PHYSICS

Better Lighting Promised For World of Future

By DR. S. G. HIBBEN

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Excerpts from address given before the Science Talent Institute.

➤ SINCE we all hope to do tomorrow's jobs in a better way, it is gratifying to realize that better tools and new tools are being invented and developed, especially those making use of radiant energy. In fact in tomorrow's civilization perhaps the greatest promise of better days lies in the great rainbow of the ether spectrum, or the radiations encompassed between long wave radio broadcasting with its relatively low frequencies together with long wavelengths of several miles, all the long way up to the secondary radiations associated with cosmic emanations where frequencies are measured in millions of millions of millions of cycles, and where the inconceivably short wavelengths represent the nadir of nothingness.

We have not developed all of the tools that some day may put to use all of the 80 or more octaves of this great ether spectrum, and since there still are "darkest Africas" to be explored, therein lies an exciting challenge to oncoming generations of scientists. Indicative of the rush of scientific research in merely the one very limited region whereof the human eye is the most common receiving photocell, and in about one octave on either side, or a total of three octaves of radiation altogether, we may note the following developments.

1. Heat lamps signal the beginning of filament type electric "lamps" radiating some 90% of their output energy generally centering around a wavelength of about 12,000 A, and from which the visible light is a by-product. Heat lamps may substitute for many of the present ineffective methods of cooking. Frying eggs or grilling chops figuratively shout aloud for research help.

2. Within the one octave of the visible spectrum it is hoped that the production of cold light, probably by fluorescence, can yet be doubled in efficiency and given a plurality of tints and hues.

3. In the near ultraviolet region, sources of radiation will be needed in expanding numbers to produce "black light," generally of about 3600 A wavelength for the excitation of fluorescent dyed fabrics such as carpets, upholstery and drapery in interior furnishings, or for ornamental changes of pattern and appearance, or in connection with crime detection, analyses of diseases and drugs, for determination of age and quality of materials and for checks on food adulterations, etc.

4. Further into the ultraviolet we find an increasing interest in the tools that are represented by lamps reproducing anti-rachitic sunshine, or for health maintenance in general, while further down the scale in the general region of the 2537 A line of mercury vapor we find perhaps the most important tool of all, namely, the Sterilamp or germicidal lamps to kill pathogenic bacteria and spore of mold forming fungi. These devices promise to control infectious diseases and should become great adjuncts to the operations of air conditioning.

Many "unknowns" await the future scientist—how to get 100 lumens per watt from a light source (or 1/6 of the possible efficiency); how to get two colors from the same electrical discharge in a gas or vapor; how to combine fluorescence with phosphorescence and prolong the rate of decay of the latter; how to conserve fuel by placing radiant heat directly onto the body or into the object involved rather than to heat the air; how to develop indoor sunshine for a vegetable garden in the basement or for comfortable seeing in the factory; how to develop walls and ceilings as softly glowing light sources; or how to use visible light as a glorifying medium, sometimes described as mood conditioning, rather than the heretofore elementary job of simple utilitarian seeing.

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AERONAUTICS

Aeronautical Engineering Scientific Methods

By DR. R. G. ROBINSON

National Advisory Committee for Aeronautics

Excerpts from address given before the Science Talent Institute.

➤ THE MAGNIFICENT performance of American Army and Naval air forces in the present war is known by ourselves, by our allies, and by our enemies, but the means for coming up with the excellent airplanes that our unsurpassed air crews use in establishing this record is less well known.

I think we can show that in aeronautics the path from theory or scientific fact to the final practical form of an aircraft, whether we look at the pieces or the whole, is direct, short, and well traveled. We can show that successful airplane design comes only from traveling this path and that the consequences of neglecting this close connection are many and serious.

If the airplane design process is examined, it will be seen that the close and exclusive relation between the job to be done and the part or parts that do it is not just apparent but is real. The connection between theory and practice is a strong and intimate one. Each leans heavily on the other. Parts or features that do not contribute directly to the efficient performance of the aircraft simply do not exist. For this reason aircraft design is perhaps the most nearly functional of any present design activity—the airplane and its parts are designed to carry out their single or multiple functions with the utmost efficiency and with no compromise because of appearance, traditional design, or materials of construction.

In aircraft design, about the only matters considered in addition to function are dependability, serviceability, and

"Science has always been my first love. Subsequently my scientific project is a large and inclusive one, for it will last the length of my life. There are many small but important problems which I am working on, and will continue working on in the future. When I was eleven years old I built a small shop which has grown much larger since that time. My shop is so organized that I can work on one hobby without disturbing another. Chemistry is in one section, radio, electronics, photography, microscopy, lens grinding, etc., in other sections. The reason I follow several hobbies is that I do not believe it is good for a person to become too one-sided or centered in one thing. I think he should have a well balanced knowledge in order to develop fully. I have spent many hours in my shop, assembling the apparatus and wiring circuits I read about in books to learn why a circuit was wired as it was to get a certain result, and a thousand other experiments to learn in a practical way the laws that govern these things. Yes, even our lives, for is not the aim of science to find and apply laws which govern our lives, and by doing so make our life and that of our posterity better? A knowledge of science will make a highly educated and advanced people."
—From the essay of Charles Davidson.

"With such tools as the light spectrum, the X-ray spectrum, and the bombardment and transmutation of atomic nuclei, men search into the atom and slowly find the answers to their questions. Which theory of atomic structure is the most nearly true? The Bohr Theory is the most comprehensive but how can it explain convincingly the phenomenon of crystallization or the formation of molecules? Is there really one fundamental substance that composes all matter? The electron and the neutron seem to be the most basic substances. Perhaps they are only states of strain in a field of electricity and the Bohr Theory is merely a pictorialization of mathematical facts. Such knowledge would have countless applications: The formation of new substances with any desired properties, cheaper and better radioactive substances for medical work, all kinds of electronic devices. It will take years of preparation and study, but someday I want to contribute one small piece of knowledge toward answering these questions, and toward the understanding of the ultimate nature of the universe."—From the essay of Anne Hagopian.

cost of manufacture, but even these items are weighed differently than in other industries. The first two are given careful quantitative analysis so that no more weight or complication is added than is absolutely required to meet the forces for the intended life of the aircraft. Cost of manufacture is considered, of course, but in view of the fact that an extra pound of weight in the aircraft costs about $30 a year per airplane to carry around, or about $12,000 per pound for a large airline using airplanes of a given type for five years, as is common. For this reason, ease of manufacture is attained more by refinement of design and improved methods, such as joining by spot welding or Cycleweld and making simplified parts with special equipment, than by standardizing on one part for several jobs or by redesigning to make the part in a machine tool having arbitrary limitations of size and ability.

What, then, are the requirements the airplane is designed to meet? We find that the shape of an airplane is all-important. Its external form in every detail and the shape of all internal passages that carry air or any gases are determined by the principles of fluid flow.

The power plant installation must provide for proper and efficient functioning of the engine without harming the aerodynamic characteristics of the airplane and with a minimum total weight.

To meet the exacting requirements of airplane design with great precision and with no excess weight, the designer must follow rational, scientifically correct methods and must pass up the temptation to adapt previously-used forms to his design.

Another characteristic of aeronautical work is the desire, if not the necessity, to eliminate unknown quantities. Many factors that are a matter of guesswork in other fields must be brought to the point of complete familiarity in aeronautical design by measurement, and by statistical information where the events are complex and do not repeat themselves exactly.

As an example of the collection of information difficult to obtain but vital to the success and safety of all aircraft, an instrument known as the NACA V-G Recorder has been at work automatically plotting the severity of bumps experienced for a total flying time of 150,000 hours amassed with landplanes and flying boats on routes all over the world over a period of ten years. This information, taken with other data obtained in flight research, fixes the probability of encountering gusts (air pockets) of different intensities, and we design our aircraft to be proportionately strong—and no heavier. The instrument is used similarly to determine how roughly military pilots handle their combat airplanes. In the cases I have discussed the information obtained has been used to specify the strength that should be built into aircraft of different types and, as a result, structural failures have been exceedingly rare.

The subject of fatigue suggests pilot and passengers who are sensitive to the same things to which the airplane structure is sensitive. We must study their physiological disposition to put up with given conditions for the same length of time as the airplane itself—that is, determine the extent of human fatigue. It will be seen that other human capabilities and limitations such as pilot strength and reaction, piloting habits, vision, comfort, etc., must be considered in airplane design. This field of research which touches both biology and aeronautical engineering is just now beginning to receive widespread attention. The names of various phases such as aeromedicine and biomechanics indicate the combined physiological and engineering viewpoint.

CONSERVATION

Americans Should Attack Soil Erosion Causes

By DR. W. C. LOWDERMILK

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Excerpts from address given before the Science Talent Institute.

➤ FOOD comes from the soil of Mother Earth. The land and its water nourish us, the children of men. Our wartime goals, as those of post-war will be, are production enough for needs of our people and some for export. This food must come almost entirely from crops growing in soils of the land.

This land is the silent partner of tillers of soil in growing food for today and tomorrow. If either partner weakens or fails, crops are lessened or fail. The land yields its increase to husbandmen who work it and care for it with understanding and skill. The earth rewards richly the knowing and diligent; it impoverishes the wasteful. This partnership of land and farmer is the rock foundation of our complex social structure. On this foundation is built our many industries and professions, and our opportunity of the ages to build the American dream.

But this land partner may be damaged—seriously damaged and destroyed for further use by inconsiderate, wasteful and reckless use. The land may be destroyed for further growing of needful crops if soil erosion is let run riot through our fields. We have learned this from a long series of scientific studies. The facts shock thinking people; they challenge our youth. We have now an understanding of this insidious menace to our food supply from year to year and how we may bring it under control for security and welfare of the nation in times of war as well as in times of peace. We have only made a beginning in this great task.

When young and old fully understand this insidious enemy of civilization—soil erosion—we shall then make an all-out attack on the waster of the Good Earth. We shall find a substitute for war, full of adventure and challenge, that should lure mankind, weary of destruction, to the saving and healing works of use with conservation of the Holy Earth as the necessary basis for a new world of peace, with hope of abundance for all, and of happiness.