Glass fibers will melt, but they will not burn. They will not absorb moisture. They will not stretch, swell or shrink, and are unaffected by most chemicals. They offer low resistance to the flow of vapors.

Extremely fine fibers are twisted and plied into yarns which are used to weave fabrics that must withstand heat, damp and decay. Somewhat larger fibers, treated with a binder, are fabricated into blankets and boards used for heat and sound insulation. Or, treated with a binder and pressed into wafer-like sheets, they are used as retainer mats in storage batteries to give them longer life. The coarse fibers, coated with an adhesive, are used to filter dust and pollen from the air circulated by air-conditioning and heating systems.

Processes of manufacturing Fiberglas differ according to the type of fiber to be produced. The basic method, however, is to attenuate fine streams of molten glass as they flow from tiny holes in the melting furnace, drawing them out with a high-speed winder or with high-pressure jets of air or steam.

So that you can see and feel different types of Fiberglas, some soft as milkweed and others quite coarse, kits have been prepared by Science Service. The Glass Fiber Unit of THINGS of science can be secured by sending 50 cents to SCIENCE NEWS LETTER, 1719 N St., N. W., Washington 6, D. C. and asking for unit No. 40.

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METEOROLOGY

Long-Range Forecasting

Weather predictions far into the future are practicable from measurements of solar radiation changes, head of Smithsonian Institution declares.

➤ LONG-RANGE weather forecasting, based on accurately made measurements of variations in the radiant energy received by the earth from the sun, are now practicable, Dr. Charles G. Abbot, secretary of the Smithsonian Institution, declared in Washington in the Twelfth Arthur Lecture of the Institution.

Dr. Abbot told of successful trial forecasts made by himself during recent years. In one, made at the request of a colonel of engineers, he predicted that the rainfall in the Tennessee Valley during a given three-month period would be between 84% and 87% normal. As subsequently measured during the period covered, it was actually 87% normal.

On the basis of what appears to be a general tendency for the weather in a given locality to repeat itself about every 23 years, Dr. Abbot made what might be termed forecasts after the event for a number of American cities, and compared them with the records of actual weather. The fit between the curves for predicted and actual weather for Peoria, Ill., he considers especially good, and on the strength of this he has laid down a continuation of the prediction-curve to indicate what the weather should be there for the balance of 1944. This curve of the future shows 1943 ending with a severe drought, which is expected to continue until well into spring, and then break sharply with a return to normal rainfall for that locality.

Last year he undertook a forecast for Washington, D. C.: "In March, 1943, I informed the Chief of the Weather Bureau that on a certain list of dates the average daily precipitation would be higher than on the remaining dates of the year. On the basis of my calculations, the selected dates were expected to show 1.66 times the average rainfall of the nonselected dates. The actual ratio, for the 175 selected dates compared to 191 nonselected, was 1.58."

Finally, for the farther future, Dr. Abbot predicted that great droughts in the Northwest in the years 1975 and 2020 will result in serious lowering of the water level in the Great Lakes.

As background for so bold an undertaking as the forecasting of weather on the earth by a study of conditions on the sun, Dr. Abbot reminded his listeners of the sun's enormous power as a radiator of free energy. The 8,000-mile circle represented by the earth's diameter, at a range of 93,000,000 miles, is incessantly receiving from the sun the heat equivalent to a quarter of a quadrillion (250,000,000,000,000) horsepower.

But this radiation is not steady and unvarying. There are fluctuations in the rate of reception. Little is known of their causes, but Dr. Abbot has identified not less than 14 cycles, or rhythmic curves of ups and downs, which the instruments maintained in three different parts of the earth by the Smithsonian Institution have measured in solar radiation.

As one fairly direct cause of departure from the average, Dr. Abbot called attention to the way sunspots operate. Each sunspot pours out a great conical spray or jet of electrically charged particles, like a stream of minute bullets from a gigantic machine gun. These sweep in vast circles as the sun makes its 27-day revolutions on its axis. These streams of particles have a scattering effect on the light that strikes them, so that when one sweeps across the earth there may be a drop of from 1% to as much as 5% below normal in the day-

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to-day radiation received on the earth.

In conclusion, the speaker suggested the desirability of adding half-a-dozen more solar observatories to the three now maintained by the Smithsonian Institution.

"I think," he stated, "there is a great probability that if such additional solar stations were in operation they would furnish information of major value to meteorology. I believe that with the solar data that would then be available, and using the rich store of information regarding terrestrial factors now familiar to meteorologists, great progress would ensue. The neglect of solar variation, which seems to be a major factor in weather, cannot continue if meteorology is to progress as it should."

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OPTICS

Least Light We Can See

Two to six trillionths of the energy it takes a flea to jump the height of a man's ankle is involved in the minimum visible light-flash.

➤ THE SMALLEST amount of light capable of stimulating the retina of the human eye has been measured and calculated. It is between five and 14 quanta, Dr. Selig Hecht, professor of biophysics at Columbia University, stated in a lecture before the Temple University chapter of the Society of the Sigma XI, national science honor society.

Measurements of this least light that we can possibly see have been the subject of two years of very careful experiments in Dr. Hecht's laboratory, on the trained eyes of seven skilled observers. As actually measured, the "minimum flash" represented an energy expenditure of between two and six ten-billionths of an erg.

An erg is a well-known physical measure of energy: it is the small amount that is sufficient to lift a weight of one milligram one centimeter in height. Or, to put it in livelier terms, imagine a flea weighing ten milligrams jumping to the height of a man's ankle. That would represent the expenditure of 100 ergs. Two to six trillionths of the energy in such an imaginary flea-power jump is therefore involved in the minimum visible light-flash.

"These incredibly small amounts of energy represent between 58 and 148 quanta of light, and when they fall on the cornea of the eye, we can see them," Dr. Hecht told his audience. "This number of quanta falling on the cornea cannot represent the number which actually is employed in vision because about 4% of it is reflected at the cornea, about half of it is absorbed by the lens and other ocular media, and of the rest, about 80% passes right through the retina without being absorbed. If corrections are made for all these factors—all of them having been well established by separate measurements—the range of 58 to 148 quanta at the cornea becomes 5 to 14 quanta of light actually absorbed by the retina."

The structure of the retina, the speaker continued, is such that it is most probable that the stimuli involve the striking of one light-sensitive cell by each quantum. Further, it seems most probable that within each such cell the effect is produced by the impingement of the light-quantum on a single molecule of visual purple, the photosensitive substance that translates light from the physics of quantum measurement to the biochemistry of physiological sensation.

"Judging by the structure of the retina, the nature of light, and the chemistry of visual purple, it is hard to conceive of a biological system which could be more sensitive than this," Dr. Hecht remarked. "Certainly there are no physical systems which even approach it."

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NUTRITION

Pastry Dough May Be Next On Frozen Foods List

➤ HOUSEWIVES of the future may bring home from the grocery store frozen, ready-to-bake pastry dough as well as frozen berries or other fruit for the pie for dinner, it appears from an announcement by United Air Lines.

Not that the air line company has entered the frozen food field, but Fred Raich, pastry cook in its Chicago flight commissary, has taken what may be the first step toward frozen pastry dough on the shelves of tomorrow's grocery stores.

At the time he joined United in 1938, Chef Raich, who came to this country from Austria in 1923, was vitally interested in the "retarded method" of keeping pastry dough overnight by placing it in temperatures ranging from 38 to 44 degrees above zero Fahrenheit.

ICE-BOX MIX—A sweet-roll dough, which can be stored for at least 90 days before baking if kept at temperatures between 12 and 16 degrees above zero Fahrenheit, has been developed by Fred Raich, shown in this picture, who is pastry cook in United Air Lines' Chicago flight commissary. Rolls made from this dough taste the same as those made from non-frozen mixes.

He experienced further with this "ice box dough." Doughs, with a high fat content, he discovered, could, when frozen, be kept in a perfect state of preservation for at least 90 days. As a result, much time can be saved, since he now makes up single, large batches of sweet roll dough instead of small quantities every other day. This dough, when baked, is said to taste the same as rolls from non-frozen dough.

Dough for bread or dinner rolls does not stand up quite as well under the freezing process, Mr. Raich explains, because it lacks sufficient fat to protect completely the wheat structure within the dough. This causes the necessary fermentation process to break down when such dough is baked.

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A *chestnut tree* near the foot of Mt. Etna in Sicily measures approximately 200 feet in circumference; this is the largest tree trunk measurement known.