OUR INHABITED UNIVERSE

Part V—The Rings of Sol

By JAMES BLISH

AT THE American Museum of Natural History in New York City there is a model which must have given many a visitor to the museum a bad case of creeps. It is a model of the city, as it looks from an airplane coming in toward La Guardia Airport at an altitude of about 4,000 feet. And hanging over the center of Manhattan, almost resting on Times Square, is a smooth ball of rock which looks to be almost a mile in diameter.

The model is intended only to give visitors a good visualization of the size of the minor planet (or "asteroid," a misnomer but now official) named Hermes; but it succeeds also in suggesting an incipient disaster of unprecedented magnitude. If the visitor happens to know that in 1937 Hermes came within 485,000 miles of the Earth—and that at one point in its orbit it may likely come even closer, inside the orbit of our own moon—the model becomes even more vividly suggestive. And if, to top it all off, the visitor has seen Chesley Bonestell's painting of what New York might look like *after* an object only a fourth the size of Hermes had hit it—a painting which happens to picture the city from about the same height and visual angle as the model—the impulse to get out of the museum fast and head inland is almost overpowering.

Actually, of course, the chance that our Earth might suffer a collision with Hermes or any other asteroid is vanishingly small.

And with the thought of such unlikely calamity aside, the asteroids in general take on a different and much more interesting appearance.

Ringside Seat

Suppose we "stand" out in empty space, at a position about one light-year above the north pole of the sun. From here, the orbits of all the planets are laid out below us in a flat plane, like imaginary circles (or, for the purist, ellipses) on a platter. Seen from this point of view, the asteroids lie in a broad ring around the sun, between the orbits of Jupiter and Mars.

The resemblance of this ring-system

Rivers of Cosmic Junk Surround the Bringer of Light!

to the rings of Saturn is startling in some respects. Like Saturn's rings, the rings of Sol consist of rivers of cosmic junk: more than 1500 known bits of flotsam, plus a probable 28,000 others of much smaller size. The known planetoids range from mountain-sized lumps no bigger than Hermes to large "islands" in space almost 500 miles through. (None of the particles making up Saturn's rings is any bigger than an ordinary pebble, of course.)

And, like Saturn's rings, the rings of Sol show marked divisions, known in both cases as Kirkwood's Gaps, caused by gravitational disturbance from larger planets nearby. The gaps in the rings of Saturn are created by Saturn's three inner moons, Mimas, Enceladus and Tethys; Jupiter causes most of the gaps in the asteroid belt, but there is also a faint division attributable to Mars.

In the asteroid belt, however, things get done on a bigger scale, as befits the rings of a star. The belt starts much farther out from the sun, in comparison with Sol's diameter, than do Saturn's rings in comparison with that planet's diameter; and the belt is far broader on the same comparison scale than are Saturn's rings. A simple table shows quickly the enormous discrepancies between the two systems (the figures represent miles):

	Saturn's Rings	*Asteroid Belt*
Diameter of Primary	75,000	864,400
Inside Radius	82,000	175,642,000
Width	83,000	223,207,000

Reduced to proportions, these figures become even more startling. The rings of Saturn begin at a distance less than 1/11th the diameter of Saturn above the visible surface of the planet; and they are about 1.12 times as wide as Saturn itself. The radius of the innermost asteroid orbit, on the other hand, is more than 204 times as great as the diameter of the sun, and the belt is more than 258 times as wide as its primary!

Left-overs of Creation

These proportions would seem to indicate that the rings of Sol are not, after all, basically like the rings of Saturn. This suspicion deepens when we note that there is at least one other sun (RW Tauri) which is ringed, and that this ring is made of incandescent gases, not solid particles. Here the resemblance to Saturn completely evaporates, leaving us with the more likely notion that the sun's rings are simply a late stage of such a gas-ring as RW Tauri's.

The best theories we have developed at present, the Weisaecker Scholium and the Hoyle cosmology, tend to confirm this suspicion. Saturn's rings probably were formed by the breakup of a Saturnian satellite; we'll duscuss how that happened later on. At one time it was thought that the asteroids belt was formed by a similar process, but later it turned out that the theoretical objections to this idea were numerous and knotty. For one thing, if all the asteroids were lumped together into one body, the resultant planet would have a mass equalling, at most, only 1/500th that of the Earth's—a body a mite more massive than Mercury, perhaps, but hardly big enough to get into gravitational difficulties with the sun.

Furthermore, if we adopt the "exploded planet" theory, we are forced to account for the five major families into which the asteroids fall, and at present it looks like we'll need five separate explosions to do it—just five times as hard to account for as one explosion. It is easier at the present time to consider the asteroids as left-overs of creation—fragments that failed to be included in one of the major planets when the solar system was formed.

Nevertheless, these fragments remain interesting to astronomers because of the hundreds of theoretical problems, such as those we've just mentioned, that they continue to pose; and to the layman because they are, in a real sense, a closed universe of independent planets, each one unique and special.

Anyone investigating the asteroids for the first time finds odd and intriguing situations coming at him faster than he can take them in. There is Eros, a flat granite brick, five miles square on end and fifteen miles long, tumbling end over end through space; there is Anteros, which was given its popular name (not at all official) by the editor of a science-fiction magazine; Ceres, 480 miles in diameter, big enough to be a major moon of any of the planets (and enormously bigger than either of the moons of Mars); Hidalgo, which is at one end of its orbit, only twice as far away from the sun as the Earth, and is ten times as far away at the other end; the Trojan asteroids, which aren't in the belt at all but are grouped neatly in the orbit of Jupiter, trailing the giant planet by 60°; Ganymede, a 20-mile chunk which bears the same name as that of the most massive satellite of the entire solar system; Adonis, which comes close to the orbit of Mercury at perihelion; and Vesta, which has such a low apparent density and such a high light-reflecting power that it may be made entirely of ice. . .

The Primeval Planet

Naturally, such a large and various gathering of little planets has attracted the imaginations of science-fiction writers, who have proposed everything from mining the planetoids to putting them "back together," like a gigantic jig-saw puzzle. Back in the 1930's it was customary to refer to the larger asteroids as habitable—indeed, they were often described as jungle worlds. Actually there isn't a trace of evidence to suggest that any form of life whatsoever could exist on any asteroid now (except, perhaps, for a few bacteria in the inactive or spore state.) Probably no modern science-fiction writer would even think of penning such a sentence as this one, from a major story published in 1931:

"Pallas swung around in their field of vision, and there was a fleeting glimpse of sun-lit spires of mountains, shadowed valleys, and mysterious crevasses from which clouds of steam and yellow vapor curled."

Even in those days it was known that Pallas was only 304 miles in diameter—the story even says so a page earlier—so that the chances for its having mountains large enough to notice, an atmosphere, enough water vapor to make steam, or enough vulcanism to make fumaroles are precisely nil. Furthermore, just how noticeably "sun-lit" a spire could be at a distance from the sun of 257,618,000 miles remains dubious.

If we are to think about life in connection with the asteroids, we must go back to the old (and still favored here and there) concept of the single planet which exploded. Following the lead of Ross Rocklynne, who sent an expedition to the asteroids for that purpose in TIME WANTS A SKELETON, let's re-assemble that primeval planet—always bearing in mind the chance that it may never have existed—and see what it might have been like.

We'll put its distance from the sun at 2.8 times the distance of the Earth, which is where it "ought" to be according to the Bode-Titius rule. We'll assign it a maximum possible mass of .05; (the total mass of the asteroids has been put as low as .006 by Alter and Cleminshaw, but the four largest alone should add up to more than that.) If we then assign our synthetic planet the same density as its nearest terrestial-type of neighbor—Mars (4.0)—we will emerge with a sphere 3,000 miles in diameter; a sphere displaying almost exactly the mass, and density characteristics of the planet Mercury!* (And needless to say, a good deal bigger than our moon.)

Atmosphere and Life

At 2.8 astronomical units from the

*A good many considerations enter into the choice of the figure for density which would require more discussion than we have space for here. In order to play safe, I've put it at 0.2 on what is probably the conservative side; if this correction should prove unnecessary, our synthetic planet's diameter would expand at about 3500 miles, or only slightly smaller than Pluto.

sun, the asteroid-planet would be cold. Even under a heat-conserving atmosphere the temperature would rarely rise above 10° F. on the "hottest" day of summer; the average normal temperature would be around -55° F., while the low point (midnight in winter) would fall around -110°. This low point is too ferociously cold to permit the survival of any creature of known metabolism which is not safely sealed in a comparatively warm burrow long before the low point is reached. However, the low temperature-average has an even more interesting consequence: it means that if our synthetic planet had an atmosphere, it would have been able to hold it.

Probably the planet would have had an atmosphere. Almost all the bodies in the solar system capable of holding an atmosphere have one, including Jupiter's satellite Ganymede and Saturn's satellite Titan, both of which are about of a size with our asteroid-planet. In addition to this observational evidence, our present theories of the formation of the solar system strongly favor the chance that a planet forming between Mars and Jupiter would pick up an atmosphere.

Which raises the question: what kind of an atmosphere?

A thin one, since the planet would have been small; but perhaps no thinner than that of Mars, which has successfully nurtured so much life that we can see it growing from Earth. Since there is at least one asteroid, and that a major one, which seems to be made of ice, the atmosphere would have contained some water vapor. Very possibly it might also have contained ammonia, methane, or even cyanogen, poisonous gases all; whether or not it would have contained free oxygen is more difficult to guess; here we can say only that we can't be sure enough of our speculations to risk writing them down.

Traces of Life

If there ever *was* a single planet in the area where the asteroids are now, however—and the question has by no means been settled—it might have harbored some form of life; probably something simple, tough, and fantastically cold-resistant. Nor are we barred from any practical answer to the problem, for if there ever was an "Asteroidium" which carried life, that life will have left traces in the exploded rocks, traces which are still waiting for us, traces which the first explorers of the asteroids will find.

Science-fiction writers have often pictured spacemen mining the asteroids for mineral riches. It may well be, however, that the first explorers of the minor planets will be looking for something far more interesting:

Fossils!

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by
Frank Belknap Long

And Someday to MARS

He was the first man on Mars, and the last to find happiness

YOUNG JIM stood on the high bleached hill, staring down at the Martian village. It had stopped raining, and there was a smell of burning autumn leaves in the air. Not the raked-over autumn leaves of Earth, brown and crisp and sere, but the blue lichenous leaves of Mars, many-petaled, poppy fragrant.

Young Jim straightened his shoulders and went striding down into the village he'd helped to build.

He sang a song as he went, a trivial little song he'd picked up at his mother's knee long ago on Earth.

Someday to Mars
We'll all be going
It will be like stepping