

of the earth by individuals, groups or nations, causing a struggle between the "have" and "have nots" which is the major cause of war and destruction.

2. Private ownership of the means of production by a small group which imposes its will on mankind, leading to unemployment and want in the midst of abundance of resources, tool power, and human skill and energy.

3. Consequent distribution of increasing portion of the fruits of production so that there is a maladjustment between our capacity to produce and our capacity to consume.

"All attempts at the reorganization of the processes of civilization should be judged in the light of their probable effects at these three focal points of integration," Prof. Rautenstrauch declared.

Dictators operate not so much in consequence of these factors, but by manipulating credit, controlling news and limiting the rights of assembly and freedom of speech, Prof. Rautenstrauch declared.

"Since no civilization can rise to higher levels than those derived from the capacities of the individuals who func-

tion in it, Prof. Rautenstrauch observed, it is perfectly obvious that whatever understandings are gained from our studies and experiences must be transmitted to and generally disseminated among the people."

*Science News Letter, January 4, 1941*

## Useful Things Cheapest

**T**HE GREATER and more immediate the need, the greater the natural provision and the lower the price of the raw material. In other words, the greater the value in use the less the value in exchange."

This dictum was laid before the meeting as a sort of natural law covering the value of raw materials, by Dr. Alfred C. Lane, emeritus professor of geology at Tufts College.

As extreme but familiar examples, Dr. Lane cited air and water. They are both vital necessities, compared with which gold and pearls are as nothing. Yet in themselves they have no market value. We pay for things we do to them, as in air conditioning and city water supplies, but the substances themselves come free.

Less extreme but still familiar is the example of relative usefulness and rela-

tive prices of metals. Iron and copper would be more useful, intrinsically, than gold and platinum even if they were less abundant. But they are (fortunately) quite abundant, and quite cheap.

Yet even necessary things that are quite abundant in normal times may suddenly become scarce when the world is dislocated by war. Dr. Lane pointed out. He set up a list of five questions, for scientific workers and planning boards to ask about any given strategic resource:

(1) Have we a sufficient supply of our own, or in immediately contiguous territory?

(2) Have we reserve supplies, in scrap or other form?

(3) Are there any unnecessary uses that can be curtailed?

(4) Are there possible satisfactory substitutes?

(5) Can new sources be readily developed?

*Science News Letter, January 4, 1941*

A new use for *cotton*—to make cotton-padded waterproofed hoods for beehives in winter.

Libraries report a boom demand for books on *national defense* and books on skills required in strategic industries.



### VOICE TEST

*This measure of the cries of a bat revealed that many are higher in pitch than the limits of human audibility.*

PSYCHOLOGY-ZOOLOGY

# Bats Use Supershrill Cries To Pilot Themselves in Dark

## "Flying the Beam" of Inaudible Sound Waves, Bats Avoid Mishap Guided By Echoes From Obstacles

**B**LIND-FLYING bats use supersonic echoes to pilot themselves through winding, pitch-dark caves without crack-ups, a team of Harvard scientists told the American Association for the Advancement of Science.

One of the most puzzling mysteries of biology has been solved. If airplane pilots could utilize the skill and flying mechanisms of bats, flying would be safer in peace and war. Some of the newest aviation instruments are believed to use a device similar to the one developed so effectively by nature in the bat.

The bats "fly the beam" of inaudible sound waves. This beam is composed of supersonic sound echoes which warn the bats of obstacles in their path and thus enable them to swerve from them. With

this beam bats can execute complicated maneuvers through virtual networks of wires without mishap.

The bats themselves broadcast the sounds composing the beam—they're far too high-pitched for human ears—and then tune in to them as they are bounced back from obstacles. A similar idea is used in ocean navigation when the echo sounding device is used to determine water depths. A sound is bounced on the ocean floor and the time of travel tells the depth.

It is possible that the researches may have defense applications in arming America in the air.

The study of the bats, made by Robert Galambos and Donald R. Griffin of Harvard's biological laboratories, destroyed a few old superstitions. For one

thing it should end the fears of those who encounter bats in dark rooms that the animals will strike them.

A normal bat will usually perceive and avoid an intruder by means of its sound echoes but even if a clumsy bat should alight on a person's hair, it does not become entangled, it has been found, but quickly extricates itself.

Scientists have suspected for some time that bats use their ears to guide them but this had never definitely been proved. The experiments just reported not only showed that hearing is essential for blind-flying but also gave the first proof that the apparently noiseless flight of a bat is actually accompanied by a clamor of shrill cries which the unaided human ear cannot hear.

To study these sounds the experimenters used apparatus which Prof. G. W. Pierce of Harvard's Cruft laboratory of physics developed for supersonic research. It revealed that the bat cries were loudest at 50,000 vibrations per second. This is well beyond the range of the human ear which even under favorable circumstances can rarely detect sounds with more than 20,000 vibrations a second.

Actually, bats are not blind, the Harvard biologists found, but their supersonic blind-flying system is so good they do not need to see. To prove that the sounds were required for blind-flying, the ears of bats were covered to prevent hearing and their mouths were covered to prevent them from uttering sounds.

Such animals when set free in a room hung with wires blundered helplessly into them. Yet as soon as the coverings were removed, the same bats flew skilfully and neatly avoided the wires.

On the other hand, bats fly as well with their eyes covered as they do with them open, provided the mouth and ears are uncovered. In reporting the research, the two biologists emphasized that the theory that bats were warned of the nearness of obstacles by a very delicate sense of touch in their wings, repeatedly disproved before this, but still heard occasionally, was wrong.

The supersonic cries, when translated into sounds the human ear can hear, sound like the rattle of distant machine-gun fire. Bats utter these cries at the rate of about 25 a second when flying in unobstructed space, raising the rate to about 50 a second when approaching an obstacle.

*Science News Letter, January 4, 1941*

Chocolate becomes *cocoa* when its fat content is less than 50%.

#### ASTRONOMY

# Astronomer Suggests Search For Ghosts of Universe

## Advances Theory That Supernovae After Explosion Become So Dense Any Light They Emit Could Not Leave

**A**STRONOMERS may soon be searching for ghosts if a suggestion made recently is followed.

These are ghosts of the universe, tiny images of all the stars beyond one of extremely high density. They may be produced as the star bends light rays going past in a manner comparable to the way that a camera lens bends light rays from a scene and focusses them to form a picture on the film.

Speaking before the American Physical Society, Dr. Fritz Zwicky, of the California Institute of Technology, said that such images would afford a check of his theory of the ultimate fate of the gigantic star explosions called supernovae. When one occurs, a previously inconspicuous star suddenly rises to equal a hundred million suns in brilliance.

After such an explosion, which occurs on the average only once in several centuries in any one galaxy, such as our own Milky Way system, the end result is a collapsed neutron star, according to the Zwicky theory. This would represent the lowest states of energy that matter could possess without actually turning into radiation.

Because they would be so exceedingly dense, far surpassing even the "white dwarf" stars in which a cubic inch of matter might weigh millions of pounds, they could not be seen. The force of gravity would be so great that any light they might emit would not be able to get away.

That there is an effect of gravity on light was one of the predictions of the theory of relativity of Prof. Einstein. It has been confirmed by observations of the sun, where the effect is so slight that very delicate measurements are required to detect it.

With the neutron stars so dense, light from a distant star of the normal kind passing near one would be bent through a large angle, as if through a prism, Dr. Zwicky proposes. Where the light rays that have passed all parts of the edge of the neutron star meet, an image would be formed, so the star would really act as a gravitational lens. The image would

be seen, if at all, floating in space, between us and the neutron star. Images of other stars would also be formed, so, within a small ring, there would appear, he said, "a miniature edition of all the unobscured luminous objects in the universe."

If the neutron star is close enough, and in the right position, this image might be observed, Dr. Zwicky declared, suggesting that astronomers search for such images. Even if the details could not be seen, an analysis of the light from this ghost image might reveal its character, for the spectrum would be a combination of the spectra of many different kinds of stars.

"If the neutron star theory of supernovae is correct," said the speaker, "the number of collapsed stellar remnants of supernovae in our galaxy would exceed one million, and several collapsed neutron stars may be expected within a sphere of ten light years."

Less than ten visible stars are now known to be within this distance.

*Science News Letter, January 4, 1941*

#### PALEONTOLOGY

## Find Dinosaur Neck Bone Nearly Four Feet Long

**N**OBODY could have complained about getting a piece of the neck, if there had been anyone around to make a holiday turkey out of a dinosaur whose fragmentary remains have been brought back to the American Museum of Natural History by Barnum Brown, recently returned after a season of field work in the Big Bend country of Texas. A single vertebra, or neck joint bone, is three feet across, only two inches less than four feet long, and in its present fossilized state weighs 600 pounds.

For stuffing, there could have been shellfish on the same scale. The party found oyster shells six inches wide and fourteen long, and there was one clamshell forty inches in diameter.

Dr. Brown, with his companions Dr. Erich M. Schlaikjer of Brooklyn College