SPECIAL ISSUE

A DECADE IN SCIENCE

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THE WORLD OF SCIENCE

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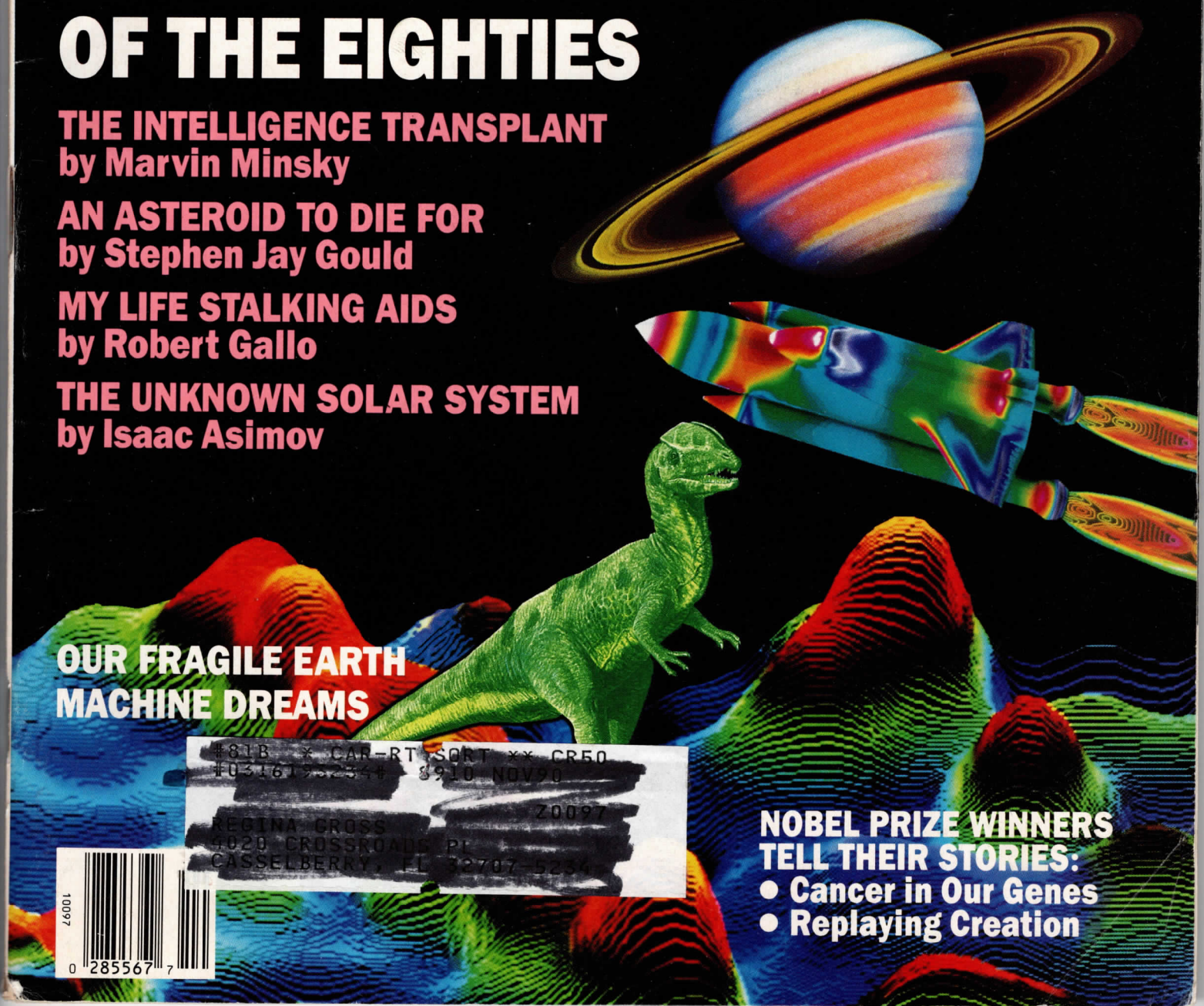
THE EIGHT BIG IDEAS OF THE EIGHTIES

THE INTELLIGENCE TRANSPLANT
by Marvin Minsky

AN ASTEROID TO DIE FOR
by Stephen Jay Gould

MY LIFE STALKING AIDS
by Robert Gallo

THE UNKNOWN SOLAR SYSTEM
by Isaac Asimov



OUR FRAGILE EARTH
MACHINE DREAMS

NOBEL PRIZE WINNERS TELL THEIR STORIES:
- **Cancer in Our Genes**
- **Replaying Creation**

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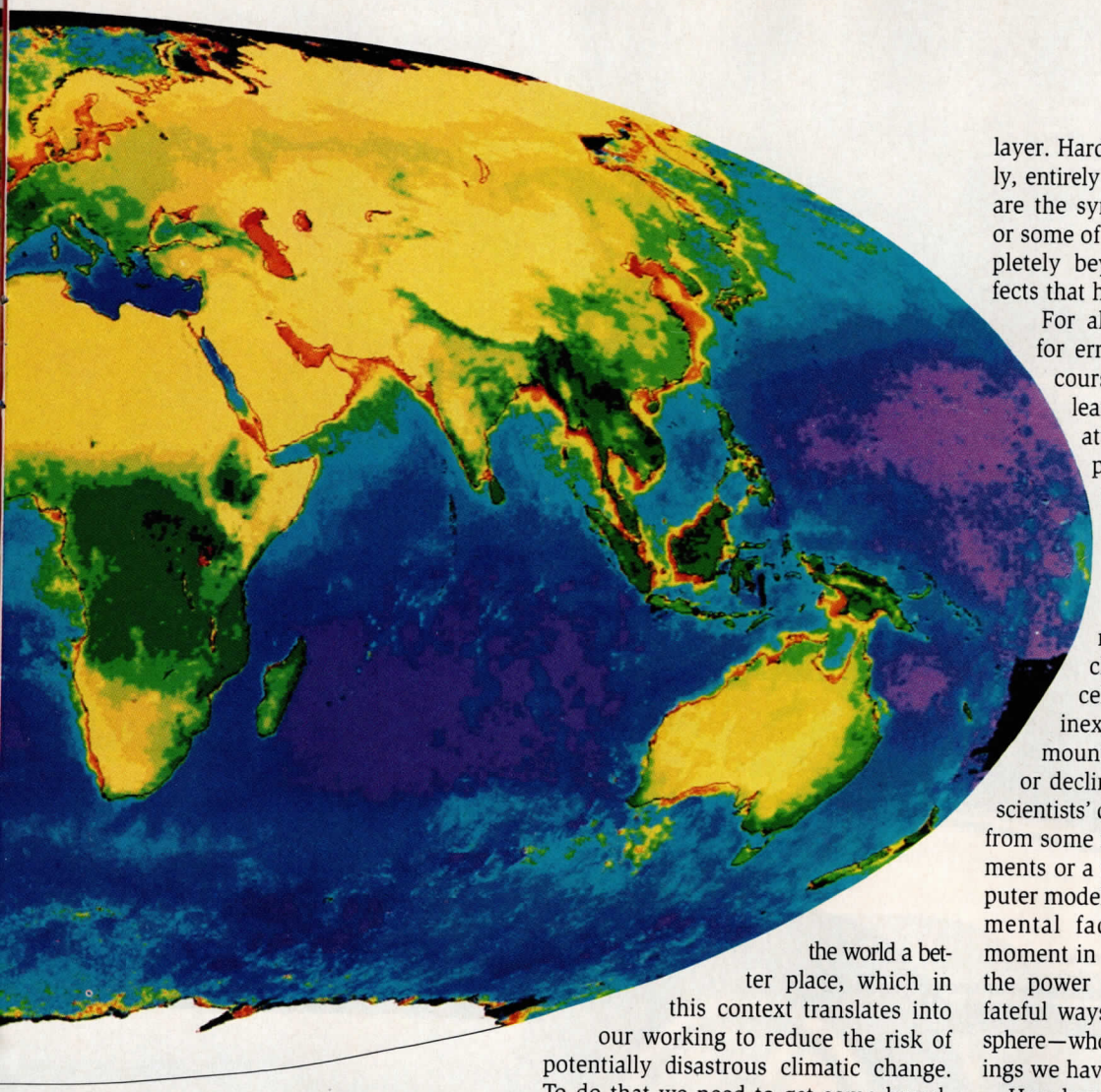

sented no grave, immediate danger to the ozone layer. However, our wish for certainty—for solid factual ground beneath our feet—places the scientists in a quandary. We are asking them to do something that in their profession is normally considered mildly disreputable: we are asking them to make predictions based on little information. Worse, we are asking them to make predictions about that notoriously unpredictable matter, the weather—and to do so regarding the weather not just of, say, Michigan over the next three days but of Earth over the next century.

Stephen Schneider of the National Center for Atmospheric Research described the scientists' dilemma this way: "On the one hand, as scientists, we are ethically bound to the scientific method, in effect promising to tell the truth, the whole truth, and nothing but—which means that we must include all the doubts, the caveats, the ifs, ands, and buts. On the other hand, we are not just scientists but human beings as well. And like most people we'd like to see the world a better place, which in this context translates into our working to reduce the risk of potentially disastrous climatic change. To do that we need to get some broad-based support, to capture the public's imagination. That, of course, entails getting loads of media coverage. So we have to offer up scary scenarios, make simplified, dramatic statements, and make little mention of any doubts we might have. This 'double ethical bind' we frequently find ourselves in cannot be solved by any formula. Each of us has to decide what the right balance is between being effective and being honest. I hope that means being both."

The caveats, ifs, ands, and buts are extensive. To begin with, the magnitude of the various perturbations (to use the scientists' delicate word) of the environment are difficult to predict. And estimates of even the immediate effects of those perturbations are unreliable. Still harder to predict are the ground-level consequences of these effects—for example, the number of feet by which sea level will rise given a particular rise in the temperature of the globe, or the effects on phytoplankton of a particular increase in ultraviolet radiation caused by a particular reduction in the ozone layer. Harder yet to predict—lying, really, entirely in the realm of speculation—are the synergistic consequences of all or some of these effects. And lying completely beyond prediction are any effects that have not yet been anticipated.

For all these reasons, the margin for error is immense. And that, of course, is the real lesson to be learned from the world's earlier attempts at predicting global perils. What the mistakes show is that in these questions even the most disinterested and professional predictions are filled with uncertainty. Uncertainty in such forecasts is not a detail, soon to be cleared up; it is part and parcel of the new situation—as inextricably bound up with it as mounting levels of carbon dioxide or declining levels of ozone. For the scientists' difficulties do not stem merely from some imperfections in their instruments or a few distortions in their computer models; they stem from the fundamental fact that at this particular moment in history mankind has gained the power to intervene in drastic and fateful ways in a mechanism—the ecosphere—whose overall structure and workings we have barely begun to grasp.

Here human power has outrun human knowledge. The stream of history, once contained within the natural world, has now overflowed its banks and threatens to inundate both nature and itself. If the stories of melting glaciers and drowned cities seem out of place in our newspapers, that is because we are now called on to decide in a few years questions that until now were decided over eons by the rise and fall of mountain ranges, by rain, by wind, by the patient winnowing of natural selection, by continental drift. In several decades we threaten casually to alter the conditions of life on Earth in dramatic and possibly irreparable ways. We have placed ourselves in the driver's seat of evolution and are now the guarantors of the survival of all species, including our own.

Last April a candidate for president in Brazil advocated a reduction in international debt payments as the price for saving his country's rain forests, whose rapid destruction is contributing heavily to the buildup of carbon dioxide in the atmosphere. Such demands are sure to be the stock-in-trade of international