time traveling on horseback or in a horse-drawn carriage he might travel 500,000 miles in his entire life.

Man invented, however, the motor car, the airplane, and the railroad train to enable him to travel farther and faster; and in the process some people are killed just as people occasionally are killed in walking or by riding horseback.

"Compare the wasting of an entire life in covering from 250,000 to 500,000 miles by primitive modes of transportation," urges Dr. Dickinson, "with the life cost of modern travel by automobile where we sacrifice what is left of someone's life for each 10,000,000 passenger miles traveled."

Dr. Dickinson's point is that life is more efficient if we have motor cars and airplanes and railroad trains which kill people occasionally than it is to spend whole lifetimes figuratively crawling from place to place with less loss of life.

The reason why man wants faster airplanes, trains and automobiles is that mass consciousness has a dim but inexpressible realization that the faster way is the more efficient way.

Says Dr. Dickinson:

"We use the automobile not only because we like it but because it saves time, which is life. It enables us to do more in a lifetime, to enjoy more leisure, to produce more of what we want, to 'save part of our lives.' Suppose now that some one proposes to reduce the average speed of automobile travel. If we reduce the average speed so that we cover 250,000 miles less out of each 10 million miles traveled before for each fatality, we shall have lost as much distance as would have been covered in a lifetime of walking. This would represent a reduction of only 2.5 per cent in the average speed of travel. If we did this and thereby saved every single highway fatality, it would be a questionable investment in life saving. But a reduction of 2.5 or 5 per cent in average speed certainly would save very few lives, possibly none at all."

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PHYSICS

Tiny Transparent Balloons Probe Stratosphere Secrets

See Front Cover

SHIMMERING bags of transparent material of the kind used in wrapping cigarette packages are the latest tools of science to tap stratosphere secrets. Soaring to altitudes of 20 miles, these small unmanned balloons are being used to pierce the atmospheric heights far above where men can probe them with giant balloons carrying loads of equipment and human pilots. A vastly wider usefulness to science, research at only a fraction of the former cost, and complete freedom from any possibilities of loss of life are the three motives behind the gleaming balloons now being sent aloft which, through robot scientists in their "gondolas," record and send back to earth the reports from near the "surface" of the sea of air which surrounds the planet earth.

Climbed 100,000 Feet

At the National Bureau of Standards in Washington, D. C., Dr. L. F. Curtiss has sent up such a balloon to an estimated height of over 100,000 feet. From such a height one could look down on the famed Explorer II as it broke the world's altitude record, 72,395 feet, as would the climbers of Mt. Everest on the ground 29,000 feet below.

And at the Franklin Institute's Bartol Research Foundation, Dr. Thomas H. Johnson is sending up similar balloons in studies with which it is hoped to close the last gaps in the mystery of science that has been the cosmic ray.

Low Cost

The cost? Comparatively trivial when viewed in relation to the variously estimated cost of $185,000 spent on the two flights of the National Geographic Society-U. S. Army Air Corps' Explorer I and II.

Dr. Johnson, for example, estimated $25 as the outside cost of the recent ascension from Swarthmore College campus shown in the accompanying photographs. And that figure includes the cost of the tiny shortwave radio transmitter which served as the robot mechanism to send back to his laboratory the stratosphere information.

Considering economics alone, some future gigantic world-wide stratosphere research might send up simultaneously, from over seven thousand spots in the world, these midget balloons for the price paid for the Explorer I-II flights.

Key mechanism in the new midget balloons is the tiny broadcasting set which sends back, at regular intervals, the information being recorded on the scientific instruments. The sending set used by Dr. Curtiss of the National Bureau of Standards consists of only two radio tubes with electric power supplied by an ordinary dry cell battery like those used to operate a doorbell. Its total weight is only a few pounds.

In the Bartol Research equipment of Dr. Johnson there is also apparatus which dumps a total of ten pounds of sand ballast wherever the upward ascent of the balloon stops.

Weather Men Pioneered

Pioneer explorers of the upper air were the weather men who have ever sought to learn new facts about what is happening high over the earth. To study air currents they first sent up small free balloons and watched them through telescopes. Or they sent up large kites with wind-speed recording mechanisms. Today, with the new system of weather forecasting known as air-mass analysis, daily airplane flights are made at many stations throughout the country to probe the temperature, pressure and velocities of upper air winds.

But the quest for higher altitudes and more information has brought in the newer radio balloons. Twenty-mile ascensions have been achieved and in U. S. S. R., where such research has been especially active, a record of 26 miles altitude has been reported. All the while, the robot radio operator aboard the balloon sent back its messages.

For Cosmic Ray Research

It is in the field of cosmic ray research that scientists have great hopes for the radio balloon technique. That is the motive behind Dr. Johnson's preliminary Bartol Research ascensions.

A whole new region of the stratosphere can thus be studied, it is believed. Scattered measurements made with tiny balloons bearing automatic recording cosmic ray instruments have already been made in years past. The apparatus of Prof. Robert A. Millikan, California Institute of Technology, was typical. The balloons, with their instruments, were sent aloft in Texas with a note attached asking the finder to return the equipment and collect a small reward. Most times the equipment came back, but sometimes it was lost.

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To Attack Wilderness

Especially was the method feasible only in fairly well-populated regions of the earth where the chances of finding the balloon, after its descent, were reasonable. The use of the method in the regions near the magnetic poles of the earth—in far northwestern Canada and in the Antarctic—was impractical and yet those regions hold some of the most pertinent secrets of high altitude cosmic rays research.

Trying to learn sufficient facts about cosmic rays to build a really complete theory of their origin is handicapped because the observation must be made on an earth which is, in part, guarded from the rays. Not only does the air itself stop some of the cosmic rays and decrease their energy in an amount equal to a foot of lead, but, more important, the magnetic field of the earth bends the electrical particles in the rays and in some cases prevents them from reaching the surface of the earth at all.

Near the magnetic equator, for example, only the most piercing high-energy rays of all can get through to the instruments of scientists. Farther north and south from the equator more and more of the so-called "softer" or weaker rays can be observed. And at the magnetic poles of the earth very weak rays should be observed at not-too-great altitudes.

Thus the hope of scientists to study cosmic rays near the magnetic poles is like a man who seeks to pierce the weakest point in the "armor" which guards the earth. The magnetic pole regions are the Achilles' heel areas in cosmic ray study.

But no one is going to transport large $185,000 balloons far north into Canada where the chance of landing successfully and without injury to human pilots or apparatus is extremely minute. Robot radio balloons appear to be the only way out.

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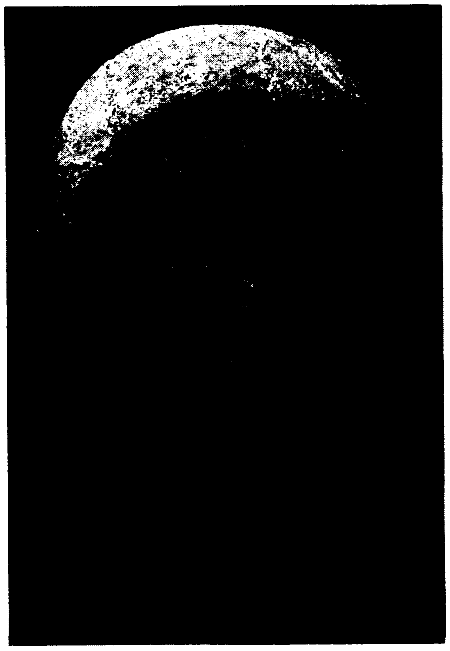

SAVED BY DEFECT

This early Greek sculpture, which paradoxically survived 2400 years because it was thrown away, has come to adorn the Boston Museum of Fine Arts. Finding his marble imperfect, the Greek sculptor apparently abandoned the head unfinished; and in its obscurity the head escaped serious ravages of war and time.

CONSERVATION

Sciences Put Heads Together Over Flood Control Problems

FLOOD control problems motivated a three-cornered scientific get-together at the summer meeting of the Ecological Society of America, at Rochester, N. Y., where three lines of scientific activity—forestry, soil conservation, and engineering—pooled ideas and suggested ways and means for combating the national menace of great waters broken loose.

Participants in the symposium were Ferdinand Silcox, chief of the U. S. Forest Service, Dr. W. C. Lowdermilk, associate chief of the Soil Conservation Service, and Dr. Morris L. Cooke, head of the Rural Electrification Administration.

"Eyes unto the Hills"

The speakers were unanimous in the opinion that flood problems in the great stream valleys can not be met wholly on the spot, but that the ultimate effective efforts must be put forth far upstream, where the "little waters" are.

To achieve flood control, said Mr. Silcox, we must "lift up our eyes unto the hills;" in them lies the danger, and from them must come the help. For there our little waters rise; there man may restore and protect that vegetative cover which forms nature's own great reservoirs and settling basins, dams, revetments, and levees.

And there, he pointed out, are the National Forests. Flanking the Appalachians from New Hampshire to Georgia; abutting the Great Lakes and dotting headwaters of the Mississippi; blanketing the Rockies from Canada to Mexico, the Cascade, Sierra, and Coast Range mountains from north to south; they offer an opportunity and a challenge to ecologists, foresters, and engineers alike. Maintenance of their forest, forage, and other vegetative cover is vital to flood control.

Foresters believe that if each drop of water is held for a time in the soil where it falls, there will be lesser volumes of water than now pile up in lower reaches of our rivers; that man's mighty engineering works alone can not wholly prevent death from stalking through the lowlands; that to do this, conditions which serve to hold back rains at the headwaters must be restored, improved and maintained. Flood control must start, not with raging torrents of the lower Mississippi, but with raindrops and rivulets in places far from the haunts of man.

Lessons from Raindrops

From single falling raindrops man can learn the beginnings of wisdom regarding soil conservation, Dr. Lowdermilk told his audience. When a drop falls, it splashes into a spray of clear water if it strikes a leaf or grassblade or anything else than bare, unprotected earth. The spray settles upon the soil and is absorbed, with little or no surface runoff.

But if the drop falls on bare earth, it splashes up not clean but muddy. The fine particles in the muddy spray, as it falls back to earth, "filter out at the surface to form a thin film which chokes up the surface pores of the soil. Only a part of the drop goes into the soil, another part flows over the surface, and by the accumulation of infinite drops, superficial flow is formed. As streamlets enlarge, the waters are released from surface frictional forces; the velocity of flow rapidly accelerates and generates erosive power. The rampant waters become gully-washers, to coalesce into raging torrential flows."

Another thing that prevents the soil from absorbing its proper quota of water is the presence of imprisoned air. In the aggregate these air bubbles im-