SCIENCE NEWS

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X-RAYS PRODUCED BY POSITIVE PARTICLES

"POSITIVE" x-rays can now be produced at a million volts instead of the few thousand necessary for ordinary or "negative" x-rays.

Positive x-rays are produced in a vacuum by the impact of positively charged ions, or atoms that have lost an electron, on a metal target; whereas negative x-rays, found by Roentgen in 1895, are produced by fast electrons.

Dr. W. M. Coates and Professor E. O. Lawrence, of the University of California, have stepped up mercury positive ions to 1,000,000 volts and on allowing them to strike targets of various elements have observed that real x-rays are given off.

Ever since Roentgen's original discovery of the common "negative" x-ray that has played such an important part in modern medicine, physicists have been attempting to produce these rays by positive as well as negative projectiles. Sir J. J. Thomson, as early as 1914, observed a non-penetrating radiation from targets struck by protons or hydrogen positive ions, but the very softness or lack of penetrating power of the radiation proved that this was not a positive x-ray.

Even Drs. J. D. Cockcroft and E. T. S. Walton, of the University of Cambridge, the pioneers in nuclear disintegration by high velocity protons, found no appreciable quantity of this positive x-radiation at projectile speeds equivalent to 700,000 volts. It remained for F. L. Verwiebe, of the University of Chicago, to settle the question as to the exact nature of the Thomson radiation resulting from proton bombardment.

At energies up to 50,000 volts he found that the hardest radiation given off was not due to the metal being used as a target but to the changes in the bullets themselves at the time of the impact. This is to be contrasted with the effects of Drs. Coates and Lawrence where the radiation has without doubt the same penetrating power as our ordinary x-rays, and where, from targets of the lighter elements the rays are characteristic of the targets, a true x-ray effect. However, for the heavier targets it is again the bullet itself that breaks up.

At present there are no prospects of utilizing this new method to produce better or cheaper x-rays. The process is remarkably inefficient as a million volt positive ion will produce only approximately the same quantity of x-rays as a ten thousand volt electron.

The scientific solution of the old problem as to the previous non-existence of positive x-rays is twofold—higher voltages and heavier projectiles.

THE BEHAVIOR OF SINGLE ELECTRIC PARTICLES

A GOAL of physics just now is to discover one single electron acting as a wave. To clarify some of the latest enigmas of the most advanced knowledge of our physical world, Professors P. L. Kapitza and P. A. M. Dirac, theoretical physicists at the University of Cambridge, have appealed to fellow experimental physicists to perform a crucial experiment, that of passing a beam of electrons through a double beam of light. They do not know how the experiment can best be done and they can only hope for success.

Since Prince Louis de Broglie showed that electrons have wave characteristics and Dr. A. Heisenberg, the German physicist, stated that absolutely precise simultaneous measurements of both the position and the momentum of a particle were impossible, physicists have been inquiring into the behavior of individual electrons. These experiments have always shown an uncertainty in one of the fundamental quantities measured.

The new scheme suggested by Professors Kapitza and Dirac is to let a green light shine on a perfect mirror and be reflected straight back. The superimposed waves of light will form a periodic field through which electrons will be shot at a definite speed. This field is expected to act on these electric particles which may also be considered as waves and bend them slightly.

It is hoped that the interference of the light wave field and the electron wave field will produce a pattern on a screen or detecting device, from which they may acquire new conceptions of the behavior of single electric particles.

LAND LEVELS IN THE NORTH

NORTHERN lands that bore the vast ice load of the Glacial Age for a million years now appear to be slowly rising, as one end of a raft rises in the water when a burden has been removed.

This is the interpretation of apparent changes in land levels in the northern United States, Canada, and the Baltic regions of Europe, by Dr. B. Gutenberg, of the California Institute of Technology. Dr. Gutenberg's study, based on data collected from many sources, appears in the current issue of the *Journal of Geology*.

The tiltings are very slight, as measured by the year—only about two fifths of an inch annually between Chicago and the northeastern part of the Great Lakes region. But if they have been going on for the past hundred thousand years or so they would amount to a good deal in the aggregate.

Dr. Gutenberg's suggestion is based on the theory, widely accepted among geologists, that the continents really are like rafts floating in water. They consist of masses of lighter rock, mostly granite, floating in a heavier rock that is not wholly rigid, but rather yielding under a burden after the fashion of the traditional molasses in January, or oozy asphalt on a hot summer street. The extreme viscosity of such "gummy" rocks would account for the fact that the continent-rafts are still tilting, though the last fragments of the great glaciers melted off the face of northern Europe some eight or ten thousand years ago.

If the northern ends of the continents are rising, a compensating sinking should be expected to the southward. Some evidences that such a thing is occurring have been obtained, but they are rather too equivocal to

be satisfying, and Dr. Gutenberg recommends further close study of the subject of sinking coasts.

FOREST COVER AND THE WATER YIELD

STRIPPING off the forest cover does not decrease the water which can be obtained from a given area of land; contrary to widely accepted beliefs, it actually increases the water yield. This disagreement with orthodox forestry creed is presented by W. G. Hoyt and H. C. Troxell, hydraulic engineers of the U. S. Geological Survey, as the result of experiments which have been conducted in two typical watersheds in the West, one of which was deliberately deforested, while the other lost a chaparral cover accidentally through fire.

By measuring the water yields before the forest cover was removed, immediately afterwards while the ground was still bare and through several subsequent years while the areas were growing up in brush, a considerable mass of comparative data was accumulated.

The total annual run-off from both sample areas was increased, 15 per cent. in the case of the cut-over forested area and 29 per cent. from the burned-over chaparral area. This is considered evidence that forests and brush do not "conserve the water supply." One very important factor in the reduction of water obtainable from a forested area, the two engineers hold, is the loss of great quantities of water through evaporation and transpiration.

Messrs. Hoyt and Troxell state that the increased run-off was not confined to sudden destructive flood periods, as the summer low-water flow was increased on one area 12 per cent. and on the other area 400 per cent. It was true, however, that the loss of vegetation did increase normal flood heights. They conclude, on the basis of these and other facts learned from the two areas studied, that reforestation for the purpose of increasing the annual yield or low-water stream flow will have an opposite effect.

They hold that change should be made in the concepts to be implied by the term, "watershed protection," maintaining that undue and, in the main, erroneous emphasis has been laid on the value of timber growth for "increasing water supply," "securing favorable conditions of flow," and "promoting and protecting navigation." They emphasize their belief that where watershed protection means "retarding erosion," "conserving soil," or lessening torrential run-off it may be obtained as well by a cover of shrubs or grass, which may use relatively little water, as by trees, which may consume large amounts of water.

PUBLIC WORKS ALLOTMENTS FOR SCIENTIFIC SURVEYS

MORE than $5,000,000 of the federal public works appropriation will be spent in mapping and surveying of the country and its waterways with resulting benefits to reviving industry, agriculture, shipping and mining now and in the future.

While this money will speed the eventual completion of the country's mapping, much of it will be used for wages and will be spent locally in communities widely scattered over the United States.

The allotment of $2,600,000 to the Coast and Geodetic Survey of the Department of Commerce will enable the Department to proceed with scientific work of surveying the nation's coast lines and the making of triangulations and elevation measurements in the interior of the country.

With regard to mariner's charts, the situation in respect to intracoastal waters of the Atlantic coast is particularly bad. Secretary Roper has pointed out that most of the surveys of these waters were made 30 to 50 years or more ago. Since that time both the forces of nature and the works of man have made radical changes in many sections. New charts based on new surveys will become of increasing importance with the expected increase in commerce and transportation. The money will also prevent the suspension of earthquake studies in California.

No action has been taken as yet on Secretary Roper's request for public works funds for testing work at the National Bureau of Standards in connection with the recovery program.

The U. S. Geological Survey in the Department of the Interior is another scientific agency of the Government which has secured relief for severe curtailments in funds through new allotments from the public works funds. In addition to the $1,200,000 which was recently allotted to this survey for construction and repair work, another allotment of $2,500,000 has been announced.

Most of this sum will be used for topographical survey work, which will employ the services of a great many engineers and technical employees. But it is understood that it will not relieve the situation for the scientific men in the survey. A small part of the allotment, $100,000, is to be used for investigation of underground water resources, and this work will employ some geologists and chemists. No public works funds have as yet been assigned for the geological work of the survey. Secretary Ickes had previously decided, however, not to dismiss the geologists slated to go because of lack of funds for salaries. Instead he instituted a system of staggering furloughs so that the survey can have the benefit of their expert advice at least during part of the time.

ENERGY FOR THE FUTURE

AMPLE energy for mankind's future use is contained in the sunshine, wind, tides and ocean heat. This is the conclusion of Dr. Arthur B. Lamb, professor of chemistry and director of the chemical laboratories at Harvard University.

Each year the world uses 17,800,000,000,000,000 kilogram calories or as much energy as is contained in 2,700,000,000 tons of coal; if our supply of natural resources were cut off, it would take the labor of 11,000,000,000 men—5 times the population of the world—to furnish the same amount of energy. At present, only 17 per cent. of this total is actual human energy, while coal furnishes 50 per cent. and the remainder comes chiefly from oil, wood, gas and the labor of domestic animals.

Even these present sources of energy represent but a small fraction of the available supply of coal, oil and gas. The untapped reserves of these three natural resources amount to 2,200 times the world's annual consumption of all kinds of energy, that is, at the present rate of

consumption, we can get along for a couple of thousand of years.

But this assurance, pleasing as it may be, is insignificant beside the tremendous stores of energy in sources as yet unutilized. Annual solar energy to the earth totals almost 42 times the energy of all the world's energy reserves in the forms of coal, oil and gas. If, for example, all the light energy that falls on Boston's 43 square miles could be converted into power, the output would surpass the total present output of power in the United States. Even the common winds, if harnessed, could deliver in one year 75 per cent. as much energy as could all coal, oil and gas sources during the next 2,000 years.

Another important source is the heat of the earth which would yield millions of times as much energy as all present sources but which, unfortunately, probably will not be tapped. Dr. Lamb points out that proposals to sink deep shafts into the ground and use the subterranean heat to generate steam are not feasible.

"Simple calculations show this is quite out of the question," according to Dr. Lamb. "The only hope is to take advantage of the accidental supplies of hot water, or better, of superheated steam occurring in certain volcanic regions, such supplies, for instance, as Count Conti has utilized with conspicuous success in Italy and which can doubtless be utilized in Sonoma County, California."

Other sources draw Dr. Lamb's attention. One possibility is the fuel cell which uses carbon or carbon monoxide as one depolarizer and the air as the other. At 1,500 degrees Fahrenheit, these cells deliver large supplies of energy and their use, at room temperatures, is not out of the question.

Another source is rain water. The annual yield of rain water in the clouds would, if harnessed, be sufficient at the present rate of energy consumption to satisfy all demands for the next 150 years.

Still other sources are being examined at present. Georges Claude is engaged in an attempt to utilize ocean heat economically. Tidal energy has been sought on a large scale, the most important current proposal being the Bay of Fundy plant which would yield over a half billion kilowatts. The photoelectric cell, still in its infancy as a commercial proposition, is expected to add further to this enormous store of energy which may some day entirely relieve mankind of the necessity of providing for its own economic welfare.

ITEMS

THE theory that tubercle bacilli may change from the bovine type to the human type in the body has been put forward by Colonel Nathan Raw in connection with a case of tuberculosis which he has reported in a recent issue of *The British Medical Journal*. Colonel Raw was a member of the International Committee for the Prevention of Tuberculosis. In the case reported, the girl's glands showed definitely the presence of bovine tubercle bacilli when she was a child. Eighteen years later she developed pulmonary tuberculosis in which the bacilli were of the human type. It is suggested that living bovine tubercle bacilli that are swallowed by infants may lie dormant in their new environment of human tissues and eventually be conveyed to the lungs before or after being changed into human tubercle bacilli.

CARBON monoxide, deadly gas of closed garages, may take toll of unborn generations, according to a report before the Phi Sigma Biological Research Society by Lloyd L. Wells and W. E. Batchelder, of the University of New Hampshire. Messrs. Wells and Batchelder, with their associates, gave repeated doses of an atmosphere containing one and one half per cent. of carbon monoxide to female rats about to produce litters of young. Some of the litters were born prematurely, others were absorbed back into the mother's body and not born at all. Many of the young rats that were born alive were not normal. It was found that a rat could build up a resistance to carbon monoxide, but this resistance was only temporary.

DISTILLATION and adsorption can now be used to concentrate heavy weight water out of ordinary water, Drs. Edward W. Washburn and Edgar R. Smith, of the U. S. Bureau of Standards, have determined and reported to the *Journal of Chemical Physics*. Electrolysis was the earlier method used by Dr. Washburn and his associates to manufacture water heavier than normal. The common sorts of hydrogen and oxygen, masses 1 and 16, are given off first as gases in electrolysis, leaving the remaining water rich in the double weight hydrogen and the heavier oxygen isotopes 17 and 18. Because the heavy water so made was found to have a higher boiling point, Dr. Washburn realized that it should be possible to fractionate water by distillation. He distilled ten quarts and the two portions obtained were found to differ in density by 65 parts per million. Water was also fractionated by allowing a mass of activated charcoal to stand for three weeks in water. The adsorbed water was found to be denser than the unadsorbed portion.

WE unconsciously apply certain simple mathematical criteria in our enjoyment of art, whether of plastic form or of musical sounds. This is in bare outline the thesis of a discussion before the Mathematical Association of America, presented by Professor George D. Birkhoff, of Harvard University. According to his theory of esthetics, certain elements of order are of fundamental importance; and it is the density of these elements of order that determines primarily the enjoyability of a work of art. These elements, he said, correspond in general to simple mathematical relations, and this suggests that esthetic enjoyment may arise in part from the intuitive appreciation of such relations. For example, primitive man doubtless enjoyed the beauty of form of the moon or sun because of an intuitive appreciation of the geometric relation of circularity. In the applications considered, the most important relations of this kind were found to involve geometry, the theories of groups and of periodic functions. It was only in this special sense, concluded Professor Birkhoff, that a connection was developed between mathematics and art, despite the fact that many writers from the time of antiquity have endeavored to establish a mystical connection between the two fields.