ASTRONOMY-BALLISTICS

Meteor Like Rocket Front

For the same reason that a shooting star shines brightly as result of friction from the air, the front of a rocket also glows dull red.

➤ WHY A METEOR shines brightly as friction with the air heats it to high temperature is essentially the same problem as the heating of the front of a rocket traveling at one or more miles per second through the upper air. V-2 rockets have been seen to glow dull red as their tips were heated by this atmospheric friction.

The boundary that separates our knowledge of high-velocity rocket ballistics and the astronomers' knowledge of what happens to meteors as they plunge earthward has probably been crossed as a result of investigations still in progress. Dr. Richard N. Thomas of the University of Utah and Dr. Fred L. Whipple of Harvard College Observatory described to members of the American Astronomical Society meeting at Strawbridge Observatory, Haverford, Pa., their current joint investigations of astro-ballistic heat transfer.

These astronomers have calculated the rate of heat transfer in the region where a solid body such as a meteor is just beginning to melt. They find that the transfer varies directly as the air density rather than with the square-root of the density as used in current aerodynamic theory.

The heat transfer is something like ten times more efficient at the high speeds of meteors, which are racing through space ten to forty miles per second when they enter our atmosphere, than at the speeds of our present fastest rockets.

With his associates Dr. Thomas computes the temperature of the glowing surface of a meteor to be about 3,000 degrees Centigrade when at its brightest.

Further work is being done to determine the maximum size of a meteor that can reach the ground in one piece, this depending partly on the rate of deceleration of the meteor as it falls.

What Is Temperature?

WANTED: New definition of temperature.

Dr. Charles Hetzler of Brown University pointed out to those attending the meeting at Haverford College that astronomers themselves have been guilty of considerable confusion.

Temperature to the man in the street is something he feels by his sense of touch. Actually, it is a result of the transfer to his skin of the energy of molecules in the air or in solid substances. Or it may be received directly from the radiant energy of the sun, a sun lamp, a stove or radiator, or just from the walls of a room.

To a physics student, temperature is proportional to the average kinetic energy of the particles in a given volume of a substance, a gas being the simplest case. Astronomically, the surface temperature of a star is that to which an idealized mass of material, called a "black body," would have to be raised to duplicate the radiation spectrum of that star.

But in the outermost regions of the sun's atmosphere, where the density is that of a vacuum and there couldn't possibly be enough particles to make one feel hot were he located there, astronomers find evidence that the atoms are or have been at one time very hot.

These particles of the sun's corona have lost serious numbers of their outermost parts, or ring electrons. The only way known for this to take place is for such atoms to have been knocked around quite badly at temperatures of millions of degrees known to prevail inside the sun and other stars, or to have been subject to the terrific X-ray radiation that must accompany such high temperatures at the high densities found in the sun's and star's interiors.

All of which, Dr. Hetzler points out, leaves the concept of temperature in a rather confusing state. Bringing in the concepts of relativity, he suggests that "temperature is a measure of the density, in space and time combined, of the relative motion."

The temperature at a point therefore depends on the total energy of the motion, including atomic, molecular, electronic, and the like, relative to the unit volume about that point per unit time.

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MATHEMATICS

Machines Can Play Chess; But Human Should Win

➤ MACHINES can learn to play chess and other games, a British mathematician, Dr. J. Bronowski, argues in a discussion being conducted in columns of the leading British scientific journal, NATURE (Dec. 16).

Dr. Bronowski, who during World War II conducted bombing studies, and who now is with the Central Research Establishment of the National Coal Board, argues that while it is true that a machine cannot learn unless it is provided with a mechanism for learning, it is quite possible to devise such a mechanism.

Machines can be designed to make the best move at each step in a game of tic-tac-toe or chess, Dr. Bronowski reports.

"When playing against a series of human opponents, such a machine may never do much better than draw. A good human player against the same opponents may score more wins by making unsound but more puzzling moves," he says.

A machine can be made to imitate the human player; instead of playing perfectly, it can be made to play well, by the inclusion of an empirical or statistical mechanism in three units. One unit makes the machine experiment with different alternatives each time certain positions are reached; the second unit counts the results and relates them to the alternatives chosen; and the third steers the machine into the lines of play which have been winning most often.

"Indeed, the mechanism may be made more subtle," Dr. Bronowski states. "The second unit could also be made to classify players, say by their opening moves, into the bold and the timid. The third unit would then, in a given end game, choose the move which had won most often against players of that type."

By putting in a mechanism which estimates the probability of success in the future by analyzing the distribution of successes in the past, it is possible to devise a machine so that it learns, matures and even develops a style.

"Perhaps this is not the way in which animals learn," Dr. Bronowski observed, "or perhaps, on the contrary, it is the very reason why animals play games at all. But I am confident that the inclusion of such statistical mechanisms will be an important development in machines. I can speak for its usefulness in strategic problems, for I myself used it in a rudimentary form in bombing studies, in those spacious days when we worked with punched cards."

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METEOROLOGY

Billion Tons of Air Moved to Make Weather

➤ BEFORE scientists get any fancy notions about making weather to order they had better sit down and figure out a way to move a billion tons of air. That is the amount of air that has to be shifted to make a reasonable area of depression, according to Sir David Brunt, professor of meteorology at London's Imperial College, who calculated it all out to an accuracy of within two per cent.

It is the movement of cold air from a high pressure area into an area of depression that is the major factor in weather making, he told the Royal Institution.

Until science develops a way to move that billion tons of air, it just will not make much of a depression—or impression on the weather for that matter.

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