Uranus, one-thirtieth of the sun's diameter. Thus, a pint of its material would weigh about 20 tons.

Explanation of this super-density is believed to be that the atoms are completely ionized, or broken into bits, by the extreme temperatures that prevail inside, around two billion degrees Fahrenheit. Thus, the wood in a pile of boxes, corresponding to the atoms and like them containing a great deal of empty space, takes up a lot more room than if the same boxes are broken into small pieces.

Just how dense is the newly discovered white dwarf, Ross 198, remains to be determined. However, another star of the same class that Dr. Kuiper discovered a few years ago is estimated to be a thousand times as dense as the companion of Sirius.

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GENERAL SCIENCE

Supernovae, Rarest Phenomena, Found To Be Of Two Types

Even Members of Fainter Group are a Hundred Times As Bright as Ordinary Novae; Others 1,000 Times

EXPLODING STARS, known to astronomers as "supernovae" and described as "the rarest and most spectacular phenomena recorded in the study of the observable region of the universe," are of two types. This is shown by a survey conducted jointly by the Mount Wilson Observatory of the Carnegie Institution of Washington and the Palomar Observatory of the California Institute of Technology.

Some results of this investigation, of which the exploratory phase is now completed, are shown in the Carnegie Institution of Washington's annual exhibition, which opened on December 13.

Ordinary "new" stars reach a maximum brightness only about 100,000 times that of the sun. Such a star, says the Institution's catalog of the exhibition, "becomes unstable, swells up, and blows off its cover." Several of these occur each year in our own Milky Way system, and presumably they are about as frequent in the millions of similar systems observed by astronomers. In the more distant ones, even when brightest, they are not sufficiently brilliant to be apparent.

Until the joint investigation was inaugurated, six years ago, only fragmentary information about supernovae, which are far more brilliant, was available. Now it is found that one appears in each star system about once in three to six centuries. The last in our system was in 1572.

"All well observed supernovae seem to follow closely one of two patterns," it is announced, "and are distinguished as groups I and II. Those of group II are the fainter (average maxima about 10,000,000 suns) and their spectra, that is, analyses of their light, resemble the spectra of normal novae on an enhanced scale. Practically all the features in the spectra have been identified. The spectra of group I (average maxima about 100,000,000 suns) are quite different, and so strange that scarcely a single feature has yet been identified with certainty. These spectra evidently reflect the sudden release of energy on an enormous scale, and their final interpretation should contribute information concerning the behavior of matter under extreme conditions."

Machines Develop Pressures

PRESSURES in the laboratory as great as three million pounds per square inch, which duplicate those at a depth of 300 miles below the earth's surface, or about a twelfth of the distance from surface to center, are proving a powerful new tool to scientists in their studies of what is happening in the earth itself.

First results of researches made with such pressures in the Geophysical Laboratory of the Carnegie Institution of Washington are revealed as part of the annual exhibit of the Institution.

To obtain such pressures it is necessary to have a material that will withstand them. Tungsten carbide, known as carboloy, is one that has been widely used, but even with this the trick of "a bomb within a bomb" is needed.

"A carboloy piston 1.13 inches in diameter (roughly one square inch in cross section) will support a load of about 375 tons before rupture," it was stated. "It is one of the strongest known materials. This compressive load thus appears to set up an upper limit to the pressure obtainable in a single-stage apparatus. If, now, we support this piston laterally by a pressure of, say 250,000 pounds per square inch, on the basis of ordinary elastic theory we can expect the piston to support a load of about 500 tons as an upper limit. Actually, however, it will withstand much more than 500 tons, because the lateral confining pressure acts also to increase its strength. A piston supported in this manner withstands a load of as much as 1500 tons.

"This phenomenon has been utilized in the apparatus for work at very high pressures. The apparatus consists of a two-stage or cascaded arrangement of pressure vessels, that is, a bomb within a bomb. A pressure of 300,000 pounds per square inch developed in the first stage or outer pressure vessel acts on the second stage or inner pressure assemblage to support and also to strengthen it, and thus allows the generation of a pressure about ten times that in the outer vessel. The advantage of this two-stage cascade apparatus, therefore, lies not only in the circumstance that the second stage immediately doubles the pressure range, but also, in the great increase of strength caused by the confining pressure on the inner bomb. The pressure in each stage is developed by means of a piston, and the mechanism is so designed that the pressure in either stage may be varied independently of the other."

Plant Fossils Evidence

EVIDENCE that the continents have "stayed put" during the past 60 million years, and have not been drifting slowly around like rafts on a millpond as one theory holds, is presented by successive deposits of plant fossils representing various periods in American geological history. These are illustrated in exhibits arranged by the Institution's division of plant biology, with the collaboration of the Museum of Science and Industry of New York.

If all present continents are fragments of one original super-continent, that broke up about 60 million years ago and let its fragments go a-drifting, then we could expect lines of distribution of plant fossils to have no necessary relation to the distribution of plants today. As a matter of fact, however, Institution paleobotanists have found, given species in past ages were distributed very much as plants of today are distributed: push-

ing farther north along the continental borders, where weather is warmer in winter, and dipping far toward the south in the interior, where weathers are severe.

This is strong indication that our continent has remained in essentially its present position since Eocene time, and that plant populations have done the drifting, moving slowly southward as the climate cooled, and shifting a little to the north again during warmer interludes.

Other exhibits will illustrate work done recently by Institution scientists on such diverse subjects as the gene, or basic physiological unit of heredity, the interpretation of Maya religion as recorded in the architecture, art and hieroglyphic writings of that once great people, and the phenomena of volcanic activity.

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ASTRONOMY

Relation Is Traced Between Meteors and Encke's Comet

If You Saw "Shooting Stars" During October or November, They May Have Been Parts of Stone-Age Wonder

IF, DURING the autumn, you notice a shooting star that seems to emerge from the constellation of Taurus, in the eastern evening sky at present, you are probably seeing the remains of a huge comet that may have been watched with fear and wonder many thousands of years ago by our late Stone Age ancestors.

These meteors are members of the Taurid shower, so called because of the direction from which they come. According to Dr. Fred L. Whipple, Harvard astronomer who reports on his researches in *The Telescope* (Nov.-Dec.), the Taurids seem to be cousins of puzzling Encke's comet. It comes around once every three years and four months, but is never visible to the naked eye.

From observations of Taurid meteors, with special cameras, he finds that their speed around the sun varies from 23.3 to 23.5 miles per second. This shows conclusively that they are part of the solar system, moving about the sun in a closed path. Had they been moving faster than 26.5 miles per second, they would have come in from outer space.

This, indeed, had been suggested in the past, but Dr. Whipple finds the reason for such an erroneous conclusion. The meteors that are seen in early November have longer and narrower orbits than those that come in late October, and this led the earlier astronomers astray.

Dr. Whipple also finds that the paths of the meteors are quite similar to that of the comet, except that the planes of the meteor and comet orbits are at an angle of about 12 degrees. This would seem to preclude the possibility of a connection, but he has worked out a new mathematical theory for the pull of Jupiter on the comet. The plane of the comet's motion, he demonstrates, wabbles over a long period of time. Many thousands of years ago the orbits were nearly the same.

"The most reasonable conclusion to be drawn from this evidence," Dr. Whipple says, "is not that the Taurid meteors arise from Encke's comet but rather that they both have a common ancestor, some large comet that broke up into several smaller ones.

"One of the smaller descendants can still be seen alive as Encke's comet, while only the skeletal remains of others occasionally collide with the earth to produce showers of meteors. It is interesting to know just how long ago the parent comet met with disaster and we may estimate from the present data that the break-up probably occurred some five thousand to fifteen thousand years ago."

First observed in 1786 by a French astronomer named Mechain, Encke's comet has been watched on forty or more visits since then. Its three-and-a-third-year period is the shortest of any periodic comet.

Unlike most comets, the name commemorates not the discoverer, but Johann Franz Encke, a German, who first showed that it was a periodic comet. He also made an exhaustive mathematical study, which revealed that its period was gradually shortening. Between 1819 and 1914 this amounted to about two and a half days. However, after Encke's death in 1865 the rate of decrease was considerably reduced and in recent years the period has hardly changed at all.

Encke's suggestion that the decrease was the result of some cloud of resisting material through which the comet passed has thus been discarded, because, says Dr. Whipple, "a resisting medium dense enough to affect the comet's motion could hardly disappear in a few years."

The reason for this change is an astronomical puzzle. So, indeed, is the fact that the comet still exists. Because it moves in a small orbit, says Dr. Whipple, it "is activated by fairly intense sunlight at all times and brightens up every three and one-third years when it approaches the sun. How it can continue to show indefinitely as a hazy diffuse object and not be completely dissipated is truly a mystery."

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WINGS AT THE WINDOW

Judy, a baby rosebreasted grosbeak, being fed by Mrs. Ada Clapham Govan, author of "Wings at My Window," (Reviewed, SNL, this issue)

The world's most *northern highway* is the macadam road in Finland, running 310 miles north from a rail head near the Arctic Circle to an ice-free Arctic Ocean port.

● RADIO

P. L. Ricker, president of the Wild Flower Preservation Society and botanist of the U. S. Department of Agriculture, will discuss "Our Disappearing Christmas Greens," as guest scientist on "Adventures in Science" with Watson Davis, director of Science Service, over the coast to coast network of the Columbia Broadcasting System, Thursday, Dec. 19, 3:45 p.m. EST, 2:45 CST, 1:45 MST, 12:45 PST. Listen in on your local station. Listen in each Thursday.