

ASTRONOMY

# Atom Building Keeps Stars Shining, Says A.A.A.S. Head

## 4,200,000 Tons of Heat Per Second From Sun Called Mass Left Over From Element Forming Process

**T**HE BUILDING up of other heavier atoms out of hydrogen stokes the internal heat of the stars, including the sun, Prof. Henry Norris Russell, Princeton University astronomer recently elected president of the American Association for the Advancement of Science, suggested in the Maiben lecture before the Association.

The hardest problem of all star study is the source of the energy which keeps the stars shining, he explained. Synthesis and annihilation of atoms are the only two processes so far suggested which would supply enough heat to last for the millions of years of geological time.

Present theories indicate that the mutual annihilation of the positive and negative particles, the protons and the electrons, would not happen except at temperatures of many billions of degrees such as do not exist within the stars.

Prof. Russell's provisional theory is therefore that atomic synthesis makes the sun and stars give off heat and light.

### "A Pound of Heat"

"The rate of loss of heat from a star is almost incomprehensively great," Prof. Russell said. "We can come nearest to realizing it by remembering that, according to the theory of relativity, heat, like other forms of energy, possesses mass. It is as proper to speak of a pound of heat as a pound of ice; but a pound of heat is a very large amount—enough, in fact, to melt 30 million tons of rock and turn it into white hot lava. The sun radiates heat away into the depths of space at the rate of 4,200,000 tons per second—and the sun is a smallish star! Upon what vast stores of energy can it draw to keep going?"

The mechanism for building heavier atoms out of hydrogen visualized by Prof. Russell is that suggested by the new and attractive theory of Prof. Werner Heisenberg, German physicist. Atomic nuclei are built up of protons and the recently discovered neutrons. The incorporation of a proton into a nucleus would in many cases change an

atom of a known element into one of the following elements. For instance, beryllium of mass 9 would change into boron of mass 10, boron 11 would change into carbon 12. The introduction of a neutron would change an atom into an isotope of the same element, but with atomic weight greater by one, as for example, lithium 6 to lithium 7 and boron 10 to boron 11. By alternation of these processes the heavy elements might be built up, step by step.

### 1/130 of Mass Lost

The important feature of this process from the standpoint of keeping the stars stoked is that when a proton or hydrogen atomic heart is built into a heavier element, about 1/130 of its mass disappears and must be represented by heat liberated in the process. This is the loss of mass that has caused physicists to say that there is enough energy in a spoonful of water to run a liner across the Atlantic. Building in a neutron probably liberates heat in the same way.

"At distances greater than 1/1000 of the outer diameter of an atom," Prof. Russell explained, "protons and nuclei repel one another. A fast moving proton, rushing directly at a nucleus might, however, get so near it that attraction succeeded repulsion, and thus penetrate the nucleus and be- (Turn to page 12)

NUTRITION

## Artificial Feeding Keeps Up Weight of New-Born Babies

**A** SOLUTION of dextrose or grape sugar, gelatin and common salt has been successfully used in combatting birth shock and keeping down to a minimum the weight usually lost by new-born babies, Dr. I. Newton Kugelmass, New York baby specialist, reported to the American Association for the Advancement of Science.

Studies of animals and of primitive tribes of men have convinced Dr. Kugelmass that the customary loss of weight in civilized babies just after birth is

neither necessary nor normal. He criticized the usual modern practice of awaiting an ample food supply from the mother before feeding the new baby, and declared that the consequence is an initial period of starvation.

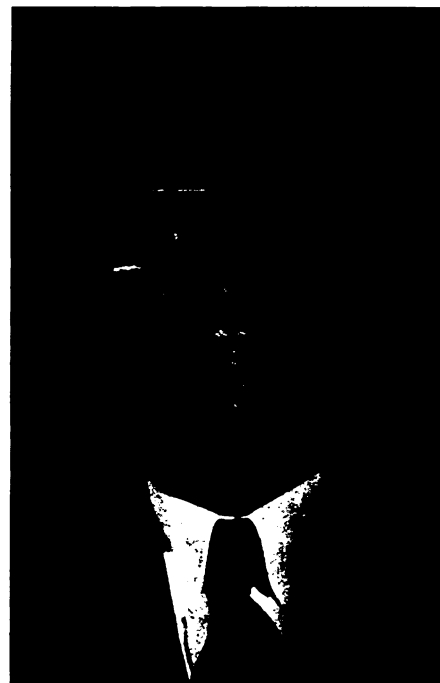
The birth mechanism produces the condition that he calls birth shock, he explained. New-born babies show all the characteristic signs and symptoms of shock, including low blood pressure, low blood sugar, sleepiness, stupor and lack of appetite. Refusing to accept these as normal, Dr. Kugelmass devised the gelatin-sugar-salt solution which he gives every two hours for the first 24 hours beginning immediately after birth. He finds it better than artificial feeding during the first two days of life and although it contains less calories than such feedings, it nevertheless reduces the loss of weight to the irreducible minimum of less than two per cent.

*Science News Letter, January 7, 1933*

GENERAL SCIENCE

## American Association Elects New Permanent Secretary

**A**T THE MEETING of the American Association for the Advancement of Science in Atlantic City, Prof. Henry B. Ward of the University of Illinois was elected permanent secretary, to succeed Dr. Charles F. Roos, resigned. Prof. Ward is a veteran among American zoologists, and has (Turn Page)



PROF. HENRY B. WARD

nities having fluorine-bearing water supplies.

The results of the communities' experiment will not be fully apparent for about six or seven years, when the teeth formed subsequent to the change of water will have erupted into the mouth.

Areas effected have been found in Arizona, Arkansas, California, Colorado, Idaho, Illinois, Minnesota, New Mexico, North and South Dakota, Texas, Virginia, Kansas, North Carolina, Oregon, Washington and foreign countries.

*Science News Letter, January 7, 1933*

PHYSIOLOGY

## Secretion From Crustacean Eyes Causes Color Changes

**E**YES act as glands, in certain animals at least, secreting a substance that causes the contraction of color-bodies in their skins and thus controls their chameleon-like color changes. Experiments pointing to this hormone-production by eyes were reported by Prof. Lloyd M. Bertholf, of the University of Western Maryland before the American Society of Zoologists.

The animals furnishing the color-changing extract were crustacea, the great zoological family comprising lobsters, crabs, crayfish and their kin. The hormone was found in their eye-stalks.

The eye-stalk extract, when injected into the body, produced color changes not only in crustacea, but in frog tadpoles and several species of fishes—animals far removed in the zoological realm from the invertebrate crustacea.

*Science News Letter, January 7, 1933*

## From Page 3

come a part of it. Neutrons would not be repelled, and would probably have a better chance of going in. We do not know enough about them yet to estimate the chances; but a tolerable idea of the probability of penetration of a proton can be obtained by means of wave-mechanics. The chances are best for the lightest nuclei, which have the smallest charges and repulsive forces. Calculations by Atkinson and Houtermans show that such penetrating collisions would begin to become important when the temperature of the gas rose above a few million degrees."

The rate of heat-production by atomic synthesis increases very rapidly with the temperature. In a gas containing hydrogen, oxygen, nitrogen and carbon, all of which are very abundant in the stars, heat should be produced fast enough to keep the stars shining at temperatures of about 20 million degrees, Prof. Russell estimates. The internal temperatures of most of the stars appear to be just of this order, and it is probable that they are deriving their heat supply from processes of atomic synthesis of this general nature. What supplies the giant stars, which must be much cooler inside, unless they have dense cores, is still unknown.

The Russell theory is greatly strengthened by a kind of energy-releasing element building demonstrated this year by Drs. J. D. Cockcroft and E. T. S. Walton at Cavendish Laboratory, Cambridge, England. Lithium, lightest metallic element, was bombarded with pro-

tons or the hearts of hydrogen atoms, accelerated by a potential drop of 300,000 volts. Alpha rays, which are helium nuclei, were given off with a total energy corresponding to 16,000,000 volts.

A proton evidently enters a lithium nucleus, produces a beryllium isotope which breaks up into two alpha particles. The energy due to loss of mass sets the alpha particles in very rapid motion.

*Science News Letter, January 7, 1933*

## From Page 4

dynamics it would necessarily have uniform temperature throughout.

Another example cited by Prof. Tolman is "the possibility for reversible processes at a finite rate" which would be impossible under classical theory.

The ordinary principle of energy conservation fails under relativistic mechanics and Prof. Tolman holds out the idea that under the new thermodynamics "an unending succession of irreversible expansions and contractions which seems very strange from the point of view of classical thermodynamics" can actually occur. And this would happen without "a final state of maximum entropy" or a running down of the system to a dead level of heat.

These extensions of relativity to heat, energy and motion made by Prof. Tolman will sound as bizarre to those accustomed to physics as now taught as Einstein's new physics seemed when first made known to the world.

In present the new models of the universe possible under his new relativistic thermodynamics, Prof. Tolman warned that they were very highly simplified and idealized and that at best they are constructed to agree with the small sample of the actual universe that is within range of the most powerful telescopes. Those reach only some hundred million light years.

It is also possible, he warned, to construct a model universe that would expand never to return. Only research of the future will determine whether the real universe is expanding and contracting indefinitely, expanding like a balloon inflated by limitless breath or acting in some unknown way.

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Scientists, recording the intensity of sounds in decibels, give the following figures: hammering on steel plate, 113 decibels; riveter, 101; subway, 97; lion roaring, 87; radio loudspeaker, 81; church bells, 61.

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