKES HANGOUT FOR INSECT THIEVES

In old romances, thieves were often pictured as hiding in hedges. Sober modern science finds a parallel situation with regard to one of the commonest and most disagreeable of insect thieves, a species of aphid, or plant louse. It raids gardens and roadside flowers all summer long, and then in the winter seeks the hopitality of one of our most attractive ornamental hedge plants, the buckthorn.

Dr. Edith M. Patch, of the Maine Experiment Station, has traced the life history of this aphid species and exposed all its family secrets.

Each year, the first generation of these insects comprises wingless females only; but later generations are developed with wings. These are the spring migrants whose duty to their species it is to leave the over-crowded buckthorn and to seek other kinds of food plants, where their progeny may spend the summer.

The plants at present known to be accepted by the buckthorn aphid for summer residence number about seventy species, representing thirty or more botanic families. Some of these are weeds, some are garden vegetables, some are ornamental plants. The direct damage done by large colonies of feeding aphids is considerable. Add to that the fact that the buckthorn aphid is able to carry certain plant diseases from sick to healthy vegetation, and its potentiality for harm is found to be seriously significant.

Regardless of its diet during the summer, a time comes to this species of aphid each fall when it is impelled to reach the buckthorn. This is accomplished by winged migrants that return to the same kind of plant that their progenitors (the spring migrants) deserted several generations before. Wingless daughters of the fall migrants deposit eggs upon the buckthorn branches, usually near leaf buds.

These overwintering eggs bridge the life cycle for the species until the leaves begin to grow in the spring, when the aphids hatch and begin their major operations.

Such aphids have long been known on the buckthorn. Green and yellow aphids have been frequently observed on weeds and vegetables and flowering plants. In these different situations they have, however, always been considered different species; and entomologists have listed them up under many distinct names, never guessing until very recently that the buckthorn aphid was masquerading under many different pseudonyms. Its life cycle has now been worked out with the result that the buckthorn aphid has been found guilty of many crimes the species had never been accused of - on account of its furtive habit of slipping over to a wide range of foodplants for its summer resort.

BRITAIN TO BAR USE OF FORMALIN PRESERVATIVE

It seems probable that the next Parliament will forbid the use of formaldehyde in any article of food or internal medicine. A departmental committee appointed to investigate the matter has strongly condemed it as a food preservative.

Formaldehyde or formalin solutions are highly efficient as general external antiseptics and disinfectants, but are commonly thought to be too poisonous to be taken internally with safety. The action of the drug is cumulative, so that several small doses taken at intervals may have the same effect as a larger quantity swallowed at once.

In the United States, the Federal Pure Food and Drug Act absolutely prohibits the use of formaldehyde in the preparation of any food or drug to be taken internally.

COMPLAINING STUDENTS NOT SO INTELLIGENT

The complaint that one does not get a "square deal" from a teacher or from life is probably one of the consequences of possessing a low intelligence level, according to experimental evidence accumulated by W. Koerth and Giles M. Ruch of the State University of Iowa. They draw this conclusion from the relative accuracy with which bright and dull students estimate their academic success when a classification into bright and dull students is determined by the mentality level.

Bright students on the average judge their class work so accurately that the mark expected agrees with the mark deserved. Dull students expect a higher mark than they receive or deserve. Herein lies a problem for the teacher. How can he make a dull student see beyond his own limitations, how can he induce him to do better than he knows how?

BRICK RED BEACONS GUIDE AVIATORS

The British Air Ministry has produced a flare for night use on landing fields, that has unusually high power to penetrate through fog or mist. It makes use of the fact that light-rays of long wave-length, at the red end of the spectrum, are better able to pierce smoke and mist, and are intensely red in color. Strontium compounds are used to produce the color.

CANCER TRACED TO SPINNING MACHINERY

Cancer has been legally established as one of the industrial hazards in cotton spinning, by a recent decision in a British court.

Animal experimentation has shown that cancer may be induced in white mice by painting the skin with those ingredients of soot that can be dissolved in fat. A cotton spinner contracted cancer in a part of his body constantly kept in contact with his machine, and his heirs won a suit against his employer, claiming that the disease was induced by the dirty oil rubbed into his skin. Since the spinner ceased to be connected with the cotton industry eight years before his death, the insurance companies and cotton manufacturers are greatly concerned over such a precedent. Unless the court's decision is overruled on appeal, there will probably have to be readjustments made in industrial insurance in England, as well as in the administration of the Workmen's Compensation Act.
