The relative size of the objects of our daily environment, of atoms and of the stars, is little known and well worth some attention. The actual figures can, of course, be looked up in scientific works, but they are so vast or so tiny that they do not mean very much to us. The range of what we can visualize extends from a few tenths of a millimeter to a few hundred kilometers, which is ample for all practical purposes. Greater distances on earth we can visualize quite well by the time it takes to cover them, by boat, train, or plane. In judging the size of the earth in comparison to the objects on it, we are already rather vague; we find it hard to believe that on a globe of normal size the highest mountains and the greatest depths of the ocean appear as less than half a millimeter.

In order to visualize the relative sizes of the heavenly bodies nearest to our earth, let us imagine the earth to be a globe of one millimeter diameter, that is to say, about the size of a pin’s head. The scale would be 1:13,000 million. In that case, the moon would revolve around the earth at a distance of 3 centimeters and would have a diameter of 4 millimeter; the sun would be 12 meters away and would have a diameter of 11 centimeters, about as big as a grapefruit. So the diameter of the sun is almost twice the diameter of the moon’s orbit. Thus, if the sun were hollow, the earth and the moon in their true distance from each other would have plenty of room in it. The fact that both heavenly bodies appear to us to be of the same size is due to the ratio of their sizes happening to be equal to the ratio of their distances from the earth. In atlases or geographical works we sometimes see illustrations to explain how eclipses take place. Although factually they are correct, the dimensions shown are wrong, since a scale drawing cannot possibly be made.

In our model, Jupiter, the largest of the planets, would revolve around the sun at a distance of 63 meters and would be 11 millimeters in diameter; Pluto, the most remote of the known planets, would have to be imagined 470 meters away. This, then, would be the size of the solar system if we represented the earth as a pin’s head.

The time required by the earth, Jupiter, and Pluto for their journey round the sun is one year, 12 years, and 248 years respectively; it increases more than the distance from the sun, so that the outer planets travel more slowly than the inner ones.

What about the speed of travel? Is it great because great distances have to be covered, or small because there is plenty of time to cover them in? Actually the distance to be covered outweighs the available time, so that the speeds are great: the earth moves at a speed of 30 kilometers per second, Jupiter at 13, and Pluto at 5, while the fastest known man-made projectiles have an initial speed of approximately one kilometer per second.

We mentioned before that it is sometimes possible to visualize distances by the time taken to cover them; hence it is quite convenient to express the distances spoken of above by the time required by light to cover them. For the circumference of the earth, it is scarcely more than one eighth of a second, for the distance from the earth to the moon a little more than one second; on the other hand the light from the sun takes 8 minutes to travel to the earth, 43 minutes to Jupiter, and 5 hours and 30 minutes to Pluto. So a beam of light emitted by the sun travels for a few hours in the solar system, i.e., for the first few hours it has a chance of hitting a planet or comet; but after that there is nothing for quite a while: the next fixed star (α Centauri,
the brightest star in the constellation of Centaurus) is not reached until a little over 4 years.

In our model, in which the earth is as big as a pin's head and 12 meters away from the sun, this star would appear at a distance of 3,000 kilometers. Consequently, if we wish to visualize the comparative sizes in the solar system, our terrestrial distances become infinitesimally small and the distances in the stellar system unimaginably vast. So we need another scale for visualizing this latter system. Let us represent one light year (the distance traveled by light in a year) by one millimeter, so that the nearest fixed star appears at a distance of 4 millimeters from the sun. Then Sirius, the most brilliant of the fixed stars, would be 8 millimeters away, and most of the other brilliant stars a few centimeters up to a few score centimeters.

Now the sun belongs to a cluster of many millions of stars called the Milky Way because most of these stars are not visible to us singly on account of their great remoteness, so that all together they appear to us as a misty streak. This cluster of stars is shaped like a flat lens which in our model would be 4 to 5 meters thick and have a diameter of 10 to 20 meters. On an average there would be one star to every cubic centimeter. Our solar system is somewhere near the center of the lens. This accounts for our seeing the greatest number of stars in the direction of the outer edges of this lens, where they appear to us as the Milky Way; while, when we look to both sides through the central parts of the lens, the sky seems much emptier.

The sun is one of the smallest among the fixed stars. But although there are stars whose diameter is five hundred times that of the sun, all these sizes are minute in comparison to the distances between the stars. We can visualize this as follows: if all the matter contained in our system of the Milky Way were not concentrated in the celestial bodies but evenly distributed over the entire space of the system, an area of the earth's size would contain no more than 100 kilograms.

All the stars are moving about without any particular order. The sun moves at a speed of 20 kilometers per second, and the speeds of the other stars are of a similar magnitude, i.e., so small in comparison to the vast distances that millenniums pass before the space from one star to another is covered. For this reason and because of the comparatively small size of the stars, it is a matter of extreme rarity for two stars to collide or even to approach each other close enough to exert a noticeable gravitational force upon each other. It has been conjectured that our planetary system owes its existence to one of these rare occurrences and that hence there may be no second system of its kind anywhere in the universe.

The great emptiness within the galaxy of the Milky Way is even surpassed by conditions outside this lens-shaped structure. Far beyond the confines of this structure there are similarly shaped clusters of stars called spiral nebulae because the early telescopes were not strong enough to dissolve them into individual stars. Particularly large and close, and hence visible to the naked eye, is the nebula in the constellation of Andromeda; in our model, in which the Milky Way has a diameter of 20 meters, it would be 850 meters away, with a diameter of 45 meters. The most remote nebulae whose distance can still be determined would appear 100 kilometers away. So the emptiness between these galaxies is even worse than that within them. Before we mentioned the figure of 100 kilograms filling the space of the earth's volume if all matter were evenly distributed, but taking into account the entire known universe, it would only be one milligram! That means that every single atom has several cubic meters of space at its disposal in the universe.  

INSTEAD of making use of this space, however, the atoms crowd terribly close together in bodies, and they can do this without difficulty, as they are so small. While before we reduced the earth to the size of a pinhead, we should like to ask you now to imagine the opposite, i.e., a pinhead increased to the size of the earth. In that case the atoms and molecules would have a diameter of several meters. We might say that the dimensions we are accustomed to on earth are closer to the atoms than to astronomical dimensions. Nevertheless, a study of the smallness and number of molecules is likely to provide some surprises.

Let us take, for example, a liqueur glass of water. The number of molecules contained in it is about 10\(^{23}\). Expressed in this way, it looks quite harmless; perhaps we feel a little
more respect when we say 100,000 trillions, but we still do not realize the true significance of this gigantic figure. Now let us imagine this small glassful of water equally distributed over all the oceans down to the greatest depths. Would, in such a case, the molecules of this liqueur glass of water still be in hailing distance of each other? Indeed they would, and more so: if we were to use the same glass to scoop up some water from any part of the oceans, we would simultaneously have to fish up one of the molecules originally crowded together in the glassful of water.

By the fact that so many molecules find room in one c.c. we can estimate their size. If it were possible to string them onto a thread like pearls, some 3,000 millions would go onto one meter of thread. Yet this is only a tiny fraction of the 34,000 trillions contained in the one c.c. Should we want to string them all, we would arrive at an astronomical length, namely, about 10 times the orbit of the earth, viz., the distance the earth covers at a speed of 30 kilometers per second in ten years. One might almost feel inclined to think that the molecules are not so small after all. But let us not forget that this astronomical string of pearls can be put away in a box about half the size of a lump of sugar.

From their number it is easy to calculate the weight of atoms and molecules. Here is a nice comparison: the number of one-kilogram weights which would go to make up the weight of the earth is equal to the number of atoms which go to make up one kilogram of silver. Thus as regards weight the objects of our daily use occupy a position somewhere halfway between the atoms and the stars.

EAST WIND

By HELEN AF ENEHJELM

A Finnish novel published in Helsinki late in 1945 has just reached us. Entitled "In the Lee of the East Wind" and written in the form of a diary, it describes life in Finland from 1941 to 1943. In view of recent developments, this book is probably the last of its kind to come from the unfortunate country for a long time. The excerpts we have translated deal with the central theme of the novel.

The author was born in America. We knew her as a student at the University of California at the time when she met a visiting young aristocrat from Finland who later became her husband. In 1932 she moved to Finland, first to Helsinki and then to her husband's family estate. She rapidly acquired the language in which she published several books. Among the characters appearing in the following excerpts, Magnus is the husband of the diary writer; Haukkan her husband's friend, a surgeon who has lost an arm in the war and is employed as a tutor in her house; Brita her friend.

NOVEMBER 20, 1941. The wicked east wind, which chills all the homes of the parish, little huts and big mansions alike, is blowing again. This wind is our evil spirit and often inflicts itself upon us from November to April. It lasts for several days on end, and the people get a tortured look, not only in their eyes but in their whole faces. They set their teeth, fine wrinkles crisscross their faces, their eyes become red-rimmed and expressionless, and it is as if they hoarded all warmth deep within themselves.

Oh, how I love Finland and her people at such moments! The whipping, tireless east wind undermines their spiritual forces, but it is unable to shake their calm. Our wind is not like the sirocco of the south, the wind from Africa which drives people to the verge of insanity and causes conflicts and crime. Our east wind is the wind from Siberia, evil incarnate, which has always come from the east, depressing, ever present, but hard to put your hand on.

I think the east wind has been blowing without interruption since September 1939. I always become particularly aware of it when I look through the window over my desk and see how the stablemaids in their thin blue dresses and white aprons move in this wind. Bowing their heads and struggling forward in its teeth, they are a complete personification of the Finnish women on the home front.

I cannot help longing above all for a spiritual trade wind, a warm, steady, smiling breeze which would blow tenderly over Finland and over me, too. What could not this wind achieve! Marigolds and lilies of the valley and violets would blossom in the hearts of the people, the birds would return, the brooks would babble again, and fish would play in the whirls of little streams. But the east wind is blowing over Finland, and the women feel its