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### ROBOTS PROBE THE TITANIC - AMPHIBIOUS MAN: THE NEXT STEP IN HUMAN EVOLUTION - UNDERVATER COMETS - WHALE SUICIDES - THE ULTIMATE SPACE GUIL - WHY GOD RESTED ON THE 7" DAY-ARTHUR CASA AND OWN X TRATERRESTRIAL LIFE

### MYSTERIES OF THE DEEP



#### VOL. 8 NO. 10

**JULY 1986** 

#### EDITOR IN CHIEF & DESIGN DIRECTOR: BOB GUCCIONE

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On this month's cover hybrid Japanese carp, called kov, float anound a suspendib sphare in a sumeal underworld of effer 5 Sea Direanim—one in a sense of fandasy paintings was created by Charloy Brown and exhibited first in Paris. It belongs to a Europiani collector. 4 DNN





 It seems only reasonable that our bnormous cosmos must be bopulated with other creatures some of them more advance than we are. was sent to ague perestal real to shape Monary Merca Mars Auster Salan-

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COSMIC COMETS



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In "The Cities of Neptune" (page 36) writer Bill Lawren reports on the farsighted aguanauts who are designing submanne hebitats These self-sufficient structureselaborate tourist complexes complete with hotels and discos-will be surrounded by fields of algae and corrals of fish And utopian architect Jacques Rougerie foresees an underwater crylization where pseudomutant amphibious humans will evolve within the marine environment. developing their own philosophies and values. Other researchers are contemplating outfitting humans with artificial gills that will allow people to extract oxygen from water.

"I became more enthused about this story than any two ever written," says Lawren, who si king in Spain, completing General Growes and the A-Bamb, to be published by Dedd, Mead. I'mow plan to relocate closer to the Spainth coast so I can actively pursue sea diving and oppertment with underwater construction."

Yet another marine enthusiast, Robert

Balard, compares himself with the creature. from the Black Lagoon, needing to keep his gifts wet by frequently returning to the water in this month's Interview (page 60) the Woods Hole oceanographer and geophysicist reviews such personal accomplishments as pioneering undersea robotics, discovering hypothermal vents (small ruptures in the ocean floor); and locating the remains of the it-fated Titanic, his most publicized leat. "Most scientists have never actually seen the ocean depths," says interviewer and Omni senior editor Douglas Colligan, whose most recent book is The Healer Within (E.P. Dutton) "Ballard, however, is the real Cantain Nerro, risking his life to explore virgin territory

Deep within this mysterious world creatures have traveries for millions of years. Now such robotic devices as Balard's Argo and Alve are enabling scentrists to volve the delicase, gelatinous organisms we know as jellyfish. The pictonal "See Dinters" (page 50) offers a glimpse of these intrigung animals in their natural environment.

But while Ballard is excluding the dark cosan flow, others are studying space and finding revulses to the formation of Earth's oceans in "Cosmic Consts of the Sea" (page 68) wher James Ermany resents a staggering astronomical theory. Small sey consts may be hurting into Earth's upper atmosphere at the rate of 20 a multic, releasing enormous amounts of water. These comets may help explain drains charals characterizes that caused Earth's to agree and the extinction of the dhoreaux. This is the most exciting clear in years, and the data support the interpretation, "agree Emman, a source reporter for the Rost Standard, a source reporter to the Rost Standard, a source reporter for the Rost Standard, most Standard, and to belive:

Like travel to the ocean floor, successful spacetaring requires not only decication but also considerable skill and knowledge how wal prepered are you for living among the stars? To find out, take the space-aptitude quiz ("Space Viewnal," page 42) assembled by writer Nei MocAeor, whose book, The Com (Space Almanacin early 1987.

Science-fiction suffice Keyn O'DorneV, Jr., evides his own vision of the future in "Rock Garden" (page 46) in an alien world, protecting an endangered species can be as official as it is on Earth. O'Donnel's previous work includes "Marchiana" (June 1960) and the recordly published novel CM/s (Berkeley).

For many, July means a week in the country or long days at the beach. But Orniv contributor Judith Hooper offers an account of one family's summer vacation finoigh a firm everp and not the exofic worlds of painter Roger Dean ("Metatour," page 74), where adventure is limited only by the imagination **CO** 

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#### FOREIGN EDITIO

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### COMMUNICATIONS

#### A Garrulous Defense

I and bacapointed with Peter Carrisons column "Scheller Weis (Steece, April 1996) Why do articles about the Strategic Defense Influsive present opnismon only by those who oppose it? The article of the dots from the University of California at Benelloy—two of these professors are quoted by Samon—dispute the UNIV aren't soft or edition. See the UNIV entit the Verentian California at and won the skin certain.

The mechanics of the antibulitic missic shield have not yet been obtermined free/can the expetis from 1 missic shield have a strain of the expetise to a demonstration of something called a laser beam i had no drait i was where ing the beginning of a new identificity the samptation of the expetise of the operations to industrial strain of the called at the whole whole not and samptation of the probability would have socilited at the whole demonstration of socility of the whole demonstration of the society they both me.

William Boland, Jr Nicaslo, CA

Editors' note. As with other contraversial topics, Omni has encleavored to present both sides of this holdy debated issue (See the Robert Jastrow interview, September 1985, and the July 1984 starwars issue.)

#### Peaceable Kingdom

Thank you for this warm and telling pitooing pito is easy. "Shared Destination in April's assue. These is a beson in it for all of us. Was are hims testimony to the intercependence of this on Earth. Perinape if we put away our use of war, make obsolide by nuclear before the survey of easure the survey of the survey of easier and unive, the startish and scaller, the larvey oreb and tellivetin.

Barbara R. Morrow Madison, WI

#### Universal Scents

The Oscola High School psychology classes enjoyed the anticle "Scentmental downeys" (April 1986) I was current, informative, and well written. My students were amized because the future holds such great possibilities for this tittleunderstood sense. We had a great time taking the "Scontsability" fest" and anxjoush await the results.

> Lee Herr Osceola High School Kissimmee, FL

Lapplaud the ongoing research in the field of olfaction, but once again scientists are assuming that results from laboratory tests on frogs and mice are applicable to humans. Although it is clear that biochemical and cenetic factors explain the serise of smell in animals, human reactions are probably learned and culturally influenced I would encourage these scientists to collaborate with ethnologists in establishing cross-cultural studies on human offactory stimulation. We know that people see in the same way but crosscultural visual experiments show that people classify colors very differently. For example, the Navajo use one word to describe a green-blue-purple color range Why should people from non-Western cultures not react differently to certain offactory stimulants? We need an interdisciplinary approach to this study

Hollywood FL

#### State of Siege

The Greet Wall of Tooss Society proceeds to erect a well sorted that process save (Animator, April 1986). This some save (Animator, April 1986). This some of the most worthwith carrydca's of the cantury (wst) only that I, darm Yaheo that Jam had a space mition or two to contribute. After al, a border works two ways. It mght they the 'arrives out of the Lone Star State and contain the recencies. If were cally usaky we mght never hear again of the Contays or Clear, Datas, or Sematr Tweet.

Greg Krupey North Huntington, PADO

### ON THE MEDAL OF LIBERTY

### FORUM

Forty-one years ago I was among a number of scientists selected by the Chinese government to come to America to learn about management and technology. We planned to stay in America. only one or two years before returning to help our homeland rebuild after the war

As it turned out, the Communists seized control of China at about the same time I was completing my doctoral studies in applied physics. I knew I would never live under communism, so I made the United States my adopted home

On July 3, at the relighting of the Statue of Liberty, the President will give me a modal in recognition of my contributions to computer science. I am protoundly honored by this award. But in a larger sense the real heroes are the millions of other immigrants who came to America. and helped shape a society unique in its diversity and unimited in its opportunity

My life in both China and America bas been neworably bound to science and education. As a young boy and college student. I knew that the United States had the world's finest educational system and led the world in scientific innovation Today, however, America's students are reluctant to pursue scientific careers, and our academic institutions are hard-pressed to keep pace with our nation's ever-increasing need for individuals trained in technology

When I was still a boy my teachers ourtured my instinctive attraction to the sciences. They were visionaries who believed that by embracing these disciplines, China could regain her place among the world's great nations. Their excitament was contagious and helped engender my lifeiong affection for scientific endesvor I believe, therefore, that as a nation and as individuals, we must assist the teaching profession in its efforts to attract and retain qualified individuals who possess the talent and the will to motivate the young people entrusted to them.

This effort demands coordinated national leadership-an articulate voice to define a visionary strategy for American education. If we rely on the flexibility and creativity that built our nation, we can 12 CMINI

force the aliances needed to train the young people peoplessary for the economic and social growth of America.---An Wang Founder Wang Labs, Inc.

The news that I was among the 12 naturalized Americans to receive a Medal of Liberty on July 3, 1986 was good medicine for the surgically patched up heart of this almost eighty-year old man My thoughts went back to the first time. I gazed upon the majestic Statue of Hiberty more than 65 years ago and the exating visions it stimulated of a new life in a new land. When I look at the Statue of Liberty today. Libink not only of itty own full life as an American but of all who came to this land before and after, at different times from different nations, to build the greatest nation-but one different from all others in the world. And Lalso, cannot help remembering the millions of my fellow Jews who did not make it and were burned like garbage by barbaric members of the nation with the highest level of education and culture

The uniquely remarkable feature of becoming a naturalized American is that you not only become a citizen with all the accompanying rights and privileges but that you also become an Americana member of a nation composed of people from all nations. I could never become an Englishman, Frenchman, German, Italian, Swede, Russian II I had been naturalized or even born in those countries because the people of those nations share a common heritage that is, and of necessity must continue to be. different from mine But Americans of all national origins have built and are continuing to build a new heritage with which all Americans can identify And then, there are the beautiful and remarkable new hybrids, like my two daughters and grandchildren, who are Jewish-English-Scots-Irish-German-Americana

With this perception of my creat, unique nation of the United States of America I nurture a hope. It is a hope that it will be a president of the United States who will take the initiative to bring peace to the world by breaking the impasse of justifiable distrust and suspicion between the USSR the primary cause for each nations continuing preparations for war against the other-a war that nather nation wants. a war that the world dreads, a war that cannot be won, but if it should come to pass would destroy our civilization.

Instead of futile conferences on arms reductions in which each nation continues to seek a mittary advantage over the other. I would hope that a new mitiative would replace the present dangerous confrontations of the two superpowers in poverty-stricken countries. By cooperate ing with those and other economically undeveloped countries against the common enemy of poverty and despair that affects one half of the world's population, we may try to build the trust needed for peace and ultimate disarmament

In this dangerous era of nuclea armaments there is an urgent need for implementation of a decision that neither communism nor capitalism will conquer the world, and allow each to continue with the evolutionary changes in progress The most important challenge to mankind now is for the more developed countries. capitalist and communist alike, to develop strategies whereby they can work together in helping the hundreds of millions of desperate poor people who cannot help themselves, to a point where they would be able to help themselves. Let the USA and USSR wage war together against the miseries of poverty, which are many things but especially not enough food, poor education, the indigrity of unemployment, and no hope for eve achieving the better file that other people enxy. To meet this challenge, the need is not for armies with weapons of destruction and cleath but for new kinds of armies. They will be composed of teachers apronomists engineers architects doctors, public-health specialists, and all sorts of specialists who could help bring the benefits of science and technology for the creation of the better material and spintual life that can be had right here on Earth - Albert B Sabin

Developer oral polio vaccineDO

### WHALE SUICIDES

### EARTH

By Douglas Starr

The score is littered with black, biolad bodes swelf or in the standar smoot them, sovery so often stabborg his floring kine front a 15-lood plot whate. Wilking as the cuts, the cutyhared biologist sites the length of the address through as mich of white blubber for the little in a monitor white blubber for the little in the direction coloring for parametes and examining the adrenal gands for scars, a significant sign of stress

"Just two days before Entry hard network an emergency call all his bit in Bostor's New England Aquarium. Nnetry-four whates, it seemed, were wallowing in mersh grass off Cape Cool II was the biggest stranding in docates, driving at the scend, hiw waldor among the animals, biggest of the cool of the animals, the median cool of the animals, the median cool of the animals, the median cool of the animals, stamming its powerful tail (no Early's inght leg and discorting his knos.

Now fitted with a cast, Early dissects the whales, seeking to understand the bizarre suicide of these intelligent creatures, which occurs almost like clockwork, year after year. The phenomenon had hsunted Anstolle, who said it was "without any apparent reason." Modern biologists have been more persistent, oflering theories of their own.

One biologist, for instance, found combrowns in the inner ears of standed delpins and suggested that he worms and inersity descripted the dothinal ability to rangest it later tunned out thoop, whilen't is attracted or not. Yet another theoret suggested that whiles, which are descended from land-dwaling animits, might actually tank back to some primordial memory at deak later firms that would have rendered whiles extinct millions of years ago.

In the last couple of years, however, two teams of scientists have gained true insight into the strandings. At the University of Mam, biologist Dan Odel sludied the Gail Stream current by looking at hundreds of satellite mermal images. He noticed that smell branches of the current



Boached whales have long been one of nature's most tragic enigmes M. CMNI accasionally meander into cool waters closer to the shore, hen prich off and closethe Those off-course currents, he specialized might carry squid, a prime food source for tygrity sperm whiles Whates that follow the squid might soon consume the finited supply, finding themselves close to the shore without food Strandings would be the result

· Scientists in California, meanwhile, are advancing another theory, that whales follow the path of magnetic minima, area where the earth's magnetic field is at a minimum. The notion grew out of research conducted in the late Seventies, when the United States Geological Survey used a magnetometer to produce distailed maps of magnetic patterns along the East Coast Years later Joe Kirschvink and colleagues at the California Institute of Technolomy compared whale strandings to patterns in the earth's magnetic field Sturbring official records of stranding events, they found that in 95 percent of all cases whales washed up where magnetic minima intersected the shore "It's as though somebody had run off a road," says Kirschvink, who adds that his findings support speculation that whales navigate with internal compasses "I can't say why the whales strand, But I can say where the road is

Could either theory explain the giant stranding off Cape Cod? Odel notes that the Guil Stream often veers drastically off ocurse in the area of the Cape. But he reluese to geouate on how this affocts any species but oygmy sperm whates. Krischvirk says the very place where the plot whates became stranded is the sted of a significant mignatic mirmum.

Both Kirischwirk and Ödell stress that their fundings are merely insights into whele strandings, not explanations. Early notes that any explanation has to account for the whales herding behavior, which in some species is so strong that an enfre pod will follow one member ashore

"The strandings result from a dozen factors, maybe half of which we know about," Early says "Beached whales are like crashed planes—you can't use one theory to explain them all "OO

### MEGASCOPE

### STARS

By Marcia Bartusiak

he scene is a familiar one: a line of radio telescopes stretching to the horizon, with the miles-long network action as one diant eve on the universe: Badio astronomy's premier instrument is the Very Large Array in New Mexico Together its 27 dishes have the resolving power of a single dish 17 miles in diamotor. Until recently such a sight was the exclusive domain of radio astronomy. But by the twenty-first century optical astronomers could have their own version of a megascope on the mountaintops of the American Southwest

With the cost of optical telescopes plummeting, it is conceivable that multitelescope arrangements will become more common at ontical observatories. "It's an idea that people have had in the back of their minds for a very long time ' says University of Minnesota astronomer Boharta Humphreys "But the technolomy was just onlithere-until new."

Explains Humphreys's colleague. infrared astronomer Terry Jones "Telescope designers are beginning to offer optical telescopes that are lighter, use less motal and are easier to put innerther." For these reasons astronomers can now order a batch of telescopes without a Joan from Fort Knox

Almost by accident the two Minnesota astronomers found themselves spearhearing a movement to establish the first multiscope facility in the United States. Because available time on the world's largest and best optical telescopes is a precious commodity, the astronomy department at the University of Minnesota hoped to convince two or three other LLS universities to join in erecting a single 3.5 motor ontical/infrared telescone on an appropriately dark mountaintop somewhere in the Southwest. "To our surprise, more than a dozen universities expressed interest," Humphreys says-"From that response we knew we weren't talking about one telescope, but several "

According to Humphreys and Jones, a consortium of astronomy departments from universities across the country envisions a cluster of three or four telescopes on an Arizona or New Mexico CAN

mountaintop Spaced about 50 to 100 varia anart, all will be coordinated by a computer at a central operations petiler

With the multiple array, each telescope could be equipped with a different detector-an infrared spectrometer on one an optical photometer on another, for evenue-and could accomplish an across the spectrum observation of a sky object in one night. With observing time doled out so spannoly, it now takes three or four secarate runs with a single telescope and up to two years to accomnish the same task

The multiple array eliminates other problems. Astronomers are always trying to take the observations made at one observatory and compare them with data dathered at a different time with a different instrument. But the celestial object under study is likely to have changed between observations." Jones says And trying to get two observatories to look at the same thing at the same time can be an administrative nightmare

Being able to make simultaneous observations is particularly suited to



A bunch of telescopes at bargain rates

released objects that change dramatically over days or weeks. Such a telescope, for instance, could belo astronomers decide whether guasars-the brillant come of newborn galaxies-are truly nowward by black holes, which theorists say, intermittently gobble up matter and snew out lountains of electromagnetic energy "Dwarf novae-binary star systems where mass is being transferred leading candidates," says Jones Somehow energy is built up during the transformation and is periodically released in a temendous explosion." The multipleminor telescope will allow astronomers to observe these transformations by examining different parts of the electro magnetic spectrum simultaneously

"With identical detectors on the four 3.5-meter telescopes." Humphreys adds. we could also turn the array into the equivalent of a giant seven-meter telescone in terms of the amount of light that is collected.

In a decade or so it might even be possible to connect the telescopes with either fiberoptics or a series of mirrors and to operate the entire array as a giant interferometer. By comparing the light waves received by each telescope astronomers could deduce the sizes of holb stars and quasars

Right now the multiple-mirror telescope is just an idea, but Humphreys and Jones. hope to convince some starstruck millionare that their proposal is a bargain. And at \$20 million to \$25 million. It would be. The consortium would be building three or four telescopes for roughly the same price that one grant telescope would have cost a decade ago. Once funded, the array would join an ongoing renaissance of new optical-telescope construction that includes the Hubble Space Telescope and the ten-meter Keck Telescope atop the extinct Mauna Kea volcano in Hawaii

The project is known only by the matter of-fact name Multiple Telescope Observatory "But whoever comes up with the most money," says Jones, "will probably be able to call it anything he wants "DO

### THE ARGOSSEY

### EXPLORATIONS

By Charles R. Peliegrino

he steel compartment onboard the resourch upsed Mohille was a commotion of activity. Tanos ware being plunged into consoles maps were being made, numbers called out, and data looped. The array of screens, showed pllars of lava ahead. At the flier's station Earl Young culled back on the winch, causing Argo, the small-finned robot nearly two miles below the Pacific Opean to circh its tether The altmeter clicked up five meters six meters still Argo was not at the top of the lava mound "It's absolutely huge," sard one crew member. Ten meters. The obstruction covered half the monitor screen. And what were those on top? Crincids (sea lifes) Arao scraped the top of the column One of its cameras olimpsed chips of lava failing as hundreds of severed critical arms floated through the water

The screens flickered, and for a moment they appeared to be on the verge of blinking out, but the potture and data readouts flashed back to normal. Our robot was still allive on the bottom of the ocean it was not Aran's exonnt mission. Robert Ballard, leader of this expedition first used the sophisticated undersea robot to confirm that a large sunken ship in the North Atlantic was indeed the IIIlated Transc. (See Interview, page 80.)

We detak-pagning station, Nerrind I kenad in my oanis, doing mich Y cenners had statinged Argo's varon: The dark statistic and the statistic and the statistic transmission of the statistic and statistic control and the statistic and statistic watched by any of the statistic and statistic manned submersible and statistic and statistic manned submersible Argo and the statistic models and the statistic and the statistic and the statistic models and the statistic and the statistic and the statistic models and the statistic and the statistic and the statistic models and the statistic and the statistic and the statistic models and the statistic and the statistic and the statistic models and the statistic and the statistic and the statistic models and the statistic and the statistic and the statistic models and the statistic and the statistic and the statistic models and the statistic and the statistic and the statistic and the statistic models and the statistic and the statistic and the statistic and the statistic models and the statistic and the st

At Alvin's maximum depth of two and a half miles, the total pressure on the crew compartment is 62,000 tons. No dhing suit or airlock has yet been conceived that



After the Titanic the robot submersible Argo being prepared for its second mission 20. OWN

can allow an oceanaut to step out onto the East Partic Reis on to touch the decks of the Takare. The difference between space exploration and deep-see excloration is that you are always confined to your capacia with decep seal. On the motor, if you want to see which is beinn to you, you simply that do and food. On the the bud of Awa around—winy cancelly enter bud of Awa around—winy cancelly with Argo, though, its a little easter One need only, punch a budtor and switch to a row camera angle

For all of us abcard Meiville, the robot Argo was a gant mental transporter Our whole seemfile party could descend with Argo seeing and hearing the bottom inreal time. In a manner of speaking, we were leaving our kidneys and gallbladders of this surface and, through Argo's eyes and ears, sending our sprills into the new world

Spreading before us on the Pacitic manye were increar steams of polarised black glass (obsider). As Aryon moved tarback glass (obsider) as Aryon moved starback glass greev close and we saw an end the single sawet by a never ending providel of all from maddy heres of clean treators, and the blefators of clean treators and the blefators.

"It gate much despet toward the contunential explant Roger Heimian one of the Ferrich members of the Argo-Rise team. "The ismow's amble deep of there and everywhere you go in the cosen it you drill down's are nough through the much you will strike invis formations just like the ones we observe on the near All the very bottom, all the oceases in all the world are law?"

To me this was all a dress rehearsal for deep space. Even in the Argo control room my minio folton wandered up from the bottom of the opean to the stars and Voyagor 2. That spacedaring robot was 2 bitton miles away and in only a few weeks it would hurtle past Uranus commado an West #

### BOOKS

### THE ARTS

By Robert Weil

hat if a Christ-like figure were to appear on Earth exactly 2.000 years after the birth of Would his birth be the crowning scientific achievement of genetic engineers who by using in-vitro ferblization, create an "immaculate conception"? Would be (or she, perhaps) emerge in more mortal fashion, born to a married housewife with four other children? Like his biblical antecedent, would his place of birth be the now collocally divided city of Jerusalem or a Midwest town like Kokomo, Inclana? Most crucial of all, how would we come to recognize this long-awaited savior as the man who had come to rescue mankind from its dangerous destiny?

These and cuestions that Colleen McCollough the Australian born writer, poses in A Creed for the Third Milennium (Avon, paperback). It slanted to postukite what would happen if a rather Christlike man appeared at the dawn of our next milemmun. I brought it would be logical to have a character named Joshua Christien born in the year 2000 and to have him die in 2033," says McCulough

The incipitation for the duruntic tase even durung a valit McCuTough made to the United Status in 1894. Sins hard lead the United Status in 1894. Sins hard lead the status of the status of the status of the part of the sins datus of the status of the grad at Natio-New Heven Modical Contor and isocial decay thick had rewayed the sins at toom that two-body the industrial and isocial decay thick had rewayed the sins at toom the two obvoords dying. It also says. "Unrong the thrugs silling it was unchas the singh could be define the silling unclassified with the silling industrial unclassified with made of the decollers that the only mage industry left was National that the only mage industry left was National

Drawing upon it his apocallyptic value, McCullcup, researd the scenario for a society that had become so calibrarily descended and physically monitoriand that the Nake Haven of 1964 would seem files paradise in companion. Projecting any scenific theory that also called the industrial McCullage Accession industrial McCullage, these to plungs the area into a new ice age.



If government taks, spinituality is main's only answer, according to author Collean McCullough 22 OMNI the Black Death."

Dut of the Arclic gloom of New Haven, crac 2020, emerges Dr. Joshua Chinstan, a genite-spritted savor who challenges this unhappy kulture's ruddniese government Creed attempts to all'em McCulcucyh scheid hait I government fasi, spenuality is men's only answer But the religon she depicts is very untradibocal and her messiah's mennoda aro not base of savors in pror centure.

Heidright to product of a starw manger. Chreften is the computerized creation of an abscitzmer, media dominated agaterized and a starward of the starward agabeganization of the Environment to provide appeil the antiferinity and agate and all the and distection. Disrwarg on hier own oxpenences as a mode star after the worpenences as a mode star and the worpe

"I'm not sure whether a Joshua Christian is entrely possible," says McCullough "but I think he is. And I've felt that I would be the Americans who would produce him rather than any other county."

Coddy encugh, Amorica has not reated as entrusationally to Cred as have other countries. The American people, according to MocAllough, doing to these to deal with the devestation brought on thy World War II and have difficulty contemplating a world where groceries and world where groceries and been hardle for Americans to deal with these themes because they lead the most comfortable lives, "the norse."

Clean the enormous television followings of American proceeders like Robert Schuler and Jimmy Swaggart, how lar are we from seeing the fingtych image of a Jesuis Hor mession on a video schem with a seducities MTV bed in the selevision seeingensal ament and messfel Soci And messi religions are not reaching their people in the wor they once did "OD

### COMFT COLLECTORS

### SPACE

By Owen Davies

carly a year before any foreign spacecraft made a first visit to Halley's Cornet, NASA astrodynamicist Robert Farguhar finessed a low-budget flyby of another visitor. Comet Giacobini-Zinner (See Stars. October 1995.) The feat was even more remarkable because he managed to do it with a used satellite. But that wasn't enough for the Goddard Space Flight Center scientist. Now he wants to return and brind bits of the cornet back to Earth

If his current scheme flies, his next mission will meet Glacobini-Zinner in 1998 Called the Multicomet Sample Return (MSR), it will also visit three other corriets D'Arrest, Honda-Mrkos-Padlusakova. and Temple-2 Farguhar plans to have MSR bring back parts of each of the compts

With typical ingenuity Farouhar plans to have MSR do more than just collect samples. He also wants the craft to study the electrical fields around the comets. collect information about the sun, and test Einstein's theory of relativity

And in the tradition of Farguhar's other mission. MSR will be cobbied together out of existing spacecraft-in this instance a backup spacecraft designed for the Mars Observer mission to be launched in the payt decade. As Earcuiter envisions. # MSR will use three craft: a 1.700-pound mother ship (a reworked Mars orbiter) and two 550-pound daughter probes adapted for the mission. The daughters will take turns fiving into the heads of the comets while the mother keeps its distance collecting data and providing guidance for the craft.

As space science probes go it will be a bargain, costing about \$200 million. "It's almost perfect," Farquhar says. "Our contract lets us buy several spacecraft with only minor modifications. With the budget problems we're all facing, we have to get as much information from each one as we can "

According to Farguhar's schedule the shuttle would carry the probes aloft in Nevember 1992. The mother craft would he equipped with an X-ray telescope. a coronagraph (a special telescope that measures the sun's outer atmosphere). OMN

and equipment for measuring electrical fields ions and neutral particles By August 1993, while MSR waits for the first comet to arrive, the instruments will scan the sun and give astronomers a sidelong view of its surface

A ractio sounding beacon on the mother craft will measure the density of electronics in the sun's corona. "That will also let us test relativity because we can measure how much the sun's gravity bends the ranto waves " he adds. Finstein had predicted that electromagnetic radiation would bend in a gravity field. We now know that starlight does, but more work is needed to confirm that it bends as much se Finstein forenast

Once the probes pass beyond the sun they will make the first rendezvous with Cornet D'Arrest in July 1995 The mother craft will study the comet's electromagnetic environment and photograph the head On July 27, 1995, It will dispatch a daughter craft to fly through the head of the cornet, where it will collect dust and gas semples. Once that is done if will begin the king journey back to Earth orbit



Comet, a new scheme to catch a failing ster

Four months later the unmanned Orbital Manerweinig Vehicle (OMV) will meet the engreenant and bring it to fee space station. Technicians will remove the collected dust and gas samples to send to Farth for analysis, outht the craft with new collectors refuel it, and send the probe out again.

While the first probe is being propared the mother craft and the second probe will have moved behind the sun to collect more data and to wait for Cornet Honda-Mirkos-Padiusakova on January 30, 1996 The second daughter craft will close in on it and collect its samples. The following November the prohe will reach the pickup point in Earth orbit

By then the probe that mot Comet D'Arrest will be on its way to reion the mother, it will make its rendezvous with Giacobni-Zinner in November 1998 and be back in Earth orbit in 2005. The tinal part of the relay will be completed when the second probe, which will leave Earth orbit in March 1999, files through Comet Temple-2 and returns for retrieval three years later

Barely on the drawing board, MSR is already winning a few friends. "Almost no one has beard of it wet ' admits Farouhar. but those who have seem to like if One of its supporters is Fred Scart, a corriet specialist at California's TRW, Inc. "It's ospecially valuable," he says, "because practically all these comets swing in close to the sun, where some of the most important processes in a comet's life occur

It MSR succeeds, it will produce a series of stunning firsts, which suits Farguhar just fine. "The French and the Soviets are really going to be upstaging us in the inner solar system," he sava The Soviets plan to land on Phobos [the innermost moon of Mars], and there will be a whole series of Soviet Venus landers. The Multicomet Sample Return one-ups them for a change

Farguhar plans to do what he did with his first coup, the International Cometary Explorer (ICE) "I'll just keep working on it until someone stops me. It's a lot easier to obtain forgiveness around here than it is to get permission "DO



### CONTINUUM

### THE OCEANS INSIDE US



efore there was a cradie of civilization, there were the oceans, endlessly rocking. We were born in their blue fathoms right along with the porpoises damselfish, groupers, and painted sea shrmp, which devour starfishes soft belies. So was all the rest of that

aleicloscopic marvel. If e on Earth, which includes such unlikely cousins as bread mold, polar bears, golden-shouldered parakeets, marine iouanas, and human beings who share an ecosysem and watery beginnings

Odd though it may seem, we have much in common with the guana. We have the same genetic code. The wardrobe of our cells is identical. Our elements were forged in an early chaos of the sun. We move because carbon is a molecular wild card that bonds easily. We spend a large portion of our lives in an odd fantasia called sleep. Our earliest versions began in the oceans. Just imagine a brand-spanking-new biology Part of the thrill of discovering life elsewhere in the universe will be how similar if makes all life on Earth suddenly appear. There are days when, in an excess of modesty. I slide off the present and remember that eans ago we began as fish flopping from pond to pond until

To some extent, we are here because water freezes to ice, and ice floats. Otherwise, the oceans would have frozen solid, and no summer would have been able to thaw them, at a time when ife trying to develop or sist hang on wouldn't have stood a chance. Remember that in winter your roof leaks because a sheet of ice is trapping a small ocean against the shingles

We still carry the primordial ocean within us. Our blood is mainly selt water. Ebbing and flowing, our veins mirror the tides in a sense, we are the opean's way of thinking about itself. When I scuba dive, a human woman with a womb in which eggs lie coded as roe. I often feel that I am returning to the womb from which I sprang. Skin is the thinnest layer between our salt water and the ocean's, our monthly tides and its. No wonder we sit for hours on beach towels and in deck chairs, with a patience now erful as thick, green glass, and watch the waves rolling without plot or purpose, as we will be in time. We watch the guils olide overhead like a pair of brackets and the waves run like herds of white mice between the hypnotic tantrums of the surf. Early in the twentieth century a kinky disciple of Fraud's Sendor Ferenczi, went so far as to write in Thalassa' A Theory of Genitality that men made love with women only because women's wombs smelled of herring brine and they were trying to get back to the primordial sea. Remember that at the wrong moment and life as

What it all boils down to is water-hydrogen and oxygen. Mainly it's hydrogen, the simplest atom, consisting of nothing but a nucleus and one electron-or one positive charge and one negative, if you like The positive charge is 1,800 times as massive as the negative, the electron, a mere instruction of matter, its whereabouts ifly (somewhere within a radius of 1 15 angstroms from the nucleus, a range scientists like to depict as shadow). Who can say where the electron really travels? You watch it the way you watch a cat run behind a slat fence. I am thinking how hydrogen gave rise to everything in the universer limestone caves sweaty and cool in the summer, clarkoli, ocelots, adenoids, realousy bombs, pulsars, star-nosed moles, pouring, the fetlock stars by which raceorses are identified, video games, desire, I'm thinking about the cosmos before the Big Bang, when the universe was all in one place and solid, a hard object in an endless ether, which exploded into a prowling radiant log of hydrogen and helium, which coalesced into stars-some hot enough in their innards to forge the elements-and into planets-some cool enough to harbor lit What a long, dicey journey from that tough, silky ball of hydrogen to a sac of chemicals that can contemplate its oceanic origins

I like to think how even the old-fashioned word fathom comes from an ancient German word, Fathmaz, which means the dis tance between two outstretched arms. So whenever we use this word we are, as it were, embracing the ocean itself, and ever when we use the word as a verb we are subconsciously pa tribute to depths that we can measure as accurately as we with but whose mysteries continue to charm and elude us. Just the other day I discovered in a medical textbook what struck me as an amazing fact, that the ions in the muscle of the heart-so dium, potassium, calcium, and magnesium-are the same as those in seawater. I don't know why that should surprise me. After

Diane Ackerman is a poet, memorist, and fiction writer whose most

### CONTINUUM



When nuclear-power plant accidents strike, such is happened at Three Mile fallend and Chemobyl, the conventional worker is to drink potassium lightle. Now there may be a more convenient antidate

#### IODINE FOR NUCLEAR ACCIDENT

What should you do if you learn there's just been an acodent at your local nuclearpower plan? After you finsh parricking, run to the bathroom and rub tricture of lodine over your paw.

Radioactive isdine is one of the most diargeous gates that can be emitted during a nuclear acolident. The thyroid gland, which uses solme to make an important more, can't distinguish between radioactive and regular lodins. So when explain lodins, So when active solme the gland absolves owner the gland ab-

Fortunately, the thryad gland doesn't absorb unitmtied quantities of lodine. Once it has stored all it needs, excess oldine in the body is excetted. That means a person can prevent his aperson can prevent his thyroid gland from taking up the radioactive chemical by flooding 4 with the sale, nonradpactive kind. So clinisate have ecommended that in the event of a nuclear accident, people drink potassaum ioide. But there are some problems, potassum soid er sa prescription drug, so it would have to be distrib uted because people don't have it tying around; it has a finite shell file; and too much is poteomous.

Noto other forms of norms of norms disactive to indice, however, are safe and readily existable inclure of locidine (the stuff you put on scraped knees) and povidene (ordine, a gemiculie used extensively in heapitals and on farms Kenneth Miller, a health physiciat, and colleagues at Pennsylvania State University reasoned that since radiactive live lother can be absorbed through the skin, iodine trom thisse norprescription preparations can be, too.

To feet the idea, the scentast ingeded 72 rats with radioactive rooms. One third received no treatment. One third were given potassum rodide orally. The researchers dipped the hind paw of the remaining third (an area comparable in size to the human hand) in other thather building or covidant idding. Dipping the paw, it turned out, was just as effective in blocking the uptake of radioactive molacules as administering the iodine orally

Miler's team will be testing the procedure on humans shortly.---Leah Wallach

SECOND SHOT

Having sexual intercourse a second time, 30 to 60 "New who have a really low aperm count might want to try a second spiculation an hour or so later," suggests the researcher, reproductive endocrinologist Jerome Check, M.D., professor of obsettrics and gynocology at Thomas Jelferson University in Philodophia, "They can try this a home and see what happens"

Def of Checkle patients, a security effective make, security effective make, security effective make, a moreoscope and discovered that his sperm count had increased on the second try. Check than documented the phonomenon in a sluidy of 20 aupposedly infortite makes. Fourteen of the man, it runsed out, had a higher sperm count on their second try, at least doubling the consertation's had he of the ame program. The unifies the standards.

"This defies the standard dogma," a surprised Check



is love better the second time around? For men who want bables but have low sparm counts, a second session may be just the licket

minutes after the initial encounter, may be a cure for infertility in some men with abnormally low sperm counts, according to one recent spentific study. says, "which holds that the second ejaculate has a lot lower concentration than the first." One possible explanation for the anomalous rabult, he theorizes, is that certain

28 OMNI

men have higher second-try sperm counts due to maifunctioning sperm ducts in the tip of the penis

"The first time they don't get a really good emptying of the ejaculatory ducts," he says, "so they need a second lush to get all the sperm out "--Enc Mishara

#### PLASTIC BATS

When Active Doubleday invented the game of basebail more then a century app, the basic ingredient of the hitter's bat was good old Northern ash' Which is why he wouldn't approve of Jail Head, why, it he has the work about made of propheterendrozed artefield with a cellular urethane foam. In other works basic

Head is president of the Worth Bat Company in Tuliahoma, Ternossee, an outfit that sells so many bats ervely year that t renks with Louiswill a Slugger, Rawings, and even McGregor in the wonderful word of bats worth alls more than 1 millian a yead. So percent of this a yead. So percent of this a yead. So percent of this a yead. So percent of pey both hardball and softpey both hardball and softball That's where the money, is in the bat business—in amateur bat.

Heald makes a telling point for his company's bat when he says that Worth's new fightwaight, plasto-resin model, dreveloped by General Electric Plastics, may sell for around \$90, but it doesn't break Breakage has been a costly problem at the bio leacue level, where a



Will major leaguers ever forsake wood for plastic?

club can destroy some 2,000 bats—costing anywhere from \$6 to \$20 apiece—in the course of a normal season

Of course, the commissoner's office sint about to orkay plastic bats the Worth's Basebal officiation doesn' while Heald is still trying to get his model accepted, he sint counting on it. He doesn't have to. The market is in amateur ball.

The Worth bat also elminates the sting that some hitters experience in cold weather, and a ball hit by one doesn't make the annoying

#### pinging sound common to a)uminum bats.

But its main advantage, says Heard, is that the distribution of his bat's main core can be adjusted to yield a 'sweat spot'---that area where a ball can be hit with the greatest force---some four times larger than that of the woolden bat.

-George Nobbe

---Walter Lippmann

"The notion that science, left to itself, is bound to evolve more and more of the truth about the world is another Jluscon, for science can never exist outside a society, and that society, whether dalibrately or unconsocutally diverse its course."

-Northrop Frye

#### CIGARETTES AND JET LAG

After years of warning that smoking causes one disease after another, maddaal science may have stumbled onto a beneficial use for the cigarette. Smoking may halp to prevent jet lag.

Neurophysiologis Joseph Miter of the Unwarkly of California has been studying arcadian rhythme, those daly peaks and vallays in our metabolisme. According to Miter, hese rhythms are controlled by the suprachasematic nucleus, a small bundie of old shart sits atop the optic nerves in the bain.

#### ter this nucleus is light (such as the rising sun), it will also respond to several chemical substances, among them interties A very small amount of nicotine—equal to one cigaretto—is enough to trigger the nucleus and start the circadian cycle for enother day

Jet lag and certain sleep disorders are caused by an interruption of the circadian rhythm. Traveling across time zones throws your internal biological clock out of symc. Smoking a cigarette at the proper time after a long time may help to resynchronize tha circadian mythm and prevent that tilled, washed-out leaing.

What's the proper time? Miler has yet to determine that "It will depand on whether a traveler is flying east or west and how many time zones he crosses."

this isn't necessarily good



A well-limed amoke cous help defeat jet-lag effect

nows for smokers: "It may be effective only with nonsmokers. Smokers have built up a tolerance for nicotina that renders the drug ineffective "---Nick Engler

### CONTINUUM

### NYMPHS AMON

Nuble maids mining the seafloor for manganese? Bridge players tapping the Compulsive gamblers farming the sea to support than costly habit? Such colonies could at he in NASA's figure (IPD), a market research firm in Norwalk Connecticut future of ocean industries

"Our staff believes that today's space agency soon will be expanded to encompass the frontiers of the deep oceans as well as the IRD's Suzanne Bores So make that NAASA the National Aquaspace. Aeronaution Bores points out that in common hostile, arless solation and loneliness There is even a school of ments should be developed by one aroup of trained astronaut/aquanauts," she adds. "So many of the activitios and skills are the same "

Then again, maybe not All this is from an IRD press release Behind the type bes a workariav market research report. 'This is more futuristic than most of our work," says Mark Pine, who wrote the report. "We're dealing with opportunities that may not mature until the year 2020. But it's all serious business "

The study, prosaically Ocean Commercial Opportunities projects the growth of mining, a possible \$3 billion industry by early in the next century: ocean waste disposal also set at \$3 billion. sea farming, to earn \$25 billion within 35 years, ocean billion, desalination, \$40 billion; and offshore oil and cas. \$50 billion it doesn't say much about nuble maidens

"We certainly feel that in the long term there might be some actual short-term homogeneous groups." Pine maintains "For example, the statting of oil rigs can easily be defined. They are run by muscular males. There may well be other groups that form because of



Will the oceans be awash with fuscious maids mining the seafloor? WWWWASA become MAASA? Maybe Than again, maybe not

we're not really saying that mnino \*

It's a brave try But when proped down. Bores berself press releases ... they're not wrong, but they stretch the truth a little to make it interesting. This is somethin() that could happen, but it's not happening "-- Owen Davies

#### MICROWAVE SCALPEL

A new microwave scalpel may save nations' spielers. and possibly their lives.

"This is an ordinary scalpel that has been modified. with a small loop antenna built into the blade so that it radiates microwave energy." ard Taylor, an electrical engineer at the University of Maryland in College Park.

The spleen is usually removed completely when it is injured because surgeons bleeding, which if allowed Unfortunately, removal of the spleen-a large, spongy organ located in the abdomen that filters harmful stream-may cause (in a nation's nearly 30,000 spleen removals a year) eventual death from infection.

But the microwave energy emitted from the new scalpel inventor Taylor explains, instantly heats the spleen's tissue, clotting blood at the exact moment the incision is made Instead of removing the entire spleen, a surgeon can cut off it ist the damaged section while sealing off



New scalpel. The loop

bleeding in the remainder. in place

"This device," Taylor says, bleeding indefinitely" Thus far the microwaye scalnd has tory animals, and the first human operation is anticinated shortly.

The device will sell for between \$5,000 and \$10,000. Taylor estimates, and is at being widely available for human surgery -Enc Mishara

-Jonathan Swift



If man is to conquer space, says one Los Alamos scientist, he'll need outposts for space voyagers to use as way stations,

#### GALACTIC GROCERY STORES

Galactic grocery stores stocked with rocket fuel, water, oxygen, building materiatis, and hospital supplies for use by future space poneers could be a reality in fewer than 40 years, accordming to a nuclear physicist at the Los Alamos National Laboratory in New Mexico

Paul Keston, in a report to the National Commission on Space, says, "The outposts, like an pass, would be a havan for space voyagers" who settle bases as near as our own moon and as distant as Mars or beyond "Partechoad" Not really.

claims Keaton, a founder of

the Lunar Base Steering Committee and a coauthor of an earlier report on the possibility of establishing an international research center on the motion

Keaton's newst report prigonts two locations, called Lagrange equilibrum points. The first, L1, is about 1 mittion mikes *away*, where the earth's gravitational pull just about balances that of the sun. L2 is 300,000 mikes out, where Earth's pull roughly equals that of our moon.

According to Keaton, if we began the developmental process in 1997, we could have prototypes in position by 2007, the fifteth annwersary of the first Sputnik launch by the solver other other set up, he says, the stations would need title fuel to remain in place and could drift about in what the space people call halo ofbts. And they would still be close to construction supplies such as the natural resources of the moon, certain asteroids, and the Martian moons.

and the Wastes i moons Not only that, they might serve as transportation depots from which future space travelers could catch connecting flights to other destinations in the solar system, using gravitational vebority as singshots to assist them farther out into space — George Nobbe

#### RAT MOTELS

Ever wonder what rats do when they to on the roam? Well, rost easy: UCLA bologist Michael Richt has done your wondering for you. Richt fillted ministure rack transmitters to he nocke of four city-diveting Norway rats and nins cold rais, which prefer the more suburban environs of hy wreas and bougamittes busites. After monitorium their reverences in

for a month or more. Recht

had what he calls an "enor-

mous file" on what the rats were doing. ("The CIA," he notes, "has been doing this sort of thing for years ")

Recht found that the range of Norway rats was as extensive as 20 acres-about 20 times larger than previously thought in fact, so farflung are their territories that they sometimes end up spending nights in little motels" auxiliary burrows dug at the fringes of the rance (Boof rats, with a range of only about three acres, make alternate nests that function more like rest areas. Recht likes to think of them as "calés ")

Actually, Recht tound, the 'motel' burrows are much more like occlusive vacation homes: As the rait moves in and out, he fur deposits oils on the burrow walls, and the eletinchive odors of these oils are almost as good as dead botts—ones sinf, and an intruding rait takes it on the tam

Is there any social significance to this research? "Certainly," says Recht "It kept me from doing a lot of extra teaching, and who knows what damage I would have done in the classroom?"—Bit Lawren



One of Recht's roof rats, litted with radio transmitter, being released These particular animals prefer creating their own "cafes "

### CONTINUUM



Frequent manuana smokrisk from viruses, foreign bactena, and disease, warn of Illinois in Chicago

cannabinol, the psychoactive incredient in manuana. was placed into human blood samples, researchers David noticed blood-onli changes ability of the body's immune system to combat disease

proteins, called receptors, on the outer membrane of disease-fighting white blood cells. Without the receptors, immunologist Wederhold says, the white blood cells can't identify or interact with other substances and thus might not be able to coordnate counterattacks acainst invader diseases

Although no actual link between manjuana use and disease has been shown. not only cast a shadow tional use of manuana but raise doubts about the manuana and its chemical cannabinoids, to prevent pressure associated with alaucoma

tion in the structure of the cannabinoid molecule," Ou, a pathologist, says, "would purposes, while decreasing -Eric Mishara

'Jesus said love one another He didn't say lave the whole

Relaxing may be hazardous to your mental health

woman whom we had hooked moasures heart rate, muscle ders Clinic of the State University of New York at Albany. and beginning to relax. Then, a massive panic attack, full-

had the same response, Barlow and colleagues sharply increased anxiety



was often reported by clinicians as a side effect of relaxation therapy. Thomas Borkovec of Pennsylvania State University noted that as many as 54 percent of his patients reported anxiety -Mother Teresa di ring meditation 30 percent.

Barlow believes these people are alarmed by physiciogical sensations associhands, for example, and changes in breathing. They feel they are losing control or Hence, panic. They can work through the panic easily Barlow says by practicing the relaxation exercises with the help of a trained supervisor

away for tapes, play them at home panic, and come tages and couldn't even get came to us and said. 'I can't come to the clinic regularly and I can't afford the full get me to the point where I can get through my tapes?" -- Leah Wallach

---Sigmund Freud

"Budget a mathematical

of American motion pictures, I order to convert the entire



Preemie pouch Taking a mothering tip from kangaroos

#### BABY IN A POUCH

A frail baby girl born in a Michigan hospital 12 weeks prematurely grew fat and testy when removed from the isolette and carried around in a kangaroolike pouch

brth, had to be separated from ber mother and placed in a neonatal intensive care unit. Premature babies fike Cill often have to be taken from their mothers and until they develop sufficiently womb These procedures otherwise die but also disrupt the normal process of infantmother bearing. In Cals case, as in many premature births the mother just sixteen, wasn't very interested in her newborn child. The nostbirth separation bari bonding with Cit. "I would say 'Pick her up, hold her,

#### louch her," " Dr. Marta Airala

a pediatrician at Albion Community Hospital, says of Ciji's young mother. "She would do it for a few minutes, but then she would stop."

Arala had been thinking of using a pouch to help mothers of preemies reestablish intimacy with their infants by constant physical contact. Og seemed the ideal candidate to test the idea

Arate prepared a contion grow with a preemve-size pocket positioned over the chest so the baby would rest on the left side, near the bealing heart. Clif's mother began carrying her baby in the pouch whenever she was in the hospital.

Ci) thread on the human contact. Her emotional, physical, and neurological improvement was dramatic Her appetite increased, she gained weight, and she bocame allott and demanding. After ten days of the pouch treatment she was olumo enough to go home

Arials, a nistive of South Annota, got the rise to the pouch by observing women in traditional cultures, who obtain carry then bables nead to there badies "Human mothers have been carrying their infants close to themselves in a variety of positions for thousands of years," she says, "The pouch is year another application of the same ontional"

-Leah Wallach

#### SWEETNESS METER

Consumers soon may find sweetness labels on the onions in supermarkets Scientists with the U.S. De-

#### partment of Agriculture

(USDA) have developed a light meter that can "read" the sweetness of onions and possibly of other fruits and vegetables

"We found that by using near-intered light and speace filters we could measure the dry matter in onors, which is related to their seventress." says chemist Gerald D. Duil of the USDAs Agroutural Pessach Sarvice Duil and engineer Gerald S. Birth have been working logither at the agency's Russel Research Center in Atlanta since 1973. Their goel is to rely on an instrument, rather than taste and sight, to analyze fruits.

A silver-colored aluminum box about a foot long and two feet deep, the onion melar works because the skin of an onion is translucent, in fact, about 1 percent

#### Dull believes the same

technique can be adapted to test other fruits and vegatables as well "A portable meter in a supermarket could analyze fruits and vegetables to find out what carbohydrates and nutrents they contain," says Dull "It would be like the labels on canned and froan forder "

The onion meter is available through the Varex Corporation in Rockville, Maryland: So far its primary users have been chion growers and breeders, who use it to search quality chions for replanting. "Prevous selection methods involved borring out a section of the onion," explains Duil This is destructive and slow, whe the tight meter can sample an online a second.

What's next? Dull and Birth have developed a meter that measures the sweetness



About 1 percent of the light directed at an owion passes right through it, which is why a sweetness meter can be built

of light directed at an onion passes right through it. In the box, devices on either side of the onion measure the amount of light transmitted. Once collected, this information is fed into a computer that analyzes the onion of papayas based on the amount of the pigment carctene they contain. They hope to expand present technology so that they can measure the sugar in cantaloupes, melons, and even potatoes—Lisa Werner

### CONTINUUM



Gibvaliar. Ever since the days of the ancient Romans man has dreams of building a bridge to initi The Rock with the mainland. Now a Swiss engineer has come up with a carbon-reinforced plen

#### PLASTIC BRIDGE

The bridging of the Straits of Gibraritar has been a dream of man since the days of the ancient Romans. Now that dream is being reviewed on the drafting table of a Svitis engineer who wants to link Europe and Alnoa with a bindge constructed of soace-size closelic.

The problem up to now, explains Urs Melier, head of the Department of Burching Maternais at the Federal Laboratories for Maternals and Testing near Zurich, is that the Mediterranean is so deep where it flows 34 ONNI through the Straits that it would be impossible to ank the concrete towers necessary to support a conventional steel suspension bridge. But cables of carbon fiber reinforced plastic (CFRP)-a sophisticated material used in the construction of airplanes and thoroughbred racing bicy cles-would, says Meler, be light enough and, more important, strong enough to suspend the nine-mile bridge without having to anchor it to an unwieldy tower

Meier is the first to admit that such a bridge could not be built today. But he is alreacy lab-desting CFRP for strength and hopes to persuade Swas or German authorities to take a fest step by using the fibers to replace steel cables an exetting bridges. Once the fibers are proved and a guitable ancharing system developed, he witt make a formal proposal to the governments of Span and Moroco Given an al clear, Meert thriks, the bridge could be a reality by the turn of the century. —Bil Lawren

#### WHY GOD RESTED ON THE SEVENTH

Ever wonder why it seems so natural to spend your Sundays doing absolutely nothing? A British physioan and university researcher provides a madical explanation. The huma hody, says Verna Wright, professor of rheumaiology at the Univ versity of Leeds, safeguards itself from undue stress by taking Sundays off.

"The brain," says Wright, "is an amazing computer that God has programmed to need one day's rest in seven."

Wright set out to test his assertion by monitoring of hormones found in an average working man Known these hormones are breakdown products of the adrenal aland, and high volumes often occur in association with stress. After measuring the man's steroid levels for months. Wright concluded that "there was a weekly rhythm of these chemicals The lowest levels," he says, were on Sunday. Small wonder Wright

adds, that every attempt by industrial society to extend the work week to eight or even ten davs has failed He recalls one of his own students who ignored his advice and scent all of one Sunday studying relentlessly for a Monday exam, then could do nothing but fill the exam paper with endless repetitions of his own name. We ignore the Sabbath," Wright concludes, "at our peril We keep it at our inestimable benefit "-Bill Lawren



Undersea towns, kelp farms, Homo aquaticus---all part of the new frontier of ocean settlements

### THE CITIES OF NEPTUNE

BY BILL LAWREN

we hundred years from now some astute historian may write that underwater man was born in a converted houseboat on the River Seine in 1988. There, moored just the other side Concorde and within walking distance of the venerable Paris Opera. sits the Peralche St. Paul, the 90-foot houseboal-cum-studio of French architect of French architest and aquanaut Jacques Rougerie More than anyone eise, he is the man who has though through-nin elaborate detail—the elements of a subma-rine civilization. A visitor to Rouger-mic official fones what le's office faces what obstacle course. One first descends a stairway below the Pont de Concorde. then scrambles up a

ladder onto a housetraverse to reach the St. Paul. Once through the small hatch-marked only by an inconspicuous card that says AGENCE - POLICIERE - and down a narrow stairway the visitor comes on a sparking postmodern studio. There are drafting tables with On the walls are Un the warts are some of Rougene's arrestingly beautiful drawings of his projects: a sleek glass-and-steel National Marine Center, a distance/shored fixeding diatom-shaped floating children's village, and a vast marine theme park inspired by the work of another Jacoues Révoerie is a handsome forty-

AINTING BY ATTILA HEJJA

one-year-old Frenchman with wavy sallbleached har, and syss that are alarmingly bible During the interview in the houseboal's lung quarters—ckmreted by an enormous globe of an equarum in which people can, and often do, swim alongside the fish—he falked of his vision of a submatine critication.

Ce Rougenes drafting table is the nuclears of its offers an underwater village lits center is a marketplace—a coneshaged building. Rougen sease this as an underwater version of the traditional Europen plaza, the centre of small-forwarisocial and account lite. Within its busy concentaring against "busy toot in contaring against" busy toot public or pick up some day lator from the people harging around "

water family farms, consisting of a farmhouse: a round, flying-saucer-like man building, and Plexiglas anchored to the ocean floor by a complex system of steel cables. Near each single-family dwelling there are sheds, garages, pensiol fish, and helds of such underwater crops as kelp. All homes are made of concrete resin molded into graceful shapes. Each farm is connected to the rest of the village by a series of tubular, water filed streets through which residents swim. They feature frequent sights to help undersea commuters find their way Doorways to the various buildings are in the bottoms of the structures because underwater it requires much less energy to move vertically than horizontally

Bouppreinse trought Introduction all the buildings would be rounded, with no right angles or our means to the girl and harbor infection esusing microgrammers. As luttler processlased table particular to the process label day battle underwork. Colors used insub would be dark, allowing the eye to wandler seally to the targe windows and not be regarded "aked by whites of and not be regarded." Aked by whites of hase ("pwillighting tends to make popular to the seal proceeding to floagueere).

staple diët based on domesticated fish and kelp. If Type got recipes for thirty different kinds of seafood salad "Rougene says ) It would be supplemented by meats and grains imported from the surface. Seatloon crops would be exported "up' to wating vessels. Air would be piped in from the surface, at least until artificial gifs were perfected Nonipiodecradable refuse would be sealed in containers and floated to the surface for disposal by oceangoing garbage craft. The considerable power needed to pressurize the interiors of houses and coerate deselination plants would be furrished by an ingenicus geothermal generator that uses the different water temperatures found layered through the ocean's deoths-

Rougene sees his villages as eventually forming a loose federation of undersea as OMN

communities, independent of the surface backness of trades and commercial agreements. His utilinate vision is of a "submarine exvirable", a serias of small 2,500citizen underwater villages scattered across the commercial shelves and fucked injo ceral needs all over the planet.

Requere is one memory of the workwork network of workers accurate who want to escape the bonds of the surface and realize the grand and ancered valen of living ful-time baneatin the sea. These acquate processment—size detaining and childras businesimmed and business of childras businesimmed and business of childras businesimmed and business of one processment that wild oraced the dunation of main stage underwater to rivial that our underwater memorials

They are even tinkering with man himself For many of them the goal is nothing less than the creation of an underwater civilization. And its citizens will be members of a new species. "amphblous man,"

says Rougerie, "a pseudomutant free to evolve in an underwater environment

"Even as a only," he explains "Takeys had the dream of living under the sea. As, I grew up I saw that the two prest advertures of this contruly are the compass of space and the compassion of the submanner envormmer. Right new men are able to drea down and todk at the faunt for only an up to the boat the submanner as an exchange of the submanner text in thying to create solutions so that men can live underwater"

The desarrol thing underwater as least and last the period down of Bastyon, who, some 5 GMO years ago. Indo to extend here to the second down of Bastyon, who some of the second down of Bastyon, and Coustage, inverted the Acquise Coustage, inclastart reading the bastworks is seened of investor annual Count in the hoped inaugurate the Undersite A whom he speat in the Undersite A whom he speat with here is set of the the coust of the interview of the one of the set of the set of set of the the coust of the set of the set of set of the the coust of the set of the set of set of the the coust of the set of the set of set of the set of the set of the set of the set of set of the set of t

different habitats, representing the labors of 17 countries, were built

A standout was Jacques Cousteau's seres of three experiments in which a total of 13 aquancuis and one paret kull fish cers, studed the maine environment, and recorded their physical and psychological reachers own the ocurse of 50 days spent on the ocean floor. Another outstanding isfor was the American Takital I hebitat, in which some of the 53 aquanauts lived for a month at ame

By the mid-Seventies the flurry of experments with underwater living ended, but the aquanauts had made their point. Man could live and work successfully in fixed underwater habitats with surprisingly few adverse effects. Medical problems in most cases were minor-the most common being nagging ear intections. Psychological problems were minor as well. After a three- to five-day adjustment period involving sleeplessness and mild depression, most aquanauts settled comfortably and contentedly into their environment. The stresses of confinement ware more than balanced by a spirit of adventure. In fact, Tektite aquanauts James Miller and Ian Koblick wrote that "people who have clashed previously on the surface often get along well while on the seafloor

Bouquene hopes to offer others this experiodoe, and unlike many visionanes, behas done more than dream about it. In the early Sevenies he designed and built a submarine habitat, Galithee, large enough to hold five people for as long as three months at depths of up to 60 meters. In 1960 several Japanese aquanauts lived there. It was subsequently bought by the Japanese government and put on display in a Rougerie-designed marine pavilion in Osaka Gaithee was followed in 1981 by Hippocampe, a smaller underwater habitat where Rougerie and French physiolocist Bernard Gardette Ived for three weeks Pougerie has also built Aquabubblessmall mobile underwater laboratories that he has used to assemble submarine childrens vilages-and several varieties of partially submerged vehicles. And his prospectus is overflowing with designs for underwater restaurants, farms, universities

The technology to build submarine villages already exists." Rougene says Once started, it will not take long for this cream to become reality. For the most part the village structures would use the same technologies applied to other deep-sea habitats But some experimentors have already devised ingenious alternatives. Architecturally even more freewheeling than Pougene himself is German-born architact Wolf Hilberiz. He has used a process called electrolytic accretion to actually prow submarine structures. His inspiration for the technique came from German attempts in the early 1900's to use electric current to extract gold from seawater. "I read about that as a boy Apparently it worked, and I soon found out that just about every possible building material can be found dissolved in seawater. So when I became an architect I decided to try to build fike nature did, using natural processes and available matenals," save Hitbertz.

During the Seventies Hilbertz adapted the technology by attaching a cathode and anode to chicken wire and submerging it in the ocean. When he passed an electric current through the wire he found that dissolved matter in the seawater formed a solid structure. Over the next decade he tinkered with the technology until he devaloped a strong, lightweight building metenal he dubbed Seacrete. He has since used Seacrete to build artificial reals off St Grow and is now "accreting," a large solfal structure the size of a room in Galveston Bay Although he calls it a piece of conceptual art, he says it moves us a little claser to grawing not only underwater habitats but startingly elegant, reelike submarine cities

Others there already begun to explore the possibility of corring the selector to a new generation of equariants. Ian Kobick, a vetterar of the Teldeta projects who has spent more than two months in subminimbehod the La Chalupa histella that is degeneration with the arrivation of the sense of the selection of the selection generation of the selection of the selection and has collisied at as a subminime more in smooted on the selection of the selection Fronda, and will be accommodified unforces a curriest the summer. The sequest Interspace, in Koblick's words will be "very luxinous, like a fancy yacht or customized aiplane" and will teeture a swimming pool whose bottom opens right into the sea. Even at \$250 per person per night resérvations "are already booked way ahread." Koblick save.

coing an underwater culture, but preparing for a submanne society where people will become residents and not just tourists is a more complex undertaking. Rouperie to maintain the balance and harmony necessary to sustain an underwater civitzation. In the peopling of underwater towns he foresees an exploratory stage in which acuanauts, "like astronauts, will have to be supermen-people who are in extremely good physical condition and extremely strong psychologically "Later, he thinks, the first generation of pioneers could be igned by people who, though still in good physical and psychological shape, would be chosen mostly for specific skills

Resizing this dream would not take long. Rougene says: "Given the money, a viflage could be constructed in two of three years." The project would involve building several vitlages and then using them as inving experments, watching the physical and paychological reactions of the people sent to live there.

The technology to extend man's ability to keep up with the fish is being devel-



coad. Perhaps the most spectacular advance is the hemosponge, an artificial gill that works like a fish's, extracting exvoen directly from seawater. In the mid-Seventies marine biologists Joseph and Celia Bonaventura, husband and write codirectors of Duke University's Marine Biology Center, decided to mimic the breathing apparatus of the fish. Whereas the human transfers the oxygen he uses from a gas (ar) to a liquid (blood), the fish transfers. oxygen from one liquid (water) to another (blood). To duplicate that the Bonaventuras needed a porous material that could retain water and be permeated with a substance that could extract the oxygen and retain it for transfer to a container, where it would be available for broathing

After several trails they found a special polyurithane that satch as there sponge. Knowng that blood hemoptoin can withdraw oxyan from water Joseph Bonaventura experimented first with his own blood and thew with fish blood before finally finding success using heme, an owygen fixing substance extracted from sheep blood. To free the oxygen from the heme for transfer to a container the Bonaventures deviced a system that uses an alectronic charge.

Right now the most advanced hemospronge and divert one quarter lifer of oxygen par mruna. far less than the two lifers part mrune a dwe meets. Bu, says Joseph Bonwentura, it won't take a torthological breakthrough to norseas oxygen output—"just some engineering, some intering". Alwapt the Bonwentuiss are thriking tog. They believe it is possible to ulid a sporge that care meet all the oxygen needs of a submanne community of up to 150 polyce

The next step-one that is vital says Rouperie-is to create a human whose body and mind are adapted to life in a suboceanic town. In other words, create a fully realized uriderwater man. Duke University researcher Johannes Kvistra has attempted just that by trying to transform man from an air breather to a liquid breather. During the Seventies and early Eighties he excentrated with filling the lungs of mice. rats, and dogs with a saline solution saturated with revoen. The animals breathed as long as 43 minutes with no adverse aftereffects. Encouraged, Kylstra filled one lung of a human subject with a similar so jution and was gratified to get the same results. The man breathed comfortably for 47 minutes and suffered no altereffects once his jung was drained

Since then Kyster has experimented with more promising solubies celled functionbox enuisates, which do a more efficient job of retaining oxygen. Altrough Kyster asses the technicule as limited to such emigracing upportations as ease scale from submarines, aquanisul ulemes Miter thinks in could sometory be used for routine duing operations as well. One can imagine some future submarine citizan filling his lungs with the appropriate solution and contrastic pointer in a Are you ready to go aloft? Test your acumen in





ere you for the ngors of space have? How fit are both your mind and your body for life based a space fattor? Do you have the proverbial "optiutif" that will enable you to acapit easily to life on the high fronter? Onrw. working in conjunction with a seam of space experts, has devised

PHOTOGRAPHS BY MICHEL TCHEREVKOFF this quiz to test your space aptitude

Most of the test questions and donese to simulate actual confitners that you might likely encounter white in space offs! Serie and of these are patterned after crisis situations that did, in fact, occur in the tast2 years. but are presented in a simulation formal to you, know for example, have indicacuse with gapes elation of have to mediacouse with gapes elation of have to you may not be a NASA actionaut, but your general space application. Usages whether or not you can act decervely and locarally inside the pressure suit.

Most of the 25 gluestions test your basic space abilities but a lew history and trivia questions have also been added to gauge your sense of the past. Allor answering all the questions roter to the Quz Scorecard on page 92 and tally your total number of correct responses.

- You are commander of the space station that is orbiting the earth at an altitude of 250 nautoal miles (about 300 statute miles), Why did NASA choose such a low orbit?
  - a the Pentagon required it for military reconnaissance
  - b space shuttle payload limits dictated the orbit affitude
  - the orbit was required for Earth-resource programs
  - d. there is less space junk in this orbit and less risk of damage to the pressurized modules.

- Your Apolo spacecraft is on a flight to the moon. About 100,000 miles out an oxygen tank explodes and cripples several critical systems in the command ship How do you return to Earth? a turn the spacecraft 180° and fire the
  - main engines b execute a series of midcourse ma-
  - b execute a series of midcourse maneuvers that put you on a rendezyous trajectory with Earth
  - c continue on your trajectory and loop around the moon before heading back to Earth
  - d jettison the damaged service module and return to Earth in the lunar excursion module
- Do astronauts dream more, less, or about the same during flight than when they are earthbound?
  - a. much more
  - b. slightly more e.
  - c. much less
- About half of all astronauts experience spacesckness during the first few days of flight. What can you do before liftoff
- to avoid the undesirable symptoms? a spend preflight training time on the
  - spend preflight
     patallel swing
- b follow a restricted prellight diet
- c take medication
- d spend time in the Prophylactic Adaptive Traner
- e nothing
- 5 The Russians still hold the world's space endurance record, which stands at 237



days. The U.S. record is just over 84 days for the last Skylab crew. Such long tights cause the human body to lose calcum and as a result bones weaken How will such bone deterioration be avoided on a ten-month manned journey to Mars?

- a the crew will take calcium supplements
- b strenuous exercise for two hours a day will reverse the problem
- artificial gravity on the spaceship will halt the calcium loss
- 5 You are commanding a Gemini spacecraft mission and have rendezvoused and docked with an Agena vehicle to lest these techniques. Suddenly, the combined spaceral begin to spin out of control, and you must act quickly how do you save the mission? (Meet than one sinswer is acceptable.)
  - a. fire the maneuvering thrusters while still docked
  - b undock from the Agena and then fire the thrusters
  - undock and deactivate the thruster system
  - d undock and activate the reentry control system
- <sup>7</sup> As a mission specialist on a shuttle fight, you are responsible for operating the robot arm. After deploying a satellite, the arm freezes and won't respond to control panel commands. But the arm must be clear of the cargo bay doors so they can be closed for a safe reentry. What do you do?
  - a use the manual backup system by cranking the arm in
  - b go on an EVA mission and use tools to disconnect the arm at its elbow
  - amputate the arm by activaling an attached explosive package
  - close the cargo bay doors and force the robot arm inside
- 8 By 2010 commercial space ventures will gross more than S50 bilion annually in revenues. You are on a business the to orbit. What type of spacecraft will fly you there? (More than one answer is acceptable.)
  - a a second-generation shuttle with all solid-fuel rocket boosters
  - b a single-stage-to-orbit scramjet
  - a hypersonic, oxygen-breathing spaceplane
  - d the British HOTOL
  - e the French Hermes
- 9 You are commanding a moon landing mission and are just 50 feet above the surface when you see a diangerous boulder held that threatens the moonship. You take over manually and search for another landing sits, but you have only 40 seconds of tuel left. What do you do?
  - a land within 40 seconds
  - b land within 20 seconds, if not down in that time abort the landing and start the accent engines
  - depend on your reserve fuel supply and land within 60 seconds

d slightly less e, about the



scattered round about him broke the lwi light gloom Star-pricked shadows shrouded all the rest of the rocky surface.

Passing his guarnietet hand hirouch a ooki lama, hen murmered nie propagator a modium eisze tock, gray and sharp odgod is suitikace shal with a thousand flecks of syrife. Under thei pale suit is esemed to briske with argument, be called list ha bullon in the Calestal Equity territotake on he, prosenant of that oce would even none life improgramment of that oce would even none life improgramment.

The Lawyer did not murmur back, but the digital readout on the receiver said it stiff sang to itself at about 30 7 megahertz, tes reedy voice racing through a short snappy ane wave Livingston wondered if its tone had lyrics, and if it did, what they meant. Did the confront a Beethoven or a buakter27 He ached to learn

He doubted that he would have the time. An expert in endangered speces, he had won the invitation to conclut the first exheustine, nondestructure study of the asterrid belt mysterious till form's because terrid belt mysterious till form's because he had fought so tenaciously for Yellowstom's grizzles—and his odds then had been a hundred times better

Asrupply the saleroid shuddend: Taken by surprese, he among load harmon the yetped and grabbed at nothingness. Dust shaken from the carder wall gittlered in the bilae-green auras, hung in microjovel meds, adfield salevy to the ground. To terring on one toot, he wated for gravity to the and take the Boforei dd, and wated water. It have auguing the Mathies in the state water water and the bilaetime. The scatagine we Mathie Health? at hom can find came water aura automose the came water aura automose.

Like a vel-anesthetized amputes. The inervices but not pain. Not yet Now a sick cetanity washed through tim this guardans, his constant companions for the late two years—this friends—had died. The washe bacyout a doubt And he washed not to how it. Eyes calceared that "face wash to said," hou they do that here wash to said, "hou they do the here and the said, "hou they do the here here any the said they are the here any the said they are the here any the said they are the here any the said."

Eighteen times that bitter wind had blown through him. Eighteen times he had learned that the one so named had died moments before. Always someone close, a dear finend or a brother or a parent.

It came rarely, then, because he had no more than an average complement of people special to him. And it came more wrenchingly because already the complement had dwindled.

He wished he knew the source of his sensitivity or all less the name of one other persor who hore its curse. But he could only feel its impact. Save for irsh toktales of banshees and the occasional story of a twin aware of his siblings danger or domise, he had never encountered anything akin to what was happening to him. And m

an empire skeptical of claims to paranormail tajorit, he had to keep it his secret. Were he even to hint of it, the reek of instability would foul his tife and all his works.

It did give him something in common with endangered species, though

He moved to wipe his eyes. His gauntlet crashed into his heimet leaving in his ears a nging that took a long time to quiet. It brought him back to that choir in the garden beneath the unblinking stars.

And started the knowledge gained over two years in space litem heavy vibration in the trock time, small asteroids display no assmera activity item odds against miece strain prototively high time, eightytwo Celestial Egaty prospectars—poseh ers—operating in this sector of bell at fast report. Item: ten billion dollars worth of gens at my feet.

He tongued the intercom switch "Watson-san!"

"Hai, Livingston-san?"

He gave an maucible sigh of relief Al

#### **6**Fire

scorched his right ankle, then faded to frost. A metal ring in the leg of his suit contracted on his call; arterial blood froze in midair, drifting slowly to the ground.

least the base computer had survived "What's going on?"

"Syntax error, Livingston-san."

"At---" He tried to remember what Habishi, the laconic dabbler in haiku, used to say "---Ah, status report."

"Shin Malaumoto Base at present unnhabited Life support systems functioning in in all areas except [cick] Hangar. Turniel Two beyond hundred meter door [cick]. All readings nominal in all areas except [cick] Hangar, Turniel Two beyond hundred metor door, where surviving monitors report dancerous levels of radioectivity [cick].

Of course the poachers had hit the hangar frist. Without their ship the two imperial Mannes could barely defend Shin Matsumoto Base against an unarmed ore carrier—certamity not against a lough, feat Beit Breaker that could ang a nuke into a trash basket from twenty kilocicks.

And of course the fates would make Tommun and Habishi choose that morning to overhaul a balky attitude jet

Again he stood among the liverocks, washed in their auras, tingting with their inaudiole, immutable music. He knew exactly what he had to do, hide the treasures so the robel raidos would depait entrylhandout, get word to the Imperial Space Force at Shru Edo on Mass, then hold the poparties of thi reinforcements arrived. If they were did The Celestate Equity Necch hand argod for more than for years and showd on signs of cooling down. The robels of amando for mimicade weblattion of all resources that powed popular position, most of Aroca and South Amerca, and subtle churks of the more develoed continents.

Ther unceasing attempts to put more ships into space kept most of the ISF tied up in mear-Earth orbit. Beyond Mars, poachers outnumbered ISF ships sor to one Even Shin Edo, the sprawling HKI on Mars had directed all ISF forces in the outer system; are eightly percent under stimight.

Watson-san!"

"Hai, Livingston-san?"

"I need a sled out here, quick!"

"Ha [click] Dispatched

Write he waited for the self-popelled set to askitte over the lip of the crater, he crouched by the neurost liverock. The proud, graneta one he called the Abbot He grapped it. Yes, maybe a hundred kines both of a mess to have to muscle around, both the burg avoid helps, and the autosted tool kit boasted a cravidar He could move it Alterward he could apologize for upsetting its cignity.

Rocking back on his heels, he scanned The Abbots eleven companions. The larg est of them. The Crown Prince, massed maybe half what The Abbot did, though it stood straighter and tailer. The Lawyer, twenty kilos—twenty five, tops. The elev would haut up to ask hundred kilos he could probably transport all of them in one tho

And utivities the days of Project Closely the would get to argument from flows he laboard to save. No prases attiffer, but Mos exprost dhaft in the sevent yeaks ance a Sony Steel. Compation exploration team for the sevent yeak particular team for an accessible and exterible da armer four tacks about the éfens. They broadcast seeksy save waves in the high megateriz, they wanged memory and particular and the sevent and the sevent and and the sevent and the sevent and they wanged memory and the sevent and would even notice being moved.

Watson-san!"

"Hai Livingston-san?"

'What's going on up there?"

"Syntax error, Livingston-san."

He shock his head in frustration. A civiian volunteer, with multiple degrees in biology, forestry, and wildfile management, he knew nothing about the battle computer's operating system. "Look Wat---

Dust plumed a meter from his left foot Reacting immediately he dove, heedless of risk, behind the nearest boulder. So maybe he tore the outer layer of his suit, he could patch that. But a builet hole in the head, now, that was somewhat harder to batch out there in the vacuum of the Bet. The boulder loomed over him, bleakly obsidien. Hunkering down under singer frewas second nature to him. He had emergad intact from a dozen freflights at Yellowstons. He wished he were back there—the International Park Service had given him an automatic riffle, not mirrely a sonal pixel. Weston-sen<sup>1</sup>

"Hai Livingston-san?"

"There's a poacher here shooting at me!" "Ab so, desu, Recorded "

"Recorded?" The below rang in his ears "For God's sake, Watson-san, would you give me some help?"

"Hail Running Program Heads-Up."

Across to information of the transparent heimst sprawked the crater as seen from above the granned. All of glocal it would be a seen to a second be a second to the second table of the second build have a second build have a second build have a second build have a would have him find a sometiming guild to guild means that have build have a second build have would have him find a sometiming guild to guild means that have a some short a some second the owner have the build have a some short and of alumnum behind a cosh black autopart of alumnum behind a some the to some of more than the balance of the build of the second that the some the balance autopart of more than the balance autopart of the some than the second that the balance autopart of more and means the balance autoparts

Pyrite-flocked splinters flew "Not" screamed Liangsion "Not" The Abbol's aura dissolved Slaughtered, the liverock collegised into a pile of rubble. The Crown Prince's aural finges brushed brilliantly where they touched the exposed crystaline core.

Livingston peeked around the edge of his sheater. In theory, a liverock The Abbot's size would have a core - he gapped. Not softball size, oh no Junk another theory. More like a bowing ball. And dammit, the peecher had spotted ii, too.

What the hell kind of people would finance a revolution by eracticating an alien species? Not even the grazzy killers at Vidlowatone had thed to clook gread in metaphysical paye about clamming a far share of heaven's largess. They had been blunt "I can get half a mill sor the skin, jack A full mill II o'n make em boliever its the last

Celestial Equity, though—/'God has given us the tools to help curselves and if we do not use whatever tools we need, God will hold us accountable. 'He could not understand thair shortsightedness, their disregard for their descendants.

Another builet sporked off the patch of bare store before hm, he found himself waiting for the winne of the mobibil and cursed his own footeness. He drew his flare pistol. At that range it would do the other no harm, but maybe it would do the other on harm, but maybe it would doztle him. Or her, impossible to tall, given the builkness of spoke suits.

He crouched, aimed at a slight upward angle, and squeezed the trigger just as the poacher reached the crater floor

A second later, the one in the silvery suit slapped at the fire on his chest and lifted backward off the ground as he took the flare's velocity for his own so own Livingston chuckled, inordinately pleased with back. Three meters high, nearing the peak of his arc. the burring trabs leveled his weapon and lef loose a wild purst. Now Longston laughed about, Inhe panci, their obarh ad clearly forgotten about recoil. The downspray of builds booted him live a rockst. He---- maybe she--was tumbing heads over head backward, away from the crater.

'Watson-san!'

Hai, Livingston-san?"

"Do your screens detect that poacher?" "Hat "

"Can we capture htm?"

"[Click] Remote Servo Number Seventeen reports total destruction of fighter ship. Capture [click] is not viable option [click]."

"Damn." He had spent cumulative months studying caligraphy with the dett Tommuri, why had he not asked for instruction on the care and use of Watsonsan? Surely the damn machine could do something. Crouching by the dabins that

Stranded on a chunk of rock spinning so far from the sun a candle could cast a sharper shadow, he never wanted to see the rock garden again, but he marched on anyway

had been The Abbot, he gently brushed chips of rock away from the crystaline core. Flawless, a single massive jowel, it chimmared in the shadows.

If the poachers could carryit to Celestia: Souty tentory, the relied government would purchase it with CC dollars, then sell it surreptitually for good, hard Imporial currency. They would have no poblem finding buyers. As generations of museum thaves had established, a market for irreplaceable works of at Anyes costs.

More all the core came into view, refracting more and more of the surving livesoles auras. Colors roled in its depths and pulsed in near-tangbia waves from its facets. The wary soul of the now dead rock, or made harm understand why people would fail—and de—to own it And it made him would on that all least, he was in complete accord with the Empire. Only battes and rape to pulse would be all the source would on the would be not the served.

It occurred to him that if he came through the attack alive, an autopsy of the core would offer an invaluable look at the alien's nervous system. Assuming he could devise a means of autopsying crystel He clapped his gloved hands as an idea struck "Watson-san!"

"Hai, Livingston-san?"

"Please list our viable options for dealing with the poacher."

"[Click] Program Arrow [click]

He had no idee what Program Arrow entailed He could ask, of course, He strugged Anyone who would murder a fiving alten to sell its soul to benkroll an uprising deserved whatever he—or shé gal. "Then do if."

Syntax error, Livingston-san

"On, shit" He stared off at the distant stars There had to be at thousand ways to tell a computer to run a program. If he had to try each way in turn. He sighed He had no other choice "Okay, how about this Bun Program Arrow."

"Password of the day?"

"Bygan-II"

"Running [chok] \*

Harsh light flashed beyond the crater rim as a surface-to air missile hit the poacher

He did not need to ask Watson about the glare. The holo of the SAM destroying the President's copter had made it lamous. Quesariess wriggled in this gut. He had swom himsell for the not death. And yet the rebet had helped nuke. Tommun and Habish: Those who law by the blast.

Watson said, 'Program Arrow executed Fun terminated "

He made a face "Interesting choice of words. Watson-san."

Syntax error, Lwingston-ean."

"I need some halo, Watson-san "

"(cick) Detai nature of inquiry, and this program will attempt to provide appropriala command structure [cick]

Are there other poachers?

"You must request status report on unauthorized personnel, specifying either redius of volume of space to be investigated or physical object demarcating space to be investigated from space to be ignored."

'Okay, do it."

'Syntax error Livingston-san'

Dammill He kicked a pebble in frustration. As he began to somersault backward, the pebble soared up over the orater im it twikled in the feable surright, then disappeared. "Status report, unauthorized personnel um maximum range?"

"At three point seven five times ten to three meters, on twenty-three-minute equatoral cobit, one AMC Renaut reconnaissance vehicle, model RC-808X, fully equipped, of Impenal Space Force registration, rise tumans abound."

He blinked 'An Imper-

"At five point seven times ten to six meters, on eighteen-hour intercept trajectory with Shin Matsumoto Base, one Honda-Moi interplanetary vahiola, model Bolt Broaker, tully equipped, of uncertain registration, three humans aboard."

Confused, Livingston sat on a smooth black boulder and peered into the ebony sky Somewhere up there an ISF rooon situp orbited the asteroid. The Imperial Forces had claimed they had no troops to spare continue@overPeese



#### Fishing for "jellies" has revealed a host of exotic new species







SEA DRIFTERS

BY VICTORIA A, KAHARL

With domas of a thousand colors and shapes, galaxinus animals float through the status of lowy one one facts. No even on subtracts the status of lowy one colors of the into a bady's shoe. Note this are not payly that used is at the disk ply downeys soft ward's metassite (for your ward at side). I increase of the physical colors at the status of the status of

- 83

 Jellies are hard to collect because they are easily injured.





ographere Ruch Harbson of the Woods to be Oceanographic for Solution and Solution and Solution police (log), named for their citia, which are algored like the teach or a comb. They are the head or a boold bookson in wyn ar ampling gear as nate my tear the yelles fragelo bodes. Ard some spoces, even when caphaned garrity by hand in jas, me full and the surface.

Like other jellyfish (above, center, and far right), the comb jelles have been traversing the oceans for at least 400 million years; and for the handful of oceanographers who are studying the organisms, they are the



€The transparent mass floated through the dark sea. 9





 quintessential ocean dwellers, The jetty animals are going.

to still on tract that must are must about the open coest." Hattacer stap. They are a work that the stap. They are a work that the stap. They are a work while exploring the cocan in the mand adversarial work work associate. Larry, Much adversaria associate and portoxia. It was been through the cack waster with the start hand a start and a start through the cack waster with a boot mough the cack waster with a boot mough the cack waster with a boot and a start and a mough start. The start and a start and a



6The medusae (below) are the most whimsical of jelly animals.9





The underwater explorer who discovered superhot springs pulsing from the ocean floor and who located the wreck of the Titanic is sending his robot to swim through the "unsinkable" liner resting 13.000 feet beneath the sea 8000K

- for main and 1930

### INTERVIEW

eing on a research ship is the same as being a prisoner of war---with the added risk of drowning " says Bobert Ballard with his characteristic wise-guy onn. And he should know. He has done his share of time on and in the oceans. pursuing his fascination with the submerged two thirds of the planet we can't see. In his voyages to the depths the forty-threeyear-old oceanographer/geophysicist and senior scientist with the Woods Hole Oceanographic Institution has shown that there is a lot at the bottom of the sea worth the nak

Even to those who know nothing about oceanography, Ballard's achievements are impressive. He participated in the first excedition to examine the Mid-Atlantic Ridge, a mammoth undersea mountain range, he discovered superhot water springs. called hydrothermal vents, on the ocean floor, and found there a ocean studies, and from then on he plotted his career for the werd zoo of undersea life thriving on chemicals belched from

the inside of the earth. He helped develop such undersea robotic exploring equipment as Angus (for Acoustically Navigated Geological Underwater Survey) and its successor. Argo Both are deep-sea sleds that can be loaded with cameras and pulled along the ocean floor. Last fall Ballard accomplished his most publicized feat: He located the Titanic, which he described as lying "in thirteen thousand feet of water on a gently sloping, alpine-looking countryside, overlooking a small canyon i

Ballard's fascination, some might say obsession, with the sea goes back to his childhood days in San Diego, where in the Fifties he swam, scuba dived, and surfed off the California coast When he was a teenager he attended a summer program at the Scripps Institute of Oceanography that galvanized his interest in seas. After getting an undergraduate degree in chemistry and

PHOTOGRAPH BY WAYNE EASTEP

What we do know is that the deep sea is as complicated as any landmass. The biggest mountain, the deepest valley are under the sea.9



peology at the University of California at Santa Barbara, he applied to Scripps for graduate work but was turned down. He moved to Hawalt, where he pursued his master's degree at the University of Hawail (In 1974 he received his Ph.D. in mame deplocy and neonbysics from the Liniversity of Rhode Island ) To support himself he taught porpoises at Sea Life Park in Honolulu In 1966 Ballard, as a brand-new Navy ension, was assigned as a taison officer to the Woods Hole Occanographic Institution on Cape Cod. Massachusetts He's been there ever since.

At Woods Hole Ballard began making dive after dive in what was then a new un dersea vehicle, Alvin Built as a research vessel for the Navy. Alwa is a minisub capable of dwing to deaths of 13,000 feet. (Conventional submannes can go down only 1.000 feet 1 A three-person crew. working within the protection of a titanium sphere designed to resist the crushing pressures of the deep, collects samples from the ocean floor with a remote-controlled robot arm. With his cives Balard helped elevate Alwn from a technological curiosity to a major oceanographic tool

Ballard stayed on at Woods Hole after his Navy discharge and became intridued by the then controversial theory of plate tectonics, the idea that the earth's crust is actually 12 distinct pieces floating on a



molten interior. His fascination with plate tectonics and his reputation as a skilled undersea scientist qualified him as a member of a 1974 expedition, Project FAMOUS (French American Mid-Ocean Undersea Study), to explore the Mid-Atlantic Fidge a 40,000 mile-long undersea seam running around the planet. He was one of the first humans to peer into the cracks where the molten interior of the earth secons up to the rift valley of the Mid-Atlantic Ridge and pushes the massive plates farther apart The FAMOUS dives, some nearly two milles down, produced the first graphic evidence that tears in the skin of the earth allow hot lava to squeeze out from the interior and add to the seafoor

Continuing his deep-sea exploration in Alwn, Ballard helped lead an expedition to the bottom of the Pacific near the Galanagos Islands in search of another geophysical feature. In the Sixties scientists had predicted that there would be vents in the Pacific floor, springs of superheated seawater flowing up from the boltiom. In 1977 his expedition found them, as suspected.

near the Galápagos Islands, making what some have classified the most important oceanographic discovery of the century

Yet what Ballard and his crew saw some 9 000 feet down when they dicked on Alvin's lights was totally unexpected, an exotic bestiary of sea life, creatures that depended not on photosynthesis-sunlight for support in the food chain-but on chemosynthesis. Deriving their energy from chemical reactions the undersea fauna had evolved a way of thriving in the hydrogen sulfide-rich, superheated water. Vent areas were carpeted with bacteria Swarming around the thermal vents, like wildlife around desert cases, were blind crabs as white as snow, gigantic tube worms with blood-red tips, red clams a font long, mammoth glowing jellyfishlike creatures Ballard called "dandelions." in 1979 he found similar vents off the coast of Bara California. "black smokers"---superheated vents beiching seawater so saturated with minerals from the earth's interior that the water looks like black smoke

In September 1965 Ballard towed his deep-sea robot submersibles Annus-a boxy underwater sea sled equipped with still cameras-and Argo-a newer, sleeker finned vehicle carrying video camerasover an anonymous patch of the ocean floor in the North Atlantic and became the first to see the Titarivo since it sank in 1912. The discovery of the legendary luxury liner signaled the dawn of a new era-when machines, not humans, are sent to the ocean floor. Eventually Argo will be paired with a smaller but more mobile offspring, Jason. an ovoid, self-propelled, remote-controlled robot with two pincer arms and stereo vision that feeds back what its carrera sees to its human operator (Ballard calls it the Argo-Jason system because "I thought I'd go for the Golden Fleece Award naht off the top.")

The allure of machines would be obvious to anyone whose working life consists of deep-ocean dives. Humans cram themselves into a tranium sphere and work for hours in the chilly depths. It takes two hours to get to the opean floor and two hours to get back, Ballard once explained, and "when you get done with a dive, you are beat, you've got a headache that won't ouit, you're exhausted."

It can be dangerous work as well. When Ballard was diving in the French submersible Archimede on the FAMOUS excedition, an electrical fire broke out in the crow compartment after it had reached the

Anhot's every of the Titanic, the shin's how with anchor chain, capstan, and winch still in place (top) and the forward deck (holow). The crew's quarters he just beneath this section **DMNI** 

ocean foor. The Ancharade filed with acinstancia, and life trapped acknowsks. Bellard and the French sciencists with him had to make the long ascent back to the surface breathing the emergency oxygen supplies and wering scub-adving masks to protect their eves from the fumes. So it's machines down instead of helpresence serving machines down instead of humans.

Extroverted and articulate he has sometimes been criticized by his lessoffed colleagues for being such a highprofile scientist. Yet others characterize him as a driven perfectionist. Despite his academic controls and considerable accomplishments, he hardly fits the mold of the tenured protessor When Orga servor editor Douglas Colfigan caught up with Ballard one brisk spring morning, it was between research trips at Woods Hole His cavernous office has just a bint of the man an eight-by-ten photo of him wearing a tux edo and shaking President Reagan's hand. an Alviz sticker, and a paper cup that had traveled unprotected to the seafloor and as a result been compressed to the size of a shot glass. Bailard radiated almost inexhaustble energy Between sins from his can of Coke (Classic), he seemed to be in constant motion. After discussing the more cosmic quests of his life. Ballard and Colligan careened around local roads in a pickup truck in search of the right-size Sheetrock for the farmhouse Ballard is renqualing. (A segment of this interview was conducted by Charles Pellegrino aboard the research vassal Metwile !

#### Omnit How much do we know about the deep sea today?

Ballard: Fragmented knowledge Welknow more about the surface of the moon of some distant planet. What we do know is that the deep sea is as complicated as any landmass. The biggest mountain, the deepest valley are under the sea. Did you know that there are more active volcances underwater than above on the land? Did you know that? Most people don't know that The mid-ocean ridge is the planet's largest geologic feature. If you walked up In the average person on the street and asked. "What's the largest single geologic feature on the earth?" he might say "Ohuit must he the Rockes " A pretty good quess. but it isn't. They could fit in a small corner of the Mid-Atlantic Ridge Twenty-three percent of the earth's total surface is wrapped up in this mountain range. Peoole should not be unaware of the largest feature on the earth, but they are. Isn't that sort of sad? That speaks a lot about our ability to transmit information.

Omn: What's the significance of finding the hydrothermal vents?

Ballard: Hydrothermal vents helped axplain the cherrisitry of the occasin. The really excited that I was able to place a mind like John Edmond's [an NIT geochemat] in the john spot. Also, Jean Franchetesu [of the University of Pans] and I generated a model for finding hydrothermal vents. We tested it, and it worked. We found the vential thin the long, long term, when I evaluate myself, i'm going to think more highly about writing that paper than about inding the 7famic. It was harder to do

Omni is it true that over an eight-mittionyear cycle the equivalent of the entire ocean goes down into the vents and returns?

Bated 11s the The warm try calculation. The was been famorial acculation. When most people think of the hydrologocycle (by which wairs is cycled up from the local and bate to this coeres) they imagine that the lowest point it reaches is the coeters. If it has open make the coeres if the lowest point it reaches or correctly which the coeres is warmed and correctly which the coere is warmed and that it was able to put other mids in a posion to know that

Omni. Before you went down did you have a concrete image of these vents?

I don't know if I can ever beat space— I'm sure going to give it a run for its money. But if they find a smart worm somewhere, then all bets are off ?

Ballard: We didn't know what we were looking for We were totally supprised. We had an abstract ides that there would be a crask and were water corring out fill like a spring. But then to wate knib Disneyland't wou now that move Loss Content. Where the like same dammed movie releved with the like same dammed movie releved with the same dammed movie releved with there for all the impact that do no me.

Omni: And there were no biologists who went along with you?

Ballard No That was furny. The was furny They didn'think weld find anything biologically important! We had to use bottles of vocks and bourbon to pickle what we found. We reliated the ships hospital and were quickly out of all the alcohol there. So we were using booze

Ownet Must have been a kind of dry trip Ballard. We clicht care. We were on our own high 1 Net to say that the ocean's bottomis more interesting than the moon's bohind. People aren't aware of this. What are we going to do about it? In the first place we've goit to have a better PB, office than NASA's out. We're in competition for access to American minds and purse strings. Everyone's mind is very busy, Just full of Cheft's Angels or NE, football or "I might get mugged." And we've got to compete for attention Sciencisis have to get off her (pause) vory towers and go to the public.

I don't know if I can ever heat snace, but I'm sure going to give it a run for its money They've got such an advantage with that view. What a shot! But if they find an intelligent being, a smart worm, somewhere then all bets are off. The most important gram is the yew it have us of Earth a beautiful emeraid suspended in a blackveluet which of politingness. It also popped what I call the Superman balloon. What was that myth? That there was this planet called Krypton and they mucked it up and accidentally blewit up. Superman escaped and came to Earth. The idea is that we're all going to be like Superman-we're going other planets. Were doing to swim in the canals of Mars: when I was a little kid Mars had canals, and there were always beautiful women on Venus and you could arrow tomatoes on Mercury, and all this bull. But what did the space program show us? That the smaller planets, Mars and Venus, are like the moon barren hot no canals no lomatoos, no pretty pirts. And the larger planets-Jupiter, Saturn, Uranus, Neptune-wou can't even land on. There's no land You go into a big red spot. You know no one ever said the following. If you go to Jupiter you can't stand up. The gravitational forces will alue you to the planet Throwing his arms out spread eagle filt. ing his chair back as if pinned to Jupiter's surface, he talks through gritted teeth ] "This sure is great!" You'd have to be Superman to go to Jupiter if it had a surface. Ornni: Well, there's an ocean on Uranus Ballard: Big deal Borrring The point is Earth is the pretbest of all. The earth is a

living, breathing thing, a giant organism. We live on it in a potentially parasitic terminal situation. We could kill the host, blow it up, polute it. We almost did that. Thank God (\$ act restlence!

Omn? You think being a public scientist so early might explain the antagonism?

Balard, Lourss Lwas disrespectful and paradoxically radical-since I'm an economic conservative. As for us taking chances, I'm about as conservative as Genohis Khan, I'm verv experimental But Like rules of conduct, gentlemaniv rules of conduct. Yet I'm also less bridled by convention. Eve got a good dose of cowhov in me, I mean, a freer spirit. I haven't been broken. My grandfather was marshal of Wichita Kansas He was shot to death in a gunfight in 1920 by a kid, a nineteen year old kid, evidently on drugs. He killed my grandlather and his two deputies. Bang bang bang. Shot my grandlather dead in his tracks. And my father was a cowboy He punched cows in Montana. My orandmother died when my father was twelve, and he was orphaned out to kin who were

homesteaders. He was passed around from homestead to homestead. He eventualy escaped through his intelligence. going off to become a test-flight engineer just before World War II. He was a guy behind the "right stuff" He eventually be came head of the Minuteman missile program for North American Aviation. Ligrew up in an aerospace family, and our house was a meeting ground for engineers. The earliest waking moments of my life were the Muroc Ar Base, the Molave Desert, the first jet planes streaking overhead. I always wondered what happened to Muroc. Then just a few years ago someone said to me. "You dumb idiot, Muroc is Edwards, Edwards Air Ecroe Base

My tarrity came from England in the seventeen hundred. By the optimation hundreds they were in Kanasa, and they kept ogning yest. I'm the first Ballad to have oome back But I really didn't, i just wert underwater Wy the heck smith in here on Cape Dod? It's because of Woods Hole Woods Hole deart belong here. It belongs in California It's wide open a tronter town—oceaerographity a a fronter.

Omni: Where did your interest in the ocean begin?

Bailact Weitvein San Diego when it was at litte toorn on the access. San Diego Bay was at a marshi, with bait gost suppro gothous a sever how whet was going to washup. Japaneer ghas-bait floats from a distrat shore, shelb-- and aways the hythm of the potent When you're a messadand suppresses at a messadand potent was company. The ocean has a rely you could go the socean and court on that wave company. The ocean has a float of hythm at the states company and but generally suppresses it in a gentif way. In this the balance

Omni When did you realize you'd rather be in the ocean than on it?

Ballard: When I decided not to get on the surfboard but to stay in the waves as a body-surfer. I grew up in the surfer days "Surfer Stomp," "Rendezvous Baliroom," Bruce Brown's Endless Summer-great movie Getting the tan. You didn't peel Nothing was worse than biotching. Td go to Huntington Beach lifeguard station number three. The biggest surf along the coast was at Huntington Beach. Big tollers. Lused to bodysurf through the pillings. That was a trip, but it was nots. You could get torn to shreds by the barnacies on the offings, I never got interested in a surfboard-you were decoupled from the ocean I love water I take two showers a day. I feel like the creature from the Black Lagoon. I've got to keep my gills wet

Omni: Did it all come together when you first went down in a submersible?

Balard: No. I scubs divide a tremendous artount before, and diving in a submanne was anticlimatic. It's so sale an eighty-fiveyear-old oculd do II. I went through the evolution of trying to be comfortable underwater I started by holding my breath 66. DRMI and going down to pick up dimes from the bottom of a pool. When I trained dolphins I just about fived in the water

Training dolphins was very stratige | will carry it with me for the rest of my life. For almost two years while in graduate school I worked at Sea Life Park. The trainers performed public shows, which is where I learned shout speaking in front of people. We also trained dolphins to work in the open ocean. Lworked with Ho, a very young female. I really got into that animal on a human to porpoise level. I worked with her around the clock, eight hours a day in the water, working on a purely personal level. The animal reached a contrivinere love became the motivating tool in the training Forget the fish, it was really affection and caring. Elterally loved that an maillike a human would love a human

With porposes your primary communications loop is eye contact. You're looking at one another. They're trying to communicate and you're trying to understand

The empty
Ifeboat davits—to me that was the symbolism of the Titanic. That's what those people who died saw as they came up to the deck looking for lifeboats Gone!

What a strange learing to lock into architecreaturits eyes, and see affection. It was like meeting a Martian II where ever pairs to communicate with extendential species, see toget locates with provides. They apply the set of the

Omnir Your undersea explorations have revealed many mineral deposits on the ocean floor. Will the feasible to extract them?

Bellard its not economical We're closing down copper mines in the middle of Montana. The metals market is really depressed, and I cont see improving I cont, look at the cotan as a way of feeding the world or supplying that naw marks. We have a farm crise because we can't set have a farm crise because we can't set have a farm crise because we can't set active still could't pitt if of the because of transportation costs. I don't look to the open as a source of food messures food. rather as a part of our human experience of exploring, as a practical frontier. Most of our oxygen comes from the ocean. It's not from trees: we don't get our oxygen from recisionals we breathe it from plankton. I love redwoods, but c'mon, tell the truth here! And so I want to make sure I don't kill the ocean. It's pretty hard to hold my breath Omni: After making hundreds of dives in manned submersibles, what made you move into robotics and telepresence? Ballard: You won't ever eliminate the excitement of making your first few dives. Adrenaline is flowing-there's a sense of human pani, of 'what am I doing here?' That Wow! So people will probably want to go down forever. But after you've done it a lot, it's none. You still get all excited on certain occasions, but eventually it's like professional football-your knees start to go i don't get that big a thrill, and diving for me has almost potten to the hobby stage. I quess you could take anything doing to Yellowstone Park every day-it's a beautiful drive in and out of the park, but I've stopped looking out the window

My indexement with Advir we very intense from (987, when I first got has as a nearly officer, through Propert FAVOUS with was a log melation. It was a very very risky project that burned out to bear incluent programment (19, 1974 we got on a roll and througs started as a tocking of the docovery of black shokes in 78. These docovery of black shokes in 78. These was a real normarm. This diskloped hards still going But 1 got of the train in 79 alters still going But 1 got of the train in 79 alters

I went to Stanford for a sabbalical, plus I was up for tenure. It's just brutal. Your whole life is on the line. So I sat there and said "Okay let's say I get tenure. Am I going back to Woods Hole and crawl back into a submarine for the rest of my life?" And the bottom line was: No. I was not. I have nothing against the submarine-this is where it find myself pitted against myself in the media, that I hat's submarines. I don't, I love em It's like you left home and got married. so you must hate your mother. No. I love my mother, but I love my wife too. I love manned submersibles, and I love Alvin, it has a special spot in my heart. But that doesn't mean we can't evolve And that evolution is clearly toward robotic vehicle

There's so much exciting technology in the nonmarine world that I'm just now trying to lay my hands on lineed fiberoptic cable Dynamic positioning [being able to hold a craft in a fixed position in the water) is doable, but I need money Also high-resolution television. We must implement technology from the normarine marketolace and turn it into an operational system that can po out and do battle in the deep. A/00 did a marvelous job on the Titanic If I can bring Argo-Jason online, and Jason follows its schedule and is fully operational in about three years. I'll be happy Omnit: How did your lab at Woods Hole be come a leader in underwater robolics?

CONTINUED ON PAGE 7



A radical theory explains Earth's enigmas





BY JAMES EHMANN

At the edge of the atmosphere, where stars shine on in perpetual blackness and togclouds hautin the shimmering poles, obeans hurtle earthward at Mach 20. These future ease, primorcial balls of ice and snow, are coming in this second, caught by the gravitational puil of the third planet from the suin.

A bypical sphere, or koy correct, in the swarm is unmpreserve by cosmic standards, not much larger than your living room But what the objects tack in suce thay make up loc in number. They arrive in fleet strength—perturps 20 correls a minute, 1200 an hour, 26000 each dgw—and they have done so day after day since the birth of the openet, 4.5 birth vates ago

The cornels do not reach the safe's surface intact. A combination of disrupters—gravitational stress, the surface intraction, and the ram force of stimospheric dragshafters the tragite bodies between 900 and 1.500 miles up Each frozen sphere quiety goes *plfl*, the a scep bubble in a humcane, releasing 100 tions of mois-

PAINTINGS BY DON DIXON

#### Each black hole appeared suddenly, remained in the image for a few minutes, then disappeared.

are to the scattering windle. The ice particles eventually reach the surface as rain or snow at a planetwide raile of about one ten thousandth of an inch per year, almost exactly enough, over geologic time, to create the rivers, lakes, and seas as we know them today.

Traits'the proposition—in a contestrait, so it were it ifs correct—and a renowned team of researchers at the University of lows asyst it is then the implications are staggering. The rain of comets, says astrophysics Louss Frank, head of the Iowa group, could explain large numbers of geophysical mystemes. For instance, perhaps loe ages occurred when relatively more comets

arrived, forming global-loc actuad of sufficient from sunlight And perhaps that thele caused count hackness to a brief the planet from sunlight And perhaps that thele caused count for the lower mass extinctions, of entre tamelies, including the directory of entre tamelies, including the directory of ing meta-tamelies from support and the index support. The particularly complex index and the most support meta-based that might be based in come meta-based that might be based in come in the babone subject of DSS.

And the dramatic impact of the icy comets is not contined to Earth. Comets could have delivered water to the nowicy crusts of moons orbiting Jupiter and Uranus. The polar caps of Mars may be comet loe and the mysterious Martian conel water during the cendit Martian spring.

If the lowe team is correct, the textbooks will have to be rewriter and a dozen scenois revemped as a major tenet of modorn geology is put to rest. Today most scortists think that all Earth's water was here at the planets motien core During the planets hery first half billion years, the theory goes, water vacor was blown up.

When photographed with an ultraviolet camera, the atmosphere should have formed an unbroken expense of orange. But the Earthscape (above) photographed at the University of forme was broken by phonoks of black.



through valcanic vents and cooled to form the lakes, rivers, and seas. And, the theorists add, the plenet's water is slowly evaporating, rising through the atmosphere and escaping to space.

Bull Fränk säys no Water annwed not from below, he says, but from above, troking in since the dawn of time And its volume ts slowly increasing. Home septens is now, and atways has been, fashing in, bahling in, cooking with, and dirinking matter of extraerrestrial orgin.

It goes without saying that many established scientists are unconvinced "It's a bit fantastical" says Thomas Donahue, professor of atmospheric sciences at the University of Michigan "Thave any number of problems with it."

The researchers expected no less "I can't say I blame the critics," Frank says "II somobody hit me with an idea life thrs, I'd be shocked All of a sudden i's life we're twing on a different planet II the comet the ory is correct and we're comes from space, a whole generation of scientists in a dozen fields will have been working from geonitivasia lass mentions that usat aren't tire".

Supporters of the proposal are writing to attempt the invite/catal adjustment, howware. Nex Dessier, editor of the journal (sequhyscal freesarch Letters and diractor of the space acence lab at NASIs Maral) Space Tript Contror in Luntwite, Alabama, thinks Frank scornet theory is "the most exciting new idea in more than a decade. Frank is a very senior, very respected quy in the field, and the does very respecsible science. You just can't reject the idea out of hand."

And James Van Allen, whose Earth encicting belts of charged particles produce phenomena. Ike the autora borealis, supports Frank as well "Tim very persuded by Frank's delta," he says. "There's no reeson to think this interpretation is impossible; it's ust a question of whether or not it's true."

Indeed, friends and enemice alike agree that Frank, forty server, is a highly meticulious researcher who lends to the conservative in his deserve, his life-style, and his dress the ns, they add an unifikely hardringer of radical change. With his casual sweaters of muled gray and brown and an open even-

leatured grin, he seems as down-homo American as the expansive flowa plains Unpreferitious and irrepressible when it comes to his work, he drives to the lab in a prokuptruck and empties the office trash

Students walking through the halts, in lact, have michaen Frank for the university handyman. But these who bother to investigate seen desover that impression is wrong. Back in 1981, after years of work, frank and colleague John Carven. Indryline on the second second second second second frank and colleague John Carven. Indryline has a chart of the optical system for a seathlite called Oynamics Expedient (DE 0), the first craft capable of photographing the upper dimosphere of our phenet.

When their satellite was boosted into space. Frank and Craven hoped to dather straightforward pictures of the atmosphere and the electrical activity within Frank was especially excited about capturing the dazzling auroral lights, produced when solar wind, trapped by the earth's magnetic field, flows into the atmosphere above the poles. Thus the scientists had equipped DE / with three cameras-two that captured light in the visible range and one that cantured ultraviolet ravs. normally invisible to the human eye. And much to their delight, the images sent back were spectacular Pictures of the earth's atmosphere in visible and ultraviolet wavelengths soon began to appear in magazines and textbooks. And Frank was asked to show his slides around the world

Despite all the hoopla, though, there was a problem. When photographed in the ultravoist and color-enhanced by computer, the atmosphere above the daysefe of the earth-the side illuminated by the sunshould have formed a binght orange percong color, the scientists grimped an orange Earthscape broken by dozens of pupping pages auditory, remained for a few minules, and then disacceared

"Whenever Llectured," Frank now says, "someone in the audience was sure to say. "Gee, what are those black spots on the dayaide of the earth?" And my response was always, it must be some sort of electronic noise or interference. It was a reasonable response, and i got by that way.

That is, at least for a while in 1982 John Sravarth, an undergraduale student working with Frank, was scruinzing the images for gravity waves, rupples in the atmosphre that sometimes follow the brightening of auroas. But the computer program designed to analyze the pictures allutered and burged when it scamed the holes.

So one day laten 1982 the larky student sixth 100 computer room on the sixth 100 computer room on the sixth 100 computer room on the address second-dec grades Tadows, set for a sixth 100 computer of dows, set for coupt holes in a core Desk weep pled high with books and papers, gapores of data ready to agit over on the tore address and sets was clear for new targets and the coupt of the sixth 100 computer to address of the coupt of the sixth 100 computer to address of the coupt of the sixth 100 computer to address of the coupt of the sixth 100 computer to address of the coupt of the sixth 100 computer to address of the coupt of the coupt of the 100 computer to address of the coupt of the 100 computer to address of the coupt of the coupt of the 100 computer to address of the coupt of the 100 computer to address of the coupt of the 100 computer to address of the coupt of the 100 computer to address of the coupt of the 100 computer to address of the coupt of the 100 computer to address of the coupt of the 100 computer to address of the coupt of the 100 computer to address of the coupt of the 100 computer to address of the coupt of the 100 computer to address of the coupt of the 100 computer to address of the coupt of the 100 computer to address of the 1

And the student with holes in his data puthis findings there. "I went in and asked. "How can we get nd of this stuf?" "rocals Sigwarth, who, like Frank, thought the spot resulted from a transmission problem.

Frank was so busy working on the aurora, the solar wind, and his collection of vintage cars that he wished he could sweep the problem away. But in order to use his data he had to proport the citich.

The search," Frank now says, "went on for years. First we tried to see if we were picking up extraneous signals-from another satellite, from lightning, or from a radio source on Earth. When we could locate no extraneous noise, we began to ask whether the pixels [individual electronic dots, thousands of which make up each satellite image] were being transmitted properly from the spacecraft. And as it turned out, that question was easy to answer. The pixels in the ultraviolet camera on DE / were controlled by fwo sets of electroocs, each operating half the pixels. The sets took turns. And each set showed us the same holes. We could either assume that both sets were bad in exactly the same way, which was almost an electronic mpossibility, or we could conclude that the holes were real

Though that interpretation was staring Frank in the face, he desperately wanted to prove it untrue "Sigwarth was excited 72 OMM about the holes," he says, "but not me When you're as conservative as I am and you turn up data that go against all your incewledge, you do everything possible to show that it's some sort of spurous effect."

He decided on two more tests. First he nathored rariar records of meleoric dust trais entering the atmosphere over the past top years. Then he compared the motion of this known debris to the motion of the elusive black holes. Much of the meteoric dust. Frank says, tends to orbit the sun even more rapidly than the earth does. Thus it assentially natches up to the earth, entering the atmosphere from the west. "If the black boles resulted from mere porse. Frank adds. You would expect their patterns to be random. But we found the black spots traveling in patterns identical to those of the meteoric particles. That wasn't the turbing implication was that the objects

If so Frank reasoned in his final expen-

Perhaps the ice ages occurred when comets formed clouds thick enough to shield the planet from sunlight. The resulting dark and cold may have caused the extinction of the dinosaurs.<sup>9</sup>

ment he would see the holes from another perspective as well Up unit 1964 held been imaging the holes as they seemingly lell against the binght orange screen of the earth. Now he turned the eye of his utravicet camera outward, into the hydrogen cloud that forms the finge of the earths atmosphere, the last gaseous ring before the utter vacuum of space.

To the eye of the utswold cameres Frank, says, "that cloud of hydrogen is like a dense marring log." And as he focused his likes into that fog. he saw dozens of "big black dises" coming toward him, family at hist but growing larger and darker with time. "These black spote emerged from the cover of hydrogen," he says. "much like the headlights of a care emerged from the dark and the cover of hy-

"It was at that point, fate in 1985," Frank says. "that I ended my search for noise I was obviously observing something starting above the atmosphere and falling in "

The next step, of course, was identifying the looming black discs, objects that Frank estimated to be roughly 30 miles across A number of explanations were quickly conceived and rejected. For example, per haps meteors were hitting the atmosphere heating molecular oxygen at lower altitudes and causing it to rise in the form of gair gas clouds. "But the meter you big one hundred klogarars cos, and were talking about twenty of them per minute," says Frank. "Now, if these were mations they due impacting all over the place all the time, and werd all be time in a caves."

Frank and his team eventually 'wont through all the abundant molecules to see which ones absorbed a broad enough range of wavelengths to appear black. Water' Frank says, 'was the only reasonable candidate'

Thats when Fierk stated trinking about comits the galactic shuttles of H<sub>4</sub>D. He calculated that to form holes 30 miles web, the celosits would have to be 30 or 40 test in dometer and full of enough fully snow to create clause in the upper atmosphere. The appearance and disoptientime of the sould appear when this cloud formed and would disappear as the monsture disposed to the atmosphere below.

Fight also suggeted that the correls might come from the Oard skuot of correls, a cache of detrins formed during the creating the set of the start of the start of the set galaxy's over charging gravitational during the reast file sum in the scipite gains shared the set of the set minimum during the set of the set of

"I looked al overy planet, fryng to get rid of his interpretation; and i just couldn't dou', Frank says. The baffing spokes between the rings of Saturn. for example, are thought to be electical discharges, but no one has proposed a mechanism for finggering time." These correls are perfect for that," Frank says. "They pass through one ring, lift the dust, and runk to the next."

The astronomical data also suggest the comets may have a role in such events as ice ages and the extinction of the clinosaurs. Frank explains. It takes the solar system about 250 million years to pass from one spiral arm of the Milky Way to the next And as it proceeds, the galactic lorges may shift, causing the rate of cometary impact to change When increased forces shake out an especially large number of cometawe would see a giant global cloud thrustno the earth into years of darkness and cold As it turns out Frank adds the ice ages seem to occur in sync with our passage through the spiral arms about once every 250 million years

By the beginning of 1986 the teem of Frank. Signarth, and Creane had their data in order, ther theories formulated. The papers were written and ready to go Bat the hought of actually publiciting the work filled the group with dread. "In deciding to pubcommune betware tee

Everything you do or think instantly alters the landscape





Goceans are the result of lovesick medieval tears?







for explained that every strong emotion remains in the universe forever, and that the oceans are the result of lovesick tears shed in the thirtteenth century Tuesday we waited the Land of Pure Reason, where there is

Tuesday we valided the Land of Puro Resource, where there is we relationed to the second of the second on the remain tensor. The second of on the remain tensor, and sudderity these dances lating the because everything you do or think changes he inarkogen because everything you do or think changes he inarkogen Jammy spati out its bubble gum, and it turned in the disguarding under a the tensor of the work, and met God. Wish you were here them change.

 Roger Dean, 1964–1975. Paintings by Roger Dean from Views, republished by Paper Tiger



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ONTINUED FROM PAGE 05

Ballard: Marine science didn't have a talent base. It was not doing to make an Aspo-Jason on its own, so I started hring people. I didn't know how I was going to pay for them, but Efitured talent sells itself. You know. Get the right people together and don't worry. I went to MIT, to the Man Machine Lab, and met this graduate student, Dana [Dr. Dana Yoerger, an assistant scientst at Woods Hole and a specialist in artificial intelligence]. I went after him like a headhunter I wooed him, clid everything possible-I infected him with my dream Now bes backed. And be's the long-term expert. He's Jason/ The crowd downstairs is a breeder reactor-they feed thembecan, and it's already once critical. These guys are so talented I feel embarrassed being in the same room with them

Omni. How long will it take before Argo-Jason is in full swing?

Balladt 115 giring to take me hos to sm years to fully develop my valion of it. I see Argo viason as an inseparable couple. They I go down together Jasson is in the garage finistic Argo) and when Argo sees something rifeseling Jason goes cut. Argo stags up above the site and looks at the here's Jasson-the oppoint the riphs as the derespectful cut in. But this gay sett

Ommi: Won't Jasco have 3-D vision or something like the "toyeal hat," which incorporates two small television screens into a helmet the operator wears?

Baland 'Oh, yeah Poople go apervers stuff like Intal Were going to use a 11 Womitor, so the actual stereo part will be a limited ring it will be mostly high-recollation color TV Bascaly we have become a society confisional to having the world come to us through TV montors. Lock at Sar 764 dows come direct latering to you, the next you're toking at the galaxy through all locks of changes.

Orann III were coming up now in this field, and I was told that my version of a dive would be sitting in a room looking at a TV monitor, it would be kind of a letdown

Baladt Well, perhaps well put you in the chamber squaese yourhead and bounce you down—let you have your Wow—and then get you up here with the rest of us to work. It will be like in the Antarcic "What do you mean, I'm going to be in a Winnebago the whole lime! I want to go out." Fine Put tim out in the deep freeze for limityseven seconds and bring him back in the Winnebago

In the long term manned submersibles are coorned, it's inevitable. Dring will become an anticlinactic thing because will be able to move you around mentally. In ten years you'll be making simulated drives, and when I put you in a submanne you'll be the put you in a submanne you'll be able to move you around mentally. be disappointed because you're not going to have the freedom of vision, freedom of movement of your mind

Omm: Marvin Minsky at MIT has talked about workers wearing telepresence remote-control jackets, exoskeletons, and doing work in remote areas of space.

Ballard: Well, would you give up a portion of your life to go to the moon? Of course. Would you drop twenty years to make one round trip somewhere? Nope One day we will do most of our traveling in telepresence. We'll choose to be humanly present only on vacations. I do not enjoy sitting on the runway at Logan Airport for two hours because some lark didn't plow it. And we're not going to get rid of those jerks. With today's telepresence vou're just looking at a guy yelling into a tin can on a string, right. compared to where the technology can go Telecresence will simply give us further freedom. Look at the window of time in which the body is really perfect. It's very short. Were going to live to be one hundred one hundred twenty. Our bodies are going to be hanging in there as best they can, but they're not going to be able to climb Mount Everest at pipety. Your mindcan. No longer will we look at our bodies as a prison for our minds. The epic journey, is part of human development in iterature. in exploration, and in everyday life. The journey's goal is to attain a truth, a new knowledge so unless it is brought back and shared, the journey isn't complete. The telepresence technology makes it possible for others to tune it in. Why not make people feel good? There are so many thros that are going wrong. The Titanic was a nice piece of good news, and I think the world reacted to it in that way

Orani: Were you engaged in a test run of the Argo when you found the Titanic? Bellerif: It was an unofficial search. It was

The biggest unofficial thing that's happend for a white We chose the Tatavic bacause it was fairly double. Although most experied out think of it, the Tatavic as only about eight hundred mikes due as of Woods Hole. We was controlly for them it has a the second second path of our cruss. It was gring to stop and our second second second Woods Hele, and the Tatavic was right in the middle. So that was no avent

bonally. The ship itself had such an impact. I had researched the disaster in intricate detail to find it. And suddenly there it was! A disaster partially put to rest seventy-three, seventy-four years app came roaring back into the present like a freight train. There were the empty lifeboat davits hanging there with no boats. To me that was the symbolism of the Titanso-the empty Meboat davits. They were what all the people who died saw as they were looking for a lifeboal-empty davits. To come up finally, perticularly from the second or third class. to the boat deck and find all the lifeboats done. Gone! And there it was in the picture. We came over the top of that with Argo,

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running shoes that will match excellence with any top brand in the businese. Lynx builds in the best of the best features, and leaves of the un-needed finils. You'll find them at Foot Locker side by side with Nike, Reebok, Puma, Addias and the rest. Compare them feature for feature, including the price. You'll find what been missing. Lynx.

saw the picture, and-Bang/---It was like a sock to my stomach

Omni: You had a memorial service shortly after the discovery.

Befault Viss, we vert up this tig excitoment spike and then just phrametical mican emotional trough! Amazing, amiszing -1 like (sheccyhrene) Wiss human being weite out them. There was this good protescenal—like being good al conciting, 1% graftlying to make the right call, to be inhawing abait Huwas it his park. And there was this other human who kept getting in the way who kept getting enclonal.

You feet let down after pursuing some thing for so long. The star is gone. All my its I have erected stars on the horizon and moved toward each in this five- to ten-year journey. It's my epic journey And it's always a disappointment when I arrive. The star is none. This journey was ten years. ten years! The other more important factor was that it was physically very tough. The Tritanic did not yield easily We were almost ready to concede detest. Once we found the ship, we worked around the clock. The Titanic was war with no one getting hurt. People were dropping not from bullets but from fatigue. But they were out of action when you needed them. And you stepped over them and kept the battle going. You kept saying to yourself, "Is there another hour left in me?" And then another hour and another, it was really a tough job. It was the most physically grueling and technically challenging thing two ever done. And the final factor was that 1 had gotten to know their shin in the abstract.

Omn: You must know more about the 7tenic then those who built it

Balard, No, some Trance buffs are much better schooled. My research focused on facts that week here me locate it as opposed to exactly how many bollers or like jackets in that There are people who can ratie that off like a fundamental stopping from the New Testament They show it chapter and verse. I never got involved im ore that dark tell im where the ship was

Still, i cain't resize how much I had absorbed. I was stretched to the Imit We really pushed the onvelope that trp. 14 do t again, but couldn't doit that many three. I mean, I am yust recovering I don't know what hoppened to Ocobot at all. In December I went to sea, I and way Aud all in De-Combine I went to sea, I and way Aud all in December I went to sea, I and way Aud all in De-Ower's war methoned that while doing a radio interview with Tom Brokew on NBC, you were emotionally overwhemed

Bellard: I was fatigued, and all hell was breaking locae. I had to get the final lowering of Angus under way. You know those beautiful pictures of the Titanic? They were taken in the final four hours of the expecttion. I elept under the table in the tab as they prepared for the final lowering, and literally crawled out from underneath and draped myself on the operator's shoulder and made that run with Angus and got those occures. During all that we were getwere not done. You're dead on your feet. but they want their interview, and you're band told by the management on the beach to do as many interviews as you can After we finished the lowering, we were trying to clear the area because our taxcab meter had expired and everyone was anxious to get home 1 did the interview with Brokaw in the radio room. As I looked through the porthole I could see the ship had gotten under way I don't recail what puestion Brokaw asked, but I started tosing it. My eyes were swelling up. We were leaving, and I hadn't said good-bye. Like the last time you not to see your grandfather. That feeling of remorse for having improperty bid actieu. I cot choked up and couldn't talk. I had to get back to the fantal and make my peace.

We hope to return to the Triane and get inside of a soon We plan to also in the deck with the submemp and send the robot. Jesoo, down the main staticase and the whole at end of the ship. The ship's cut completivity in still You see a cross section of a sectory building, the grand balloom bang under the forwerd skiylith. The grand statesee lekes you down into the first-blass accommodations. This expedition must not seem ghoulsh. The filance is a tomb it's the first pyramid of the deep. There are many others. Man's history is recorded in the deep see, particularly the Mediterranean. I am after the Mediterranean You could start almost anywhere. There history gees back beyond is writing it down—ever since a guy could float a log.

Take a dart and throw it at the board it's like shooling trout in a barrel. In 255 s.c. the Roman fleet defeated the Carthanini ans off the coast of Cane Bon, but the Bomans themselves lost the greater battle to Neptune. Of three hundred sety-four ships that put to sea, only eighty survived the storm. Casualties were set at twenty-live thousand mariners, seventy thousand noremen\_fifteen norment of Itak's ohie. bodied men. And thet's all in just one site amund this area hetween Malta, Sink Tunisia, and the fip of the boot. It's doable. and it just might be my next star on the horizon. I've got to have a star if you can do it in a year, it isn't worth doing, if you can do it in five years, it's marginal Omn: What are your new opals?

Balad Multiple state: I variet occrute to use Ago Jason to explore the mid occarr ridge and the Arctic: I are gravitating more toward the Arctic: Lare gravitating more toward the Arctic baan i variet to confinue projects (Bar the Tranc burt for our finance in marrier activation); I variet to work closely with the Navy in terrane variatee (marking stating); use of understa the rane). And I want to contrue the dowopment of deep-submergence technoogn Thits encogin. So I need to pick a star for each of mose worlds.

#### Ornnl: Who are you?

Balked: In this incident who also all optimized in the transmission bows the occam. And this all explores who lowes the occam. And this also begins the occam. And the optimized in the optimized and the optimized and the optimate of any occam. Name the analysis of any occam, how the optimized and the present of the optimized and the

I also think truths are inevitable. If the apple barin't fallen op Newton's beart it would have fallen on someone else's a year later What a scientist or a person pursuing truth does is precipitate something earlier than it would normally happen. He accelerates it. He's a true catalyst. A catalyst precipitates a reaction but is not consumed in the reaction. I'm a catalyst that doesn't necessarily care whether my catalytic properties are used in science, in commercial areas, in the military, anywhere I don't want to be known as a scientist. I have nothing against it, but it's not my world. Recently the question was asked. What do you want on your tombstope? Explorer That's what I want DO

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 This past May, in the wake of Halley's Cornel, renowned ufologist
 J. Allen Hynek passed away.

### ANTIXMATTER

UFO UPDA

Backin 1910, which is the days old, his father days old, his father of their born to view the glowing trail of their born to view the glowing trail of their sources and accuration of the accuration of the accuration of accuration of the days the old has a construction of the point. The days the sources are accurated and the Northern Hemsphere for the lins. The parts Hag, in the accuration terms approtation terms appro-

scientific study of the unidentified fiving object, or UFO

When Hynek started his cancer in the Forties, he produced rigorous papers on supernovas and established a dozen major observations around the world. So it indices sense that when the Air Force asked him to applien humdiods of UPC reports, he todd tham secures were a faid.

Hynek the skeptic ultimately agreed to help the Ar Force deluse some of the public panies, signing on rise a constraint to the notorious Project Bue Book. For the next 16 years he had access to a vast amount of data on UFDs. And eventually her video began to change. "Nou confribute discount traily her video began to change." Nou confribute discount that from origineers and pilots, "he said." i realizes that from book their reports servicely, patterns emerged."

From the Skries on it was those patients that Hynek endeavored to explain. His obsession resulted in 1922, in the Center for UFO Studies in Evenatori, Illinois. A small operation nucleon by iterast, use center produces negociated papers in a field replete with meguided enthusiests and aged to define the UFO and characterize the UFO witness

He also traveled around the wolid investigating cases. And to describe contact between humans and ables, he over coined the phrase close encounters of the third kind

Despite his efforts Hynoic was riskwer able to explain the UFO He didn't believe intaligent lie could Iterally traverse the vastness of physical Space. Nor did he accept the notori hat sabore were merely Illusors He 5tally puggested that UFOs were part of a parallel reality "apgening Spontane-

ously within a timited area and then disappearing to another universe or dimension without a trace "

The otherworldy theory, but forth in Hyneis star years, neocoacped elarady skiptical colleagues and even some supporties to dismas his case. His toubles were componded when an anonymous benefabor priomaed to endow a million-dollar UPO conter in Soutbedie, Anone. Hyrek left his tongrine home in Exension to start the facility, only to find hashe other had been withdrawn.

He such struggies even the proof that must be paid by these who charges our mundher includes of make, transondring the bounds of time and space. In the times more that finally was the initial of therefore, the space of the space of the time of therefore, and the space tensors, and beyond Our formation dougset Bio fixed the transace of the LEG in manyor mystel in there of the transace of the LEG in manyor mystel in there of the transace of the LEG.

#### UNRRENOLY SIDES

Though Displays kind to the Weight bookers show the Weight bookers the weight bookers the keyrong as if the Min Reheated fram a possible. The high get concern is ingreshin of parts into the engration which if the book are boo encough a negative the show encough an regular in engrate which will be and the show encough and the show encough and the show encough a show the show the show the manager that Safety Board's available to the show the manager that the show the s

Now Tokyo-based Ali-Nippon Anways thriks it has the solution to this dangerous problem. The artino is partibrings of its 43 Bocting 727s and 747s in the hope that nature's avalors with mistake the planis for huge predatos and fly the other way.

The block and-write eyecone are known as 'doubleoffsat prinner markings' reports Sugi (uch, Al-Nocprans New York representiatios 'We have been studying them area 1938 and (sadd) them on a 747 last year do not have statistics to prove that they are effective in any off the statistics of the print of the statistics of the print of the statistics of the print of the statistics of the print any off the statistics while bard striver in repairs

Will the novel technique work? Mike Harrison, birdstinke sponelist for the Federal Avabor. Administration, chuckles. "The seen the marking on only one airplane," he says. "The engine st. OMM:





were diing, and all i saw was a blur it's not going to be clearar at top speed

takes the serve, the principle isn't seal if might help to give the turbines some kind of spoteal identification that the brids can learn to recognize and stay away from Offinand Ms say that strobe lights are a lot more lakely to work than painted-on cyses "--Owin Davids

linguas go med in the end " —James Jovce

### ANTIAMATTER

#### ANDIGAN AND

A unulant epidemic spread primary by sexual contact may sound like AIDS, a disease unique to the latter part of this texticith centruit But according to British chemist John Gwit, whith has southad medical informass in the Babb for over a decade, have suffered an AIDSlike nancen theatism

Gwill, who is a vice president of the New York-based Starling Drug Inc., points out that a deadly, sexually transmitted disease is de-



scribed in the Bible in the work/with negative of Number, The landlide had been partying with Mubble been partying with Mubble negative prostructures and negative states and dyng. Gwit suppects that transenters negative from 2 400, the plaque dourty negative download a very semous throad to the grave from 2 400, the plaque dourty negative. spidemic? "He destroyed all potential human carnets of the disease by executing them," Gwit explains. "That's a course of action that would be unacceptable today."

According to Gent the tabbits, issued with decorpbits, issued with decorpattacks and epilopy to hypathema and table, but on a deal syndrome. The Black epilon to only on current decarso, he adds, but on a final decarso, he adds, but on a here have an in the solution to hys send on the field that any send on the field that any send on the field that any send that it more constrained and that any send on a muchaer war.

-Sherry Baker

He would dream perhaps ince a week that it had all been a dream "

I have often wished to ecome an insect but could ever attain my desne."



#### HOUR LINES COR LINEY

when Norary Dear tocame Index prime mittedie in 1975, pocjal wire shadoed to beam that he drank has own ume--straght. But the noise don't natile deark has own of Leeds, England, who has been studying he folk uses at ume for years. The att of dening upmills' common not only in Indea, says Ste2id, but don in Weat. In tack durang the Twentes a Yorkthere herbatte ganned some istonety for suggesting that inne might enhance his second up at the

Units has also been used to cleance sion Another man from "dirickine, for instance recently biol Staad hai ha grandhonger "weathor her take with units, then demanded alkes from us betoro all eff for school." The measurement to work, adds Stead, since the man could remember rany a writke on his scandmark face

And English housewwes have historically used urino to oblach aprone, remove hren stains, and wash clothes hren stains, and wash clothes hou on clothos in tube of urina? she says. Then ninse the lot in a stream."

Urne has even been used in weedings One Yofk-tree section scrubbed his church steps with unne before the caremony, says Stead. And the technique provid a great success, since "the church steps in the photos care up lowly and white"



### AUTI\*MATTER



#### PSYCHIC SUI

A Philadelphia jury has awarded a psychio nearly \$1 milten for a medical procedure that she claims runted her psychio ability.

Judia Rectandon Harnes This a thinking procession and this a thinking procession and the state of the state and the state of the state and the state of the state of a Suff Head state of the state a state of the state the state of the suras, " says her lewyer, uset Usbermen, But her headaches make the readings too painful, "it has destroyed her practice completely."

Upring the trail, instructions of the New Juley and Perinalylivana crime commissions estitled that themetis actition has holped them locals bodies and solve or tracs A doctor tractified that have no inspectically disgraced that his doct. Harries interfact that the CAT estim had cost har more than put that business Har son was in a cer acodant that put affact to puscice

The detined has patheo: to present magnain Jamãe Rêndi, emong others, lo snow that Hambe's peychio powars welle not real. But before they could do it the yoge had had enough. He rulad that Hatmes's lawyers had failed to show a ficial mationalis between the dye and the headfaches that cost her powers, and he ordered the jury not to consider them. After deliberating for an hour, the jury awarded Hames \$936,465,75

"It's a bizarre case," says the respital's lawyet, Richard Gall, "The juty must have taken her psychic clams into rocesideration."

Since than Gall has filed an appeal But Lieberman is certain that Harmes will wit. After all, he says, "My client was clearly a bona fide psychib."---Deeplas Starr

#### NUKE BAN

Nuclea enginer Galen Wintor has a damatuc eay of poting attention. He eats uterium outde. What's more, he instals if the harmless installes the radioactive usenotable the radioactive usenotable the radioactive usefluct in door mixe me radioactive, and according to government revealations (to be burned three have radioactive den).

Writefor unusual dia, however, ent meet boowntaay, it is part of his camtary, it is part of his camtary and the second second second line and the second second second line and second second second in use an encount of the second in any second second second second in any second second second second in the second second second second in the second second second second in the second second in the second second second second in the second second in these the second second second second in these the second second second second in the second second second second second in these the second second second second in these the second second second second in the second second second second second in the second second second second second in the second second second second second second is the second second second second second is the second second second second second is the second second second second second second is the second second second second second second is the second second second second second is the second second second second second second is the second second second second second second is the second second second second second second second is the second se recycled and used in small, portable reactors that require reflueing only once every 20 years. Such reactors, moreover, would free homeowners from community power companies.

In pursuited that goat, the velocitian of 35 years in the nuclear industry receives, 5100 a day, pilos expenses, from the Jahn Brich Society's American Opnian Speakes Bursitu to travel and the safe a cencalization E J. Crostly and Associates, a Rehimind. Washington, company that washis to purchase all the spear fuel in the United States.

But NRO's Robert Alexmade doubts that Which has been compakily unatteched you han unsued do and yound not suggest that anyone else by Alexander politik out, and alexander politik out, and alexander politik out, and alexander being the substantiation and analyon the lothing with alexander the outer theory at the substantiation with the substantiation alexander alexander alexander be dastroyed and sub parts alexander bear alexander bear alexander bear alexander alexan

Whow disagrees "The truth is, if you hereft been fremally burned by radicetive materialy our read by radicetive materialy our ready and and purstantee you, there are no people anywhere with cough of it in ther bodies to herm them "He plans to contrave demenstrating the hermisss effects of ummain until the government stope burying and watting valuable sport fuel.

—Kevin McKinitev



CONTINUED FROM PAGE 40

dwing outside to swim happily for hours, unencumbered by hardware of any kind

Once man has settled on the seatloor, nature may take up where technology leaves off. There is already a tantaizing suggestion that the evolution of man's ancestors included a long aquatic phase, holding out the possibility that latert within Armo sageness is the genetic raw material that could engender a sea-dwelling species. *Homo aquatocus* 

Some of the clues may be in the Danakil Alos, a particularly forbidding stretch in the backlands of Ethonia where a series of cracov, almost lunar mountains rises 4,000 feet out of a lava and basali desert. With scrub growth clinging like an afterthought In the few cracks in the rock where moisture can lincer it is the unlikeliest of set tings for the emergence of what one set of theorists has taken to calling the aquation ape. Sometime between 2 million and 5 million years and advancing seas encreached upon the Danakil Alos and all but isolated them in a swampy marshland In this region, some believe, lived a small group of australiorithecines-the upright apes widely regarded as man's distant ancestor. Separated from their savanna food sources, they survived the only way they could by spending more and more

time hunting for food underwater. Over the next several million years evolution incorported the physical capabilities necessary to eustain a partially aquatic tife-style. When the seas receded, the australopthocines returned to the savanna and eventually passed their genefic endowment along to Homo savains.

This theory was originally drawn out by German biologist Max Westenholer and British matine biolocist Sir Alistan Harrly and later developed by Weish writer-researcher Elaine Morgan in her book The douatio Ano. It has been offered to exnian a number of curious ourks of the buman anatomy. These include our relative hartessness and well-developed laver of subcutateous fat. (Both, the theory cores, are of Ittle value in most terrestrial environments but are of value in water Less hair moans loss water resistance and fester swmming speed, and the laver of fat offers protection from the cold ) The outpusty low placement of the larvrx, a potential disadvantage on land because it can impedie breathing and swallowing, allows man both to close down his anway and to hold his breath and swallow food while submerged These leatures argues Morgan are rare among land memmals-wartually unique to primates-but are found routinely among such aguatic mammals as seals. sea lions, and dolphins. Their origin, she thinks, can best be exclained by an acuatic phase in human evolution that was real-

1 (Devel x 1 A 10) X P13X (0<sup>+</sup> x 30 pm x 52 (bit x 1 M 20 x 0 W cl + x - 32 x 10) + 8 x 50 x 30 pm x 52 (bit x 1 M 20 x 0 W cl + x - 32 x 10) + 8 x 50 x 30 pm x 52 (1 M 20 x 1 - 2) + 8 x 50 x 30 pm x 52 (1 M 20 x 1 - 2) + 8 x 50 x 30 pm x 52 (1 M 20 x 1 - 2) + 8 x 50 x 30 pm x 52 (1 M 20 x 1 - 2) + 8 x 50 x 30 pm x 52 (1 M 20 x 1 - 2) + 8 x 50 x 30 pm x 52 (1 M 20 x 1 - 2) + 8 x 50 x 30 pm x 52 (1 M 20 x 1 - 2) + 8 x 50 x 30 pm x 52 (1 M 20 x 1 - 2) + 8 x 50 y x 2 #2 X A # C + [4 + 1 LC < X + . 50 x] / Jev + 4-2 21.24 x 72 × 10 / 72 × 6 \* 4  $\begin{array}{c} 4 \\ (6 | x| t_{2} \ 6 ) \times \frac{3}{2} \\ \ast \left( \frac{5}{6} \right) \times \frac{5}{2} \\ \ast \left( \frac{5}{6} \right) \times \frac{5}{2} \\ \ast \left( \frac{5}{6} \right) \times \frac{5}{6} \\ \times \left( \frac{5}{6} \right) \times \frac{5}{6} \\ \times \left( \frac{5}{6} \right) \times \frac{5}{6} \\ \times \left( \frac{5}{6} \right$ <sup>2</sup> 6 × 10<sup>-10</sup> C (a) 8<sup>2</sup> + WORD = 1 6 × 6<sup>2</sup> - 43.06391(0) × 9(x0.0000 × 9(x)(x)) 2 3  $\mathbb{E} e^{\frac{1}{2} \mathbf{m}_{q} \cdot \mathbf{x}} \times p \cdot \delta d(\mathbf{x}) + \frac{\delta \theta^{-1}}{2\gamma} (\mathbf{m} \cdot \mathbf{x} \mathbf{m}_{q}) e^{\frac{1}{2}} + \frac{\mathbf{m}_{q} \cdot 10^{-10}}{1 - 600^{-1}} + \Delta \mathbf{m}^{-1} - \mathbf{r} \cdot \frac{Q_{1} \cdot 2}{3^{-1}} + \frac{2\theta \mathbf{H}}{20} \approx 4(\mathbf{0})$  $\frac{2\gamma}{3\mu-71} \times F_{0} + 344799 \times 7 \times 7 \times \frac{1}{2} - \frac{1}{4} \times (2244\times \frac{1}{2}) = 7 = -644646 \times 100$  $\begin{array}{l} \chi(b_{1}^{\prime}b_{1}^{\prime}+\frac{1}{2})^{2} \overset{(a)}{=} \chi^{\prime} \chi^{\prime} \chi(2)(2) \chi(1+-\frac{1}{2\sqrt{2}})^{\prime} \chi(b_{1}^{\prime}b_{1}^{\prime}+\frac{1}{2})^{\prime} \chi(b_{1}^{\prime}b_{1$  $(2Dk \ \text{cyrin} \times \frac{16\sqrt{2Dk}}{\sqrt{2}} + 7 + (n|x| + 8 \times 3700)(n|y| - 4^{1}|x) - \chi_{2k}^{2k} \times \frac{6}{2k}$  $f_0 \times J_n = f_0 \times c_1 \left(\frac{1}{2}\right) \vee = 7 \int_{-\infty}^{+\infty} dt + \frac{1}{20} - R_0 + B(n)^4 \left(y\right)^2 = \frac{1}{\sqrt{2}} \times (nn+HD/6 \ yH$  $\begin{array}{l} \int_{\frac{1}{2}} \chi_{-}(x) \, T + (x) |x|^{2} + 3 \, dT = 1 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, T + (x) |x|^{2} + 3 \, dT = 1 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx = 3 \, \chi_{-}(x) \, dx \, dy = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx \, dx = - \cos(\chi) \, |x| \, y - 23 = 0 \\ \int_{\frac{1}{2}} \chi_{-}(x) \, dx \, dx \, dx + - \cos(\chi) \, dx + - \cos(\chi$  $\begin{array}{c} (4)^{1-1}_{1-1} \cos (2\pi) + (1+2)^{1-1}_{1-1} \cos (2\pi) + (1+2)^{1-1}_{1-1$ 

ized in the emergence of an aquatic ape

Morgan is the first to admit that the the pry is held by a distinct minority of scientists and it will remain that way until someone finds some 2-million- to 5-million vearold australion theorine fossuls in the Danalol Alps. And even the most enthusiastro prononents of the acuatic-ane theory would admit that for the moment there are physiological problems that make it impossible for contemporary map to become a fully aquatic creature. At depths greater than 48 feet nitrogen builds up in the bloodstream producing the well-known "rapture of the deen." which can fatally discrent a diver. The human body tends to retain corbon droude, which can cause blackouts. even death by aschwiation. Ascending too rapidly from the depths can bring on the bends, a painful and sometimes fatal reaction to rapid decompression. And dal-Mon too loop in cold water can induce hynothermia and fatious

But the close that man may be physiobogcally equipped or at least a part time underwaiter existince ratures to go away. It is well-known in ceample, that when human cause are immerside carly and the adapt cardy and happly. In the Soviel Union and among the Tupe-Guaranso of Bazil, babes are delevered underwaiter and gardy trained to sam immediately after the unclucio cord a cut in delet parts of the work, the parts cord acut in delet parts of the work, the parts cord acut in the topset of the work, the parts of the parts of the work, the parts of the same to the parts of the work, the parts of a same to the parts of the work, the parts of a same to the parts of the work, the parts of a same to the parts of the work of cards of a same to the parts.

Given a few million years of submarine civilization, evolution might produce a new race of Homo acuaticus Such a man might have the inhorn shilty to extract oxygen and nitrogen from his body. According to Belgian physician and researcher Mark Verhaegen a proponent of the aquato-ape theory, man's neurophysiology might be transformed to function better in a liquid atmosphere. It would change to make such an aquatic species more at ease in the water. His vision would be diminished, but his hearing would be more acute. Most startling is Verhaegen's image of how the human form might change shape to accommodate the hydrodynamics needed to move swittly and gradefully through the water Legs would be reduced and slightly atrophed, but the feet would be broader. and the body would be practically hairless but equipped with more subcutaneous faf "In other words," he concludes, "more like a seal or a dolphin

Although Rougene is sangure about the dires that we had an aquatic forebarm in our evolutionary past or that there may be a newly avoived aquatic human in our flutter, he does not discount the possibilities. How protoundry may transforms human fitting parts protoundry may transform human fitting protoundry may transform human fitting when quatation hanging on Rougenes wai declarates. ANYTHING THAT ONE MAR DAR MADE AVOITHING THAT ONE MAR DAR

#### EXPLOR/ATIONS

CONTINUED FROM FAGE 20

and Minanda at 20 mises per second, a speed that meed our one-mino-per-hour traverse of the rise seem tudicrous by comparison (Buch of, to be biel ostudy Minanda in such dotail) Balard and the others know me well enough to guess where my mind was. My habit of thirtieng my all the bottom of the ocean was not as strange as it seemed at first. Indeed, Balrad was largely responsible for it.

Years ago Jesse Stoff (a physician at Leonard Hospital in Great Barrington. Massachusatts) and Licame up with models surgesting that underground streams once existed inside astemids and that actual oceans might now exist inside certain icv moons of Juniter Saturn, Utanus, and Neptune I remember asking Jesse early in 1979 what the hynothetical beasties in those oceans could be eating. On what do you base a food chain inside a world, where there is no sunjusht, where chlorophylthe molecule that sustains life on this planet-cannot possibly function? Jesse was ready for me. He had stacks of papers from Ballard, whose team had just made one of the biological discovenes of the century. Protruding from the bottom like organ pines, but springs on the East Pacific Rise were spouting continuous jets of sulfide-laden water Bacteria living near the springs were slowly burning, or exideing, hydrogen sulfide and using it as a source of energy Around the springs the ocean floor had become an casis, supporting dense communities of clams, mussels impets and crabs, with the bacteria forming the base of the food chain. One species of worm arrew 12 feet loog and fixed in clusters of thousands. The worms however, did not feed on the bacleria but were themselves carbohydrate-producing organisms, the only animals on Earth known. to synthesize their own food like plants They had no stomachs, no digestive system at all. Not even a mouth

Batteri had found creatures that drew life from suffice snstead of surght havng seen them, Josse and i fhought momodately of the some, Calyke meteorities we had been studying. They were chocktuid suffices And is the moon next door to Europa, was spewing mountaine of the suffice on two reasonable to expect lifeing and the second second second to the other is a worklow wailing to be discovered. "What it site most was and house to find

"What is the most you can hope to find out there " asked Ballard. When Voyager files past Uranus next month?"

"Oceans," I said

'And what is the most you can hope to see in those oceans, assuming they exist, and assuming you can break through mites of ice, and assuming anyone is ever willing to give you a budget to explore them?'

"Suffide cases; life; even fishlike things "

"Then look down here," he said. "We already have what you want."DO



If you'd like to taste Jook Damei's Lyachburg Lamonarde, look for the display and a recipe in a liquor share near yo

AFTER A DAY'S WORK in Jack Daniel's Country, folks unwind with checkers and lemonade.

Our oldtime distillery is located here in Lynchburg, Tennessee, a country town that's legally dry. So even folks who make Jack Daniel's whiskey—like Bill Durm and Foote Scott here—aren't allowed to buy a single drop! It's an unusual law, that's

for sure. But we've never complained about it much. You see, as long as the law lets us go on <u>making</u> Jack Daniel's, we don't mind going someplace else to order it.



VISIONS

CONTINUED FROM PAGE 44

- 10. You are a member of the engineering learn designing the space station; and you know that there will be eight crew members during the first few years of operation. How many bathrooms will you plan for the crew quarters? a. B. c. c. 3.
  - 4 6
- Some experts believe that the first soual encountro between a man and a woman in space will occur before the year 2000 Newtor's takes of motion, of occurs, still apply in weght instrume that and populations due to a neutral and populations due to a neutral and populations due to a neutral and populations and the issense. Inove will couples a state to prevent themselves from physically lying away from each other during romantic intelluides? (More than one answer's acceptable )
  - a they will wear an elastic sex belt to hold themselves together
  - b robotic arms will be employed to help couples remain united
  - enclosures with adjustable walls will be built in the space station
- It is 2020, and space tourism is available and affordable for many people. You are planning a two-week vacation

Which of the following vacations can you choose? (More than one answer is acceptable.)

- a a flight to the national monument at the Sea of Tranquility
- luxury accommodations and zerogravity recreation at the orbiting High Hilton
- a circumnavigation of the earthmoon system
- d. an African wildtife safari
- e a trip to Disneyspace
- Astronauts do not shore in weightlessness. Why is this?
  - ther breathing during sleep is shallow and slow and there is not enough air to vibrate the uvula
  - b cabin atmosphere is oxygen rich, and the tissue does not vibrate
  - weighflessness causes the soft palate to float.
- 14 You are finally spacebound after years of training. During the first few hours in orbit your body adapts to weightlessness in many ways. One important change occurs in your circulatory system, and a major shift in blood occurs. To where does the blood shift?
  - a. from the legs and arms to the midsection, including the genitals
  - b from the lower part of the body to the upper torso and head
  - from the head and neck to the heart
     The Apolio astronauts left their body
- wastes on the lunar surface. Waste



water on space shuttle flights is cumped overboard. When the space station becomes operational and as many as eight crew members have 90 day tours of duty, how will human wastes be handled? (More than one answer is acceptable ?)

- a they will be dehydrated and dumped overboard
- b. they will be returned to Earth in the space shuttle
- they will be used as fertilizer in the green module
- Inquids will be purified recycled, and added to the water supply
- solids will be freeze-dried and used as reaction propellant for the space station thrusters
- 16 During prelight training at the Johnson Space Center your sensory responses are tested under many conditions and are found to be normal. You understand, however, this some of your senses become severely limited during spaceflight. Which sensee? (More than one answer is acceptable).
  - a hearing d taste
  - b sight e touch
  - c smell
- 17 You become taller during spaceflight a true b false
- Time is big money in space, and leisure time is therefore at a premum When estrematis do have a cherhoe to relax after their busy workdays what are their favorite activities? (More than one answer is acceptable.)
  - a conversation in the galley
  - b. weightiess acrobatics
  - c Earth watching
  - d reading
  - e playing cards
  - f. clart games played with Velcrotipped darts
- 19 If has been said that your heart goes on vacation during spaceflight because it doesn't have to work as hard as it does under gravity. In 1998 you are on a space station tour of dury that lasts for 90 days. What is the best exercise to keep your cardiovascular system in good shape?
  - a zero-g jogging with feet held by elastic bungee cords
  - b treadmill exercise
  - spending time in the lower-body negative pressure tank
  - d sex
  - e. pedaling a bicycle ergometer
- During the Apollo voyages to the moon the return trip to Earth was faster than the moon-bound trajectory. Why?
  - there was no longer a reason to conserve fuel, and the rocket burn was longer for the roturn trip
  - b the returning spacecraft was much lighter after the moon expectitions
  - c the gravitational influences were different
  - d exposure to solar radiation became more hazardous during the trans-Earth trajectory

- 21. Because a conventional shower cannot possibly work in zero a, how will the space station astronauts keep clean during their three-month missions in space?
  - a they will use prepacked and treated washcloths and towelettes on a daly basis
  - b they will use personal, hand-held water dispenser/vacuums that wash, lather, rinse, and collect the wash water
  - c. they will use showers that force the water downward with airflow
  - d they will use large bath bubbles filled with water, with watertight collars to keep their heads clear
- 22 The Skylab space station of the early Seventies had onboard the first space food freezer, which stowed such gustatory delights as ice cream and prime ribs. The space station will have an even larger food freezer to provide astronauts with a wide selection of freshfrozen foods and prepared meals What will be the most popular entrée among the following?
  - a. surf and turf, with hot butter
  - b. chicken and noe
  - c. shrimp creale
  - d vegetable cassergle
- 23 Why did NASA managers decide that space station astronauts should fly three-month-long missions?
  - a because serious bone deterioration occurs after this period
  - b. because they had no data from a loncer manned spaceflicht
  - c because cardiovascular rregularities increase dramatically after 100 days in weightlessness
  - d because they wanted to offer more flight opportunities to a greater number of astronauts
- 24 Many scenarios for future excloration of the solar system exist both within and outside NASA. After a manned Mars expedition, what will be the most likely destination for a manned space mission in the twenty-first century? a. Jupiter's icy moon Europa
  - b the asteroid belt

  - Saturn's atmosphere-cloeked moon
  - d. None Mars willkeep us busy for at least 100 years
- 25. A space station crew of eight will use some 44,000 pounds of water every year, and the costs of supplying this water will be tremendous. The space shuttle will have to make at least one dedicated water-supply flight a year. in false

#### OMNI OLIIZ SCORECARD

Here are the answers. Give yourself a point for each matching answer for fractions of a point where indicated). Then find your Omni Future Quotient. Are you ready for Earth orbit or a trip to Mars?

3. d (Sleep studies of the Skylab missions OMN

show that REM sleep decreases slightly during spaceflight )

- 6 c. d. Give yoursell half a point for each correct response
- b, c, d. Give yourself a third of a point for each correct response. a 10 d
- 11 a, b, c, d. Give yourself a quarter of a point for each correct response.
- b. c. d. e. Give yourself a quarter of a point for each correct response
- 15 b. d. Give yourself half a point for each correct response.
- 16 c, d (Redistribution of the body's blood volume in zero g congests the head and sinuses and degrades smell and taste) Give yourself half a point for each correct response
- 17 a (Body height increases because of spinal lengthening caused by additional fluid between the discs )
- b. c. Give yourself half a point for each correct response
- 19. h 20 c
- 22 c (Spicy space foods taste best be cause the head is stuffed up, and taste and smell are adversely affected ).
- 24 h
- 25 h (Designers will incorporate advanced recycling systems )

Tally your points and find out which cat epory applies to you

0-6: Earthbound Very probably you love quizzes more than you love the manned apacellicht program. If your aptitude for finance is better than your antitude for space, you could become an earthbound financial analyst of future commercial actwittes on the high frontier, but you'l have to learn a lot more about space first

7-12: Looking Skyward. You take personal pride in our space accomplishments and want to know more. If you did well with the practical landing, maneuvering, and repair questions, you could be spacebound by the turn of the century

13-18: Space Station Bound. Your space aptitude and knowledge are above averape. You realize that our destiny as a species is inextricably bound to our future spacefaring accomplishments. And you agree with the Russian space pioneer Konstantin Tajoikovsky, who wrote. This Farth is the cradle of mankind, but manspace station beckons you, and if it is your goal to serve on the high frontier before the end of this century, you will be there.

19-25: Commander on the High Frontier, II you scored at the top end of this range, you may alrearly be an astronaut or at least a candidate at the Johnson Space Center You have demonstrated an extraordinary knowledge of space and a practical aptitude for carrying out its activities. You are one of a chosen lew with the "right stuff" to become a spacefaring leader DO

### GARDEN

but Tommuri and Habishi. Why then had the ship come? Why did the computer consider it unauthorized?

- Watson-san
- "Hai. Livingston-san?"
- 1 need some more help

"[Click] Detail nature of inquiry, and this program will attempt to provide appropriate command structure [click]

"I want to know what that ISF ship is doing up there, for one thing

You must request backtrace and extrapolative report, specifying vessel in question by either name or location and establishing commencement and termination dates

"Okay Watson-san give me a backtrace and an extrapolative report on the ISF ship now in, um-' what'd it say? "twenty-three-minute equatorial orbit around this asteroid commencing um, when it left its last port of call and terminating in twenty-

"[Click] Ankar Maru departed Shin Edo eighteen November 2021 on three-year reconnaissance mission of asteroid belt, with primary focus on distribution and density of Celestial Equity Iverock prospectors, and secondary focus on identifying and locating ripety percent probable liverock cardens Twenty-two February 2023 Ankay Maru encountered flotilia of seven fully equipped Belt Breakers: brief engagement broached hull integrity of Ankai Maru Iclick1 Three of seven crew members died n battle. Four survivors placed in medifreeze by boarding party and remain in medi-freeze as hostages against imperial Soace Force missiles

Livingston shuddered Medi-freeze suscended matabolic activity successfully for periods up to two years, but that poor crew had slept in ice for going on seven years already 'Watson-san

"Hai Livinciston-san!

What are the survivors' chances of emercing undernaged from medi-freeze?"

Average probability of permanent skin damage, 0.857 probability of permanent organ damage, excluding brain and soinal cord, 0.739, probability of permanent bone damage. 0.644 probability of permanent brain and/or central nervous system damage, 0.579. Average probability of emerging undamaged is 0.006.

He would be doing them a favor if he ordered Watson-san to run Program Arrow on their ship. If they were anything like Tommun and Habishu

Once late of an evening, as Tomimur's magic brush inscribed Habishi's latest haku on a bolt of ours white silk, unleashing the thought in space as well as in time. they spoke of the inevitable. Tomimuri had said, "The way of the warrior leads always to death. All the sweeter, then, the life en route. What I fear is not the road's end but its shoulder-to know the way without

### HOW TO IMPROVE YOUR GAME AT HOME AND AWAY.



ENGLISH LEATHER TOILETRIES FOR MEN. Wear English Leather or Wear Nothing at All



being able to walk it is more frightening than any other thought L can imagine

Hahishi had frowned into his tea, then oursed his lios and said. Yes, that is the way of the way

Looking up again. Livingston guartered the sky with his gaze. They orbited less then four kilometers high the should be ship to soot them, unless they were on the other side of the asterned

"Livingston-san? Yes Watson-san?"

"You interrupted this program's report on

Anker Menu Should this program continue or terminate?

He waved a weary hand in the direction of Shin Matsumoto Base "Let me just ask a few questions: First of all. I thought you were supposed to warn us if anything came within a thousand kilometers of the base "

"Ah so, but Anker Marry pulsed proper ISF IDs and informed this program she carried high-ranking ISF officials desirous of conducting surprise inspection of Shin Matsumpto Base Such information caused Overrice Subroutine to prevent initiation of Incoming Warning Program

"Ub-hub. He podded giurnly to himself. Was it the Ankar Maru that bombed the

"Hoi

"Does she have more bombs?

'Hai.

The hijscked ISF ship carried four of her printing crew Bombs enough to blast Livingston-san and Watson-san outside Jupter's orbit. And someone willing to use those bombs. Someone willing to kill the eleven surviving liverocks for the cash then aem-souls would bring

'Watson-san'

"Hai Livingston-san?"

"Fun Program Arrow on the Ankai Maru" Iclick] Apploales, Livingston-san, but

authority insufficient What the hell does that mean?

York commissioned ISE officer at staff level or above or individual appropriately authorized by CinCBet can order this pro-

You you refuse to shoot down the Ankar Maru?"

"This program is unable to run Program Arrow except on command of sufficiently authorized individual

Yes, yes, he could see that, though he wished he did not have to Watson had not dua in its metaohorical heels. Watson was paralyzed. Somewhere in its program a statement or two, aware of Livingston's lack of rank, had evaluated a conditional inequality and then disabled the launch routine for the surface-to-air missiles

For the first time since leaving the Unversity of Oregon, Livingston wished he had devoted less of his life to saving the helpiess victims of technology and more of it to mastering the technology itself. Fluency in computer programming would sure come in handy

Back to the original plan, then, Load the iverocks aboard the sigd-whenever if showed up, which it ought to any minute now--hide them, get some sort of weapon from the base, and hold off the poachers uniff enforcements arrived

"Oh, no." He sank to his knees, oblivious to the hard, cold stone beneath them "Watson-san!"

Hai, Livingston-san?"

"Have you notified Mars HQ-uh, Shin Edo Command-yet?"

"No, Watson-san, order to broadcast has not been issued."

"Well do it dammit!"

"Syntax error, Livingston-san."

He clerched his teeth. "Watson san, Notify ISF Headquarters at Shin Edo on Mars that two shiptoads of poachers have attacked, killing Habish-san and Tomimun-san, as well as destroying the lighter. Request assistance ASAP"

"Syntax error, Livingston-san."

"Oh, Jesus Christ, Watson san, you know what I want to do, would you please just help me out here?"

"[click click] You must request Program Michight Scream, details provided from this program's memory banks "

He sighed "Watson san! Run Program Midnight Screem, provide details from your memory banks"

"Password of the day?"

"Rypan-ji"

"Running"

'And where's that damn sted?"

"[click] Commencing climb of outer crater wall. ETA your position six minutes thirty.

seconds plus or minus forty-five seconds." "All right. Thank you. 'He settled into the shadow of a boulder to minimize the

chance that his suit would reflect light. Six minutes. Long enough to grab a

six minutes. Cong enough to grab a snack He pressed the controls, and a tube slipped into his mouth

God, what he would give for a steak and a beer He haled suiflood Seaweed mush washed down with bracksh water sucked from an opaque tube. Although maybe he should be grateful for the tube's opacity. The water was probably torown.

Grumbling to himself, he tooked around And melowed. Eaven auras shone bright and complex and aluring. He shock his head Mozarts or mockingbirds, it didn't matter. For the chance to study liverocks, for the chance to someday comprehend their songs, he would live in the darm suit. (Fored be, And dain is its omred them

A flicker of motion caught his eye. About time the sled arrived, He began to rise and squatted down again immediately.

The Ankar Maru came in last and level It spat a rocket that lespt shead of the ship to dive into the outside wall of the crater The stone beneath Livingston guivered. He blinked, and the recon ship varished behind his back. His earphones crackled

"Lwingston-san!" "Yes, Watson-san?

"Sled destroyed Should this program

dispatch replacement?

"You might as well, Watson-san, al though I don't---"



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A 52 do contribution is the Millerencis-Keen(Y) and Adata Collections is not entry (Fe Casos will be add Adata Collections is not entry (Fe Casos will Conserve entry 5<sup>-1</sup> a 7<sup>-1</sup> ordor y mills maked from engend 5<sup>-1</sup> sine approx of transpared conserved in the Miller add Adata (Section 1998). A final million mark of the y-mithage in Follow Collection (Section 1998). The Miller add Adata (Section 2004) and the Millson of the y-mithage in Follow Collection (Section 1998). The Respect to card be recorded by the Agent is 1998 (Section 2004). The Section 2004 of the Section 2004 of the Respect to card be recorded by Agent is 1998 (Section 2004). The Section 2004 of the Section 2004 of the Section 2004 of the Section 2004 of the Section 2004 (Section 2004). The Section 2004 of the Section 2004 (Section 2004) and the Section 2004 of the Section 2004 (Section 2004). The Section 2004 of the Section 2004 (Section 2004) and the Section 2004 of the Section 2004 (Section 2004). The Section 2004 of the Section 2004 (Section 2004) and Section 2004 of the Section 2004 (Section 2004). The Section 2004 of the Section 2004 of the Section 2004 (Section 2004). The Section 2004 of the Sec





He never saw the sing heart. The tocket, hough at, hits heart. It housed loward the center of the order as adrenaline skiwed his time same to a cavit. Ung and kean, the missile wore a particid shark grin and stencied lottming that reade "Housenvomon. The warhead, attricing, would splatter shrapnet throughout the criter. He twested all the way eround. I'm supposed to get a gut and defend my rocks'

Hot bits of jagged metal would scythe down the liverocks, killing them, barng their crystalline souls to the stars

He dove over the top of the boulder in search of shelter. I'm supposed to fight off the poschers, not-

Light flashed behind him. Upside down, head and torso behind the boulder, he walfad to touch the ground. He would have a few minutes before the Ankar Maru landed, minutes he could use to-

Fire scorched his right ankle, then faded to frost. He gasped as his suil lost pressure. A metal ing built into the log of his suit contracted on his calf and tightened instandy.

The spurt of arterial blood froze in midair and drifted slowly, of so slowly, to the ground He blacked out before his helmet rang on rock—but not before knowing he had failed. Again

The voice murmured in his ears like muted surf "Livingston-san,"

"Ye e ss "Wake up now, Lhingston-san." "Wat son?" "Hai."

He billinked his syste open He lay on this back in this own bunk at Shrin Matsamole Base. There was something strange about that, but he oodd not put his finger on it He sat up stowly Yes, he had to be at Shrin Matsamoto Base. He had it Natowetone two yatar ago, note the shuttle to Shin Edu at LS, hindo up with Tommun, guezed agprecisively at pictures of the smitting matrick nectors. and ---

#### CREDITS

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Forbes Trinchera Ranch Son Carland CO 81130 "Unit' He sank back. Now he remembered.....Then he trowned His bare right toot and ankle tooked the He wingtled hes toes thoughtfully. He could have sworn a dream? No Not with those two hollows in his heart. The samurar of Shim Matsumote Base were cleard As the alien singles had to be.

"Watson-san?" He forced himself to rise and reach for his clothes

"Hai, Livingston-san?"

"You did a good job on my right foot " "Medi-freaze and autodoc programs ran at one hundred percent afficiency, Livingston-san."

He stopped. "You froze ma?"

Apploges for insufficient consultation, Livingston-san, but circumstances seemed to require hasky initiation of Program Last Survivor Your condition indicated need for regeneration, media insect established successful completion its there pair?"

'Eighteen months, Livingston-san'

It took a while to digest that. 'Wh-why so long?'

"Refaxe attempted to accept plim Marsumobiase This program permits them to enter to territory easis, and to galter in during yourn. Them the program executed apabeter discompression to thim program hausted at an apply. To manufacture the phoement air and to birry Daske up to attradiate pressure expression the trong base up to define the expression. This program compaties that Livreget near world railer treman in suspansion than two is suit to assuwriting the suspansion than the suit of to available of the sub-territory.

He stood for a moment in silence "Venfied the said softly."Did you get them all?" "Har."

"And just where drd you learn that 'explosive decompression' trick?

"Program Last Survivor installed subsequent to Celestial Equity capture and subordination of Ankai Maru

Startled, he straightened up. "Their ships! Ara they still here?"

"Apologies, Livingston-san, Acting under orders from Snin Edo, this program placed remote servos on board, each with instructions to pilot ships to Mars."

"What?" He slapped an open paim against the buikhead "You sent them back without me? You left me marconed here?"

"Hai: Shin Edo requested that you fulfil terms of your contract with Impenal Space Forces. Said contract does not expire for eighteen more months."

"But ... but..." Helpless with astonished rage, he stormed through the base to the lock, found his suit....scuffed and duiled except for one shray new boot...and swept out onto the surface

He could not believe it. The poachers had killed his guards, destroyed then ship, and murdered the fiverocks---but the ISF

#### wanted him to stay or

Punishment. He had failed, and this was his punishment. It hardly mattered that he had never signed on as a soldier. The milstary mind in all its low cunning had deorded that since he had not stopped the tobols \_\_never mind that the military's own regulations had prevented him from doing so-he should have plenty of time to ponder his failure. Like eichteen months Stranded on a chunk of rock spinning so far out from the sun that a candle would cast a sharper shadow

He found himself striding up the crater wall and almost turned back. He wanted never to see the damn rock garden again. But he marched on anyway. He had returned to Yellowstone, he might as well view the site of this disaster. It would give him brood lood for the next year and a hall And maybe he could find his lost foot. What a souvenir that would make, huh? Maybe if he brought it back, nailed it to the wall, and made ritual obeisance to it. Watson would report that he had gone irrevocably insane, and Shin Edo would send a ship to retrieve him. Ah, there was a thought

He had done over the top and halfway down the interior wall when he slammed to a halt

A thousand tongues of green flame lanned the crater floor. A thousand ministure auras lit up the shadows. A thousand voices trilled sine songs in the mergahertz.

"Jesus, Mary and Joseph!" His knees buckled, his legs gave way Slowly, oh so slowly, he dropped to a sitting position

The liverocks lived! But how? And so He had always thought the cores lived. building story shells of protection around thomselves. Clearly he had mistaken the pearl for the oyster. Never had he felt so good about a mistake before.

Livingston-san!"

"Yes, Watson-san?"

Now you have seen, and perhaps understood

'Perhaps " With genuine affection, he said, "Thank you, Walson san."

74h .... you are welcome; Elvingston-san Shin Edo advises Livingston-san that OnCBelt has conferred upon him untimited authority to initiate Program Arrow."

"Better late than never," he said dryly

And this program reports detecting, at nine point two times ten to eight meters, on intercept trajectory with Shin Metsumoto Base, one Honda-Mol Interplanetary vehicle. Distance too great to ascertain ETA. model, equipment, or crew size

He pushed himself to his feet and looked outward, though it was far too early to see anything "Celestial Equity poachers?"

So this program assumes, Livingstonsan

With one last, fond gaze at the nursery below him, he turned and made his way back up the slope "This time we'll be ready for them, won't we, Watson-san?"

"Hai, Livingston-san Hail" DO



DRINK FOR TASTE, NOT TRENDS DOS EQUIS



### HOLE or 1/2 BRAIN?



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#### Science comes to stone skipping



By Scot Morris

You throw a flat stone across calm water and it skips. As universal and timeless as this experience is, you would think that scientists by now would have settled the question of why a skipping stone behaves as it does They haven't in fact, the physics involved is about as complex. as anything imaginable for a simple thrown projectile Consider that factors involved include aerodynamic lift, hydrodynamic planing, solid-liquid interaction, turbulent and laminar flow in fluid motion, surface tension on the water, surface texture on the stone, gyroscopic motion and procession, the stone's shape and distribution of mass around its center, the angle of incidence of the throw, plus all the "ordinary" laws affecting motionvelocity, friction, inertia, linear momentum, and angular momentum

In 1958 Scientific American's Amateur Scientist column published a letter from Ernest Hunter Wright, a former head of the English department at Columbia. University Wright had noticed that when he skipped a stone along the hard sand at water's edge, it left a trail of alternating short hops of about four inches and long hounces of several feet

This was in marked contrast to the way a stone skips across water, with leaps of relatively uniform length. Wright asked his physicist friends at Columbia why this should be, but none could give him an answer "With the luck of a layman," he wrote. "I have had the novel experience of seeing several of the men who have plucked the heart out of the atom's mystery scyatch their heads in vain for the solution. of a problem which I now submit to a wider audience.

Over the next decade Scientific American received more than 10,000 letters on the subject. Finally, in 1968 oditor C. L. Stong published a follow-up. Part of the question was answered. On sand each 'skip' was in fact two-the stone struck first with its trailing edge, then tipped over to stoke with its leading edge a few inches away then took its long flight of several feet and reneated the cycle When a stone hits water, it planes along building a crest of water in front, then 102 OMN



Scandal in stone skipping. Will man-made stones Skip-On and Orbiter (loreground) outskip Lake Michigan naturals in backgroung? Purists say artificial stones will run the sport

it lifts out and makes a long hop

But why does it skip at ail? James S Trofil asked and answered the question in the August 1985 issue of Smithsonian manazine. "Can a modern theoretical physicist, armed with the biggest and fastest number-crunching computer, tell you exactly how and why a stone skips? In a word, no

Written records of this centlemanly art go back at least to 1583, the narbest reference in the Oxford English Dictionary to ducks and drakes "A kind of sport or play with an eister shell or stone throwne into the water, and making circles yer it sinke, etc. It is called a ducke and a drake, and a hallepenie cake " The English term duck and drake quickly came to be synonymous with recidess souandering, throwing things away 'to duck and

drake away a treasure" (carly 1700 s) A secondary inflammatory implication is that the whole activity of stone skipping is a foolish waste of time

Armed with such ideas I returned to my home state last summer to attend the International Stone Skipping Championshins, anorsored by the Lake Superior State College Stone-Skipping and Gerplunking Club, held annually since 1968 on Michigan's Mackinac (pronounced "Machinaw") Island every Fourth of July

it was here in 1932, that Navy commander E M Tellefson set the first modern record of 17 skips. The Gunness records people say that this record was taken away in 1957 by one Carl Wanholdt on Copenhagen Bay with a 21-smutter (the Danish word for stone skipping), but that it returned to these same Mackinac Island shores on July 4, 1975, when Warren Klope of Troy, Michigan, recorded an official 24-skpper: Later, the 24 mark, was bed by Clem Loy, it, or 16 hin and John S Kolar of Birmingham, Michigan Gawness has recognitized ance 1975 the record of 24 skps, consisting of 10 pinks and 4 party pass (These are technical terms descriping the first clean skips at the head of a run and the fast sense at the end, just bettere final sinkdown )

As a participating journalist, I paid my 50-cent fee and entered the contest. I was curious how the skips would be "officially" counted, especially at the end of a run, when the pitty-pats seem to b) ir into one another in a smooth hydroplaning action. I had already set aside the of sty "chukkers." But Lasked one urdge to count a preliminary throw to explain the procedure. I hauled off and gave my best Michigan sidearm-and got a solid series of plinks, then a mosi set of pitty pats "Nineleen," he said, then proceeded to explain how, after long experience in ruciano, he was able to reliably track those last critical skips

On my ax official chukkers my best hrow went only to skeps, but the wriming, throw of the day by John Kofar was only 15 skeps. Thus I had the regret of "If only" I had counted that that threw and the comfort that I had been beaten by an established champion. This is a garute world of sampions areas 1977 and have consistently scored as winners of finalists every was rate.

Kein and Loy taught me serveral points on form. You divide data at a close to the exige of the waker as possible. Some which have been as the server horizon to which but others and a proper followthrough, is most popular. Add as much is enclates aquiau, and a proper followthrough, is most popular. Add as much is enclated as the server of the mean as which the tooghts. The way the and skip through the tooghts. The way the agint another of the through the too agin close are waived. goal those the agint another of the tooght of the store acceleration. will be a rightward arc. like a right-handed slice in golf

The choice of store is important. It should be fill and owno but not so waterkle as to be afficited by the wind. A too light store can be taken by the wind, by off at too great an angle, and in the index lings and humb, with the round anoth ske on the bottom. Thus there is such a thing as a store that is naturally meet for a right-handed throw.

#### NEW CHAMP: AGE SEVENTY-ONE

After liast years event we learned that some slopping already had a new champion, Arthur Ping, who akopied a sone 28 times on Guerneville, Cafternate Russian River in August 1994. Ring asse "Two been throwing clamarchels and aluff over ance i was fine years old," Now seventy-one. Ring was bei captam al San Francisco's famous Sant Francis Hole! for 15 wars.

The Russian River event, sponsored by Skip 'n' Rock, Box 323, Rio Nido, Californa 95471, has several advantages over the Mackinac Island contest. For one thing it is possible to station observers along the at those last, critical pitty pats. But this opens a new controversy. The water is moving, constantly approaching the thrower. This is like throwing off the bow of a boat as it speeds across a calm lake. The net effect is as if you had added a few miles per hour to the speed of your throwing arm. We insist that the Guinness people recognize two categories for ducks and drakes 1) ordinary cond, lake, or ocean water; and 2) upriver or speedaugmented water

#### THE MAN-MADE SKIPPIN' STONE

Controversy of another sort raged at the 1977 Mackinac Island tournament The previous year a man-made stone the Skp-On Skppin' Stone, was introduced and thrown on a few trial runs. The gione is made of sand and a water-soluble binder, so after a lew months underwater it dignitegrates mit of the sand in 177 the Mackinal bournament directors banned the store from future competition lest its artificatily run the sport. This seems rather high-named from an organization that includes in its motiv-serous rules becught to the fournament must be bold becught to the fournament must be bold bread pointing ceremony begins with the anouncement. Tuch the who is without Frainte cast the first store."

The Sign On stone was designed by Dea Glovia to Dearborn, McNagan. He experimented with several sizes, weights, and angles of curvature on the outer rim before setting on an optimum size for an "includucing stone". A really skilled thrower might wart a stone that is larger heavier, and possibly with a smoother surface. We fink that the same was amounter surface. We fink that the same was she to motive on a out bail of the site dim these on a out bail of the site dim these on a out bail of the site dim these on a out bail of the site dim these on a out bail of the site dim these on a out bail of the site dim these on a out bail of the site dim these sites site site of the site of the sites of the sites site site of the sites site sites site sites site sites si

In an elsal, controlled environment, locavita toti, cr.) Think that signs of over fonty could be well within reason. The problem is that the product was a financial top. No one seemed withing to pay here distais for a book cold Selenes and then just threw inem away. "That's a manketing hurde we apil haven't cleared. "Obvious and table, but this semethory, and using such a product would be to "duke and drake away" you money.

On the other hand George Washington, who skipped a which edital across the Potomac might have been an eager customer Unterunately, the Skip-On stone shift on the markat now. (The stones at left are shown with the curved "hulf" acte down. The dimples on top are a manufacturing antifact and don't contribute to the suppring action.)

A competing artificial stone, called the Orbiter World-Class Stone Suppor, has found some success by being marketed through grit catalogs. Of course, thereis no talling if the stones are really being used as suppers. Purchasers may instead use them as peperweights, backgammon thes, or conversition openers **DO** 

### Dedication.

If you have conviction and dedication, you can solve this J&B cross-number puzzle. Note: keep a dictionary and an almanac nearby; they may prove useful.

#### CLUES

#### ACROSS

- Ides of March day times the legal voting age in the United States prior to passage of the 26th Amendment in 1971.
- The number of years Methuselah lived divided by nursery rhyme "\_\_\_\_\_Men in a Tub."
- 6. Kellogi's Product \_\_\_\_\_ trates \_\_\_\_\_\_ Up times Colt\_\_\_\_\_ Malt Lequor times Chanel No.\_\_\_\_\_
- Dollars in the TV show "Question" divided by (\_\_\_\_\_Arabian Nights minus "\_\_\_\_\_\_O'Clock Jump").
- (Fornane \_\_\_\_\_\_ times months with 31 days) plus what's frightening to a triskuidekaphobic.
- 11: Confederate states plus states touching the Pacific Ocean.
- Blackburds baked in a pie plus "boxcars" in dice plus "Life begins at \_\_\_\_\_."
- (Number of bones in an adult human times number of corners on home plate) plus red stripes on the American flag.
- (Year of Women's Suffrage amendment [the 19th] divided by days in Phileas Fogg's circumravigation, according to SF pioneer Jules Verne) plus Franklin D. Rooseveld's freedoms.
- Cliff Robertson movie P.T. \_\_\_\_\_ tunes Walter Matthau movie The Taking of Pohom \_\_\_\_\_
- The number of fifths of J&B Scotch needed to equal a hogshead (U.S. measure).
- 21. The score obtained in bowling by alternating strikes and spares-

#### DOWN

- Number of days in a leap year minus days in Lent.
- Year in which King John signed the Magna Charta times the maximum weight, in rounds, of a bowline ball.
- 3. Year of John Glenn's first earth orbit

| 1  | 2  | 3  |    | 4  |    | 5  |
|----|----|----|----|----|----|----|
| 6  |    |    | 7  |    |    |    |
| S  |    |    | 9  |    | 10 |    |
|    | 11 | 12 |    | 13 |    |    |
| 14 |    |    | 15 |    | 16 | 17 |
|    |    | 18 |    | 19 |    |    |
| 20 |    |    |    | 21 |    |    |

minus year of first Wright Brothers flight-

- (Cavalrymen in the Light Bngade times sides on a snowflake) minus John F Kennedy's age when he was elected president in 1960.
- ("M"A"S"H" medical unat number divided by square feer m a square yard) minus distance m feet between bases in baseball.
- Miles in a marathon (to the nearest whole number) minus events in a pentathlon numis the number of times Bob Mathias won the Olympic decathlon.
- (Perfect score on math portion of SAT divided by sides on a stop sign times patriotic campaign slogan "\_\_\_\_\_\_40 or Fight" times \_\_\_\_\_\_ring circus.

- President's Pernaylvania Avenue address plus Sergeant Friday's badge number on "Deaver" plus strings on a vo-vo.
- Weight, in pounds, of weakling in Charles Atlas ads plus players on a volleyball team.
- William "The Refrigerator" Perry's uniform number plus the number of touchdowns the Refrigerator scored in 1986 Super Bowl.
- U.S. representatives times years in a U.S. representative's term-
- The number of whakies blended into J&B Scotch (see any J&B label or the nearest J&B ad) plus double eagle on a par-5 hole.

Look for the solution to this puzzle next month in Omni

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Ish I went through a tot of personal turmoll." Frank explains "The findings would affect so many texts, from the origin of the and the origin of the oceans to canals on Mars And I knew that the first reaction of everyone would be. It's impossible. The implications were so enormous I reked boing treated like—well, aimos fike and:

"First spant as weeks weekning the ditermitives." I de in my office each right und about two in the morming pating the floor or part reading bools. The says "Im reclusive by nature I love doing someonand I din't ware right be altitude of though to all the someties than Casethough to all the someties than Casethough to all the someties than Casethough to all the someties than Caseseminghy outlands that if work/longing asks. If ware right and (adv1 public), fail and someties a caser yeens."

Frank cost a pair of papirs to Desire at Geophysical Review Letters in January 1986, and they were published in May Ale Internations published and the set internations published and paper and effects of parythreng in the solar system to show the first is impossible. And all cit backet by publish we say they notice pecular cloud structures with no contecular cloud structures with no contesponding backets have acquisited main nuclear physicist have acquisited main nuclear physicist have acquisited main back of occurre main.

Perhaps the biggest outpouring of enthusaam, Frank adds, comes from exobiologists searching for an excitatemential source of primorcial DNA. People have long proposed that organic molecules were carried to Earth on the burning backs of meteors. But now icy comets have emerged as a possible conduct as well

The really exciting question about all this is how complex the organic molecules carned to Earth by the comets might be " says Hamid Klein scientist in residence at Santa Clara University "If a person accepts the ceneral notion of panapermia-that life arose elsewhere, arriving via spacecraft or as tiny spores on more modest bodiesthen the mechanism could be corriets." Indeed, to date only simple organic materials have been found in meteorites, and scientists doubt that more complex molecules could survive the blast-furnace heat of these cosmic rocks burning through the atmosphere. That's where comets make for interesting speculation-complex molecules might indeed land safely when encased in a shell of ice and snow

If nothing else, Frank believes the exobological implications address a Catch-22 proposed by Cornell University astronomer Carl Sagan. Sagan wonders how life, which needs oxygen to protect itself from the sunts utraviolat rays, flourished in an ISB ONI

ancient environment devoid of oxygen "The comets release oxygen when they impact the earth," says Frank, "so firey give Sagan the oxygen without having to have the to produce it."

Dessier put it neatly, too "This way you can get oxygen and life along with it--the chicken and the egg, both at once"

On the other hand, Sherwood Ohang, chief of planetary science at Arras, finds the notion 'outrageous I don't timk it is productive to take the guisstons of how fife arose from one plausable location — Earth, where we know it exists — and shift them to an errotausable one.

The most vehement criticism of the lowa group, though, comes from the University of Michigan, where atmospheric physical Thomas Donahue has voiced some specitic concerns. "If the earth is exomenoing this encomposite function water, the asks, why areant researches finding a compable rate of escape of hydrogen from the upper almiciphere? If oceans water not here from the start, why do we have escillmentary forsits dating back 3.8 bittion years? Where is the water on Venus? And by the wey, if comets are coming in at this extraordinary rate where exactly is the ocean on Mars?

"I have a very high respect for Frank," says Donahue "But his idea violates some very hasic atmospheric constraints

Hark does not agree "We're not losing hydrogen" he explains, 'bacause he water molecules don't rise high enough to be separated into their component parts of hydrogen and oxygen "He also does not know how much water was needed for the sedimentary deposits formed 38 billion years ago "But it's not unreasonable". In

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says, 'to suggest that at least part of an ocean had arrived by then."

As tor Verus, Frank says that rogancies of the rate of containing in the containing too hot to assist on an ocan. "And the lack too hot to assist on an ocan." And the lack to how to be added to the same and will be an ocean on Mars. "Trank declares, the questions is how many and will be an ocean on Mars. "Trank declares, the questions is how many and the same to the same to the same and will be an ocean on Mars." Trank declares, the tapoton of the same and will be an ocean on the same and the tapoton of the same and the same and the tapoton sources of the same and the memory of the same and the same and the same and the memory of the same and the same and the same and the memory of the same and the same and the same and the memory of the same and the same and the same and the memory of the same and the same and the same and the same and the memory of the same and the same and the same and the same and the memory of the same and the same and the same and the same and the memory of the same and th

Back at his journal, Dessier is delighted by the dobate. "Most scientific papers just add a little bit to the framework in which scientists already operate," he says. "But Frank has made a huge departure from the manstream. If he's right, past models for all sorts of things will have to be discarded and new ones protocued.

And it has wrong, after having scared the hell out of a whole bunch of respectable scenitists, they're not going to let him forget! Whatever he comes up with from here on they't asy. Oh, yeal, had guy he's the one who discovered all those sily comets that weren't really there. But this is the questioned worlded, wrefed, reproduced diversion.

And according to beside, additional experiments are already in the work. The first test will be any of advirtument or densid of the second second second second second second density of the second second second second second second density of the second second second second second second density of the second second second second second second density of the second second second second second second second density of the second seco

In addition to electronic confirmation, Frank locks to amateur skywatchers living in dry dark locales to keep an eye out for the smudged, faint, almost subvisible light of smail, entering comets.

And from other scentiss he hopes for learning applications. Convertises he hopes for obuds spend most of their traf lifetimes prong through flose mysterica zones too high for ballion observations and too tow for samille orb. This possible that hese objects have gone completely by us ' he says' 'But astronomers an oliver, and if a present instrument can't see these things, hey' develop one that WI. All they needand wrait think we've provided--is a guide to what their's tooking for.

"It's a simple proposition," Frank explains "I haven't taked to my daughters about it, but they understand it just from what they've read in the newspapers. Dessler called me up and said even his dog understands it. I engy that" DO

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