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TRAINING IN SCIENTIFIC THEORY

STRENGTH in theory as well as practice is vitally necessary for America and the democracies if they are to make full use of science, according to Dr. Marston Morse, president of the American Mathematical Society and chairman of the War Preparedness Committee of that society and the Mathematical Association of America. Speaking before the National Council of Teachers of Mathematics, he cited problems in nutrition, disease control, hours of labor, public morale, problems in planting, breeding and war substitutes, mathematical and mechanical problems in ballistics, airplane design and air defense as awaiting solution.

He said: "We must be strong in theory as well as practice. Not every emergency will be anticipated. America is strong in the extremes of science—in pure science and in its final applications. Because of our wealth we have relied heavily upon experiment, but experimentation takes time, and now we have not time. We should immediately seek a closer alliance of theory and practice. Mathematics is a principal instrument in this union. Teachers of mathematics should present to their pupils technological and industrial applications whenever possible. This can and should be done without abandoning the concept of mathematics as a general tool. We have noted with regret that aeronautical schools are lowering their entrance requirements for lack of suitably trained applicants. The teaching of trigonometry and solid geometry in the high schools would counteract this tendency and would aid in military and naval education in general. Computational trigonometry and arithmetic should be taught with an emphasis on the use of common sense.

"A proper use of science is derived from an understanding respect, and it is one of the duties of teachers to inculcate this respect. An uninformed or misinformed public is a serious danger in a democracy. We tend to be perilously lowbrow. The rulers of Germany respect scientific facts if not scientific men. Real popular understanding of science in this country goes but little beyond a superficial homage for a few scientific men. In the present crisis we can not avoid the extensive use of scientific men and methods."

The War Preparedness Committee of the two mathematical organizations is attempting to meet some of these problems. One sub-committee has reviewed the basic manuals of military and naval science to determine the amount and nature of the mathematics which they presuppose. Based on these studies, Dr. Morse made recommendations to the group.

DETECTING AIRPLANES AT NIGHT OR THROUGH FOG

RADIO waves about 20 inches long form the fingers which detect invisible airplanes at night, according to a new invention just granted patent 2,231,929 by the U. S. Patent Office. This patent went to Joseph Lyman, of Huntington, N. Y., who assigned it to the Sperry Gyroscope Company, Inc., of Brooklyn.

Repeatedly, reports have come from England that R.A.F. fighter planes have some new equipment enabling them to detect Nazi bombing planes in full darkness. The exact nature of the device has not been revealed, but, judging by Mr. Lyman's description of his invention, it might serve the purpose.

"The novel indicator," he states in the specifications, "is adapted for use on aircraft either for indicating the direction of approach of other aircraft, to thereby prevent collision under conditions of poor or zero visibility, or for use on the ground as when locating aircraft for purposes of gunfire control, or for controlling aircraft landings from the ground, and for other purposes."

He suggests the use of signals of 600 megacycles, or about 20 inches wave-length, because these can be generated and detected by simple means, and are not greatly interfered with by natural phenomena, such as solar radiation. These are about a hundredth of the wave-length of the 6 megacycle signals used for transatlantic short-wave broadcasts.

The apparatus consists of a receiving antenna in a parabolic reflector which sweeps around several hundred times a second. At the same time, the axis of rotation itself turns, but more slowly, so that the antenna sweeps all the way around. Because of the reflector it will only receive signals originating in the direction to which it is pointed. Instead of one such antenna, two can be used, one sweeping vertically, the other horizontally.

In peace time, the approaching airplane might have its own transmitter and send out a continuous warning. It can also operate with a transmitter on a defending plane, since the other would reflect the waves from its metal shell. In either event, the receivers pick up the signal only at one instant in their sweep, and this is shown by a spot of light on the end of a cathode ray tube, like that used in television receivers. The position of the spot shows the exact direction of the other plane.

For fire control from the ground, where more bulky equipment may be employed, parabolic transmitting antennas are also used, which turn in step with those of the receiver. This is more efficient, because the signals are sent only in the direction where they will be detected, not broadcast.—JAMES STOKLEY.

THE PRODUCTION OF TOLUOL

TOLUOL, basis of TNT, which is trinitrotoluol, and other chemicals important in preparing for American defense, will be aided with new formulas announced at the New York meeting of the American Institute of Mining and Metallurgical Engineers. They were developed by Dr. H. H. Lowry, director of the Coal Research Laboratory of the Carnegie Institute of Technology, with the assistance of H. G. Landau and Leah L. Naugle.

These formulas make it possible to determine accurately in advance the properties and amounts of coke and by-

products obtained from the carbonization of coal. The chief by-products are tar, gas, ammonium sulphate and light oil. The latter is the raw material from which toluol is obtained, but all the others are important also in defense industries.

In addition to giving scientific control, which assures more accurate planning in the production of the coking by-products, Dr. Lowry's work also makes possible greatly increased economy, by eliminating expensive oven tests. One steel company alone, he stated, has been able to save many thousands of dollars in the single item of eliminating the sulphur analysis of coke.

Carrying Dr. Lowry's work a step further, M. A. Mayers and H. G. Landau, also of the Coal Research Laboratory, announced a method for controlling the properties of pig iron and the economy of its production in blast furnace operation. This method ascertains the particular qualities in the coke necessary to produce certain qualities and quantities of pig iron under specific conditions of operation and ore analysis.

Formulas were developed in this research whereby for the first time blast furnace operators may calculate the quality, economy and rate of production of pig iron from the properties of the coke used. For these calculations preliminary data, defined in the paper, must be collected on each specific blast furnace operation.

SYMPHONY ORCHESTRAS AND BRASS BANDS

THAT brass bands keep their music to the standard pitch better than symphony orchestras, is reported by O. J. Murphy, of the Bell Telephone Laboratories, in the *Journal of the Acoustical Society of America.* However, his studies, based on broadcast music, included only three brass groups, compared with nineteen symphonies. Had he included as many of the bands, their variations might have been much greater.

Almost universally, he found a tendency of the orchestras to rise during a concert. In the case of four leading symphonies (which he does not identify by name) the greatest change was 2.5 cycles per second for the A note in the treble clef. For all the orchestras the variation was about twice as much, or 4.7 cycles. The change of 2.5 cycles represents about a tenth of a half-tone, or the difference between A and A sharp.

In 1925, the Music Industries Chamber of Commerce and the American Standards Association adopted the equal tempered chromatic scale, with A at 440 cycles per second. On this scale A flat is 415.30 cycles and A sharp 466.16 cycles. Mr. Murphy's measurements were intended to determine how closely the musical performers of the United States are adhering to this standard.

For his determinations, he used an electric filter on his radio set, which passed the vibrations ranging from 420 to 460 vibrations per second and included only the A note. This was compared with a standard oscillator. This, in turn, was checked regularly with the National Bureau of Standards broadcast, which sends out a standard 440 cycle note continuously.

A series of measurements comprising some 750 observations was made on various types of musical programs. The mean value of the pitch for all observations was 441.3 cycles per second and the extremes observed were 434 for a dance band and 448 on two occasions for string quartets. Approximately 70 per cent. of the observations were from 439 to 443 cycles per second.

The most accurate instrument, judging from the studies, is the electric organ, of which eight were measured. The mean was 439.9 cycles for the A note, with the minimum 437 and the maximum 440.9. Pipe organs ranged from 435.5 to 442.

BEAVERS, MINKS AND MARTEN

THAT fur-bearing animals merit much more attention than they have been getting from conservationists, was reported by Frank C. Ashbrook, of the U. S. Fish and Wildlife Service, at the sixth North American Wildlife Conference, meeting in Memphis.

Failure to take fur resources into account will, Mr. Ashbrook believes, result in the ultimate failure of the entire movement, for there is not sufficient revenue in sight from other sources to pay for adequate administration of all wildlife refuges in the United States.

Exclusive attention to intangible values, like hunting and fishing for sportsmen, and esthetic satisfaction for the touring public is not enough. Despite the persistent classification of fur-bearing carnivores, like mink and marten as "vermin" by some old-fashioned game wardens, and despite the temporary nuisance value of beaver where they become too numerous, the hard cash realizable from their pelts will justify their existence to a great many farmers and through them to many public officials who control the public purse-strings.

Beaver can be "managed" as are other animals, both wild and domestic, so that they will not remain nuisances, but will become permanent assets both in cash returns and in value as water conservation agents, was pointed pointed out by Victor B. Scheffer, also of the U. S. Fish and Wildlife Service. Humane traps that permit conservation workers to capture them alive make possible the transplantation of beaver into the places where they will do the most good and the least mischief.

The hard-cash value of the fur crop was stressed by Douglas E. Wade, of the University of Missouri. Over twelve trapping seasons in one state (Pennsylvania), the average annual take was more than a million pelts, with a value approaching a million and a quarter dollars.—FRANK THONE.

HAIR SIZE IN RACES AND INDIVIDUALS

THE device of a government investigator for measuring sheep's wool has given anthropologists a new idea for measuring the tiny breadth of human hairs with such speed that in ten minutes they can gain facts about hair size that used to require two days' tedious work.

Speeding study of racial traits with the new technique, Dr. Morris Steggerda and Mrs. Ruth Eckhardt, of the Carnegie Institution of Washington, have already set tentative standards of hair sizes for races. Even varied sizes of hair on an individual's head can be charted to show his own limits of hair size in microns, or thousandths of a millimeter. Hair size variation in individuals and races is found to be very great.

The first studies, made with hair of the Mayan and Navajo Indians, Negroes and Dutch, because adequate hair samples were available, have been announced. "It is evident," according to Dr. Steggerda, "that the Maya have the largest hair in cross-section, and the Dutch the smallest, with the Navajo and the Negro approaching the Maya very closely."

For the first time it is explained that it is possible to analyze also the hair shapes of different races statistically. Negro hair is the most elliptical in shape of any he has studied. Mayan hair is the roundest. The method adopted for investigating racial and individual differences in hair was originated for wool research by Dr. J. I. Hardy, of the U. S. Department of Agriculture.

Hairs are prepared for testing by washing in carbon tetrachloride and drying, and are made into tiny samples by inserting them in packs of 150 to 200 in a slot in metal, in which the hair tips can be coated with thin solution of celluloid. Once hardened, the tiny hair specimens are cut off with a razor blade and are ready to be measured by aid of a microscope.

BLOOD TRANSFUSION GIVEN BY BONES INSTEAD OF VEINS

THAT blood transfusions can be given through the bones as well as through the veins has been found by Dr. L. M. Tocantins and Dr. J. F. O'Neill, of Jefferson Medical College and Hospital in Philadelphia.

According to their report to the Society for Experimental Biology and Medicine, in seventeen trials of this method on fourteen patients there was one failure.

Substances injected into the bone marrow enter the blood stream apparently unchanged and almost as rapidly as when injected into the veins.

Bones will not supplant veins as a route for introducing blood or other substances into the bodies of patients. In some conditions, however, it is difficult or impossible to inject into the veins. Wide-spread mutilations, burns, dropsy, shock and poorly developed or obliterated veins are conditions in which the bone transfusion route may prove vitally useful. In little babies the veins are usually so poorly developed that injections are difficult or impossible.

Blood is not the only substance that can be given through the bones as well as through the veins. Sugar solutions for patients whose blood sugar has reached dangerously low levels, blood plasma which is now being used as well as whole blood for transfusions, and salt solutions to maintain the necessary amount of fluid in the bodies of patients too sick to drink water, may also be injected through the bones.

The blood or other substances are injected into the marrow of the bones where blood cells are formed, and presumably make their way into the blood stream as the blood cells do. The breast bone, collar bone, thigh bone and shin bone were used for the injection in the cases reported.—JANE STAFFORD.

ITEMS

AN octopus species from the Galapagos Islands, hitherto unknown to science, has been named *Octopus roosevelti* in honor of President Roosevelt in a new Smithsonian Institution publication prepared by Dr. Helen G. Stuart, of the University of Southern California. Specimens of the animal were brought back by Dr. Waldo L. Schmitt, of the U. S. National Museum, who was on the presidential cruise among the islands in 1938. A number of other marine species captured on this cruise have already been given the name roosevelti.

WHOOPING cranes, an almost extinct species, show a slight increase in population on the Aransas National Wildlife Refuge in southeastern Texas. This season's count is 26, as compared with 22 last year. The total number of whooping cranes now in existence is not known, for the bird is very retiring and lives in places as remote from man as possible. Estimates vary from as few as eighty survivors to as many as two hundred.

IT is very bad for pigs to let chickens stray into their pens, the U. S. Department of Agriculture warns. Chickens are carriers of avian tuberculosis, to which swine are more susceptible than the fowls themselves. This has been proved in experiments carried out by the Bureau of Animal Industry, at the Beltsville, Md., Research Center. Fifty chickens and thirty-one hogs, all reacting negatively to the standard tuberculin test, were penned with fifty chickens known to be tubercular. They were kept together for a year, when the tuberculin test was repeated. Positive reactions were obtained from 93.5 per cent. of the hogs, whereas only 54 per cent. of the previously non-tubercular chickens reacted. The remedy is obvious and simple. Keep all chickens, even apparently healthy ones, away from the pigpens.

FOREST cuttings now wasted can be used in new kinds of wood stoves that will operate for many hours without attention. Such use can be made an important aid to conservation, L. E. Seeley and F. W. Keator, of Yale University, reported at a session of the fuels division of the American Society of Mechanical Engineers. They emphasized the importance of "space heaters." These are small units for home use to heat the room in which they are installed, and adjacent rooms through the movement of air through communicating doorways. This arrangement, they said, is used in about 45 per cent. of one- and two-family homes in cities and is even more widely employed in the country. When forests are cut for timber, "30 to 40 per cent. of the wood, constituting the branches and trimmings, is useless as timber." Use of this for heating would aid greatly in efficient maintenance of the forests. In the new types of heaters, described by the speakers, the burning is only at the bottom of the pile after they have been started. The heat, however, converts the upper wood into charcoal. As ashes drop through the grate into the pit below, fresh charcoal is automatically fed to the burning zone. The heater requires attention only occasionally, to refill the wood reservoir. The ashes are removed every few days.