

GENERAL SCIENCE

Previews Into Future of Science

Leaders in Industry and Research Foretell What the Next Century May Bring in Pure and Applied Science

PEERING into the next century, industrialists and scientists have attempted to predict the forthcoming accomplishments of pure and applied science.

These forecasts were made in connection with the "Jules Verne" survey of industrial progress in the next century arranged by General Motors Corporation simultaneously with the opening of the second summer of the Century of Progress exposition in Chicago.

Extracts from the previews obtained were:

Future of Man

"The average life of mankind in the time of Queen Elizabeth was twenty years. Today the average is fifty-eight years for man and sixty-one for woman, who is biologically more important. . . . Recent discoveries in medicine are leading to astonishing results, and give a prospect that the life of man will soon reach the Biblical promise of three score and ten."—Drs. W. J. and C. H. Mayo of Mayo Clinic, Rochester, Minn.

"Scientific research and the applications of science in the course of 150 years have increased fourfold the productivity of labor; they have doubled the length of life. Science has made it possible for each to work at routine tasks half as long as formerly and at the same time to consume twice as much wealth as formerly. Fourteen hours of labor, shared by women and children, once provided hovels, lice and black bread for most people, luxury for a few. Seven hours of labor will now supply comfortable homes, warm clothes and healthful food for all. If the resources provided by science were properly distributed—as they will be when we have an applied science of psychology—there is now sufficient wealth to enable all to share in the desirable luxuries that science has created—running water, household electric machinery, telephones and automobiles, radios and the rest—and to enjoy in full measure the most nearly ultimate goods of life—home, friends, things to do, freedom, self-respect."—J. McKeen Cattell, editor of *Science*.

"We are on the threshold of advances in biology generally, and particularly human biology, that will fundamentally alter our outlook. . . . Already we know how in the laboratory to increase the power of lower organisms to utilize their available resources in food material and energy for vital processes, such as growth and duration of life from three to ten times over their usual performance with corresponding relative increases in size, longevity, and so forth. . . . Developments and applications along these lines are likely to come in the not too distant future."—Dr. Raymond Pearl, The Johns Hopkins University.

"Biologically speaking it is fair to say that man's social progress is now only at its beginning and that the two million years that separate us from the caveman mark only the start of human life. The progress of the next two million years is as inevitable as that of the last, and when we have reached this new goal such events as the present depression will have vanished beyond recognition."—Dr. G. H. Parker, president, American Academy of Arts and Sciences.

"The next century should see an extension in the conquest of science over the forces of nature so astounding that imagination is inadequate to conceive of the final result. In the field of organic chemistry our knowledge of the vital chemical processes of living matter will be so enormously increased that it is not too much to say that the life cycle itself may be controlled to the end that old age shall have disappeared and that many then alive may live to ages rivaling that of Methuselah."—Thomas Midgley, Jr., vice-president, Ethyl Gasoline Corporation.

Future of Research

"The material world is so infinite in its variety that I am convinced modern science, modern inventions, and modern methods of mass production have only scratched the surface. The inventions which we have seen so far are only a foretaste of what is to come, provided only the spirit of man is pointed in the

right direction and we are able to experiment in the field of social science in as scientific and good-natured a way as we experiment in the field of physical science."—H. A. Wallace, Secretary of Agriculture.

"Scientific invention must continue but social invention must provide an efficient distribution of wealth to supply buying power adequate to the flow of mass production."—Charles A. Beard, Author.

"Available work can be continually expanded and progressively higher standards of living made possible through developments of science and industrial research. At the same time in my opinion if the utmost is to be achieved there must be equal development of social consciousness on part of leaders in science and industry. Planning on national scale with a view to making this a land of comfortable, efficient, attractive homes would seem to be indicated with every industry cooperating in that definite purpose rather than each working independently and sometimes at cross purposes."—Lowell Mellett, editor, Washington, D. C. Daily News.

"It is of the utmost importance to society that research in pure and applied science be speeded up to improve the methods of industry and its products and to create new processes or products that man will desire to possess and which therefore may create new industries."—R. C. Richards, president, Lehigh University.

"We believe America's inventiveness is little more than started. With seventeen hundred industrial research laboratories in operation compared with two hundred twenty years ago, no other conclusion is justified."—C. M. Chester, president, General Foods Corporation.

"I believe that the brilliant start made during past hundred years toward the wiping out of disease and the lengthening and strengthening of human life is now threatened by the defeatist attitude of those advocating retrogression instead of expansion. I know personally about four major medical research projects with results promising incalculable benefits in future human strength, long life, and happiness, which are now throttled and languishing because of the imbecile attitude that what is now available must be divided up. I believe that

the most important change demanded in the scientific spirit today is appreciation of the ridiculousness of the notion that want, disease and distress amidst potential plenty is an insoluble riddle or an act of God, instead of temporary—a disaster remediable by human energy, brains and cooperation.”—Paul de Kruif, writer.

“If scientific and industrial research are stimulated and not handicapped there will result in the future as in the past a stimulation of the wants of men and a much greater employment of labor than the unemployment resulting from displacement of old industries. Recent chemical research affords striking illustrations such as development of light metals of modified steels, the numerous cellulose industries, and most strikingly in the promotion of health and efficiency through biochemical investigations.”—Dr. Arthur A. Noyes, California Institute of Technology.

“The frontier of scientific research and industrial application is more promising than any geographical frontier yet passed by man.”—C. F. Hirshfeld, Chief of Research, Detroit Edison Company.

Future of Materials

“The more systematic application of the scientific method to the art of steel making and the development of more fundamental knowledge of the wonderful properties inherent in iron and its alloys is going to lead to a picture and a control of the molecular architecture of steels which will enable the user to choose that steel which is really best for his particular purpose, to improved steels of many kinds, to steels which will better satisfy the insistent demands of many diverse industries for a metal which will be satisfactory under continually severer conditions of service. This will result in the lightening, indeed in the redesign, of many structures and machines with economic advantages so great as to bring about a large amount of reconstruction.”—John Johnston, Director of Research, U. S. Steel Corporation.

“Rail tires of no less than three types are ready for a coming market. An astonishing new safety device for automobiles is in the making. The major line of balloon tires has undergone a radical change resulting in much longer non-skid life.”—B. Darrow, development manager, Goodyear Tire and Rubber Company.

“Rapid progress in the methods of manufacture, of improvement of quality and of methods of fabrication of sheet



REAL AND REEL

At the left is the impressive looking apparatus with which the hero of a German film demolishes atoms and wins gold from lead. Contrasted with this movie director's idea of what an atom-smashing tube looks like is the reality in the laboratory of the California Institute of Technology, Pasadena, pictured on the right. Even with this powerful apparatus, scientists do not expect to change lead to gold, but it is being used in many element transmutation experiments.

metal is making tremendous contributions to human welfare. Sheets for forming operations are offering homes of greater comfort and at greatly reduced cost. The application of sheet metal for pressed steel porcelain sanitary ware, such as sinks and wash basins, is making sanitary facilities of beauty available at only a fraction of former costs. The development of refrigeration and air conditioning is making healthful conditions of living available to a greater percentage of the people.”—Dr. Anson Hayes, Director of Research Laboratories, American Rolling Mill Company.

“Carpet making from all modern raw materials filling carefully analyzed functional requirements will replace traditional textile materials fabricated in imitation of old world craftsmanship. Rubber pyroxylin and resins are already accepted as logical carpet materials, in addition to conventional hair and vegetable fibres. Carpets will be utilized not only for adornment but because of acoustical and thermal properties as well.”—G. E. Hopkins, Technical Director, Bigelow Sanford Carpet Company.

“Incandescent lamps of improved design resulting in higher electrical efficiencies promise savings in current consumption. Ultraviolet lamps and sources of the lower wavelength radiation offer

new possibilities to this general field. Further, the development of the new gaseous vapor discharge lamps, including the sodium lamp and the high pressure mercury lamp, promise new offerings in electrical efficiency and the character of lighting.”—A. H. Hageman, Manager Research Staff, Westinghouse Lamp Company.

“We are just beginning to enter the age of alloys and much more is to be expected in improved physical properties and resistance to destruction by corrosion. Welding, precipitation, hardening, also heat treatment and methods of manipulation are only beginning to be understood. New materials are promised for commercial use.”—William H. Basset, Research Staff, American Brass Company.

“Science has shown us how to duplicate almost all the important petroleum products by chemical treatment of the almost inexhaustible supplies of shale and coal. While such processes are not economically feasible in this country at present, they certainly will become so long before our oil reserves are fully exhausted, so that a civilization based so largely on oil heat and oil power need have no fear for its basic supplies.”—E. G. Seubert, President, Standard Oil Company of Indiana.

“The greatest future development in the oxy-acetylene industry will prob-

ably be in flame machining. Applying an oxy-acetylene torch to a steel cylinder, it is possible to make a cut corresponding to a machine tool cut $\frac{1}{2}$ " deep with a 2" feed at a peripheral speed of 10 ft./min. and the power required for the rotation of the steel being cut may be a fractional horsepower motor."—John J. Crowe, Engineer, Air Reduction Sales Company.

"I can visualize the products of the orchard and field of Turkestan or California served in London ten years thence with all the native freshness and taste of those freshly gathered. This means suspended animation of both enzymes and organized micro-organisms. Not less interesting and romantic will be the container for these foods which I visualize as nonmetallic, transparent and nonbreakable."—Charles S. Ash, Director of Research, California Packing Corporation.

"Strong aluminum alloys will permit construction of more and better bridges for the taxpayer's dollar and further aluminization of automobile engines would improve efficiency and comfort in motoring."—F. C. Frary, Research Staff, Aluminum Company of America.

"More than any other human activity, our country's metallurgical, chemical, physical and social laboratories will enable us to satisfy those needs not yet realized and will continue to create more and better jobs by improving our transportation, housing and recreational facilities."—W. B. Lashar, Jr., Director of Research, American Chain Company.

"No science has progressed faster than chemistry and the one inexhaustible source of chemical raw material is the farm. More and more the chemist is showing the way toward increased markets for agricultural products. This was unknown fifteen years ago. Today in a small way it is being done. Tomorrow it should be a reality."—F. N. Peters, Director Furfural Laboratory, Quaker Oats Company.

"Progress in cellulose chemistry is just beginning to strike its stride. The rayon, cellulose, and film industries are only a beginning of new industries based upon cellulose as a raw material. Pulp and paper will continue to become more and more important in this next century of advanced civilization."—Bjarne Johnson, Director Research Staff, Hammermill Paper Company.

"In the future, metal will be removed from hard materials by new types of abrasive wheels and new methods at rates comparable with the rate at which stock is removed from softer metals by

milling machines today. The grinding of pulp by artificial abrasives will be so controlled that use of chemical processes will not be necessary to produce strong paper. New, harder, and tougher cutting materials will revolutionize the grinding industry and invade the field held by cutting tools, such as carboloy and stellite. Smoothness and accuracy of finish is advancing rapidly, with consequent decrease in the wear of moving parts. The life, efficiency and range

of action of synthetic resin bonded abrasives will be almost indefinitely increased due to application of new resins and methods of manufacturing."—R. C. Benner, Director Research and Patent Staff, Carborundum Company.

"Ophthalmic optical development to improve the vision of mankind has by no means reached its end. New optical glasses will be developed in the future which will give optical designers a chance to improve existing optical instruments."—Carl L. Bausch, Manager Research and Engineering, Bausch and Lomb Optical Company.

"Recent developments in rubber which will undoubtedly expand are the manufacture of elastic fabrics, the application of rubber to automobile and other mechanical engineering problems to absorb vibration, the protection of chemical engineering materials against corrosion and many others."—W. A. Gibbons, Director of Development, U. S. Rubber Company.

Future of Transport

"Tires of the future will be larger, softer and safer, running on immeasurably less air pressure."—W. O'Neil, President, General Tire and Rubber Company.

"We are looking forward to putting all transportation on rubber tired wheels, from the roughest farm implement on through a greatly increased highway freight expansion, and even to rubber tired wheels on light weight, high speed rail vehicles. We believe also that we are on the eve of high speed commercial transport overseas with large rigid airships."—P. W. Litchfield, President, Goodyear Tire and Rubber Company.

"Road building costs will be so reduced by scientific improvements in diesel track type tractors and allied equipment that all the inaccessible parts of our country will have the blessing and comfort of perfect highways for automotive transportation. The building of dams and levees, the digging of irrigation canals and ditches will be done so easily and cheaply that no one need farm stony, barren and unproductive soil, but will have available the fine fertile unused lands of this country that require only water and tillage to produce the crops that will be needed by highly paid skilled workmen."—Oscar L. Starr, Vice-President in Charge of Research Division, Caterpillar Tractor Company.

"Decentralization is undoubtedly the requisite for higher standards of living and a concomitant (*Turn to Page 366*)

Cooperation

"The universities and research institutes must organize to insure an earlier consideration of the social and economic effects of the discoveries of the physical scientist and industrial technologist. Under the research system to date, the social scientists get into the game too late. They wait until the discoveries of the physical scientist and industrial technologist radically upset old social and economic arrangements and then come along as a kind of wrecking crew to clean up after the catastrophe and to suggest ways of preventing its recurrence. That has proved too costly a procedure socially. From now on the physical scientists and the social scientists must work hand in hand. We must devise a new method of continuous cooperation between the physical scientists and the social scientists in all our research centers. The social scientists must be kept informed of what the physical scientists are up to, not after the physical scientists have completed their researches and worked social and economic havoc with their results, but from the very beginning of the researches. If the chemists or physicists are on the trail of a new idea in 1934 that may prove workable in 1954, the social scientists should know it in 1934, not in 1954. And, through all the twenty years between 1934 and 1954, the social scientists should be considering ways and means of making this new idea help instead of hamstringing humanity if and when it becomes workable. If we can invent such a method of sustained cooperation, we can shorten, by at least a decade, the lag between the swiftly changing processes and the slowly changing policies of our national life."—Glenn Frank, President of the University of Wisconsin.

ASTRONOMY

Bonnets for Street Lights Will Aid the Star Gazers

THANKS to modern electric street lighting, a generation of city children is growing up that has never really seen the stars.

Cows have been added to some zoological gardens because many children have thought that milk grows naturally in bottles.

Likewise, it is necessary to have planetaria, intricate projection devices that paint in light synthetic stars on artificial skies. These children and grown-ups who are sky-blinded by city lights may learn the constellations in the hope that some day they may venture into the restful darkness of the countryside and actually see them.

The great blaze of light that marks from afar a great city represents waste, light that is thrown up into the sky and serves no possible good. The suggestion has been made by Capt. J. F. Hellweg, superintendent of the U. S. Naval Observatory at Washington, that much of this upward wasted light could be reflected downward to the streets and pavements if each street lamp had a parabolic mirror for a hat. Considerable progress has been made in designing street light fixtures that put more of their light where it is needed, but Capt. Hellweg believes that more careful design and proper installation of reflectors would more than pay by allowing more adequate lighting or smaller bills for electricity.

In Capt. Hellweg's opinion, there would also be a military advantage in dimmer lights as seen from the sky because in time of war attacking airplanes would not find their targets so easily.

The sky lighting of great cities may become troublesome to those professional astronomers who man great telescopes. Stray light that brightens the sky hinders their seeing or photographing faint stars. As Washington has grown up around the U. S. Naval Observatory, its bright lights may become more troublesome although they have not yet seriously interfered with the regular positional observational work of the government astronomers.

Los Angeles, Hollywood, and dozens of towns lie below Mt. Wilson, Calif., on which is perched the world's largest telescope and lesser star mirrors. In future years if the glare of their lights increases in intensity, it may even interfere with the more delicate observations from that great observatory.

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to decentralization is better transportation."—W. C. Hamilton, Research Director, American Steel Foundries.

Future of Buildings

"We have had a large group working for four years to produce a cheap but

modern house for the masses. A five room house, equipped with every article of furniture, linens, rugs, kitchen utensils, in a word, everything together with a garage and the lot with all improvements such as sewers, pavement, sidewalks, lawns, trees can be sold to the workingman for two thousand dollars, allowing adequate profit to the manufacturer, adequate time financing cost and every other similar type of expense,"—L. R. Smith, President, A. O. Smith Corporation.

"We are on the eve of a great development of refrigeration both in air conditioning of railroad cars, theatres, restaurants and private dwellings and refrigeration of foods."—E. C. Van Diest, President, General Service Corporation.

"The office building in the future will be a shell structure only, and interiors may be made available to tenants quickly and economically, and designed to suit their own particular needs. As one step in our own research program in this field, we put on the market about a year ago a new type of partition structure made from pre-fabricated units, which, combined with ceiling and floor units that we already had available, provide a complete interior shell for office buildings."—William R. Seigle, Chairman, Johns Manville Corporation.

"It is not unreasonable to expect the future to give us any desired comfort in the home at a cost within the reach of the majority and any desired food regardless of location or season of the year."—Wm. R. Hainsworth, Director of Engineering, Servel, Inc.

"Through the development of new and better devices in transportation, air conditioning, industrial processes, home applications and improvement in public health, we can expect in the next few years great improvements, the creation of new industries and new jobs through the commercialization of new scientific knowledge, which is now being obtained faster than ever before."—L. W. Chubb, Director Research Laboratories, Westinghouse Electric and Manufacturing Company.

Future of Communication

"Lithography and printing can now be appreciated only through the medium of vision. With certain modifications they can conceivably be made to appeal to the auditory sense as well."—Robert F. Reed, Department of Lithographic Research, University of Cincinnati.

"New avenues of approach to the use of ultra short waves have recently been opened. Multiplex transmission send-

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ing three different radiograms simultaneously on the same wave length will be utilized in the new domestic radio telegraph service of RCA. High speed radio facsimile gives promise of a new method of reproducing messages in their original form instead of by coded dots and dashes."—David Sarnoff, Presi-

dent, Radio Corporation of America.

"New developments will give us pictures in real color, stereoscopic in character, and with sound practically as faithful as the original."—E. H. Hansen, Director of Sound Recording, Fox Film Corporation.

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PSYCHIATRY

Fairy Tales Given Approval If They are Properly Told

FAIRY TALES are all right for children if they are properly told. But they may do much harm, even causing a nervous breakdown after the child has grown up, Dr. Sandor Lorand, psychiatrist of New York, declared at the joint meeting of the American Psychiatric and Psychoanalytic Associations.

A case of a grown man who still lived in an imaginary fairy-tale world was described by Dr. Lorand as an example of the harm fairy tales can do under certain circumstances.

"The man was in his thirties and accomplished in his social and economic status, but the city streets on which he moved, the house where he lived, the meadows and forests where he played golf and the lakes where he went fishing were all filled up for him with giants, ogres, witches and strange animals.

"In his daily routine life he seemed to come across friends whose faces at times appeared bird-like and whose noses protruded like beaks."

In his dreams strange prehistoric animals reached through the window, and big and baby elephants, snakes and the wolf of Little Red Riding Hood were all present.

These creatures of his imagination were, in the popular phrase, driving him nearly crazy. As the psychiatrists would describe it, he was suffering from a neurosis and was obsessed with fears.

Yet in spite of this case, Dr. Lorand does not ban fairy tales for children.

"They have a constructive value and they fill a need that the child has," he asserted.

The effect they will have for good or evil depends largely on how they are told and somewhat on the conflicts that the child may be already facing. Dr. Lorand gave the following directions for telling fairy stories:

"The story must obviously be suited to the child's age and condition. Care should be taken that the tale is told in the proper physical and psychological setting. The time of the day when the story telling takes place is, of course, important (no ogre story before bed time). Even such minor details as voice modulation must be given careful consideration. Above all, the story teller should be certain that the story is really for the child, and is not told out of a sense of duty, or only to relieve certain tensions of his own."

In the case described, the fairy tales were not entirely responsible for the patient's condition, Dr. Lorand explained. The underlying cause was an Oedipus complex from which the patient suffered as a child and which he had never really outgrown.

In this case, the fairy tales which the mother told her son while waiting for the father to come home eased and partially solved the Oedipus situation. When the situation, never completely cleared up, arose again in his adult life, the patient unconsciously turned back to the fairy tales which had given relief in his childhood. Only this time instead of easing the situation they aggravated it.

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PSYCHOLOGY

Immigrants Teach Us What to do With Morons

MORONS, poor weak-witted jetsam of our hit-or-miss human breeding, have a useful place in the world. And the common sense of peasant-stock immigrants can find that place better than most of our fine-spun social theories. So Dr. Charles Bernstein of the State School for Mental Defectives at Rome, N. Y., indicated in an address

before the American Association for the Study of Mental Deficiency.

"The second generation of foreign-born will show us what to do with our morons," he declared.

The foreign-born in our population, particularly the Poles and Italians, know what to do with morons, Dr. Bernstein continued. They put the sixteen-year-old girls of subnormal intelligence to work in their homes, doing housework and watching younger children. They put the boys of this class to work in the fields.

The moron of the future will be our common laborer as he has been in the past, Dr. Bernstein prophesied. But he will be more stable.

Proper Environment Needed

The problem of delinquency among morons can be very largely solved by handling the morons as the Poles and Italians in this country do, Dr. Bernstein seems to think. The biggest task now is to create the proper environment for them after they leave the state schools for mental defectives.

Stable morons who give no trouble come from stable, orderly homes. Nine-tenths of the morons are in this class. The other tenth, which is made up of the group of delinquent mental defectives, comes from disorganized homes. The state must do something for this group. If they are returned to their disorganized homes after leaving the state schools their training in routine, orderly living will be undone and they will return to their delinquent ways.

Released to Special Homes

For this group, particularly, Dr. Bernstein recommends way-stations of the sort established by the Rome State Schools over twenty years ago. When these children are released from the school they are placed in special homes, twenty of them living together under the supervision of a stable married couple. The boys are put to work on farms and the girls help with housework or in the country-town mills, when they can be given jobs without displacing other workers. Before this depression this was easy to do because the morons would work for low wages which the mentally normal scorned.

These young people spend three years at the colony-home and are discharged at the age of seventeen, able to live an independent, orderly life.

Out of 2,500 cared for in this way, less than one-tenth failed to adjust themselves when they left the colony.

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