ASTRONOMY-PHYSICS

Cosmic Rays May Originate In Rare Super-Novae

California Scientists Suggest Briefly Flashing Stars May Emit These Extra-Galactic Rays as Well as Light

COSMIC RAYS, the mysterious radiation which bombards the earth from all sides, may originate in the strange rare phenomena during which stars flare up with sudden bursts of energy that make them shine as bright as the planets.

This is the theory of cosmic ray origin advanced by Dr. W. Baade of the Carnegie Institution's Mt. Wilson Observatory and Dr. F. Zwicky of the California Institute of Technology in a report published in the *Proceedings of the National Academy of Sciences.*

The special "erupting" stars which Drs. Baade and Zwicky believe cause cosmic rays are called super-novae. Literally translated, novae stars would mean "new" stars but they are really temporary stars. After traveling through space for eons of astronomical time they suddenly flare up and reach a brightness which, on occasions, has rivaled that of the brightest of all stars, Sirius. Some super-novae in distant nebulae produce as much light as does the whole star system which contains them.

In the short space of a few years the shining splendor of the novae type stars fades away to their former obscurity.

Novae flare-ups are rare occurrences which last about as long in comparision with the millions of years in astronomical time as the fleeting flare of a rocket compares with a century.

Radiate Half Their Mass

Super-novae stars, declare Drs. Baade and Zwicky, are ordinary stars which blow up like a bursting shell. The velocity of expansion of the star may, in some cases, be nearly that of the speed of light. Some stars, in the process, may lose over half their mass by radiating it away into space. Visible and ultraviolet light are known to come off in the star eruption. It is suggested now that cosmic rays may be emitted at the same time.

The Pasadena scientists ask that cosmic ray observers call attention promptly to any systematic intensity changes that last even a few days. If such information were obtained quickly enough astronomers could push the search for possible novae stars. Cosmic ray intensities fluctuating over a period of years in rhythm with the appearance of super-novae stars would be strong support for the new hypothesis.

Applying their theory of novae bursts to cosmic rays, Drs. Baade and Zwicky point out that in all the discussion about cosmic rays there is only one point on which all the investigators—Millikan, Compton, Regener, Hess and others—agree; cosmic rays originate outside the star system which contains the sun and its companion earth.

Extra-Galactic Origin Fits

This general agreement on the extra-galactic origin of cosmic rays, declare the California scientists, fits their hypothesis of the emission of cosmic rays by super-novae stars. Cosmic rays do not come from within our own star system for the simple reason that no super-novae flare-up has occurred near the neighborhood of the earth during the twenty years in which cosmic rays have been studied systematically.

Moreover, the Pasadena investigators add, their theoretical deductions on the possible intensities of cosmic rays, which would come out of erupting novae stars, correspond to the observed intensities.

Astronomical calculations lead also to the belief that super-novae type stars should occur in any particular star system like our Milky Way once in 1,000 years on the average. Some time between 1934 and 2934, therefore, the scientists of the future—if they are still interested in cosmic rays—will probably have a chance to test the Baade-Zwicky theory. During the next thousand years one star in the system containing the sun should flare up and become a super-novae. If this happens, say Drs. Baade and Zwicky, cosmic ray intensities should increase a thousand fold.

It will not be necessary, however, to wait 1,000 years for a test of the new hypothesis. There are about 1,000 star systems, or nebulae, which are comparatively near the earth. Every year, therefore, some one of these ought to have a star eruption. Such annual eruptions should be sufficient to change cosmic ray intensities on the earth by about one per cent. over a period of a few days.

Science News Letter, June 23, 1934

CHEMISTRY

Mysterious Explosive Is Only Ammonium Picrate

"SECRET Naval Formula for Explosive D found in Airplane Wreck." So read the headlines following the crash of the airliner in the Catskill Mountains of New York state.

Thus was launched a drama for the press, involving all those things dear to an author's heart; a mystery explosive, a chemist capable of making that explosive, and "secret" naval documents.

Today the mysterious explosive D stands revealed as the Navy's simple symbol for a common high explosive used for making shells burst—ammonium picrate. The equally mysterious "naval documents" have turned out to be the specifications for making ammonium picrate (no great chemical feat) which were carried by the chemist of a company bidding on Naval contracts for its fabrication.

Ammonium picrate, leading actor for a day in the great naval mystery, comes from carbolic acid, or phenol, familiar to everyone in weak solutions as a disinfectant; or when moderately strong, as a poison.

Treat carbolic acid properly with nitric acid and sulfuric acid, and the result is picric acid, a yellow, crystalline solid. Picric acid by itself is a valuable but somewhat outmoded explosive. Every nation has its own secret method of making it. Thus the English make "lyddite," the French "melinite" and the Japanese "shimose."

Going a step beyond simple picric acid, ammonia is added to make the organic salt of picric acid, ammonium picrate. And therewith the "lone wolf" element nitrogen is brought into the final product.

Nitrogen present in the air man breathes is often called an inert ele-

ment, because it dislikes to join readily in a working alliance with other atoms. Viewed from the other side, however, nitrogen is a very active element, for once joined to other atoms in a compound it strives energetically to get out of the combination. This readiness of nitrogen to free itself is used by man to provide the force which bursts great shells and explodes the war-heads of torpedoes.

Science News Letter, June 23, 1934

AGRICULTURE

Giant Toad Kills Grubs; Saves Puerto Rican Sugar

PUERTO RICO'S sugar crop mainstay of the island's economic life, has been saved from a menacing insect pest by a giant toad. The pest was the white grub, larva of the beetle known in the United States as the May beetle, or more widely though less correctly as the Junebug. The rescuer was a toad known scientifically as *Bufo marinus,* imported into the island from Barbadoes and Jamaica. The drama of the salvation of an industry by a clumsy but benevolent batrachian is told by Dr. George N. Wolcott, entomologist of the Insular Experiment Station at Rio Piedras.

In Puerto Rican cane fields white grubs swarmed everywhere in the soil, eating off the roots, as they do the roots of the strawberries and other plants in the "States." Search for natural enemies, such as parasitic wasps, was only partially successful, and planters had been reduced to the rather desperate expedient of having the grubs picked out by hand.

Then, through a half-accidental chain of circumstances, two lots of the giant toads were brought to Puerto Rico and liberated in the fields. In a short time their progeny had multiplied into millions. They fattened upon the beetles that were the parents of the white grubs, until beetles and grubs alike changed from a swarming plague into an actual rarity. Now, entomologists who want some of the grubs for scientific purposes have rather a hard time finding enough of them. And the Puerto Rican sugar cane is freed of its most formidable enemy.

Bufo marinus is Latin for "sea toad" —why, nobody knows, for like all toads this lumpy friend of the Puerto Rican planter shuns salt water and breeds only in freshwater ponds. The female is a veritable giant among toads, being fully six inches from her nose to where her tail would be if she had one—more than double the length of the ordinary American toad. The breeding season lasts the year round, which of course makes for extremely rapid increase when the food supply is good.

The food habits of the great toad were carefully studied by a Puerto Rican woman naturalist, Mrs. Raquel R. Dexter. She found that *Bufo* makes nearly a third of his meals off the cane-destroying May beetles. These are excellently adapted for toad-food, for they are nocturnal like the toads themselves, fly but little, and when on the ground are slow-moving and easy to catch.

Aside from the beetles, *Bufo* feeds to some extent on a few other harmful insect species, though not as much as might be desired, as well as on millipeds or "thousand-leggers," many harmless kinds of insects, and all manner of other creeping things. He has even been known to eat mice; but the accusation that he kills young chicks has been proved to be without foundation.

One bad habit he has: he eats bees. He lurks under the hives where they are set on the ground, and snaps the bees as they come out. This, however, can be avoided by the simple device of setting the hives on raised stands, or by putting toad-tight wire netting around the apiaries.

Bufo bids fair to become almost as famous a traveller as the American mosquito fish, *Fundulus.* Already he has been transplanted experimentally to Hawaii and the Gulf States, and colonization in Florida was held up only by the question whether these monsters might not terrorize squeamish tourists from the North. A lot of the toads was even taken to the island of Mauritius in the Indian Ocean, but the conservative authorities there would not permit them to be introduced, though their cane fields are suffering severely from white grub infestation.

But whatever may be his reception elsewhere, Puerto Ricans are enthusiastic about *Bufo marinus.* A sanguine local entomologist has even suggested the heraldic lamb be removed from the territorial coat-of-arms, to yield place to the Toad that saved the Island.

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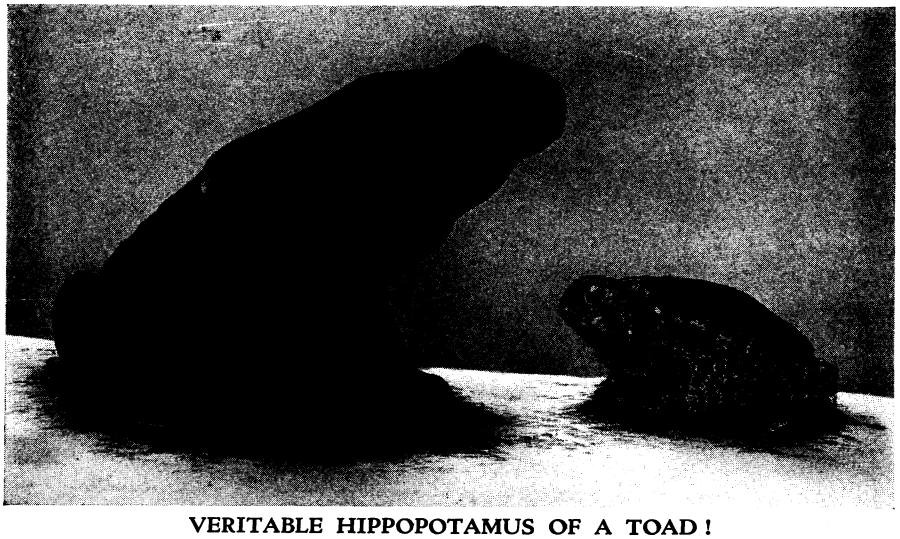
It is reported that a trial shipment of 47 tons of New Zealand beef, refrigerated with carbon dioxide, landed in London in excellent condition.

A search in Canada for domestic clay for oil refining has yielded a Canadian clay reported to be more efficient than any imported clay available there.



VERITABLE HIPPOPOTAMUS OF A TOAD!

How the giant toad, Bufo marinus, imported into Puerto Rico to save the island's sugarcane crop from swarming white grubs, looms above an ordinary American toad. The picture is a composite of photographs of the two toads on a common background. The big toad has a body length of six inches, twice the length of the smaller animal.