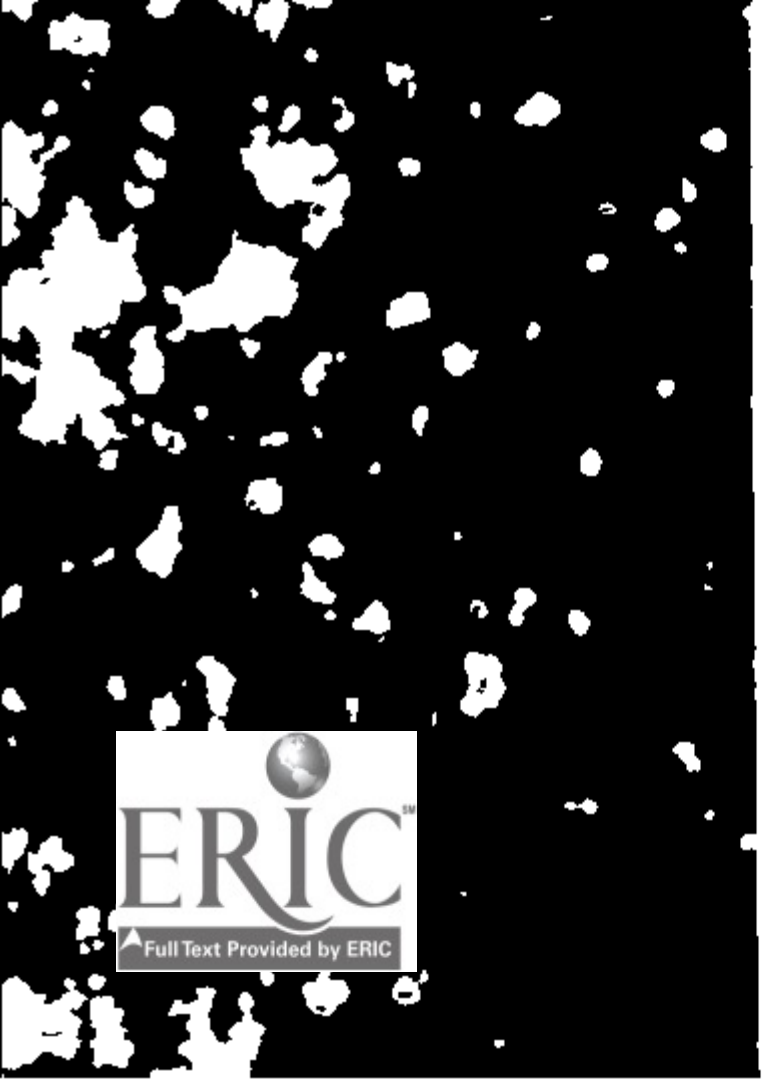
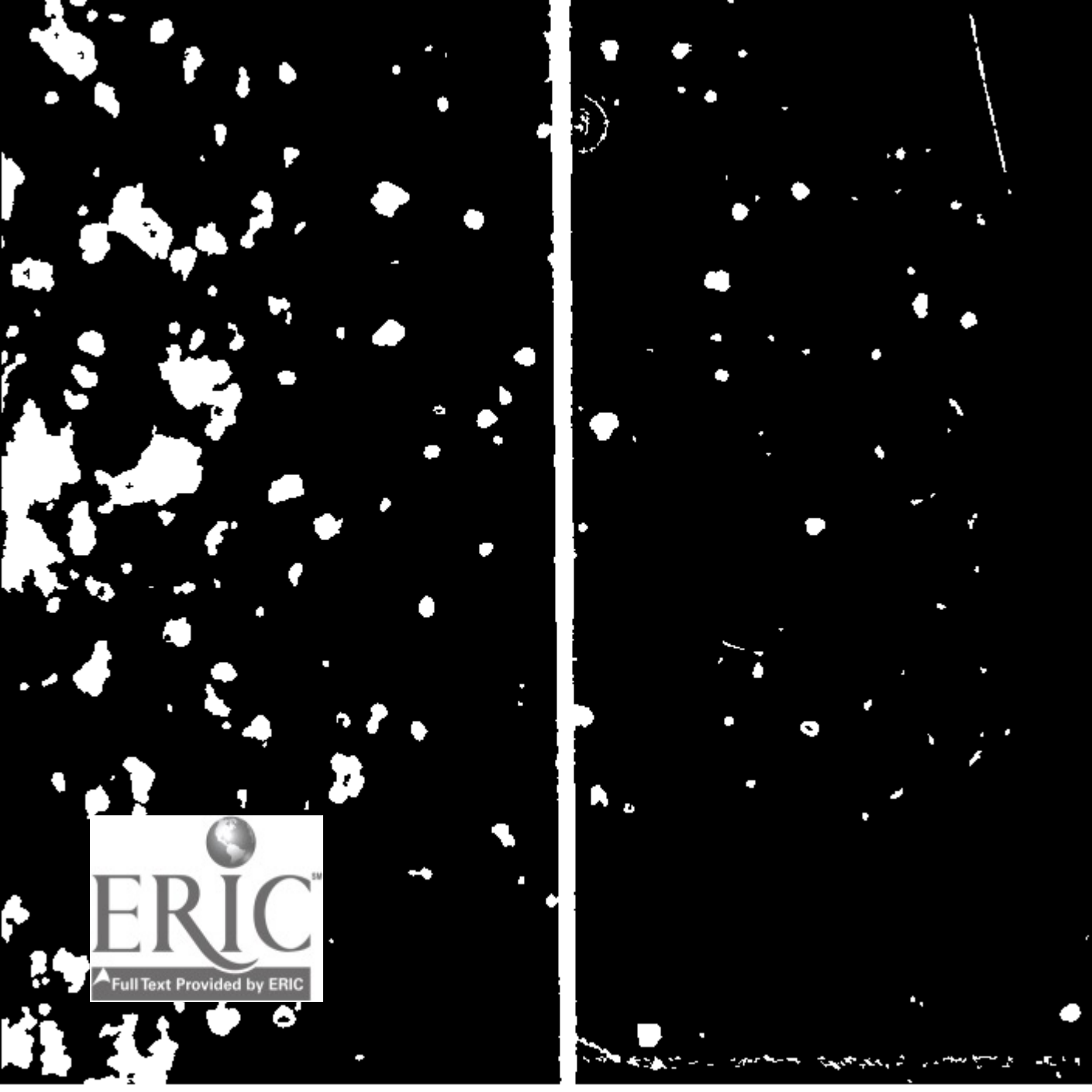
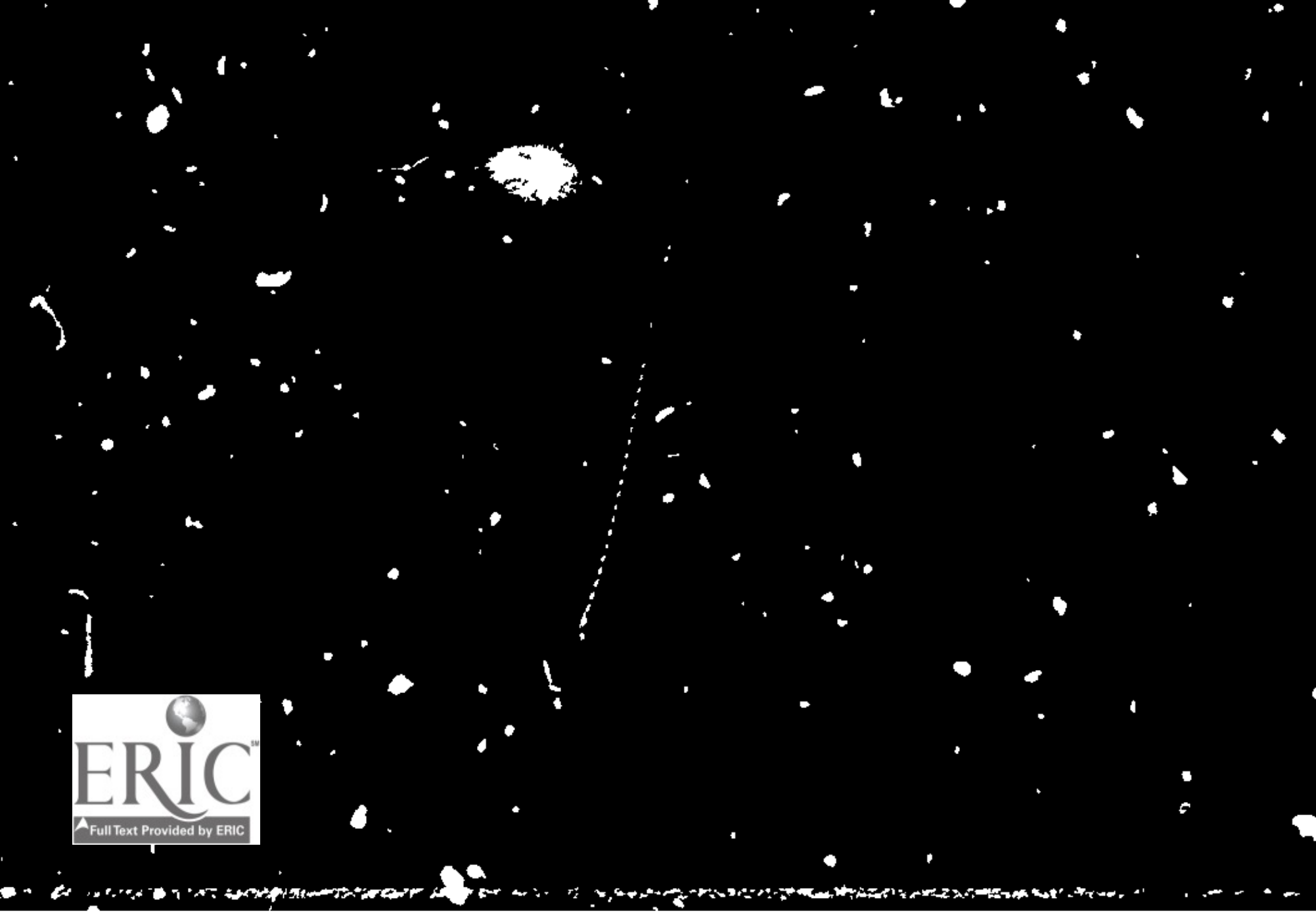





ERIC
Full Text Provided by ERIC



DOCUMENT RESUME

ED 324 223 SE 051 607

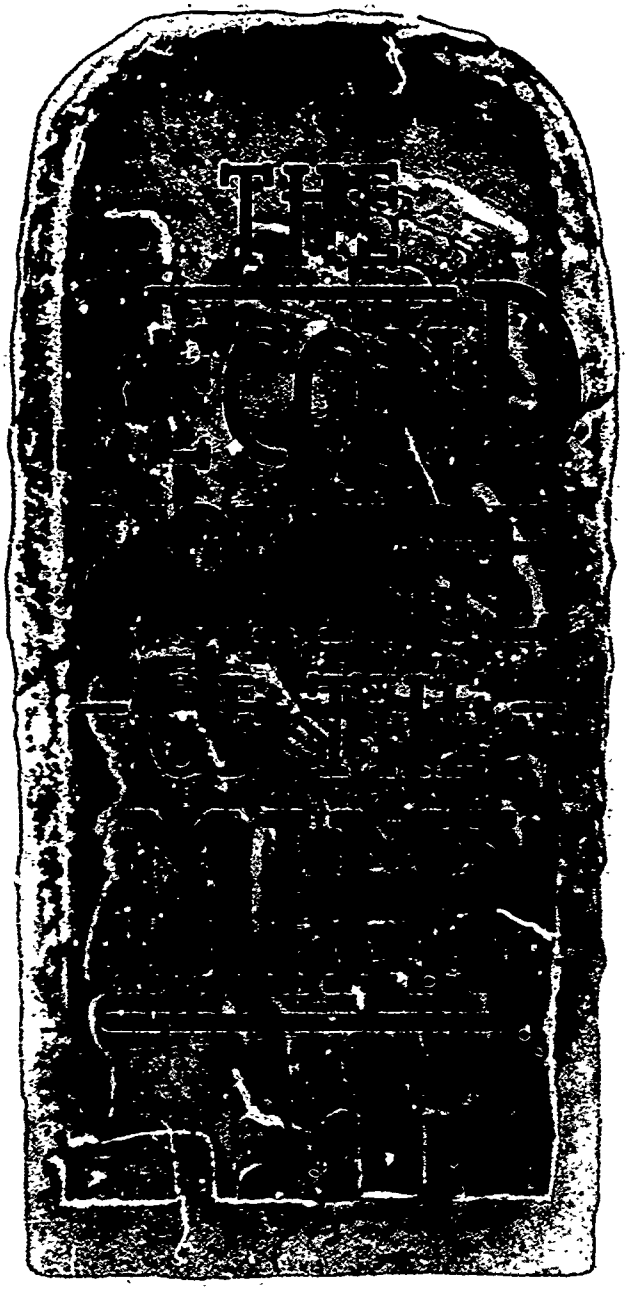
TITLE	The Second Voyage of the Mimi.
INSTITUTION	Bank Street Coll. of Education, New York, N.Y.
SPONS AGENCY	Department of Education, Washington, DC.; National Science Foundation, Washington, D.C.
REPORT NO	ISBN-1-55636-761-9
PUB DATE	89
NOTE	163p.; Contains some colored pages and pictures which may not reproduce well.
AVAILABLE FROM	Sunburst Communications, 39 Washington Avenue, Pleasantville, NY 10570 ($9.90).
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052) -- Books (010)
EDRS PRICE	MF01/PC07 Plus Postage.
DESCRIPTORS	Ancient History; Archaeology; *Cultural Awareness; *Cultural Influences; Entomology; *Interdisciplinary Approach; Map Skills; Marine Biology; Meteorology; Physics; Science Activities; *Science and Society; Science Education; Scientific Literacy; Scientific Methodology; Scientific Principles; Scientific Research; Secondary Education; *Secondary School Science; Social Studies; Technology
IDENTIFIERS	*Voyage of the Mimi

ABSTRACT

This book includes 12 units that have been adapted from the television series "Voyage of the Mimi." Each unit includes the episode, an activity, and an expedition. The episodes introduce and accompany each episode of the television series. The activity is an extension of that episode which can be done in the classroom. Mapping skills, foreign languages, cultural awareness, marine biology, scuba diving and pressure changes, archaeology, secret messages using polar coordinates, insects, and writing journals are topics covered in activities. Expeditions relate aspects of the taping of the show or a person who worked for the company. A glossary of terms used in the series is included. (KR)

BANK STREET COLLEGE PROJECT IN SCIENCE AND MATHEMATICS

THE SECOND VOYAGE OF THE MIMI



THE BOOK

THE BANK STREET COLLEGE PROJECT IN SCIENCE AND MATHEMATICS

Samuel Y. Gibbon, Jr.
Executive Director

Based on the television series,
"The Second Voyage of the *Mimi*," written by
Richard M. Hendrick

Dramatic Episodes adapted
from the TV series by
Jeffrey Nelson
and
Barbara Brenner
Lorin A. Driggs

Documentary Expeditions adapted
from the TV series by
Laurie Weisman

Activities written by
Laurie Weisman

Editor
Lorin A. Driggs

SUNBURST COMMUNICATIONS
39 Washington Avenue
Pleasantville, New York 10570
(914) 769-5030 (800) 431-1934 In Canada, (800) 247-6756

FOR BANK STREET COLLEGE

Richard R. Ruopp, Ed.D.
President Emeritus

Joseph Shenker, Ed.D.
President

Pat Greene
Vice-President/Finance & Administration

Research Staff

Jan Hawkins, Ph.D.
Director of Research

Margaret Honey, Ph.D.
Research Associate

Jennifer Howland
Judith Sudel
Research Assistants

Classroom Materials Staff

Shari Robinson, Ph.D.
Coordinator of Classroom Materials

Ralph Smallberg
Senior Product Manager

Dramatic Episodes of the TV series:

Diego Echeverria
Producer

D'Arcy Marsh
Director

Documentary Expeditions of the TV series:

Richard M. Hendrick
Producer, Director

Board of Advisors

Theodore W. Ducas, Ph.D.
Kristina Hooper, Ph.D.
Magdalene Lampert, Ph.D.
Victor Rocha, Ph.D.
Mary Budd Rowe, Ph.D.
William B.F. Ryan, Ph. D.
Exyie Chambliss Ryder. Ph.D.
Judah L. Schwartz, Ph.D.
George Stuart, Ph.D.
Gerald F. Wheeler, Ph.D.

FOR SUNBURST COMMUNICATIONS

Warren Schloat
President

Marge Kosel
Vice-President

The television series, "The Second Voyage of the *Mimi*," was produced with funding from U.S. Department of Education and National Science Foundation. Its content and the content of this book are solely the responsibility of Bank Street College.

Sunburst Communications
ISBN 1-55636-761-9

CREDITS

ART DIRECTION, DESIGN AND PRODUCTION

McNALLY GRAPHIC DESIGN
Beth McNally
Lydia Gershey

Cover design: **Beth McNally**

Cover illustration: **Frank Steiner**

Episode, Expedition and Activity title logo design: **Lydia Gershey**

Episode, Expedition and Activity title logo illustration:
Michael Waldman (4/C), **Circa 86, Inc.** (B&W)

Expedition background illustration: **Michael Waldman**

Maya stela photography: **Justin Kerr**

Maya stela glyph drawing: **George Stuart**

DESKTOP PUBLISHING

Rebecca Wyse

EPISODE ILLUSTRATIONS

Jamie Cavaliere
Episodes 3, 6

Rick Johnson
Episodes 2, 5

Stephen Marchesi
Episodes 4, 8, 11

Alan Reingold
Episodes 1, 7

Frank Steiner
Episodes 9, 10, 12

ACTIVITY ILLUSTRATIONS

Circa 86, Inc.: pp. 74, 75 (top)

Jennifer Haberstock: pp. 37, 99

Cathy Pavia: pp. 50-51, 63

Kirsten Soderlind: pp. 24-25, 74-75 (border), 86-87 (border), 87 (cartoon), 124-125, 138-139

Kenneth Spengler: pp. 111, 152

David Stuart: p. 75 (Maya carving drawing)

Fred Winkowski: pp. 11, 86 (cartoon)

PHOTOS

Martha Cooper: pp. 25 (top), 52-55, 64-67, 76-79

Rafael Doniz: pp. 25 (middle), 100-103, 112-115, 126-128, 141-143

Richard M. Hendrick: pp. 38, 39 (top), 140

Justin Kerr: p. 25, "Seated Lord," (c) 1985; "Weaving Woman," (c) 1982; p. 87, cylindrical vase, (c) 1985; p. 156, Maya stela, (c) 1989

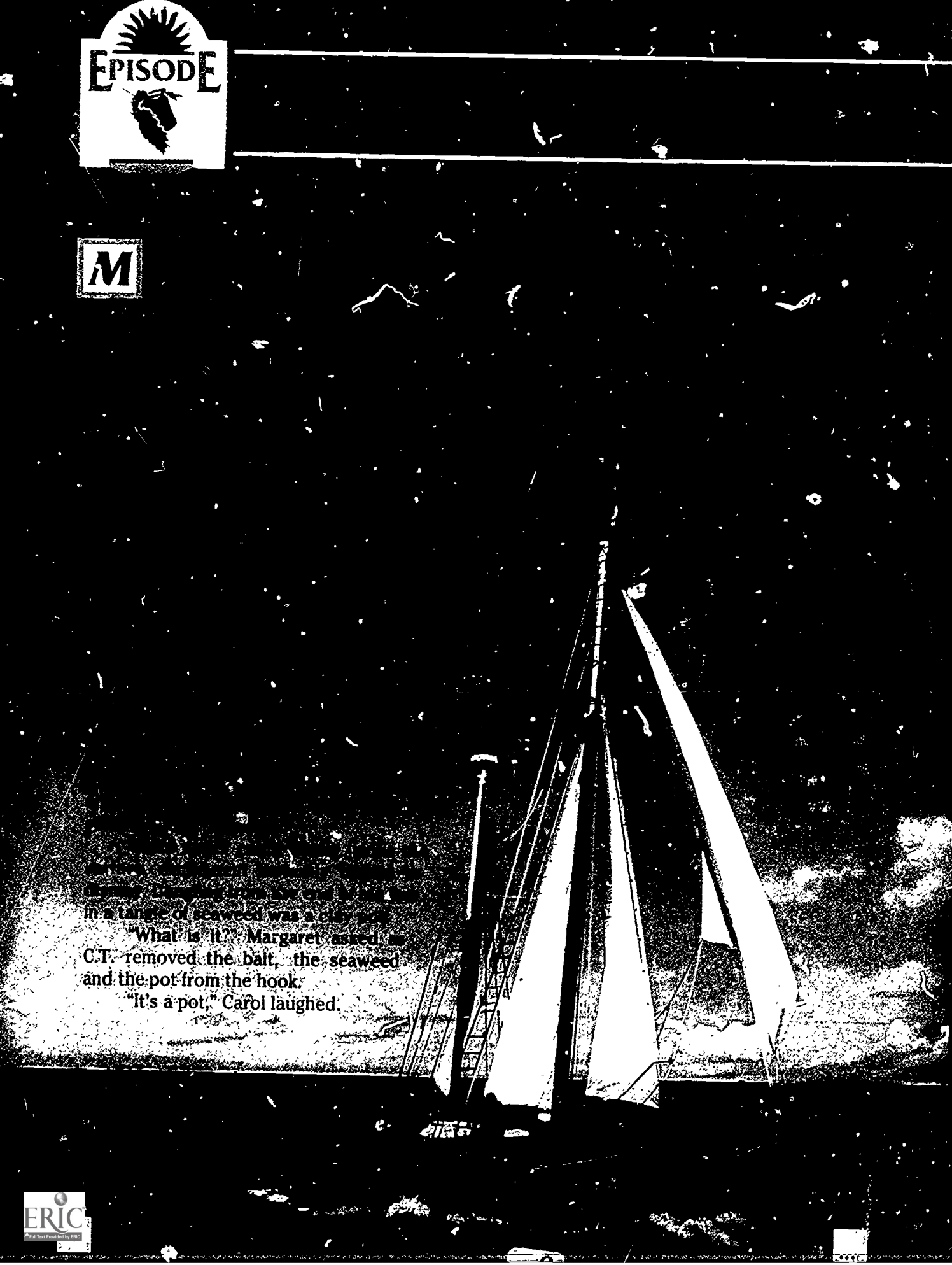
Wade McKoy: pp. 12-15, 26-29, 153-155

Peabody Museum, Harvard University: p. 79 (reconstruction drawing by Tatiana Proskouriakoff), photographed by Hillel Burger, (c) 1973, President and Fellows of Harvard College, all rights reserved

Michael St. Maur Sheil: pp. 39 (bottom), 40-41, 88-91

EPISODE

M



In a tangle of seaweed was a clay pot.

"What is it?" Margaret asked.

C.T. removed the bait, the seaweed, and the pot from the hook.

"It's a pot," Carol laughed.

'They're the Indians who lived here before the Spanish **conquistadors** came," Carol told him.

Margaret added, "They built amazing cities, C.T., fifteen hundred years ago."

C.T. wondered if the pot was fifteen hundred years old, but Carol said it was probably a **replica** from a souvenir shop.

Just then Captain Granville announced that it was time to head back to port.

As first mate, C.T.'s job included supervising the raising of the sails. He called out orders to Mr. and Mrs. Borden and Mr. and Mrs. Jeffries. Soon, *Mimi* was gliding through the water under full sail. C.T. climbed up to the crosstrees. So high above the water with the wind in his face, able to see to the horizon in all directions, it almost felt like flying.

"Hey, C.T.!" his grandfather called from below. "Take a look off the port bow."

C.T. looked toward the shore. Atop the cliffs overlooking a lagoon was an imposing building made of grayish stones.

"Must be one of those Maya temples, right?" C.T. asked.

"It's a place called Tulúm," Captain Granville answered.

It wasn't long before *Mimi* was moored at the dock in Cozumel harbor. The tourists collected their gear and the fish they'd caught.

"Mr. Borden," C.T. called, "don't forget your potfish." He tossed the pot to Sam, who was still a little embarrassed about the only "fish" he'd caught that day.

"When do you go back to Ohio?" Margaret asked C.T.

He told her that he'd be staying with his grandfather until after Christmas, keeping up with his studies while he was out of school.

"Travel's the best education there is," Carol said.

"Hey, C.T.," Mr. Borden called, "here you go." He tossed the souvenir pot to C.T., who caught it just before it fell into the water. "You can keep your bait in it."

It would be a neat place for bait and a good souvenir of his trip, C.T. thought. "Thanks!" he called out.

With the tourists gone, Captain Granville and C.T. had chores to do. They were mopping the decks, when from down the dock they heard the sound of an argument.

"But it isn't fair!" a young woman with long blonde hair was saying.

"I'll decide what's fair," said the man she was with. "You decide whether you want a job or not. You're lucky I took you on."

The young woman walked away from the man and headed down the dock. As she approached *Mimi*, something caught her eye. "Excuse me," she said. "Is this your boat?"

"Yup," Captain Granville said, not looking up from his work.

C.T. did look up. The young woman was obviously very interested in *Mimi*. And C.T. noticed she had an artificial leg.

"Say," the young woman continued, "you wouldn't by any chance know a Harold Thornton, would you?"

The Captain was still not paying much attention. "Nope," he said.

"*Sticker* Thornton?"

That got his attention. The Captain stood up and leaned on his mop, a broad smile on his face. "Sticker Thornton! By golly, you bet I know Sticker Thornton. Been in more oceans and more cafes together than I'd care to... I haven't seen him for twenty years. Never forget him, though. He saved my life once."

"He tells it the other way around," the young woman said.

"So you know Sticker, huh?"

"He's my dad."

"Well, I'll be darned," said the Captain, putting down his mop at last. He reached out to shake hands and introduced himself. "Clement Granville."

"They call me Pepper," the young woman said, shaking hands.

Captain Granville introduced Pepper to C.T., then asked, "What made you stop here?"

Pepper told him she'd grown up hearing stories from her father about Granny Granville and his wife, Mimi. And she'd seen that *Mimi* was from Gloucester.

C.T. heard the unfamiliar nickname Pepper had used. "Granny?!" he said, looking wide-eyed at his grandfather, who gave him a stern glance that said, *Just pretend you didn't hear that!*

Captain Granville told Pepper that the boat was named after his wife, who had passed away twelve years ago.

"How long have you been crewing for your grandfather?" Pepper asked C.T.

"Well, five and a half days," said C.T. "But I learned a couple of summers ago."

They were interrupted by the man Pepper had been arguing with earlier. "It's nice to see you've got so much spare time, Miss Thornton." He was a tall, unfriendly looking man who seemed to sneer as he talked.

Pepper introduced the Captain and C.T. to Harvey Westerman. Westerman wasn't very interested in making friends. "I'll see you in the morning," he said to Pepper, walking away. "[illegible]d you see to the tanks. Twenty-five hundred pounds."

C.T. was relieved this guy was gone. He really seemed like a bully. "Is that your boss?"

Pepper explained that Westerman owned a string of dive boats to take tourists scuba diving on the coral reefs. She worked for him as scuba instructor and leader of the dives. Their argument had been about how much air to put in tourists' tanks. "Westerman keeps trying to get me to put less air in the tanks so people can't stay down so long. I ignore him."

C.T. was curious. "What happened to your leg?" he asked.

Captain Granville was a little embarrassed, but Pepper reassured him that she didn't mind the question. She said she'd had cancer about five years ago. "They gave me a choice: me or my leg."

"And you can swim and all?" C.T. asked.

"Swimming's the easy part," said Pepper, smiling. She looked at her watch. "I should get going."

"[illegible] walk down th[illegible]
[illegible]ptain Gra[illegible]

As the three headed down the doc
Captain told Pepper that he was suppo
meet two people about chartering *Mimi*
thought Pepper might know them.

"Terry Gibbs and Victor Cobos," sai
Pepper, looking at the names the Captain had
written on a piece of paper. "I've taken them
diving a lot. Good people. Scientists."

She said they were **archaeologists** study-
ing the Maya ruins. Victor was Mexican and
Terry was from the United States. She added
that Terry was interested in Maya pottery.

That gave C.T. an idea. He dashed back
to *Mimi* and grabbed the souvenir pot. Maybe
these archaeologists could tell him something
about it.

Captain Granville and C.T. met the two
archaeologists and went into a restaurant to
talk business. When they entered, Harvey
Westerman was there with two people who
were looking at something wrapped in
per—a clay figure of some sort.
Cover it up!" Harvey said urgently, t
a wad of money into his pocket. The
Terry and Victor had made him very ner
and he left the restaurant in a hurry.

The Captain, C.T., Terry and Victor or-
dered their drinks and got down to business.

"Here's what we have in mind," Terry
said She described how she and Victor often
were intersted in the same questions about
the ancient Maya, but usually dis_reed about
the answers. They did agree, however, that
the Maya used the ocean for trading, using
huge dugout canoes. In the 1500s, Columbus
had seen a 70-foot Maya canoe off the coast of
Quintana Roo. The Maya traded on the sea all
during the "Classic Period" of their civiliza-
tion, from 200 to 900 A.D.

"What did they haul?" Captain Granville
wanted to know.

"Many things," Victor answered. "Corn,
cloth..."

"How about clay p ts?" C.T. asked.

"Sure, those too," said Victor. "Pots—
that's Terry's specialty."

Victor obviously felt a little uncomfor-
ble. He couldn't quite bring himself to say
hat he was thinking.

But Terry could. "Oh, Victor," she said. "He's a first-class sleaze," she said, referring Westerman. "Your own department at INAH spected him for years of **looting**—steal-
ya artifacts and selling them, which is

t sounded like a great adventure to C.T. we'll do it, Grandpa?"

The only question was whether Captain Granville could handle the scuba diving this job would involve. The Captain wasn't sure, but he did have an idea. "Maybe there is someone who can help us with that," he said.

"Then it's a deal?" Terry asked.

"It's a deal."

The four of them raised their glasses to celebrate their new partnership.

In all the excitement, C.T. had nearly forgotten. "Mayte, I already found something for you guys," he said, pulling the "potfish" out of his pack.

"Where did you get this?" Victor asked.

C.T. told them how one of their charter customers had caught it fishing.

"Well, that's pretty good fishing!" Terry said, examining the pot. "But I'm afraid this fish isn't very old."

"How do you know it isn't old?" C.T. asked.

Terry went on to explain that she and Victor had gotten some money from the National Institute of Anthropology and History—called INAH—to study Maya trade practices. INAH was in charge of all the archaeology in Mexico. She and Victor wanted to investigate some of the ancient Maya ports, such as Tulúm, underwater. That's where *Mimi* came in.

"*Under* the water?" asked the Captain.

Terry nodded. "Our **hypothesis** is that there just might be some Maya cargo down there. It could tell us more about what was traded, where, how, and maybe even why. We're always building theories, painting new pictures of the past."

Captain Granville wondered why Terry and Victor wanted to hire him, since he had only been there for two months, and didn't know the waters in the area that well. "Why not someone like that Westerman fellow?"

"Well," Terry said, "if it had been down there for even a few months, it would have something growing on it, like algae or even coral. You can imagine what it would be like after a thousand years or so."

"You mean it's a fake?" C.T. asked, disappointed. "How could it get to the bottom of the ocean?"

Victor thought maybe tourists had t..rown it or dropped it there.

C.T. had liked the idea that the pot might have been made by the ancient people called the Maya. "I wonder what they were really like," he said aloud, thinking of the temple of Tulúm that he had seen from *Mimi* today and trying to imagine the people who had built it.

Terry could see that C.T. was intrigued. "Captain Granville," she said, "Victor and I have to go back to Palenque to pick up our gear." She went on to explain that even though the Captain hardly knew her, she'd love to take C.T. with them. It would be a great chance for him to see some of the ruins up close. "I have an 11-year-old who'd get along great with C.T.," she continued.

"Can I, Grandpa?" C.T. asked eagerly.

The Captain was a little uncertain, and Terry and Victor asked him to think about it and let them know.

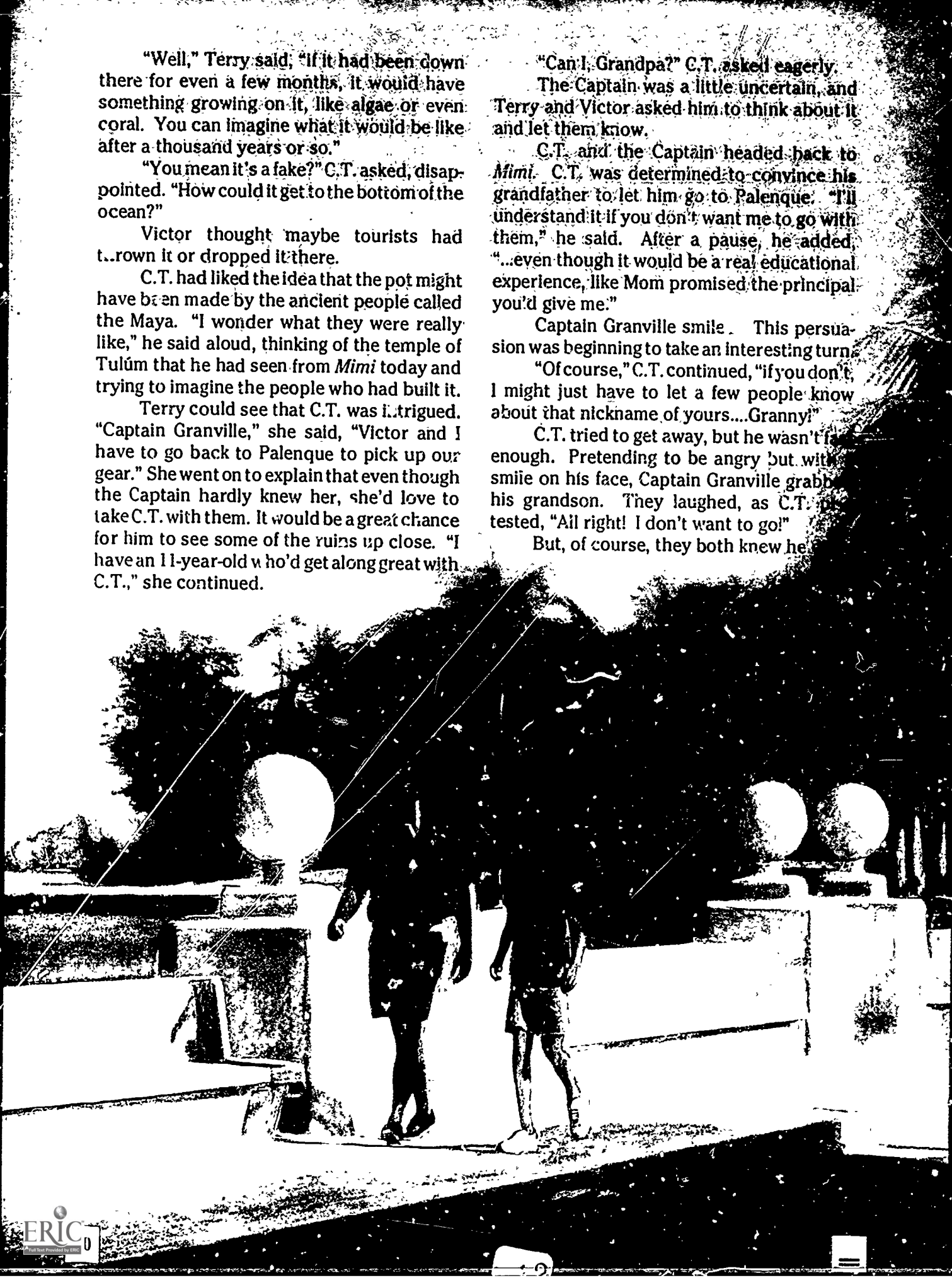
C.T. and the Captain headed back to *Mimi*. C.T. was determined to convince his grandfather to let him go to Palenque. "I'll understand it if you don't want me to go with them," he said. After a pause, he added, "...even though it would be a real educational experience, like Mom promised the principal you'd give me."

Captain Granville smiled. This persuasion was beginning to take an interesting turn.

"Of course," C.T. continued, "if you don't, I might just have to let a few people know about that nickname of yours....Granny!"

C.T. tried to get away, but he wasn't fast enough. Pretending to be angry but with a smile on his face, Captain Granville grabbed his grandson. They laughed, as C.T. protested, "All right! I don't want to go!"

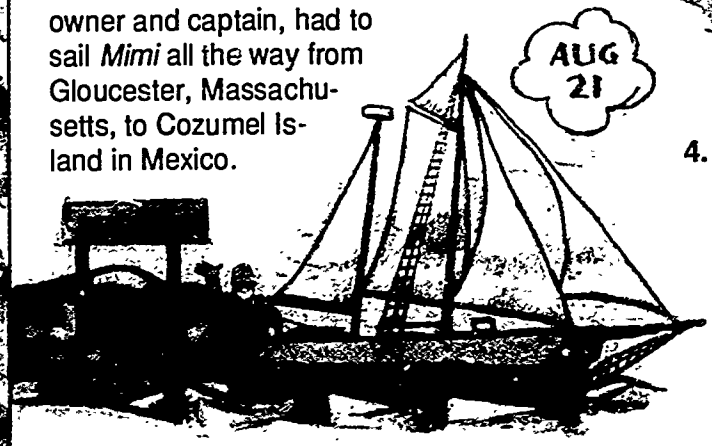
But, of course, they both knew he



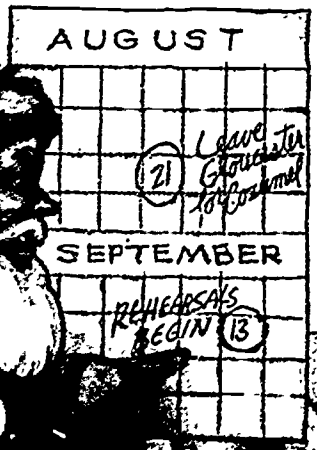
ACTIVITY

Where's Mimi?

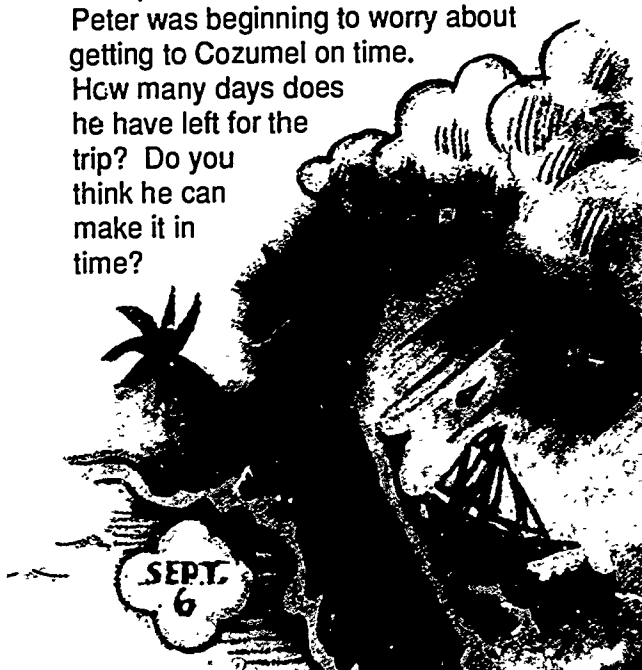
In the story of the first "Voyage of the *Mimi*," Captain Granville nearly died from **hypothermia** after falling overboard during a storm. In the story of "The Second Voyage of the *Mimi*," the sensible Captain decided to put *Mimi* up for charter in a place where the weather is sunny and warm--a place like Mexico. So, for the filming of "The Second Voyage of the *Mimi*," Peter Marston, who plays Captain Granville and is also *Mimi*'s real-life owner and captain, had to sail *Mimi* all the way from Gloucester, Massachusetts, to Cozumel Island in Mexico.



1. Use a map of North and Central America to decide on the best route for *Mimi* to take.
2. *Mimi* travels day and night. When the wind is favorable, she sails at 6 knots. (A knot is 1 nautical mile per hour.) When there's no wind and at night, she motors at the same speed. How far can she get in 24 hours under favorable conditions?
3. Peter had to get *Mimi* to Cozumel by September 13th for the first rehearsals of "The Second Voyage." It's about 1800 nautical miles from Gloucester to Cozumel. *Mimi* left Gloucester on August 21st. If the weather remained good and they didn't have to stop for any reason, how long would the whole trip take?



4. Of course, the weather never stays good and things break down. On August 26th, after only six days, *Mimi*'s **sonar** acted up. Peter had to make port in Savannah, Georgia, and wait for a week until it was repaired. He set sail again on September 3rd. They had clear sailing for three more days. Then, on September 6th, there was a hurricane warning for the waters off southern Florida. Peter brought *Mimi* to harbor to be safe. They stayed three days in Miami until the hurricane passed. It was already September 8th! Peter was beginning to worry about getting to Cozumel on time. How many days does he have left for the trip? Do you think he can make it in time?



EXPEDITION

Months after "The Second Voyage of the *Mimi*" was filmed in Mexico, Ben Affleck, the actor who plays C.T., took a trip to Jackson Hole, Wyoming. He went there to see Martha Hill compete in the National Disabled Ski Championships. Martha plays the role of Pepper in "The Second Voyage of the *Mimi*."

Jackson Hole has some of the toughest ski slopes in the world. For the past fifteen years, skiers with all kinds of disabilities have come here to compete. All are out to do their best. "I think it's because we don't like to think of ourselves as *un*able just because we are *dis*abled," Martha explained. "Sort of like our motto says, 'If I can do this, I can do anything.'"

There is even a downhill course here for blind skiers. Each blind skier has a sighted partner skiing ahead, yelling directions back to

Ben Affleck and Martha Hill

Marlee and her fellow competitors Lana Jo Chapin and Diane Golden take a spin before starting the slalom course at Jackson Hole.

"turn" or "tuck." Some blind skiers don't even need directions. They just listen for the sound of their partner's skis.

The competition at Jackson Hole was really important to Martha. She had a chance to be named the best all around skier in her class and then go on to represent the United States at the World Championships in Sweden. She had already won two out of the three events, including the slalom, her favorite race. But still to come was the downhill race, and for Martha, that would be the toughest event.

After an afternoon practice session, Martha introduced Ben to some of her friends and fellow competitors, Lana Jo Chapin and Diana Golden.

"Do you compete with each other?" Ben asked.

"We sure do," Diana said. "Martha and I are both on one leg, and she skis on outriggers and I ski on poles, but we're in the same class. Lana is a below-the-knee **amputee** and she skis on two skis with poles. But we're all out to beat each other, no matter what the class."

Ben asked, "Does it bother you when people ask you about your amputations?"

Lana answered, "It depends on how it's asked and on the situation."

"I prefer people to ask rather than to sit back and just stare," said Martha.

Diana continued, "And all of us are usually just as curious about each other's disabilities as other people are. Did you have a disease? Did you have an accident? Even though Martha's handicap looks to be the same, she's gone through different things, so I want to know what it was like for her."

Later, in Martha's room, Ben and Martha had a chance to talk privately. "Could you hand me my leg?" Martha asked.

Ben was taken aback for a second, but he turned and reached for the artificial limb that Martha sometimes uses. He had never seen her put her prosthesis on before, and she showed him how it was done.

[illegible] a long sock [illegible] around her stump. Then she pulled the end of the sock through a small hole [illegible] top of the prosthesis. As she straightened the limb, she pulled the sock [illegible] Then she closed the [illegible] against the air. No [illegible] to the leg stays on [illegible]

To make the leg, the doctors took a cast of Martha's stump and formed the socket to fit exactly. The socket was made from soft plastic which contracts and expands when she moves her muscles. It fits better that way and helps maintain the suction so the leg doesn't slip off.

"Do you have a bone in your stump?" Ben asked, growing more interested and more comfortable as he and Martha talked.

"Yes, I do." Martha showed Ben her leg, which ends about mid-thigh. The stump has a neat-looking line along the bottom where doctors stitched together the skin. Martha pointed to where the bone ends, about two inches from the bottom of the stump.

"The doctors wrapped all my muscles around the bone so that I still had strength." Her artificial leg weighs seven pounds, so that short bone lifts up seven pounds every time Martha takes a step.

Martha finished putting on the leg and pointed to another prosthesis in the corner. "That's the leg I had when we filmed the *Mimi*. This one has a knee joint, and that one doesn't." Martha's new prosthesis was sculpted from soft foam to look just like her other leg.

"What did you think when you first found out you had cancer?" Ben asked. "Did you know you were going to have to lose your leg?"

"When they first told me I had cancer," Martha said, "they weren't sure what kind I had. But they were pretty sure they were going to have to amputate. I was treated at Mayo Clinic. I was their 28th case of my type of cancer. The 26th had died and the 27th wasn't doing very well."

Martha's treatment began the day after she was diagnosed. "Within three weeks, I knew there was no way they could save my leg. By the time they'd finished the radiation I was ready to get rid of it. I'd always been really active and I was just carrying a lot of dead weight. I had known for two months that they probably would amputate and I think that made it a lot easier."

"Were you scared at all that you might die?" Ben asked.

"I knew it was pretty serious. At one point when I was filling out my hospital menu I was kind of laughing because I really didn't know whether I was going to be there the next day to eat it or not. But suddenly all my treatments started taking, and I knew I wasn't going to die. And I just started getting better and better and I've been fine ever since."

Ben asked Martha if she ever got pain from the wound.

The downhill race was the most difficult event for Martha. [illegible]

Martha invited Ben to the awards dinner at the end of the competition.

As National Champion in her class, Martha now had to start training for the World Championship competition. For Ben, just skiing down one gentle slope without falling was challenge enough.

If Martha could do well in the downhill, she would have a chance to win the overall championship. But it wouldn't be easy. Skiers were reaching sixty miles an hour on the course, and many of them had fallen. Martha had fallen on both her practice runs.

Ben waited at the most dangerous part of the downhill course for Martha to ski by. "Go, Martha! Go!" he shouted as she raced by.

Martha seemed to fly down the steep, bumpy course. She finished without falling. And her time was good enough to win the title! Martha was the National Champion!

Later, when Martha went up to receive her medal the announcer said, "And here's our own resident movie star, Ben Hill."

After the award ceremony, Martha and Ben skied down a gentle slope together. Ben struggled to keep his balance. Martha encouraged him. "You'll get it. You're doing great!"

DISABLED OR DIFFERENTLY-ABLED?

A handicap is something that makes it unusually difficult to accomplish your goals. In some ways everyone has handicaps. Physically disabled people are handicapped by things most of us don't even think about. For example, going to school can be unusually difficult.

Check out your school. Could a person in a wheelchair get into the building? The classrooms? The bathrooms? What about being able to write on the blackboard? Are there kids who might make fun of a handicapped person? Are there kids who would be friendly?

List some changes in the design of your school or classroom that might make it easier for a person in a wheelchair to go to school.

Think about other physical disabilities, such as blindness or deafness. What would make it easier for a deaf or blind person to go to school?

What are some things that make it difficult for you to achieve your goals? What are some ways people overcome their handicaps and develop special skills?

Sitting in the back of the open jeep, C.T. balanced his journal on his knees and wrote about the unfolding adventure.

December 2: Day 6 in Mexico. I'm off to Palenque. Mom checked with Mom, and she said it's OK. So here I am with Terry and Victor, driving all the way across three Mexican states.

They had left Cozumel early in the morning, taking the ferry to Playa del Carmen, then heading south and west toward Palenque. There was a lot to see and remember. Everything seemed very different from C.T.'s home in Ohio. *But I guess people are people,* he wrote. *I only wish I could speak their language.*

They drove for hours through flat, jungle-covered countryside. Then, as they got closer to Palenque, the land grew more hilly, and the jungle was even thicker. It was nearly sunset when they arrived at the ruins of Palenque.

Terry's daughter Quiché was waiting to greet them. After everyone had a chance to say "Hola," Quiché offered to give C.T. his first tour of a Maya temple.

"The light's perfect right now," she said. So off they went, promising Terry they would be back before dark.

The first thing Quiché did was to order C.T. to stand still.

"What's going on?" C.T. asked, as Quiché tied a bandanna over his eyes.

"You'll see," Quiché said, grinning.

She took C.T.'s hand and led him carefully up a long, steep flight of stone steps. When they were at the top, she asked, "Now, are you ready to see Palenque?"

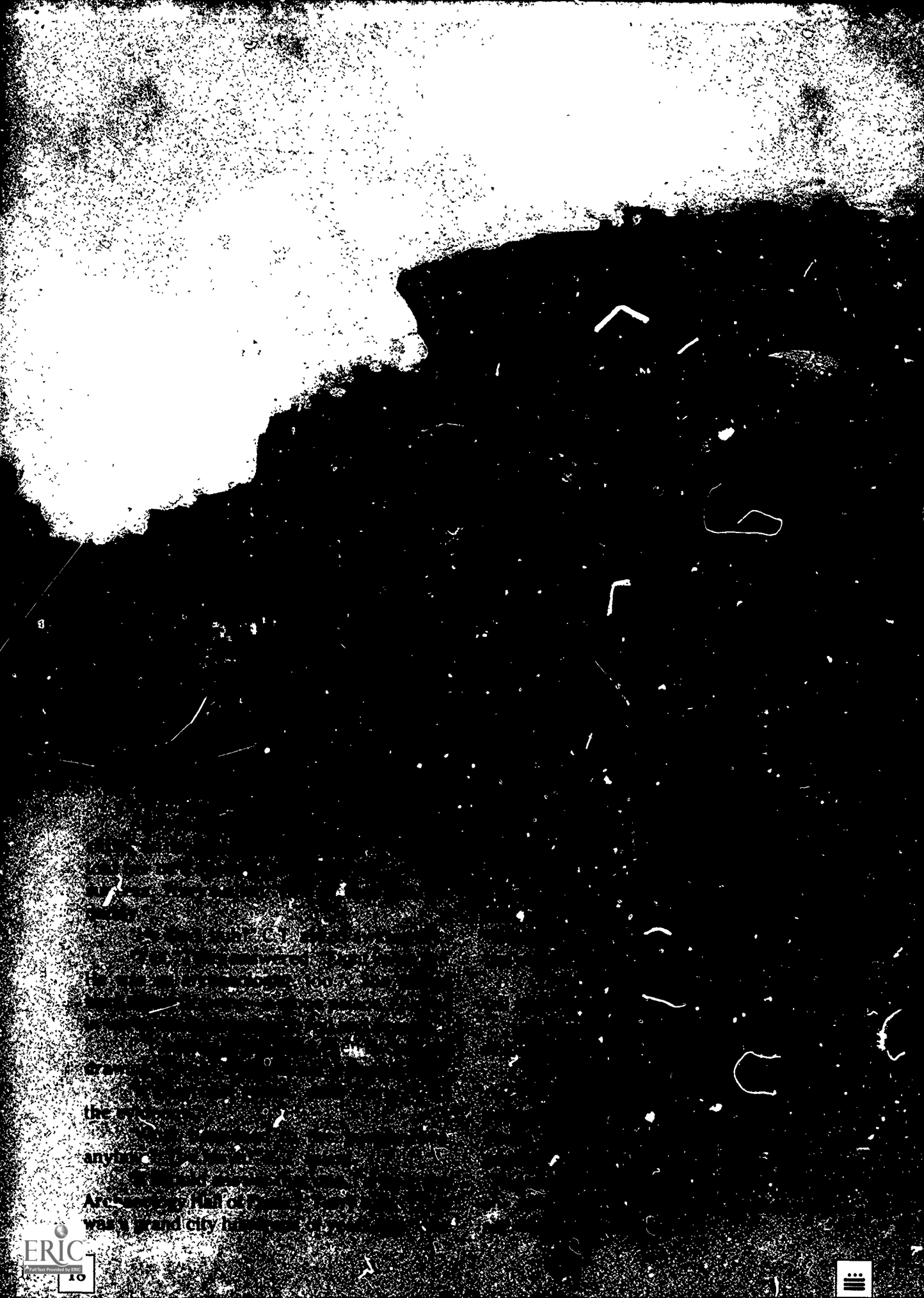
"I guess so."

With a flourish, Quiché took the bandanna from C.T.'s eyes.

There, spread out below were the remains of a vast ancient city. It gleamed in the light of late afternoon.

"Isn't it beautiful?" Quiché said softly.

C.T. had to agree. "Incredible!"



They came to a series of odd, T-shaped openings in one of the ancient walls. "What are these holes?" C.T. asked.

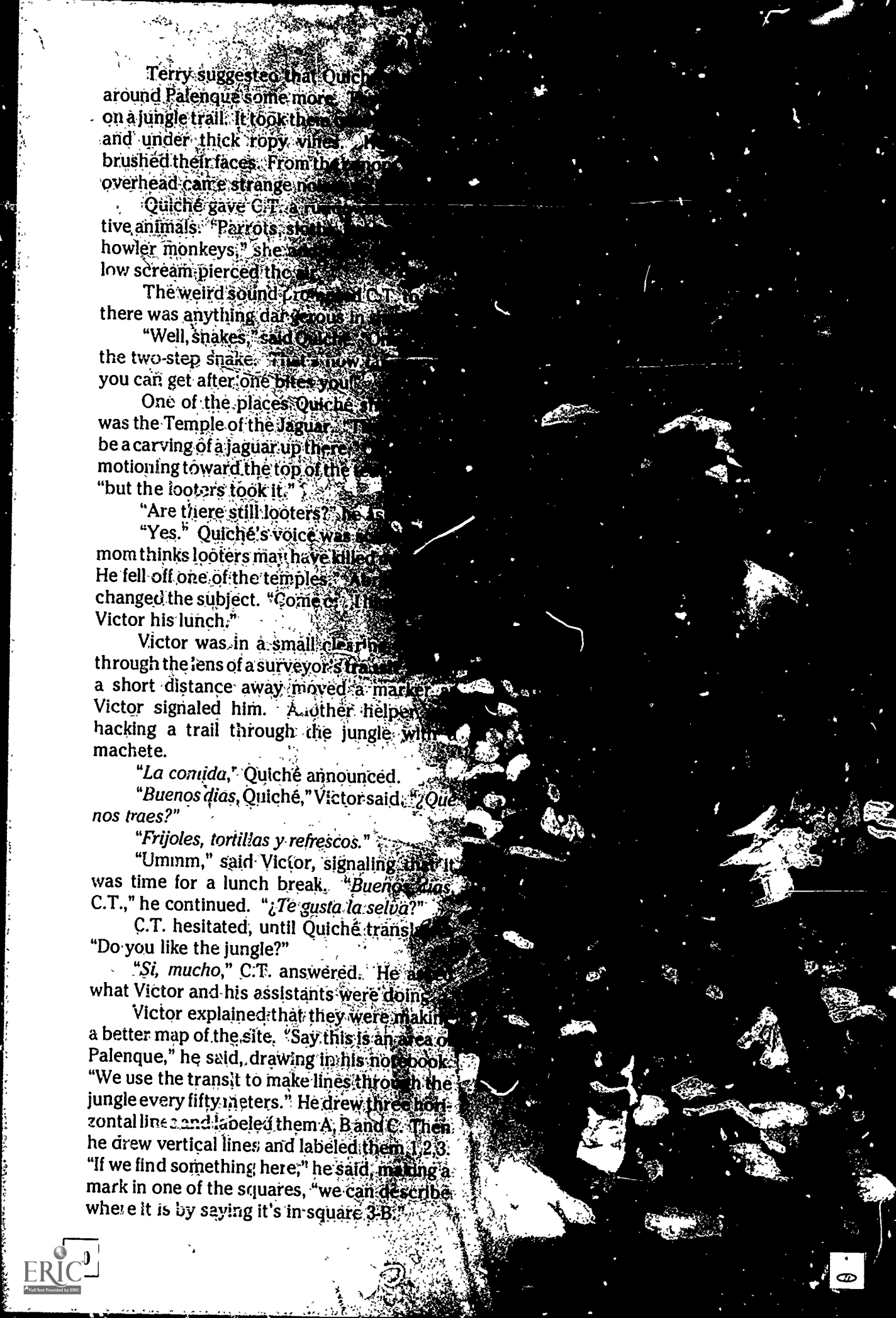
"Another mystery," said Terry. "Windows, maybe. A place to store things. We know that the T-shape was a sacred Maya symbol. They could have been a way to hang big plaster sculptures."

"But where are the sculptures?"

Terry's expression changed. "Oh, they've been looted long ago."

"Looters, huh?" C.T. peered into one of the openings. He tried to imagine the mysterious ancient people who had created this place, and the modern thieves who were now stealing from it.

Suddenly a head popped up on the other side of the opening. "Boo!" C.T. jumped back, startled. Quiché!



Terry suggested that Quich
around Palenque some more.
on a jungle trail. It took them
and under thick ropy vines.
brushed their faces. From the
overhead came strange no

Quiché gave C.T. a
tive animals. "Parrots, sloth
howler monkeys," she
low scream pierced the

The weird sound
there was anything dangerous in

"Well, snakes," said Quiché. "
the two-step snake. That's now
you can get after one bites you!"

One of the places Quiché
was the Temple of the Jaguar.
be a carving of a jaguar up there,"
motioning toward the top of the
"but the looters took it."

"Are there still looters?"

"Yes." Quiché's voice was
mom thinks looters may have killed
He fell off one of the temples." A
changed the subject. "Come on. I
Victor his lunch."

Victor was in a small clearing
through the lens of a surveyor's tra
a short distance away moved a marker
Victor signaled him. Another helper
hacking a trail through the jungle with
machete.

"*La comida*," Quiché announced.

"*Buenos días*, Quiché," Victor said. "*¿Qué nos traes?*"

"*Frijoles, tortillas y refrescos.*"

"Ummm," said Victor, signaling that it was time for a lunch break. "*Buenos días*, C.T.," he continued. "*¿Te gusta la selva?*"

C.T. hesitated, until Quiché trans
"Do you like the jungle?"

"*Si, mucho*," C.T. answered. He
what Victor and his assistants were doing.

Victor explained that they were makin
a better map of the site. "Say this is an area o
Palenque," he said, drawing in his notebook.
"We use the transit to make lines through the
jungle every fifty meters." He drew three hori-
zontal lines and labeled them A, B and C. Then
he drew vertical lines and labeled them 1, 2, 3.
"If we find something here," he said, making a
mark in one of the squares, "we can describe
where it is by saying it's in square 3-B."

"I get it. Like graph paper," said C.T.

"Exactly," said Victor.

After lunch Quiché took C.T. back to what she called "the best part of Palenque," the temple she had shown him the night before. As they stood at the top, Quiché said, "About twenty-five years ago a guy named Ruz decided there was something inside this pyramid. He saw these holes in the floor." She pointed to the stone slab at their feet. "He figured the Maya used them to move this stone. So he moved it."

Retracing the steps of Ruz, C.T. and Quiché walked down the stone stairway he had dug out of the rubble. Soon they reached a stone landing.

"When he got here after two years of digging it looked like a dead end," Quiché said. "But he kept digging...for four years!" There was another set of steps. Down, down. Now they were deep inside the pyramid.

, the huge tri gle of
scovered a oved
nestone
the l

There was the mass
had rested on the sarcop
pletely covered with carve
writing. Quiché read the
the day 8 *ahau*, 13 *pac*, he
means he was born on August 2

"And what did they find inside?"

"Pacal," said Quiché. "With a jade mask over his face!" They stood silently for a moment inside the dimly lit tomb. Finally, Quiché said, "Ready to go?"

"Yeah," C.T. said. "This place gives me the creeps."

Later in the afternoon, C.T. and the others relaxed on the temple steps. C.T. wanted to write about his day in his journal. "Terry," he asked, "the Maya had a calendar, right?"

three d kinds," Ter
all ri
C.T. wanted to
his journal.
Before
"Uh,
ter
ce
for
ting and human
"Human sacrifice?" C.T. was sure Victor was putting him on.
"I'm not kidding," Victor said. "They'd lay someone on a stone table up here, take an obsidian knife and cut out his heart. Still beating! Then they rolled the body down the steps..."

couldn't believe his ears. "Hey, ey must have been nuts!"
or pointed out that at about the same ...ory Romans were throwing Chris-
...ians.
"...three hundred years ago," Terry ...your own ancestors were burn-
...the stake."
...dded, "Now we just build bombs ...stroy the entire world!"

C.T. shook his head. "So we're *still* nuts," he muttered. Maybe the Maya weren't so weird after all.

"The Maya made sacrifices because they thought it would help every...ing rain, keep the sun shining," Vic...

sti...

ing. ...
couldn't ...
"He says ...
translated.
"I don't ...
Quiche ex... ...Spanish
was a Maya, making ... language.
"You mean there are still Mayas?" C.T. asked, surprised.
"Most of the people who live in this part of Mexico are Maya," said Terry.
C.T. had thought all the Maya were gone. Embarrassed, he turned to Victor. "Tell them I'm sorry I thought they were...oh...**extinct.**"

ACTIVITY

¿Habla Usted Mayan?

There are about twenty different Mayan languages spoken today in Mexico, Guatemala, and Honduras. The most common one, Yucatec Mayan, is spoken in "The Second Voyage of the *Mimi*." Many Maya children speak Mayan at home and Spanish in school. You can learn some Yucatec Mayan, too.

How to pronounce Mayan words

"a" = "ah" as in "calm"
"e" = "eh" as in "effort"
"i" = "ee" as in "keen"
"o" = "oh" as in "open"
"oo" = the same sound as "o" but it's held a little longer
"u" = "oo" as in "moon"
"x" = "sh" as in "bush"

An apostrophe (') means to make a sudden stop between sounds where it occurs in a word.

MAYAN	ENGLISH
Bix a belex?	How are you?
Maloob.	I'm fine (or I'm okay).
Tu'x ka binex?	Where are you going?
Kin bin tin nah.	I'm going home.
Kin bin in "escuela."*	I'm going to school.
Koox tun.	Let's go then.
Yum botic.	Thank you.
Mixba.	You're welcome.
Hax tube.	That's perfect.

*"Escuela" is the Spanish word for "school." The Maya did not have a word for it.

Practice saying these words in Mayan. See if you can have a conversation with a friend using them. The Maya characters use some of these words in "The Second Voyage of the *Mimi*."

There are also lots of Spanish phrases in the story. C.T. learns how important it is to know other languages during this voyage. Victor is Mexican, but he learned to speak Mayan from his grandfather. So, he is **fluent** in Spanish and Yucatec Mayan. Do you have any relatives who speak another language? What languages are spoken in your family?

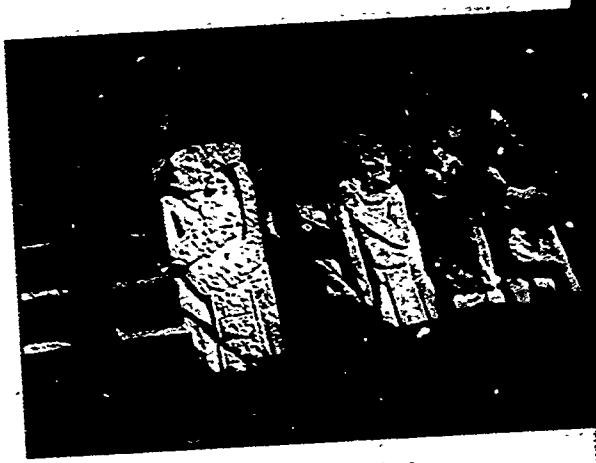
Who's a Maya?

The ancient Maya were groups of Native Americans who lived in parts of Mexico and Central America over two thousand years ago. Their civilization reached its height around 900 A.D., five hundred years before Columbus "discovered" the "New World." Their monuments, paintings, and books are the earliest written history of the Western Hemisphere.

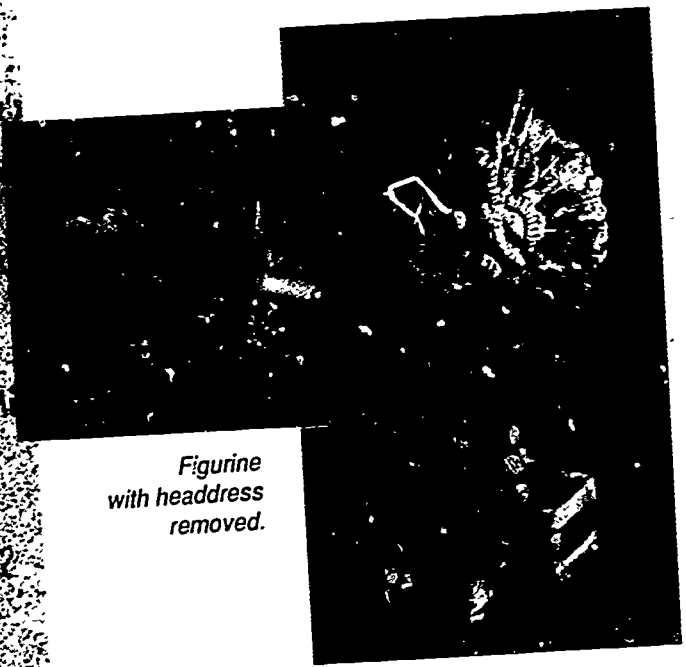
The Maya invented accurate calendars based on observations of the sun, the moon, and the planet Venus. They were excellent at mathematics and they developed a hieroglyphic written language.

Today, many Maya still live in Mexico and Central America. Some live and farm in tiny villages, much as their ancestors did. Others live and work in modern cities. We learn much about the ancient Maya by studying the objects and buildings they created. In recent years, we've gotten better at **deciphering** their hieroglyphics, but there is still much to be learned.

Stone "torchbearer," Copán, Honduras.

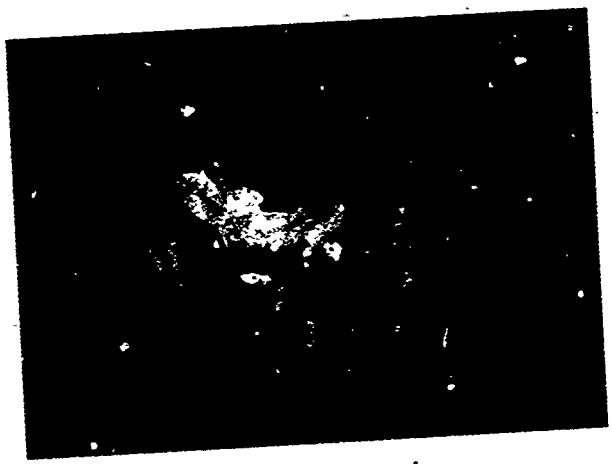


Stone "captives," Palenque, Mexico.



Figurine with headdress removed.

Ceramic figurine of seated lord with headdress.



Ceramic figurine of woman weaving.

EXPEDITION

Based on his first visit with Murray Hamlett at the U.S. Army Research Institute for Environmental Medicine, Ben Affleck was nervous about what was in store for him.

Ben Affleck first visited the U.S. Army Research Institute of Environmental Medicine in Natick, Massachusetts, a few years ago to learn about how our bodies react to cold weather. After being in Mexico's hot climate for a few months, he went back there to learn about what heat does to us.

This time Ben was a little worried. [illegible] Dr. Murray Hamlett [illegible]

[illegible]

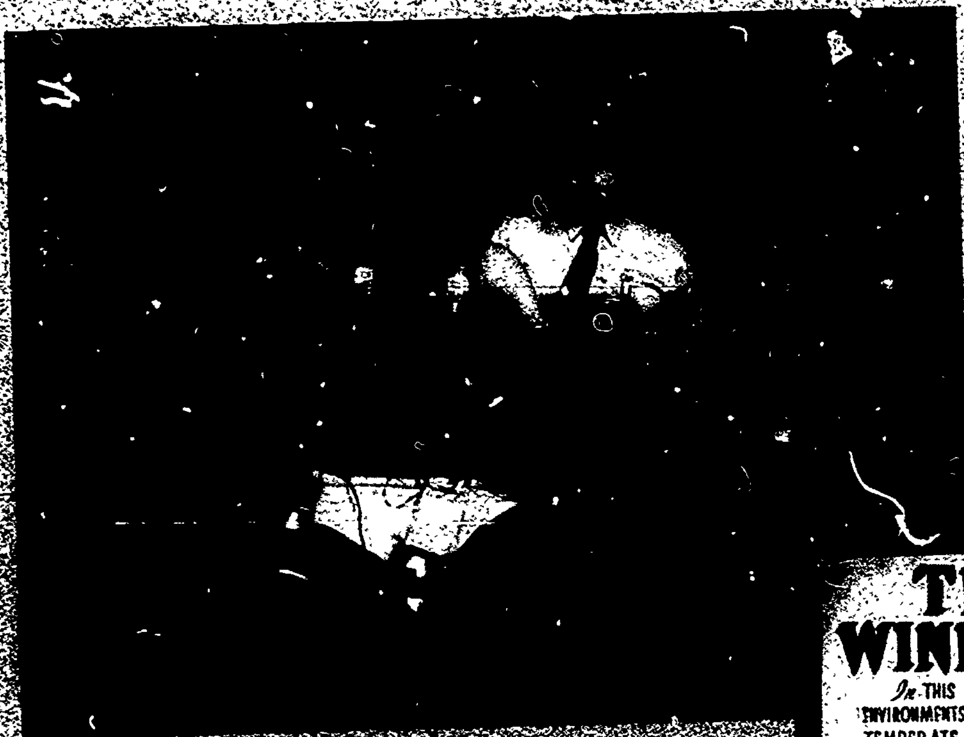
Ben had already learned about the danger when the body's core temperature drops too low. Now he wanted to learn if it was also dangerous if the core temperature got too high.

The core temperature [illegible] deep inside our bodies. [illegible] temperature [illegible] can't get too high or too low or [illegible] work right. [illegible] heat by burning or [illegible] the food we eat. If we weren't always losing heat, we'd get too hot.

"How does the body get rid of heat?" Ben asked.

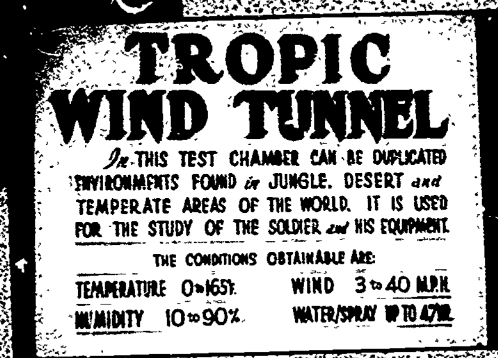
[illegible] blood and sweat," said [illegible] The body [illegible] blood from the [illegible]

[illegible]



Sensors would monitor Murray's heart rate, skin temperature and core temperature in the tropic wind tunnel.

The temperature can reach 165° F, and the humidity can reach 90%.



"I understand how your body can lose heat when the air around you is under 98 degrees," Ben said. "But how would you lose heat if you were in that chamber where it's 100 degrees?"

"Well, the best way to find that out is to put a body, or guinea pig, in the chamber," suggested Roger.

"Does it have to be *my* body?" Ben asked.

Remembering his first visit to Natick, Ben's idea of the perfect guinea pig for this experiment was [illegible] Dr. Hun[illegible] Ben [illegible]

[illegible] in sports [illegible]

To measure core temperature, a lead was inserted through Murray's nose, down through the esophagus and stopped at a level near the heart. Murray assured Ben that the apparatus wasn't too uncomfortable. The temperature in the chamber was set at 100 degrees Fahrenheit, but the air was very dry. Larry plugged in the sensors.

After Murray had been in the chamber for about twenty minutes, they checked the [illegible] on the graph. "His skin temperature [illegible] Why is that?" [illegible]

[illegible]

The dry air in the chamber made Murray's sweat evaporate quickly. And it's the evaporation that cools you, not just the sweat sitting there on your skin. When water turns from liquid to **vapor**, or evaporates, it takes heat. So your skin cools, the blood under the skin gives up heat and circulates back to your core.

Ben walked into the chamber. "Hey, it's not too bad in here," he said.

Murray explained, "Because of the very low humidity, the evaporation of sweat from the skin is working well to keep me dry. It's always more comfortable in a hot, dry situation than it is in a hot, humid situation."

Roger, Larry, and Ben check the readings.

They decided to make Murray do some work—walking on a treadmill—to see how that would affect his core temperature. Exercise causes your muscles to make extra heat that you have to get rid of. The muscles also need more blood to bring them oxygen. So now the heart has to pump hard to get blood both to the muscles that are doing the work and to the skin to help keep your core cool.

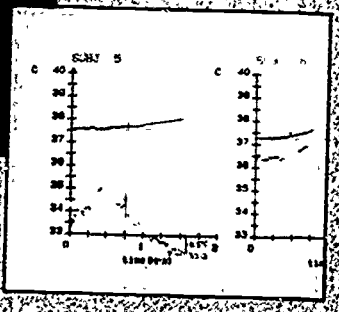
It didn't take long to see the effects. Murray's heart rate was 85 when he entered the chamber. After he'd been standing for forty-five minutes in the heat, it went to 114. After he'd been walking for fifteen minutes, his heart rate was about 120.

Murray's heart was doing its job, but so was his sweat. His core temperature remained at only about 1 degree Fahrenheit above normal. Murray was actually losing heat to the

evaporation of his sweat. Without the cooling effect of sweating, his core temperature would rise faster. If he were working in a humid environment, his core temperature would rise even more quickly because his sweat wouldn't evaporate as much.

So they decided to see what would happen if Murray's sweat wasn't cooling him much. Same temperature—100 degrees Fahrenheit—but this time they made the air very humid. Sweat won't evaporate into air that already has a lot of water vapor in it.

The graph on the right shows the effects of exercising in the hot, humid environment on Murray's core and skin temperatures.



"Whoa, it's hot!" said Ben as he entered the chamber. The high [illegible] degrees feel hotter [illegible] work. Murray was [illegible] getting no evaporative cooling.

Seeing how hot [illegible] feeling Murray, Ben [illegible] about three minutes.

Murray [illegible] very [illegible] sweating [illegible] sweat [illegible] [illegible] because the air [illegible] sweat. They [illegible] Eventually [illegible] that they [illegible] [illegible] heat.

One angry cold weather expert.

They turned on the treadmill again so Murray could start working in the hot, humid environment. He felt his heart rate and temperature go up. He was pretty uncomfortable. "I can only do this so long. As I **shunt** blood to other parts of my body—that is, move blood from my muscles and out to my skin—my blood pressure might drop significantly and I might get lightheaded and collapse or faint."

Ben left the chamber to check the graphs. Murray's core temperature was rising steadily. His heart rate was up to 134. His skin looked flushed.

"How high can your heartbeat get before it becomes dangerous?" Ben asked Larry.

"During our studies, we have a limit of 180 beats per minute. That's a very healthy exercise rate." They also carefully monitor core temperature. A core temperature above 107 degrees Fahrenheit can be very dangerous, and brain damage could result.

"His skin temperature and core temperature are very close. I think we ought to get him out of there," said Larry.

"You're looking at one very angry cold weather expert," Murray said when he came out of the chamber. "Well, are we even Ben?"

"Yes, I think we're even," Ben said as he and Murray shook hands.

Other animals pant. Breathing rapidly over the tongue and **mucous membranes** causes evaporative cooling. Dogs lose over 90 per cent of their body heat by panting. They also lose some heat through their foot pads. Cats are really desert animals and are very well adapted to hot environments. They lose heat [illegible] ears and they get some evaporative [illegible] from licking themselves. But most of [illegible] through panting.

[illegible] animals stay cool at all?"

[illegible] animals from both direc- [illegible] the outside air temperature is [illegible] temperature of the ani- [illegible] heat gain [illegible] to [illegible] underground or [illegible] They are relatively [illegible] of water.

[illegible] Ben's [illegible] with sweat. A per- [illegible] or three quarts an [illegible] is important [illegible] weather or when

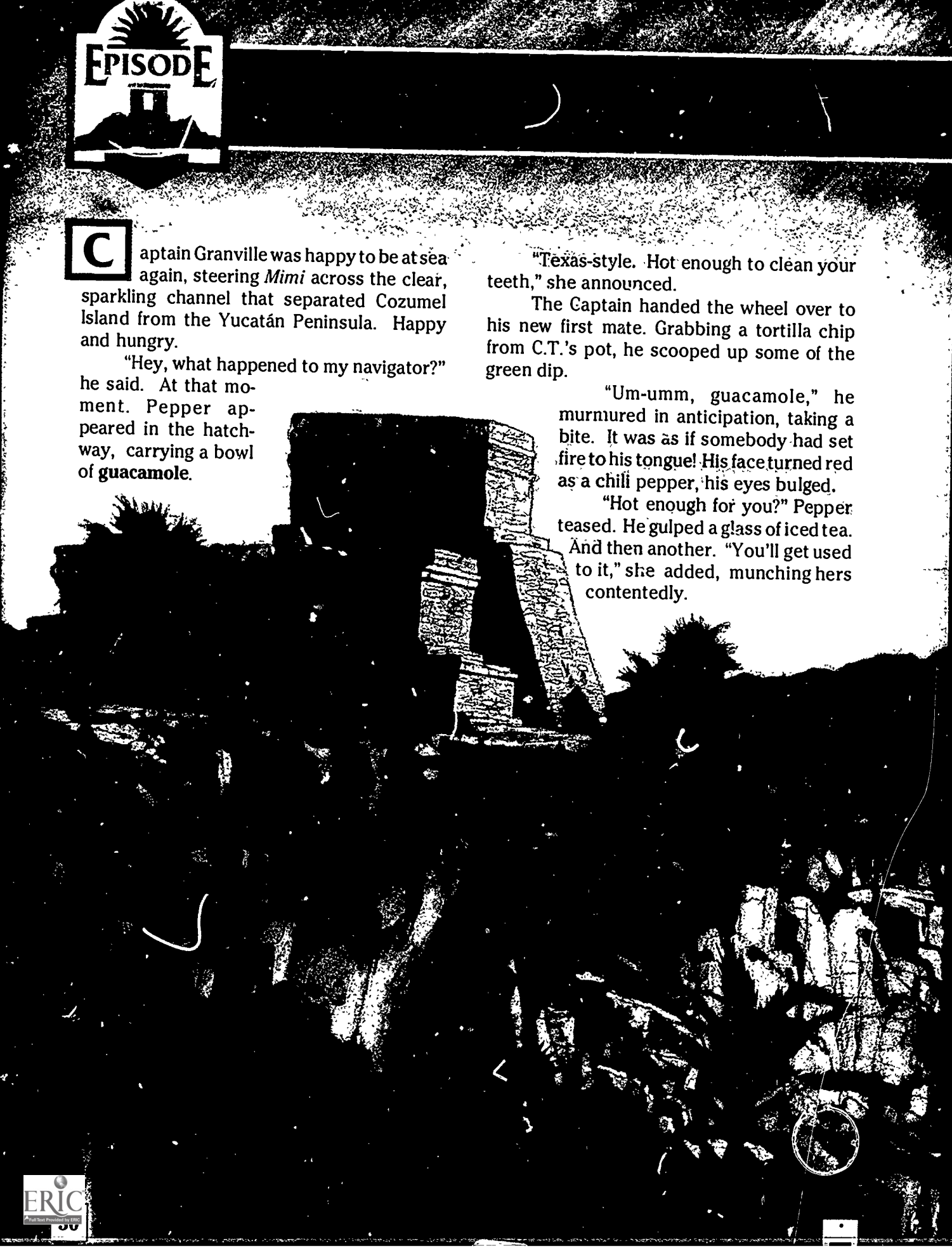
HOW DRY AM I?

Did you know that you sweat up to half a cup of liquid in an hour—even on a cool day? (Adults lose up to one cup an hour.) Playing outside on a hot day, you can lose up to four cups of liquid an hour. How much do you think you sweat in an entire day of hot weather? of cool weather? If you're sweating so much, why aren't your clothes alw- s wet?

It's important to replace all the liquids the body loses during the day. You should drink before, during and after exercising or playing, especially when it's humid and hot.

Tiny amounts of salt and other minerals are lost when you sweat. However, a normal, healthy diet contains enough salt and minerals to replace them. You don't need to take salt tablets or special drinks to make them up.

Try weighing yourself before and after exercising or playing outside in summer. You may find that you've lost up to a pound. What you've lost is water, not fat, so drink up! It's not healthy to be all dried up!



Captain Granville was happy to be at sea again, steering *Mimi* across the clear, sparkling channel that separated Cozumel Island from the Yucatán Peninsula. Happy and hungry.

"Hey, what happened to my navigator?" he said. At that moment. Pepper appeared in the hatchway, carrying a bowl of **guacamole**.

"Texas-style. Hot enough to clean your teeth," she announced.

The Captain handed the wheel over to his new first mate. Grabbing a tortilla chip from C.T.'s pot, he scooped up some of the green dip.

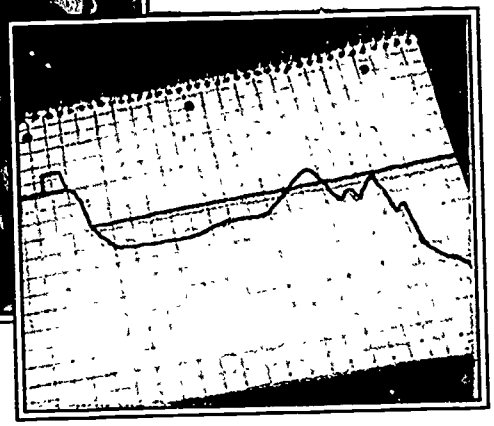
"Um-umm, guacamole," he murmured in anticipation, taking a bite. It was as if somebody had set fire to his tongue! His face turned red as a chili pepper, his eyes bulged.

"Hot enough for you?" Pepper teased. He gulped a glass of iced tea. And then another. "You'll get used to it," she added, munching hers contentedly.

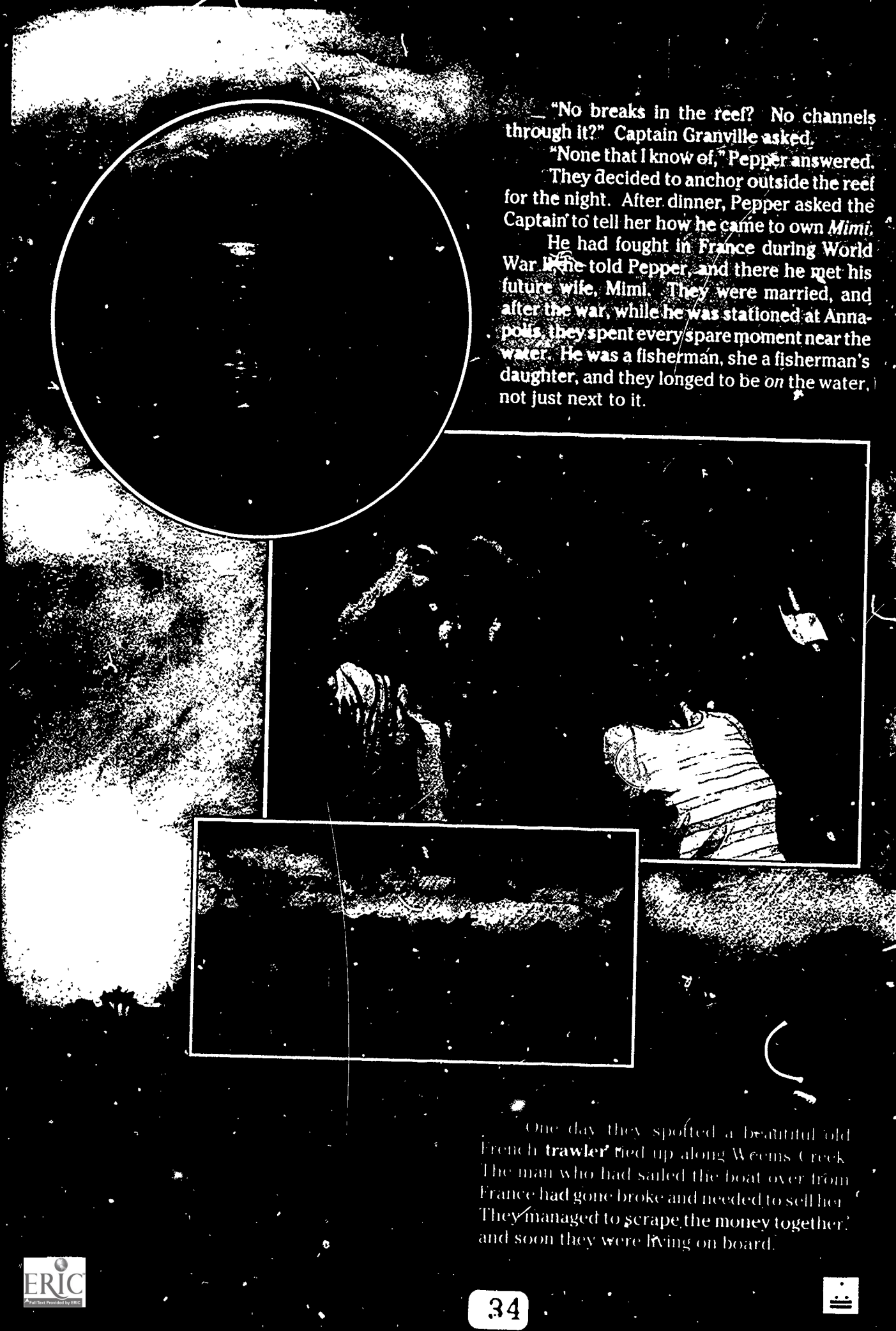
muttered, [illegible]

Soon they [illegible] ruins sat on low cliffs overlooking the turquoise sea. Pepper told Captain Granville that the first Spanish to see it said it was as beautiful as any city in Spain. The temples were painted blue then, she said.

The Captain gazed at the ancient city. "I wonder if these two archaeologists are going to find anything underwater here," he said. Then he turned to his charts. They lacked detail, and he knew that there was a dangerous reef along this coast. Pepper told him that her old boss Westerman had carefully charted these waters, but that he kept those charts for his own use.



She had done some diving in the area, so she was able to draw a picture of the reef. It could provide a nice calm anchorage if they could get through it without ripping the belly out of *Mimi*.



"No breaks in the reef? No channels through it?" Captain Granville asked.

"None that I know of," Pepper answered.

They decided to anchor outside the reef for the night. After dinner, Pepper asked the Captain to tell her how he came to own *Mimi*.

He had fought in France during World War II, he told Pepper, and there he met his future wife, Mimi. They were married, and after the war, while he was stationed at Annapolis, they spent every spare moment near the water. He was a fisherman, she a fisherman's daughter, and they longed to be *on* the water, not just next to it.

One day they spotted a beautiful old French **trawler** tied up along Weems Creek. The man who had sailed the boat over from France had gone broke and needed to sell her. They managed to scrape the money together, and soon they were living on board.

His reminiscing was suddenly interrupted by the dull [illegible] engine. They climbed up on deck and peered into the night. As their eyes adjusted to the dark they were astonished to see a powerful motor yacht heading out from the shore.

"That's a very big boat to be inside the reef," Pepper exclaimed.

"Let's ask them how they got in there," Captain Granville said. "Get the anchor [illegible]

[illegible] boat. He could [illegible] were running dark—[illegible] Either they [illegible] channel through [illegible] for [illegible]

[illegible] ing their bow. "Ahoy there!" the Captain shouted. "*¡Buenas noches, ahoy!*"

There was no response from the darkened boat, only a loud splash and the sound of somebody shouting. Somebody angry, it sounded like. The boat's engines revved as it cleared the reef, and soon the night had swallowed all traces of it.

"Try and stop her right here," the Captain shouted, and Pepper cut *Mimi*'s engine. He swept the water with his binoculars. *Surely there's a buoy to mark the channel*, he thought, but he could find no marker. *How on earth did they get through?*

His thoughts were interrupted when he noticed a glimmer of light on the cliff. The light flickered for a moment, and then disappeared. "Back her down," he called to Pepper, and the light reappeared as she slipped *Mimi* into reverse. "Well, well," the Captain murmured.

He had Pepper ease the boat back and forth a few more times, and on each pass the light would appear for a few seconds and then vanish. "See something?" Pepper asked.

"Just a light on the cliff," he answered. "We'll check it out in the morning. Let's an-

[illegible]

[illegible] Your nickname, and your old man has spilled the beans about mine."

Pepper smiled. "Goodnight, Granny," she said.

"Goodnight, Pepper."

Tulúm was alive with tourists the next morning, climbing up and down the weathered steps that had been climbed for centuries. Captain Granville separated himself from the crowd and wandered off towards the edge of the site. It was a beautiful place, dotted with palm trees and tropical flowers. Below the ruins was a perfect little beach where he had come ashore earlier. The green water was the clearest he'd ever seen. He wondered what had happened to the people who once inhabited this spectacular city.

He found what he was looking for on a windy bluff: the ashes of a fire, still warm in his hands. He looked up and saw a tiny temple standing at the edge of the cliff. The one wall that was still standing had a window in it, and through it he could see *Mimi*, resting at anchor just outside the reef.

He moved slightly to his left, and *Mimi* disappeared. He shifted to his right, and lost sight of the boat again. Only by spotting directly across the fire could he keep *Mimi* in view through the window.

"*Señor. . .*"

Captain Granville looked up to see a dark-haired man staring down at him. "It is forbidden to start fires in an archaeological zone," the man said in a stern voice.

Just as the Captain began to explain, Victor and Terry arrived. "I'm glad you came," the Captain said. "I was having a little trouble explaining to the guardian about what I..."

"Guardian?" Victor interrupted, smiling. He introduced Captain Granville to Tomás Segovia, the chief archaeologist at Tulúm. They laughed off the misunderstanding, and the Captain recounted the story of the mysterious boat the night before. He believed the fire and temple lined up to form a kind of lighthouse that marked a passage through the reef.

The others looked doubtful, but the Captain persisted. "If you're on a boat out there, and you can see the light from the fire through the small window in the temple, you're on the right course to get through the reef."

Now Victor and Terry were intrigued. "The ancient people could have done the same thing!" Victor said.

"No, no, Victor, I am afraid not," Segovia said, chuckling. His theory was that the temple was used by the ancient Maya to mark the sunrise on the first day of winter.

Smiling, Victor shook his head. "Segovia believes that every temple was built to mark the movement of some star," he said to Captain Granville. "The Maya were terrific astronomers, it's true. They figured out how to predict the movement of the sun and planets, but Maestro here believes that's all they did."

"We disagree with him," Terry said, joining the debate. "The trouble is, he keeps discovering some very good evidence."

Captain Granville suggested that they check out his lighthouse theory. "I'd sure like to get *Mimi* through that reef," he said.

"And a break in the reef would be a good place to start our explorations," Terry added.

"If the ancient Maya

dinghy. On the way C.T. was disappointed to learn that his grandfather had hired on a first mate. "I thought it was just going to be you and me," he said. "What's this guy like?"

Just then

ACTIVITY

UNDERWATER GARDEN

Star coral polyps stay closed during the day, and open at night to feed. Individual polyps are only a fraction of an inch across.

Corals are tiny animals that live in the sea. There are many different corals. Some kinds live alone in deep, cold parts of the ocean. But most kinds band together to form colonies. Some of the bands of corals build soft skeletons that wave in the ocean currents.

The best-known corals live in warm, clear, shallow water, near shore. These corals take calcium that's dissolved and invisible in sea water and use it to form colorful, stony skeletons. The skeletons of the tiny animals join together.

The coral animals (called **coral polyps**) live inside their skeletons. They have soft, cup-shaped bodies with **tentacles** on the top. At night they extend their tentacles and feed on tiny floating ocean animals. During the day, the tentacles are pulled in and the polyps close up. It's hard to know the coral is alive during the day.

When coral polyps grow, they build new skeletons on top of the old ones. As years pass, huge underwater structures are formed this way. These structures are called coral reefs. The reef corals are many different colors and shapes. Thousands of brightly colored fish and other fantastic-looking creatures live in the nooks and crannies of coral reefs.

Some coral reefs form parallel to the shore and a few miles out. Before good maps were drawn, these "barrier reefs" caused many shipwrecks as boat bottoms were pierced by their sharp prongs.

Create an underwater coral reef scene. You might use cray-pas or colored chalk on blue paper, paint or construction paper. Check books to find out about different corals and reef dwellers. Or work with a friend on a reef mural. Each of you could design and cut out different parts for it. Don't forget to paint the background before adding the reef creatures

Ben Affleck returned to Tulúm, Mexico, a year after "The Second Voyage of the *Mimi*" was filmed. He went to meet the *real* archaeologist named Segovia. The Segovia in the story of "The Second Voyage of the *Mimi*" was made up, but he was modeled on a real person named Victor Segovia. The real Segovia really does believe that some of the buildings at Tulúm were used to mark the appearance of the sun on certain days.

Keeping track of the sun can help us keep track of time. Segovia reminded Ben that the earth travels around the sun. One trip around the sun equals one year. Segovia thinks the Maya could tell almost exactly when the earth completed one trip around the sun.

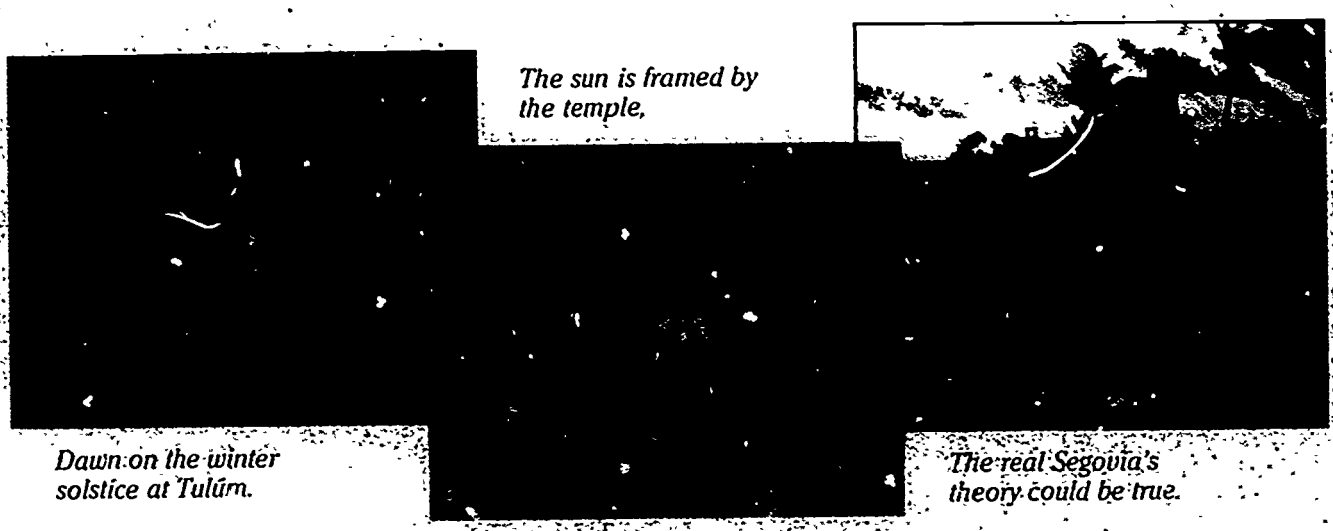
It's hard to imagine being able to tell how long a year is just by looking for clues in nature. Segovia said Ben could do the same thing if he didn't sleep so late every morning. If he got up early enough, he would see that the sun comes up in a slightly different place every day.

The sun does come up in the east, but not always due east. In fact, on the first day of winter, called the winter solstice, the sun rises pretty far to the right, or south, of due east. Then, each day the sun rises slightly further to the north, little by little, until the first day of summer. On that day, the summer solstice, the sunrise starts moving back to the south again. Each day the sun rises a little further south, until, on the next winter solstice, it rises just where it started exactly one year earlier.

Segovia thinks the Maya could tell when the winter solstice occurred. He thinks they placed a small temple in exactly the right spot so that it lined up with a special "frame" built in the wall surrounding Tulúm. Each year, on the morning of the winter solstice, the sun would shine through the temple and frame. On that one day, the first day of winter, they'd know where another year had begun.

Ben Affleck and Victor Segovia (the real Segovia) at Tulúm

Ben and Segovia ate on the ruins on December 21st, the first day of winter. Visiting the ruins on that day, they hoped to see the sun rise in the same area as Maya priests had done many centuries ago. They think [illegible]



The sun is framed by the temple.

Dawn on the winter solstice at Tulūm.

The real Segovia's theory could be true.

The earth also spins around or **rotates**, like a top, once every day, 365 days a year. That helps us keep track of time, too. Ben visited the Royal Obse vatory, near London, in Greenwich, England, where astronomers have been timing the spin of the earth by keeping track of the sun for over three hundred years.

The journey itself taught Ben a lesson about time and the earth's rotation. Ben left his home in Boston at night. By the time he reached London, it was morning. At about ten o'clock, he decided to call home. His little brother answered the phone in a sleepy voice and asked, "Ben, do you know what time it is?"

Ben answered, "Sure. It's about ten in the morning here, there's a five-hour time difference...it must be about three in the afternoon over there. Why aren't you in school?"

Casey replied grumpily, "It's not three in the afternoon. It's five o'clock in the morning!"

"Uh-oh," said Ben, "I think I miscalculated. Sorry."

Ben knew there was a five-hour time difference between Boston and London. However, he added hours when he should have subtracted. Luckily, he had an appointment at the Royal Observatory in Greenwich later that morning so he could try to straighten out his confusion.

Ben met Dr. Stuart Malin, the head of the Observatory, who used a lamp and a globe in a darkened room to show Ben why he got confused. "This is roughly what the earth would look like from space," Stuart said.

One half of the globe was illuminated by the lamp and the other half was totally dark.

Ben went to England to learn about other ways of using the earth and sun to keep track of time. The journey itself taught him a lesson about time.

The side facing the lamp (or the sun) would be in daylight and the side away from the lamp would be experiencing night. Since the earth is constantly spinning, the area facing the light keeps changing.

As the earth rotates to the east, there is an edge between darkness and light. On the side of the globe turning toward the light, that edge would be sunrise, six o'clock in the morning. On the other side, the sun would be setting, six o'clock at night. At the part of the globe in the middle of the dark side, we say it is midnight. In the middle of the light side, we say it is noon.

"If I imagine myself standing right here in Boston and then just kind of rolling toward the sun at sunrise...it's not like the sun is coming up—but more me moving toward the sun, then away from it and back to it again," Ben said.

Stuart demonstrated, using the globe, that at ten o'clock in London, the sun has not yet risen in Boston.

Stuart Hunt helped Ben understand how the earth's rotation causes day and night.

Ben was beginning to see why we have to set our clocks to different hours at different places on earth.

Ben realized that there had to be some way to **synchronize** the world's clocks. To do that, someone had to keep track of time for the world. For hundreds of years, the astronomers at Greenwich have done just that. They set the observatory clock every day by using a telescope to determine the exact moment when the noonday sun passed over an imaginary line called the Greenwich **meridian**. The meridian is marked by a brass rail in the ground. The telescope is set right on the meridian.

The next morning, Ben stood on the Greenwich meridian with Carole Stott, the curator of astronomy at Greenwich. She said that at noon, his shadow would fall right on the meridian. Since it was before noon, his shadow was on an angle several feet from the meridian.

Estimating the distance, he guessed it was about ten o'clock. Carole checked her watch and congratulated him. The human **sundial** was only about five minutes off. She said, "A sundial is, in a lot of ways, the most accurate way of keeping time, because you're using the basic time-keeper, which is the rotation of the earth."

The Greenwich astronomers used that basic time-keeper back when they were telling the rest of the world how to set their clocks. Carole showed Ben how they used to do that. Near noon, she cranked open the roof of the observatory so the big telescope inside could be focused on the sun. Carole adjusted it to the right height for the sun that day and focused it.

Looking at the sun can injure your eyes or blind you. This telescope is equipped with special lenses so the astronomers can safely look at the sun.

Ben looked through the telescope and saw a series of black lines. The center lines represented the Greenwich meridian. As he watched, the sun came into view in the telescope and moved across the lines until it was framed between the center lines. That meant it was exactly noon Greenwich time. Ben ran outside and stood on the Greenwich meridian. His shadow was right on the line.

The next thing the Greenwich astronomers would do each day, once they had noted noon, was to correct their own clocks. Then they would let everyone else in the area know

At noon Greenwich time, Ben's shadow aligned with the Greenwich meridian.

Ben [illegible] observes the sun through the big telescope.

the correct time by hoisting a big ball to the top of a mast on one of the buildings. At exactly one o'clock, the ball would drop down the mast and people around Greenwich and London could set their clocks. People nearby still use the time ball to set their watches. But the old telescope at Greenwich has given way to more modern instruments. Still, the only way to keep our clocks and calendars perfectly accurate is by watching the way the earth moves.

WHAT TIME IS IT, REALLY?

A little over one hundred years ago, there was no standard time in the United States. People all set their watches to noon when they thought the sun was at its peak in the sky. So people in different towns all had different noons.

This was an awful problem for the people running railroads. How could they make schedules when in Wisconsin alone there were thirty-eight different local times?

A school teacher named Charles Dowd met with railroad officials and they came up with a plan. They divided the United States up into four time zones. The width of each zone was determined by the distance the sun seems to travel in one hour—about fifteen degrees of longitude. Boundaries were drawn and Eastern, Central, Mountain and Pacific time zones were established on November 18, 1883.

At first people were angry about the idea. Many felt that nature should determine time, not the railroad officials. But pretty soon they realized it was helpful to have standard time. Thirty-five years later, in 1918, Congress passed the Standard Time Act, making the time zones official in the United States.

Look at a map of the United States. Why do you think the time zone lines zigzag? (Imagine what would happen if a time zone line ran right through your town...or right through your house.)

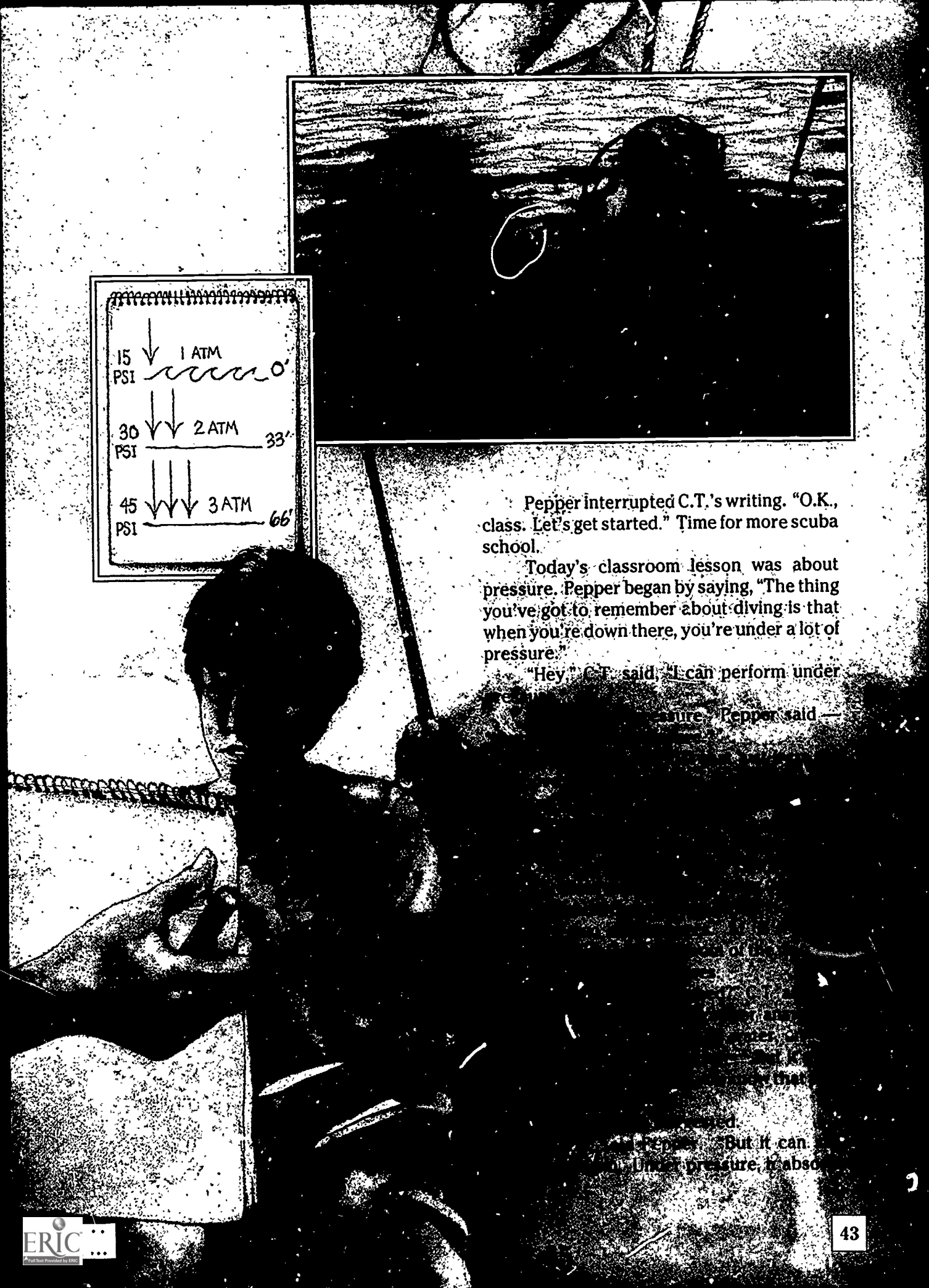
EPISODE

Pepper and C.T. plunged into the clear blue water and drifted slowly to the sandy bottom. C.T.'s scuba-diving lessons had begun. A T-shirt and blue jeans served as his wet suit.

Today, Pepper was teaching him how to get water out of his mask. To demonstrate, she pulled the mask away from her face to allow it to fill with water. Then she lifted the bottom part of the mask away from her face, tilted her head back, and breathed out through her nose. The air forced the water down and out of the mask. C.T. tried it, and it worked!

Back on deck, C.T. munched on chips from the souvenir Maya pot and wrote in his journal:

One day I'm just an ordinary swimmer, and two days later I'm breathing underwater. It's really pretty easy. Well, I guess I was scared at first, but Pepper's a great teacher. It's great to breathe underwater, but it's nice to be able to see, too, especially since you have to use sign language to communicate. Diving's like being in another world. It's easy to forget it can be dangerous.



Pepper interrupted C.T.'s writing. "O.K., class. Let's get started." Time for more scuba school.

Today's classroom lesson was about pressure. Pepper began by saying, "The thing you've got to remember about diving is that when you're down there, you're under a lot of pressure."

"Hey," C.T. said, "I can perform under

sure," Pepper said—

ed.

Pepper. But it can

Under pressure, it abso

Air is mostly nitrogen, and scuba tanks are filled with air. If your body absorbs too much nitrogen while you're underwater and you come up too fast, the nitrogen bubbles out as the pressure decreases.

Pepper popped the cap off a bottle of soda to show what happens. The gas in the bottle spewed out.

"And it's bad when it bubbles out like that?" C.T. asked.

"Let's just say it can cause serious complications," Pepper answered. "Like death."

This is what's called the **bends**, Pepper explained. Although people don't die from the bends very often, it can cause serious damage to the body. That's why scuba divers have to be careful about how long they stay underwater and how fast they come up.

As they got ready for the next diving lesson, Pepper quizzed C.T. "Remember what you do while you're coming up?"

"You remember to always keep breathing," he answered.

"Why?" asked Pepper.

"Because if you hold your breath, your lungs can explode."

"Right again. Why?"

C.T. had learned his lessons well. "Because when you ascend, the air in your lungs **expands** when you come up to less pressure."

Pepper nodded. "*¡Perfecto!*"

In the underwater lesson that followed, C.T. learned how to handle emergencies. He pretended that his tank was out of air and he and Pepper practiced buddy breathing. Then they practiced an octopus ascent, with C.T. using Pepper's extra **regulator** as they swam to the surface.

Later that afternoon, Victor, Terry, Captain Granville and Quiché arrived. They had spent two days in Mérida on paperwork for their underwater archaeological work.

Terry and Victor were happy to see Pepper aboard. And C.T. was proud to tell Quiché that he was learning to scuba dive.

"You coming with us this afternoon, C.T.?" Victor asked.

C.T. looked to his teacher, Pepper.

"He sure is," Pepper answered.

"Great!" C.T. said.

As the divers got ready for their underwater work, Captain Granville and Terry talked about the mysterious light on the cliff. Terry

The Captain and Quiché changed into swimsuits, grabbed some **snorkeling** gear and climbed into the inflatable. Soon they were anchored in shallow water near the reef. "We don't have to go down forty feet in order to check out the bottom," Captain Granville said.

"Are we still lined up with the lighthouse and the reef?" Quiché asked.

"As far as I can tell," the Captain answered. "With the reef nearby, there should be all kinds of fish for us to feed."

He was right about that. Quiché and the Captain plunged into the water and were soon surrounded by schools of shimmering fish who ate bread crumbs from their hands.

Meanwhile, not far away, Victor, C.T. and Pepper continued to scout the reef. Victor was the first one to see the opening. Excitedly, he pointed it out to the others. "Plenty wide for Mimi" he wrote on his slate.

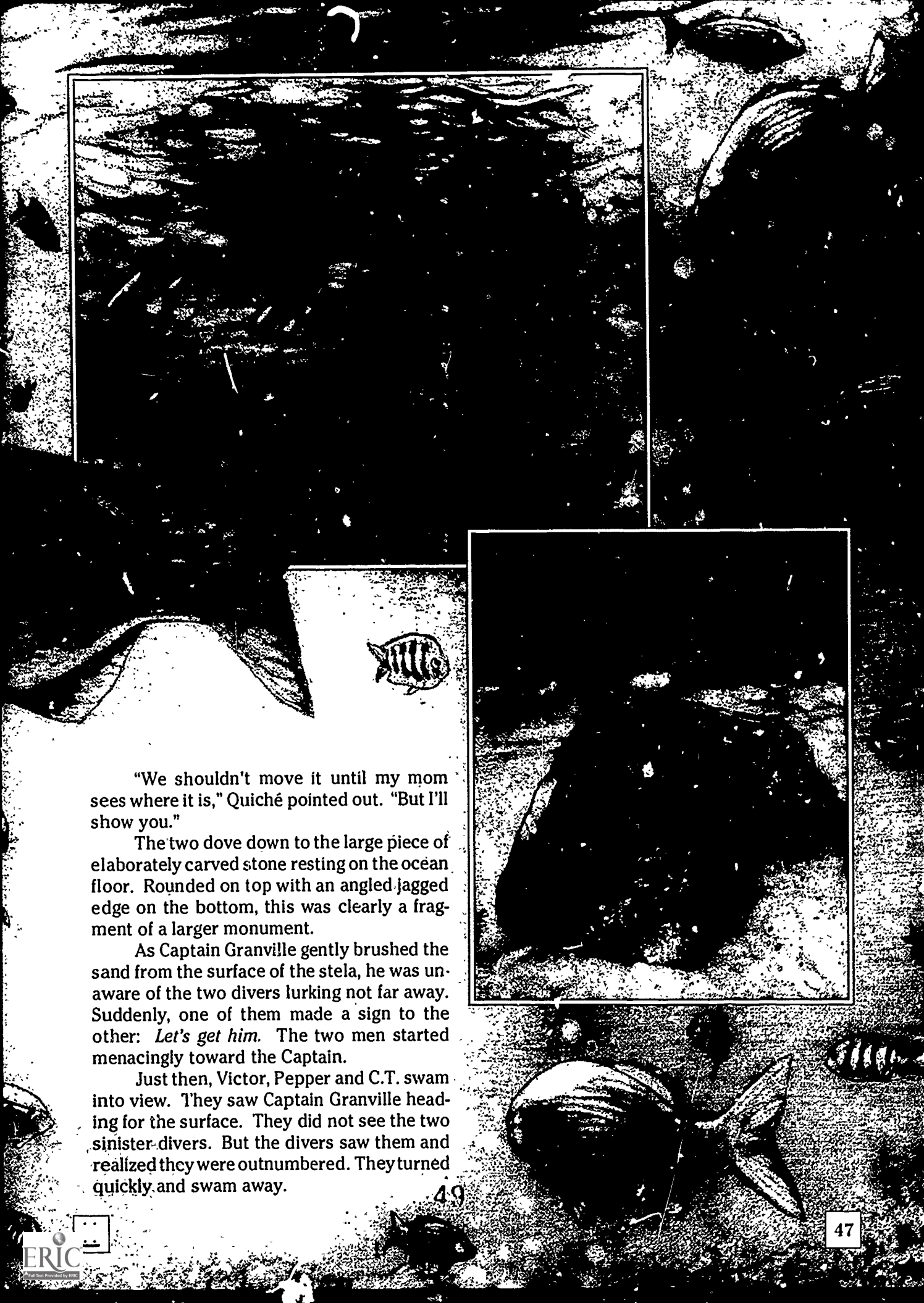
The discovery meant that *Mimi* would be able to pass through the reef and anchor in the calm waters near shore. And the archaeologists could begin to explore for evidence of ancient Maya traders.

After the fish food was gone, Quiché and Captain Granville swam about, investigating the sandy bottom near the reef. The Captain found a conch and held it up for Quiché to see.

Quiché skimmed along the surface, scanning the ocean floor for other interesting discoveries. Suddenly, she saw something strange lying in the sand on the bottom. When she went down to investigate, she could hardly believe what it was.

"Captain G., a **stela**!" she shouted excitedly when she got back to the surface. "A Maya monument! I can even read the date **glyphs**!"

"Let's get it!" Captain Granville said.



"We shouldn't move it until my mom sees where it is," Quiché pointed out. "But I'll show you."

The two dove down to the large piece of elaborately carved stone resting on the ocean floor. Rounded on top with an angled jagged edge on the bottom, this was clearly a fragment of a larger monument.

As Captain Granville gently brushed the sand from the surface of the stela, he was unaware of the two divers lurking not far away. Suddenly, one of them made a sign to the other: *Let's get him.* The two men started menacingly toward the Captain.

Just then, Victor, Pepper and C.T. swam into view. They saw Captain Granville heading for the surface. They did not see the two sinister divers. But the divers saw them and realized they were outnumbered. They turned quickly and swam away.

C.T. and the others couldn't wait to get back to *Mimi* to share news of their find with Terry.

"This is fantastic!" she said.

"I don't see how it could be in such good condition," said Victor.

Captain Granville had an idea. "That hurricane last month must have churned up the bottom and uncovered it."

"How are we going to get it up?" Quiché asked.

"We could use air," said the Captain. "We used to salvage gear from sunken ships that way."

Terry quickly got into scuba gear and joined the others in the salvage operation. Before they moved the stela, she carefully took photographs to document its location. C.T. and Quiché watched as the others tied heavy ropes around the stela. They put a plastic garbage bag inside a net bag and attached it to the ropes. Then, using air from the scuba tanks, they inflated the plastic bag.

Slowly, the heavy stone monument began to move. As the air-filled bag rose toward the surface, the stela rose with it and hung suspended in the water. Captain Granville and the others pulled the stela to *Mimi*.

"I hope whatever's on this thing is worth reading," C.T. said as the stela was hoisted onto *Mimi*'s deck.

"Heavy reading, that's for sure!" Pepper quipped.

With the stela resting safely aboard *Mimi*, the excited group gathered around to admire their find.

"I can't wait to work on it," Terry said.

She and the others were unaware that they were being observed. On shore, Harvey Westerman had his binoculars trained on the group gathered on *Mimi's* deck. He had seen them raise the stela. And he did not look happy at all!

ACTIVITY

PERFORMING UNDER PRESSURE

When Pepper gives C.T. his first scuba-diving lesson, she says,"One thing you've got to remember about diving is that when you're down there, you're under a lot of pressure."

Air pressure is a powerful force we experience every day. Since it's invisible, it's hard to understand how it affects us. These experiments will give you a chance to experience and observe the power of air and water pressure.

You will need:

- an empty clear plastic bottle with a small mouth
- a deep clear container, like an aquarium or a clear tea kettle
- a clear plastic cup, small enough to fit easily into your container
- water (enough to fill the container two-thirds)
- balloons (small round ones are best)
- tissues
- empty milk or orange juice cartons
- a pan or sink
- newspaper, to absorb spills

1. Put an uninflated balloon inside an empty clear plastic soda bottle with the opening of the balloon around the bottle rim. Now try to blow the balloon up.
   - What happens?
   - What is your theory about why you can't blow the balloon up?

2. Fill an aquarium or other large, clear container two-thirds full of water. Hold a cl plastic cup upside down. Try to get it to bottom of the tank of water without getting the inside of the cup wet.
   - How is it possible that the cup can stay dry inside?
   - If you stuff a tissue into the bottom of the cup and try it again, will the tissue stay dry?

Once you have the cup on the bottom of the tank with the inside dry, get the cup to fill up with water.

- What do you observe when the water starts going into the cup?
- What do you think is happening?

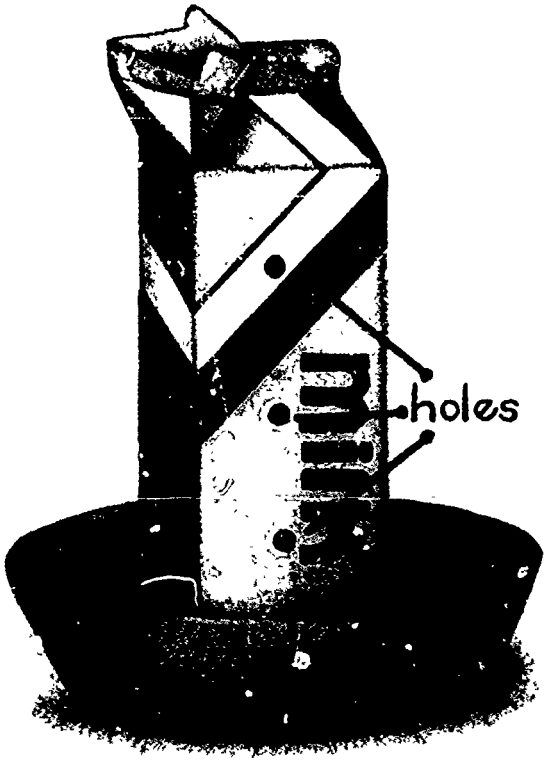
"From this day forward we would swim across miles of country no one had known, free and level, with our flesh feeling what the fish scales knew."

Jacques Cousteau, *The Silent World*

Inventors discovered this property of water and air and made diving bells which were big enough for people to stand inside. If held level, the bells would retain a pocket of air so the people could breathe. They could then swim out, explore around a little and return to the bell for more air.

3. Take an empty carton and use your pencil to punch three holes in a line going up one side of the carton. Predict what will happen if you fill the carton with water.
   - Will the water come out?
   - Will one of the holes shoot the water out in a longer stream? Predict which one might.

If you have a few cartons try different arrangements of holes and see what results you get.



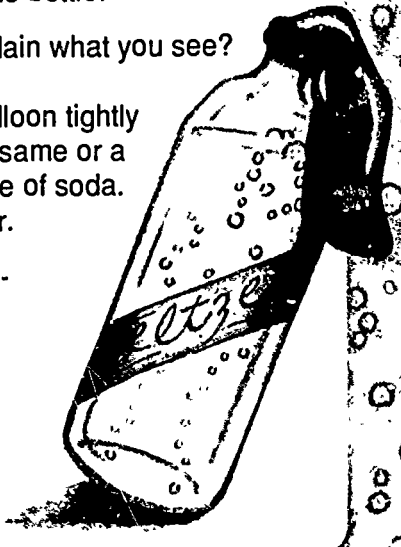
HERE COMES THE FIZZ

What causes the fizz when you open a bottle of soda? Why does soda get "flat"? What has that got to do with divers getting the bends? These experiments may give you some clues.

You will need:

- an unopened clear bottle of soda (such as seltzer or club soda)
- a clear plastic cup
- a small balloon

1. Look carefully at the sealed bottle of soda.
   - Do you see any bubbles?
2. Watch carefully and open the bottle.
   - Are there more or fewer bubbles now?
   - Where do you think the extra bubbles came from?
3. Pour some soda into a clear cup. Tightly cover the soda bottle.
   - What do you think will happen to the soda in the cup in a few hours?
   - What about the soda in the bottle?
4. To test your theory, open the bottle later and compare the number of bubbles in the cup to the number in the bottle.
   - What might explain what you see?
5. To find out, fit a balloon tightly over the top of the same or a newly opened bottle of soda. Leave it for an hour.
   - What might happen? Check and see.
   - Can you think of a theory to explain what happened?



When Ben Affleck learned to scuba dive for "The Second Voyage of the *Mimi*," he learned a lot about pressure and how it affects you. It also made him wonder about some things. He went to the North American Hyperbaric Center in City Island, New York City, to find out more about pressure. "Hyperbaric" means high pressure. The people who work at the Hyperbaric Center should be experts on the subject. They've promised to put Ben into one of their high pressure chambers. But first he'll get a lesson on what pressure is all about.

Glenn Butler is one of the diving experts at the Center. He started out by showing Ben a small hyperbaric chamber. It can be pressurized to the equivalent of ten atmospheres—ten times atmospheric pressure.

"Ten atmospheres? How do you get that much?" Ben asked.

"We have air cylinders outside that push air into this chamber. Because the volume is fixed, as we push air into the chamber, the pressure goes up," Glenn said.

The chamber is made of steel, and can't expand. So as more air is pushed into the chamber, the air becomes more dense and exerts more pressure. The chamber has to be thick to withstand ten atmospheres of pressure. In fact, the walls of this chamber are over four inches thick in spots.

"We're under the weight of the atmosphere, about 100 miles of air, all the time. That produces 14.7 pounds of pressure on each square inch of our bodies. That pressure, 14.7 pounds per square inch, is called one atmosphere of pressure. Water is a lot heavier than air. It takes only 33 feet of [illegible] to produce one atmosphere of pressure. So [illegible]

Glenn Butler, Expedition
Ben Affleck
the [illegible]
chamber [illegible]
[illegible]
[illegible]
[illegible]
[illegible]

As the gauge showed the increasing pressure, Ben looked through the small window to see the effects on the objects inside.

Ben brought a bunch of different things to put into the chamber. He wanted to see what pressure did to them before finding out what it would do to him.

He started with a basketball. A basketball is hard because of air pressure inside the ball. It has about seven pounds per square inch (psi) *more* than atmospheric pressure. Ben pressed on the ball with all his strength and couldn't squeeze it much. It was hard to imagine how just air pressure could.

Ben closed the door to the hyperbaric chamber. He had to use his whole body to move it.

"This door has to hold back 46 tons," Glenn said. He explained that 100 psi at 10 atmospheres over the whole door area, which is 2 1/2 feet in diameter, adds up to 46 tons.

[illegible]

[illegible]

air from the tanks outside began rushing into the chamber. At 10 feet of pressure, a small dent appeared in the basketball. At 20 feet, the ball began to cave in. At 33 feet, twice normal atmospheric pressure, the ball looked as if a giant had stepped on it. It was about half its original volume.

Glenn read "depth" off the gauge as Ben watched the basketball collapse. At 66 feet or 3 atmospheres—3 times normal atmospheric pressure—the air in the ball was one-third its original volume. At 4 atmospheres, the volume was one-fourth, and so on.

When the pressure in the chamber was at 6 atmospheres, 6 times normal atmospheric pressure, Ben asked, "We haven't let air out of the ball, have we?"

Glenn replied, "The same amount of air is in there, but we've compressed it. [illegible]

[illegible]

[illegible]

At 1 atmosphere, the fully inflated basketball is hard and round.

The same basketball, the same amount of air, at 10 atmospheres.

When they took the basketball out, back into 1 atmosphere or 14.7 pounds per square inch pressure, it was back to normal. Ben bounced it a few times to make sure.

"If you were in there at 130 pounds, would you feel pressure on you?" Ben wanted to know.

A person wouldn't be squashed as the basketball was because a person is mostly liquid. Liquids are not compressible. That's one of the great differences between liquids and gases. Gases can be compressed. You have air spaces in your lungs and ears, but your body is basically a liquid and it's not compressible. That's why people can go underwater.

Glenn suggested they try an experiment to compare water and gas. He filled a blue balloon with water and a yellow balloon with air until they were the same size.

As the chamber was pressurized, Ben predicted that the blue balloon would [illegible]. At 2 atmospheres, or 33 feet, the yellow balloon was about half the size of the blue one. Glenn pointed out a small air bubble in the water-filled blue balloon. The air bubble was actually getting smaller as the pressure increased.

"At a really low depth, the air bubble will disappear," said Glenn. "It will actually be absorbed into the water."

Gases can be absorbed in liquids. The more pressure is applied, the more gas is absorbed. That's how nitrogen gets in a diver's blood, sometimes causing the bends. Glenn added that soda is **carbonated** by pushing gas, usually carbon dioxide, into the liquid under pressure.

They continued adding pressure up to 230 feet of sea water. The yellow balloon got smaller and smaller while the blue balloon remained the same size. Ben wondered whether the pressure inside the water balloon was the same as the air pressure. Glenn said that it was.

Ben asked about the effect of scuba diving on his body. Would the pressure inside and outside his body be the same?

"Yes," Glenn answered. "At any given depth in the ocean, the water pressure is exerted all over the body and transmitted through the body."

As they depressurized the chamber, the balloon filled with air returned to its original size, doubling in the last 33 feet. Ben was reassured. His body, being mostly water, would survive the hyperbaric chamber. However, the next experiments got him worried again.

Two differently-shaped light bulbs, an egg, and an empty gas can were put in the chamber. The gas can developed a leak, so it never completely collapsed. Nothing happened to

At 1 atmosphere, the yellow balloon [illegible] the blue balloon and the same size.

Under [illegible] the yellow balloon [illegible] the blue balloon.

the other objects until they reached 300 feet of sea water or over 130 pounds of pressure per square inch. Suddenly one of the light bulbs burst with a loud bang.

"Whoa! It exploded!" exclaimed Ben.

"It **imploded**, it didn't explode," Glenn corrected him. "The gas pressure outside the bulb was so great that the bulb actually collapsed or imploded."

Glenn explained why the egg and the other bulb survived the pressure. First, a raw egg is filled with liquid. Plus, gases like air can pass through the shell (which is one reason a chick can live in there). The egg also has a shape that can withstand a lot of pressure. The best shape for that is a perfect **sphere**.

The second light bulb was a small, round one. "This is closer to a sphere," Glenn said. "Another reason it's so strong is that the force is divided equally over it." The other bulb had collapsed because it had a long, narrow shank that could get pushed on.

Next Ben and Glenn tried another can and a rigid plastic container. As they pressurized the chamber, Ben was surprised. The can soon looked like it had been punched. It finally folded in half and tipped over. But the plastic container just sat there.

"Believe it or not," Glenn said, "the plastic is more rigid than the steel in the can. Watch carefully now." All of a sudden the plastic container burst, splintering all over the chamber.

Ben was already worried about going into the big hyperbaric chamber. The final experiment made him feel worse.

Glenn had two styrofoam heads. He put one in the chamber and kept one outside for comparison. Styrofoam is made of thousands of little plastic bubbles filled with air. As the chamber was pressurized, the head inside began to shrink. It got smaller and smaller.

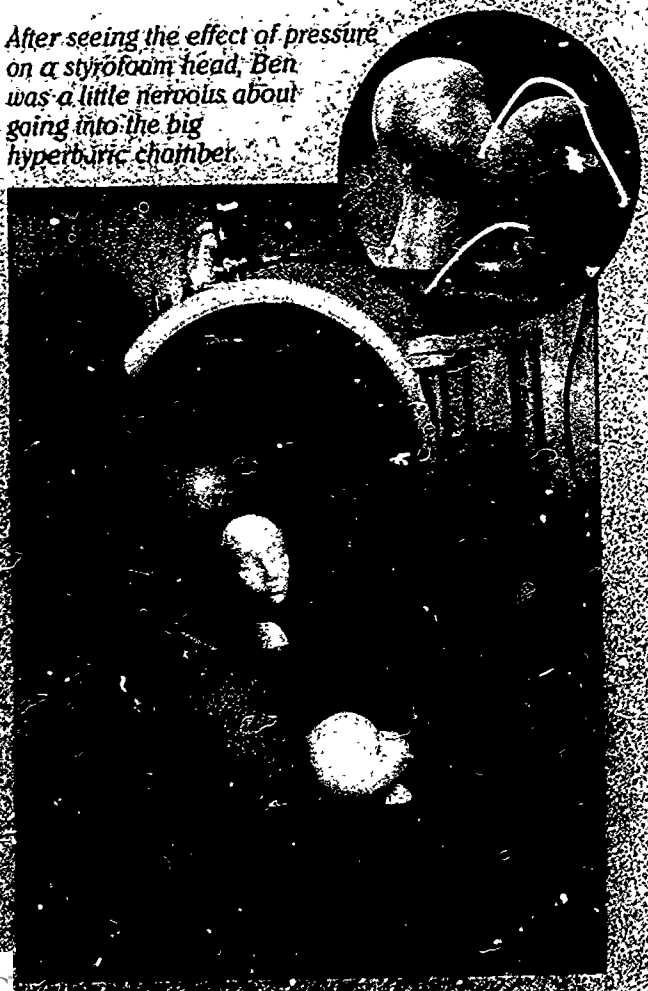
"Do you think this is going to happen to my head?" Ben asked with some trepidation.

"Not unless your head is filled with styrofoam," replied Glenn.

Some of the tiny air bubbles in the styrofoam must have burst because the head never did come back to its normal size, even after they took the pressure off.

Now it was Ben's turn. He knew he'd be O.K., but he would be under the pressure of a 100-foot dive—4 atmospheres of pressure. And he just couldn't forget that styrofoam head.

(to be continued)



After seeing the effect of pressure on a styrofoam head, Ben was a little nervous about going into the big hyperbaric chamber.

A WORD WITH MANY MEANINGS

What word is missing in these sentences?

1. "Air _____ inside the basketball makes it hold its shape no matter how hard you push on it," said the coach.
2. "I'm not sure I'm ready for this kind of _____," said the diver, as she prepared to go 500 feet under water to test some new equipment.
3. "A high _____ system is moving in from Canada," said the weather forecaster. "Sunny skies tomorrow."
4. The _____ is on when you have a science project due on Tuesday and by Monday night you haven't begun it yet.
5. "Does it hurt when I put _____ here?" asked the doctor, as she pushed on my aching swollen glands. "Ouch!" I replied.

Pressure literally means, "the state of being acted upon by a steadily applied force or weight."

EPISODE

The stela sat safely on deck, drying in the hot sun. The *Mimi* crew stared at it in awe, admiring the delicate carvings that covered the surface of the stone slab. Strange hieroglyphics. The profile of a powerful man wearing a ceremonial headdress. To C.T. it seemed as if they'd suddenly taken on a new passenger, a traveler from the past who spoke a language he'd never heard before.

"It's from Cobá," Quiché announced, pointing at a glyph. "This is the **emblem glyph** for Cobá." C.T. remembered that Quiché could understand this foreign tongue, at least some of it. He was impressed.

Terry explained that every big Maya city had its own hieroglyphic signature, like a coat of arms. This was definitely Cobá's emblem glyph, but that didn't necessarily mean the stela was *from* Cobá; whatever was written on it might be *about* Cobá. How it ended up in the waters off Tulúm was a mystery.

Victor said that stelas were usually records of major events in the lives of rulers.

"Think we'll find the other half?" Quiché said. It was frustrating not to have all the pieces of this stone puzzle.

"I sure hope so," her mother answered. "It'd be nice to know who this fancy fellow is."

Captain Granville decided it was time to try to navigate *Mimi* through the opening in the reef. "I'd better give Granny a hand," Pepper said, following him.

There was a moment's silence. Then, "Did she say *Granny*?" Terry asked in disbelief. C.T. turned away, trying to hide his smile.

The Captain and Pepper guided *Mimi* into the calm waters inside the reef. Meanwhile, high up on the cliff, Harvey Westerman observed their progress [illegible] like it when people got in his way. Something would have to be done.

By late afternoon Quiché and her mother had deciphered enough of the hieroglyphics to know that the stela referred to a ruler of Cobá: Chac Balam. His name meant "Strong Jaguar." Or "Red Jaguar," Quiché said. *Chac* meant "red" as well as "strong."

They'd seen his glyph on other monuments at Cobá. He was famous because he had disappeared. There was no record of him after age thirty, no record of his death. Very peculiar for a Maya king. His story was one of the big mysteries of Maya archaeology.

"And the answer might be right here," Quiché added, gazing down at the stony face.

Victor suggested that they go to Cobá to see if they could find any more clues.

They piled into the jeep early the next morning. Chac Balam's stela lay at C.T.'s feet, wrapped in a blanket. Pepper stayed behind to babysit *Mimi*. She'd invited Segovia for a Texas-style meal. And she'd have a chance to fix the starter motor. She was getting tired of having to start the engine by climbing down into the engine room and thwacking the starter motor with a screwdriver as Granny turned the ignition key above.

Cobá lay about fifty kilometers inland. The road was straight as a ruler. It was as if somebody had taken a giant lawn mower and cut a line through the jungle. The thick vegetation grew right to the edge of the road.

C.T. sat in back with Victor. He showed him a piece of black glass he'd picked up in Tulúm. "That's obsidian," Victor said, explaining that it was a form of natural glass made in volcanoes. The ancient Maya had no metal, so they used obsidian for their knives and tools. "This is part of a Maya knife," Victor concluded.

C.T. looked dismayed. "Oh no," he said. "I'm a looter! I took something from an archaeological site."

"It's O.K., *amigo*. Just take it to Segovia tomorrow and show him where you found it." Victor paused. "You are young; they will probably only give you a few months in jail."

C.T. laughed at his joke, but Victor only stared at him, suddenly somber. Was he serious? Jail? C.T.'s face fell. *Yikes!*

Victor laughed. He *was* joking. But he'd made his point. Looting was no joke.

Cobá wasn't like Tulúm. It was a wild place in the middle of the jungle, alive with birdsong. The main pyramid towered above the flat landscape like a mountain.

They found Jean Andrews supervising the reconstruction of an ancient Maya house. They'd hoped to find both her and her husband, but George Andrews was off trekking through the bush in search of a certain kind of orchid. He was interested in figuring out how the Maya used plants—an **archaeobotanist**, Victor called him.

The Andrews had been mapping and digging at Cobá for many years, so it was natural that Terry and Victor should turn to them for help in unraveling the mystery of Chac Balam.

Jean brought them up to date on her work. She was working with a crew of Maya masons to rebuild some of the buildings they had excavated. "They've developed a real feel for how their ancestors built," Victor said, as they watched a couple of the men cement a time-worn stone into a wall.

The site was turning out to look pretty much the way Terry had pictured it in her drawings, Jean said. To C.T., it just looked like a bunch of rough low walls.

Jean explained that they put back together only the pieces they were sure about. The site wouldn't look like it did in ancient times unless they could find all the pieces and knew exactly how they fit together

"How do you know this was a house?" C.T. asked. "Could it have been, say, a store?"

Indeed she did. The two halves fit snugly ogether like pieces of a giant jigsaw puzzle. hey couldn't believe it. Jean and George had t uncovered their half the week before.

"How could one half of a five hundred- nd stela get from here to Tulúm?" C.T. ndered.

Victor was sure this was the work of ers. Terry agreed. She said monuments his were very rare and valuable. Looters them to rich collectors all over the world. They even cut them up with chain- the pieces.

Jean showed him around the site, pointing out various pieces of evidence: a large **mortar**, called a *pila,* and **pestle**, called a *mano*, for grinding corn; pot **sherds** from plain pots; and a **midden**, or garbage dump, containing the remains of household items.

"Yeah, but why does this house look so different from the ones they build now?" C.T. asked, thinking of the thatched huts he'd noticed in the Maya villages.

"Excellent question," Jean said. "Excellent. Wood and thatch don't stick around for a thousand years," she explained. "They rot. So we're left with stone buildings, the kind richer folk lived in. Now what do you think?"

C.T. paused. "*Could've* been a house," he answered, carefully.

"I like the boy!" Jean announced.

Jean was impressed by their stela, when they finally got around to showing it to her. She studied it intently, then surprised them all by saying she thought she had the other half.

"You do?" they said in unison.

Quiché had been studying the glyphs in silence. She had noticed the glyph for "captive" next to the one that identified Chac Balam. "Maybe he was captured," she said.

Now everybody stared at the carved markings, excited by her discovery. "Does it say where they took him?" C.T. asked.

Quiché pointed to a glyph. It was right on the crack that divided the two halves of the stone, so she hadn't been able to read it before. "Isn't this an emblem glyph?"

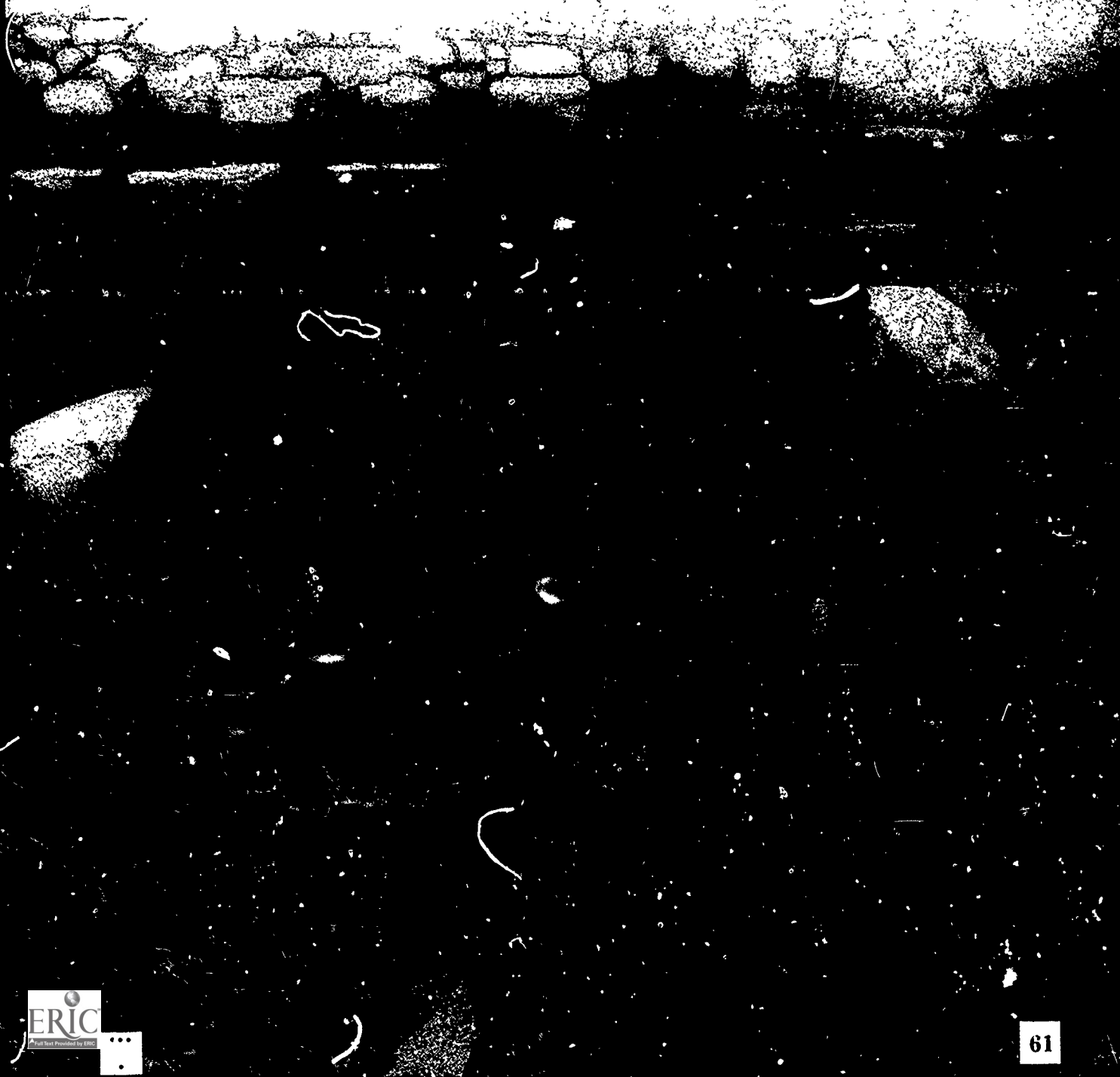
Terry leaned in to examine it. "It sure as heck is," she said, her excitement growing. She looked at Victor and smiled. "Site U?" she asked, already sure of the answer.

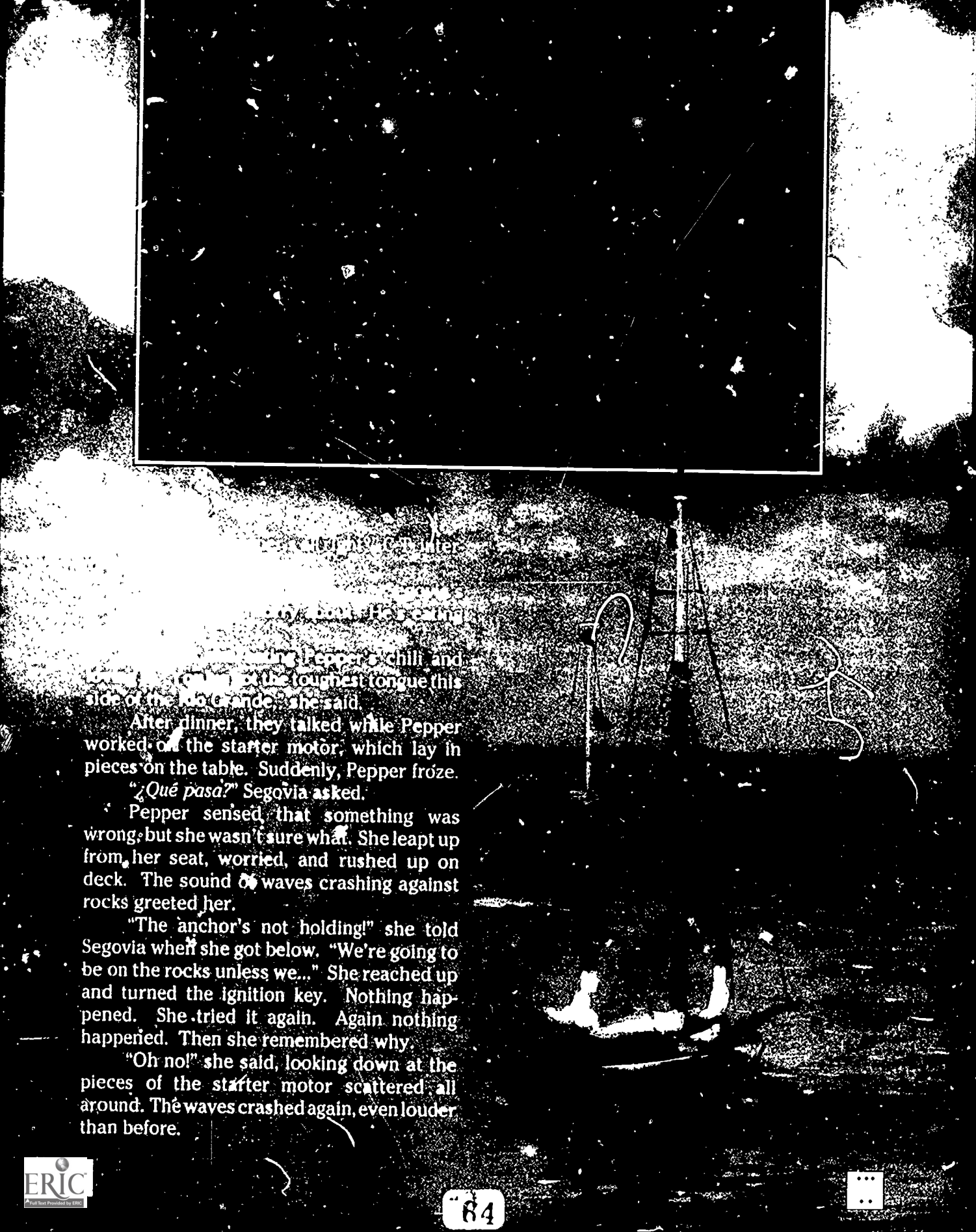
"Yes," Victor said, triumphantly. He turned to the others. "Site U is a lost city. U stands for 'undiscovered' or 'unknown' or–"

"Or 'unbelievable,'" Terry laughed. "We're not even sure if it really exists."

"This emblem glyph has turned up before," Victor said, "but so far...*¿quién sabe?*"

Granny was thinking aloud. The piece they found underwater must have been stolen from Cobá and taken to Tulúm by the looters. That much was clear. Which meant that...





...ter

...He ...ing

...g Pepper's chili and ... the toughest tongue this ...ide of the Rio Grande," she said.

After dinner, they talked while Pepper worked on the starter motor, which lay in pieces on the table. Suddenly, Pepper froze.

"*¿Qué pasa?*" Segovia asked.

Pepper sensed that something was wrong, but she wasn't sure what. She leapt up from her seat, worried, and rushed up on deck. The sound of waves crashing against rocks greeted her.

"The anchor's not holding!" she told Segovia when she got below. "We're going to be on the rocks unless we..." She reached up and turned the ignition key. Nothing happened. She tried it again. Again nothing happened. Then she remembered why.

"Oh no!" she said, looking down at the pieces of the starter motor scattered all around. The waves crashed again, even louder than before.

ACTIVITY

DIG THIS

When archaeologists find ancient **artifacts**, they find only part of the story. Most things are transformed by time. Some things disappear entirely. Other things seem to last forever, with very little change. Can you predict what kinds of things would last, what kinds of things would be changed and what kinds of things would **decompose** and disappear? Here's an experiment to help you find out.

Choose some objects you use in daily life. Include things that you think will be transformed by time and things you think will stay the same. Some suggestions are. food, a newspaper, a book, a magazine, pencils, pens, nails (not **galvanized**), chalk, artwork you've done, coins, cloth, something plastic, something glass, something metal, a piece of chicken with a bone, ceramics, carved wood.

Bury them in the ground outside, or bury them in a jar or aquarium that you can keep inside.

If you bury your artifacts outside: Make sure you have permission to dig in the spot you've chosen. Mark the spot clearly and make a map so you can find your artifacts to dig them up later. Bury them in a plastic net bag or other container that won't decompose and will allow the artifacts to be exposed to the soil.

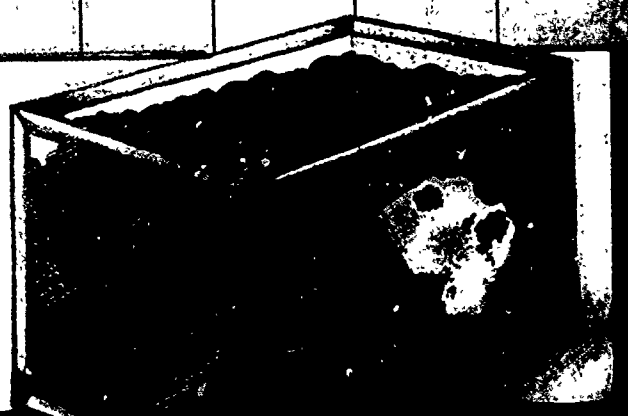
If you bury your artifacts inside: Be sure to use soil from outdoors, not packaged potting soil. Soil from outside will have lots of microbes and insects which help decomposition happen faster. Bury some artifacts near the sides, so you can see changes that are taking place. Sprinkle some water on the tank once a week. That will also help decomposition.

Make a schedule for when to dig your artifacts up. You'll probably want to check them a few times—perhaps after a few weeks and then after a few months.

Predict what you think will happen to each artifact. Make a chart or keep notes of your predictions and observations.

Here's another idea: Make duplicate sets of artifacts. Bury one set inside and one set outside and compare what happens. See which set decomposes faster.

Object	What will happen? Prediction	How it looks after 2 weeks	How it looks after 6 weeks	How it looks after 12 weeks



Ben Affleck's visit to the North American Hyperbaric Center included a simulated "dive" to a depth of 100 feet in a large hyperbaric chamber.

Ben Affleck was learning a lot about pressure during his visit to the North American Hyperbaric Center at City Island, New York. Now he was about to go into a hyperbaric chamber himself. He was a little worried. Experiments in the small hyperbaric chamber showed him how air pressure could crush a basketball, make a light bulb implode, and shrink a styrofoam head.

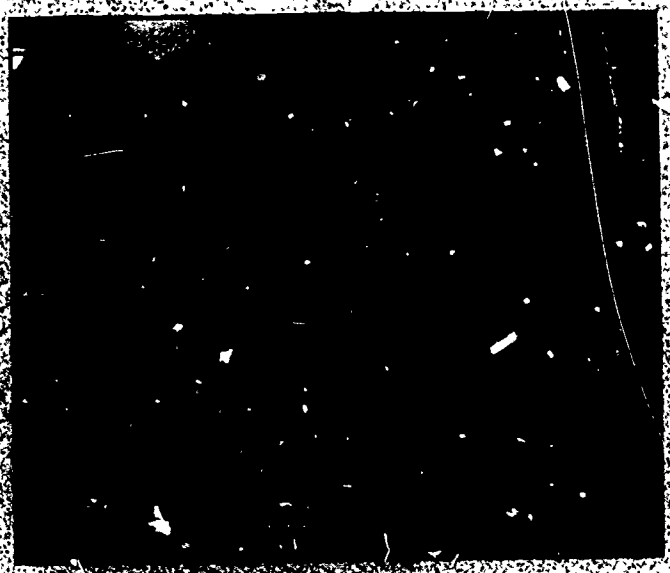
Jim Tyrrell would control Ben's simulated dive. The control panel looked like something out of a submarine. The pressure would be measured in depth of sea water, as if Ben were actually diving in the sea. Jack could control the "depth" by opening valves to push air into the chamber and increase the pressure. If anything went wrong, he could bring Ben "up" by letting air out. Dr. Rolando Sanchez would accompany Ben on the "dive."

The big hyperbaric chambers are used to train divers, but they can also save divers' lives. The chambers are used to treat scuba divers who have the bends or decompression sickness. Ben knew that the bends occurred when a bubble formed in a diver's blood.

"What we do is take them to five times [the] and recompress that bubble and get it to re-absorb," said Dr. Sanchez.

"What's going to happen to me down there?" Ben asked.

Dr. Sanchez explained that the first thing Ben would feel would be pressure in his ear. The eardrum is a thin piece of [illegible] that stretches across the [illegible]



Dr. Rolando Sanchez and Ben enter the chamber to begin their "dive."

the middle ear to the **Eustachian tube**. The Eustachian tube connects to the back of the throat.

If the external pressure increases, and you don't equalize the pressure in all the ear passages, the air can be forced in on the eardrum and could puncture it. When you close your nose and blow, that opens the Eustachian tube and forces air into the middle ear, equalizing the pressure.

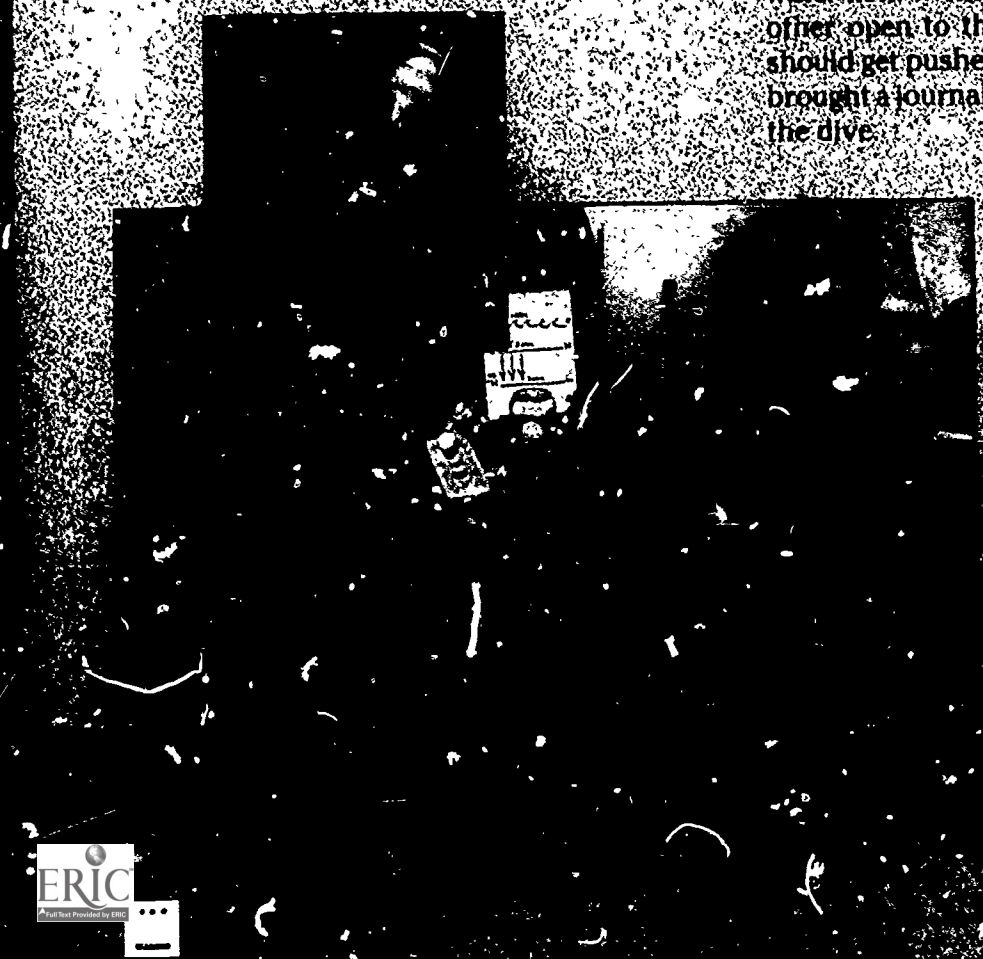
"That's why it's important, when you're flying or scuba diving, to maintain equal pressure—to clear your ears," said Dr. Sanchez.

"You guys ready to go diving?" asked Jim.

Ben and Dr. Sanchez climbed into the chamber. Ben had some experiments to set up. Some were to measure pressure and others were to show the effects of it. He brought two different homemade barometers to measure air pressure.

One barometer was made by stretching a balloon over an open jar. Ben had devised a stand made out of wire to hold a chopstick over the top of the jar so it could rest on the top of the balloon. As the air pressure increased, the balloon would be pushed down into the jar and the chopstick would go down as well. Ben could mark the change with a pencil line on the chopstick.

The other homemade barometer was just a piece of plastic tubing with some colored water in it. With one end clamped off and the other open to the rising pressure, the water should get pushed toward the closed end. Ben brought a journal to record information during the dive.



At normal atmospheric pressure, a hard-boiled egg will not fit through the opening of the bottle.

Only a slight increase in air pressure pushes the egg into the bottle. Ben had set up a number of other experiments to test the effects of increased pressure.

Before they began, Ben marked the level of the water and the level of the chopstick on his barometers. He labeled them "0 ft., one atmosphere." Outside the chamber, Jack and Jim began the countdown. Dr. Sanchez reminded Ben to clear his ears.

"Four, three, two, one..." The air rushed in with a loud groan. Ben felt the pressure on his eardrums right away. He had to keep clearing his ears to keep them from hurting.

Ben's first experiment was a success. He had peeled a hard-boiled egg and set it in the mouth of a bottle. The bottle opening was smaller than the egg, but it didn't take much of an increase in air pressure to push the egg into the bottle.

At 10 feet they stopped to make sure everything was O.K. It felt funny to Ben, having to constantly clear his ears when he wasn't really going anyplace.

"Look at my barometer!" he exclaimed. The balloon was bulging down into the jar. Ben made a new mark on the chopstick. He checked

On the way "up," fog formed!

the other barometer. The air pressure had already pushed the liquid up the closed side of the tube. Ben marked the new water level and labeled it, "10 ft."

They continued to 33 feet—one added atmosphere of pressure. Now they were under two atmospheres of pressure. Ben had to keep clearing his ears. The chamber was warmer. The thermometer read 71 degrees Fahrenheit. As the pressure increased, the temperature rose.

Ben's voice sounded higher and nasal, a little like a cartoon character. Dr. Sanchez said it was partly because the air was more dense, and partly because the pressure changes the shape of some parts of the throat.

The balloon in one barometer filled half the jar as if someone were blowing it in. The water level in the tube barometer had moved several inches.

As they "traveled" Ben noticed what was happening to the other objects he had brought with him. A gasoline can had caved in. Balloons were half their original size. He was glad his body was mostly water and couldn't collapse the way the basket ball had.

At 3 atmospheres, the equivalent of being 66 feet under water, Ben was beginning to feel lightheaded. Their voices were even weirder.

"At deep depths you do sometimes get a little funny," Dr. Sanchez said, "because you're absorbing an inordinate amount of oxygen."

As the air pressure increased, Ben had to clear his ears often to keep them from hurting.

BANG! He was interrupted as the balloon barometer burst. Ben marked 66 feet on the other barometer. He noticed that the barometer was changing less with each added atmosphere of pressure.

They went to 100 feet, just over 4 atmospheres—deeper than Ben had ever been in water. The temperature was 92 degrees. So much air was squeezed into the chamber that it actually felt thick when Ben waved his hand.

Ben shook up a bottle of carbonated water and opened it. The soda didn't bubble out. The pressure in the chamber kept the carbon dioxide dissolved in the water.

Ben had what divers call **rapture of the deep**, or **nitrogen narcosis**. So much nitrogen was dissolved in his blood that it made him feel and act silly. His handwriting was very shaky.

"It can be very dangerous for a scuba diver to experience this," Dr. Sanchez explained. "He's unable to perform even simple tasks like writing. That's why skin divers are advised not to dive below 150 feet." They couldn't stay long at that depth. They were getting more and more nitrogen in their blood, and it would take a long time to get it out.

Before they left the "bottom," Ben blew just a little of the high pressure air into something he had kept folded in his duffle bag.

Coming up was kind of fun. Ben's ears cleared by themselves. The chamber got cold. In fact, it got so cold that moisture in the air **condensed** and a fog formed! They had to make a decompression stop at 10 feet for 24 minutes. This allowed the nitrogen in their blood to come out slowly. They breathed pure oxygen from masks to help cleanse the blood of nitrogen faster. Without these precautions, the nitrogen would bubble out and cause the bends, which is painful and life-threatening.

Ben returned safe and sound, but he had created a monster with one of his experiments!

By the time they reached the surface, what had been folded up in Ben's duffle bag was now Godzilla! When Jack swung open the heavy door to the chamber, he was pretty surprised when this huge inflated monster was the first to emerge.

Ben climbed out of the chamber right behind Godzilla. Sea level, at last. He was relieved to be back to one atmosphere. And he was especially relieved that his head was the same size as when he left.

"GLUB...GLUB...GLUB"

People have been diving for at least three thousand years. They dove for food, sponges, shells, coral, pearls, treasure, to repair ships, and to sabotage enemy ships. Now people also dive to build bridges, tunnels, and oil wells, for scientific research and for the adventure of exploring new worlds.

Early divers had no diving equipment. They learned to hold their breath for minutes at a time. For hundreds of years, inventors have struggled to help humans survive under water. Leonardo da Vinci (1452-1519), the great painter and inventor, suggested sacks of sand for **ballast** and a "wine-skin to contain the breath." A wine-skin is a soft, water-proof sack, usually made from the skin of a goat, used for holding wine. Could da Vinci's design for a wine-skin air tank work? Why?

Pepper was alarmed. The wind was blowing *Vim* towards the cliffs. She figured she had five minutes, tops, to find a way to keep the boat from crashing on the rocks. And to save Segovia and herself.

"What is the problem, Pepper?" Segovia asked anxiously, as they rushed back on deck.

She explained that the anchor line must have broken. She couldn't start the engine be-

coral head

had once she was back on the boat.

"Yesssss," she answered, doing high-fives.

Segovia laughed, wiping his brow.

Pepper spent the morning re-fastening the anchor, making sure that the line wasn't near any coral. The others returned a few hours later. They were amazed to hear about Pepper's close call, and she was amazed to hear about their lucky break. "It's like in the movies," C.T. said, "only it's real!"


STATION A BEARING
STATION B BEARING
SURVEY No.
DATE
LEG
DEGREES
DISTANCE
DEPTH
1
2
3
4
5
6
11
12
13
14
15
16
17
18
19
20

"The part they don't show you in the movies," Terry said, pointedly, "is the work."

With that, they set about their duties. C.T. and Quiché helped Granny stow away the provisions they'd brought from shore. The others donned their scuba gear and spent the next few hours underwater. They were marking out a **polar coordinate** grid on the sandy bottom near the reef where they intended to start their exploration. It was slow, painstaking work. Victor stayed at the spot that was the center of their grid. Terry would swim to underwater "landmarks" with a tape measure and signal the distances to Victor. Victor recorded the information on his underwater writing tablet: depth, distance, direction. It was so beautiful down there, it hardly seemed like work.

Meanwhile, Quiché was teaching C.T. the Maya number system. She drew a dot. "This is one. . ." Another dot. "This is two. . ." And two more. "Three, four. . ."

"O.K., O.K., I think I've got that, Quiché," C.T. said, giving her an impatient look.

"Oh yeah? So what's five?"

That's pretty obvious, C.T. thought, as he drew five dots in a row. "Wrong!" Quiché proclaimed, drawing a short bar. "This is five."

Six, C.T. learned, was a bar with a dot above it. Ten was two bars, fifteen was three bars. "So this would be nineteen," C.T. said, and drew three bars crowned by four dots.

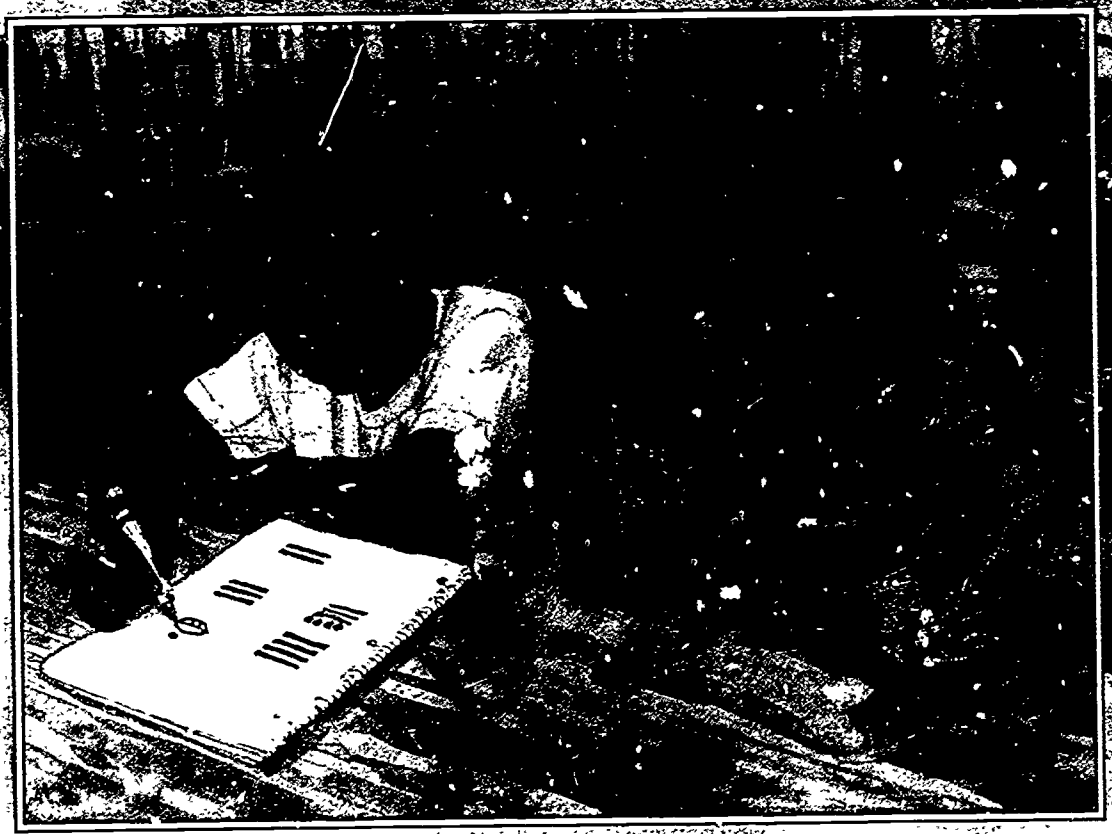
"*Hax tubé*," Quiché said. "That's Mayan for perfect."

Now I get it, C.T. thought. He drew four bars. "Twenty!" he announced proudly.

"Wrong!" Quiché drew something that looked like an eye with a dot above it. "That's twenty," she said.

C.T. shook his head. "No wonder the civilization collapsed," he said. "Everybody probably flunked math."

Just then the divers returned. On the way back to the boat they had noticed a big opening under a rock. Pepper thought it might be the entrance to an underground stream that flowed out from someplace on shore. They didn't have enough air left to let them explore it any further. Maybe they'd check it out tomorrow.



Granny cooked dinner that night. Mexican beef stew, he called it. Anything to keep Pepper from making more of her flame-thrower chili. The only Mexican thing about his stew was that he served tortillas with it.

Quiché and C.T. had prepared some predinner entertainment. C.T. had figured out a computer program that could translate numbers from Arabic to Maya. They billed it as the only computer in the world, or at least in Tulúm, that could speak Mayan.

"A number from the audience, please," Quiché announced, starting the show. "Any Arabic number between one and twenty."

"*Ocho,*" Victor volunteered.

"An eight, please," Quiché said, dramatically. C.T. entered the number, and within seconds the Maya version appeared on the screen: a bar with three dots above it. Five plus three.

Everyone was pretty impressed, especially Pepper. She'd never seen Maya numbers before. Granny thought it looked like Morse code—dots and dashes.

Pepper asked the computer for a twelve. Two dots above two bars appeared. "Nifty," she exclaimed. She was holding C.T.'s pot, helping herself to a tortilla. The pot was covered with glyphs. Wasn't that a twelve there? She showed it to Quiché. It was a twelve, all right.

Quiché had never really looked at the pot before. Not closely. Now she held it up and studied it. It didn't look like all those cheap souvenir pots. It looked. . . .*real.*

Victor took it and examined it. "There are more glyphs on the bottom," he said, getting excited. "*Si, si.*"

"What does it say?" everyone wanted to know.

"It says. . ." Victor answered, a twinkle in his eye, ". . .made in Japan!"

Everyone but Quiché chuckled. She was *serious.* Victor handed the pot to Terry, the pottery expert. She looked it over carefully. Her expression changed. "This little gem just could be real," she said, finally.

"So it is a prize catch, after all," Granny said. *Could* be, was all Terry would say.

Quiché was convinced the pot was real. She kept looking at it as everyone else ate. Not all glyphs were signs for things, she remembered. Some were syllables. These looked like syllables: *chac. . .ba. . .la. . .ma. . .* Those sounds seemed familiar.

Of course! Chac Balam. *Chac Balam!* Suddenly everyone was excited. Pepper couldn't understand why, so C.T. told her what they had figured out: Chac Balam was the king of Cobá mentioned on their stela; he was captured and taken to another city, the lost city; nobody knew what happened to him there; what they did know was that the half of the stela they found underwater must have been stolen by looters.

"There must have been looters [illegible] *here*," C.T. concluded.

Victor wanted to know where they had found the pot, so C.T. checked the ship's log. He went to the computer and typed in a command. Up came the log. Terry was amazed. So that was why there was a computer on board.

"You're welcome to use it," Granny said.

"Nothing like being drawn into the eighties on a nineteen thirties sailboat," Terry said, laughing.

It turned out that they had found the pot just down the coast from Tulúm. "Then it could have been looted too," Terry said.

Captain Granville had a theory. He told the others about the mysterious boat he and Pepper had seen the first night. It had taken off fast when he hailed it. Something had fallen off the stern, he remembered, something big and heavy. He had thought nothing of it at the time, but now...

"The stela!" Victor said. Of course! "That dark boat was looters, big-time looters."

"They must operate out of here all the time," C.T. joined in.

"Using [illegible] temples as [illegible]," Granny concluded.

[illegible] Pepper had [illegible] ancestor [illegible] had been cut—cut by a person with a knife, not by the coral.

"*Desgraciados!*" said Victor.

"Wow!" said C.T.

"Hold on a minute, folks," said Terry. "Let's not jump too far."

The Captain agreed. It was all just a theory. Was there any way to check it out?

Terry suggested they go to INAH in Mérida. They'd be able to test the pot at the archaeology labs, to make sure it was authentic. And they'd be able to file a report about the looters. They would dock *Mimi* up the coast, in Playa del Carmen, so they could all go, including Pepper.

C.T. couldn't believe it. At this rate, he'd get to see the whole Yucatán Peninsula before this trip was over.

"Can I see the pot again?" Quiché said.

"You see something else?" Pepper asked.

"Yeah," Quiché replied, putting her hand into the pot. "An ancient tortilla!"

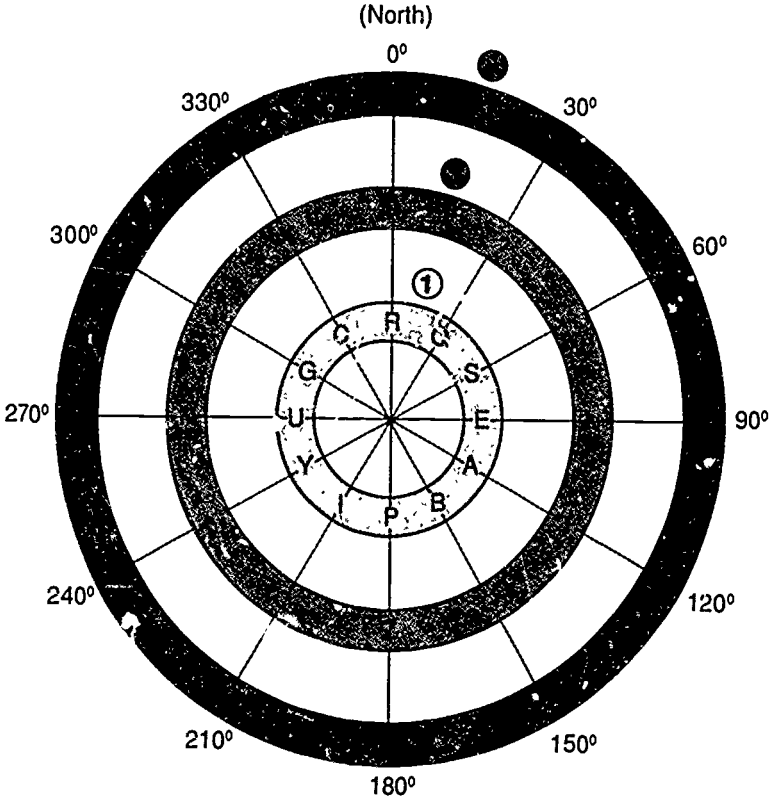
She'd been too excited to eat before. Now she dove into Granny's Mexican beef stew. It tasted *muy bien*.

ACTIVITY

Secret Messages

In this episode, Terry and Victor and Pepper do some underwater mapping, using polar coordinates. With polar coordinates, if you choose a center point and you know where north is, you can specify any location as a distance and a **bearing** from the center.

A **Cartesian coordinate** system is different. There, you mark out a grid using vertical and horizontal lines that look like graph paper. Label the horizontal lines "1,2,3,4" and the vertical lines "A,B,C,D" and you can name points as "1A" or "3C" so anyone looking at the grid will know where you mean. (In Episode 2 Victor was mapping the jungle around Palenque using a Cartesian coordinate system.)



The polar coordinate system is often used for mapping difficult terrain and for surveying. However, we've discovered another use for it: sending secret messages in code! In the polar coordinate grid below, letters of the alphabet have been placed at the places where bearing lines and distance lines intersect (cross). On a piece of paper, write down, in the order given, the letters found at the intersections of the coordinates listed. The letters will spell out the answers to these riddles.

Riddle 1. Where do extra smart frankfurters end up?

Coordinates for Solution to Riddle 1

1. 150°; 2
2. 270°; 2
3. 90°; 3
4. 270°; 3
5. 90°; 1
6. 270°; 3
7. 210°; 2
8. 90°; 2
9. 210°; 2
10. 30°; 3
11. 0°; 1
12. 150°; 2
13. 60°; 3
14. 60°; 3

Riddle 2: What has six legs, bites, and talks in code?

Coordinates for Solution to Riddle 2

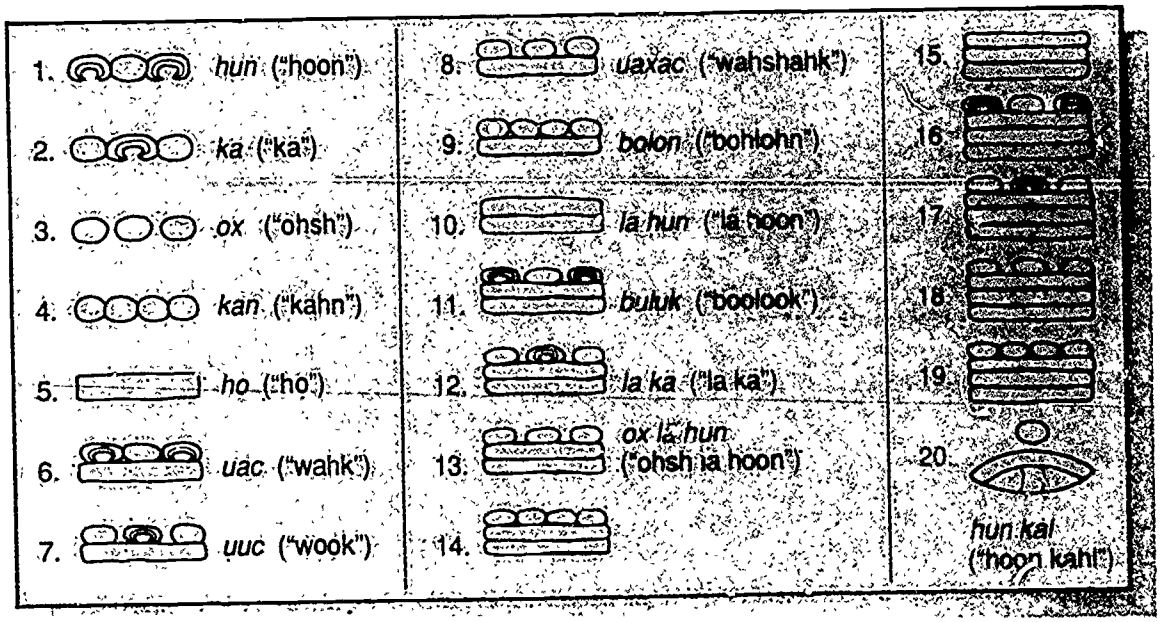
1. 120°; 1
2. 0°; 3
3. 150°; 2
4. 30°; 3
5. 300°; 3
6. 330°; 3
7. 30°; 1
8. 270°; 1
9. 210°; 3
10. 120°; 2
11. 210°; 2

If you and a friend each have a copy of this grid (or if you make a new grid, with the letters in different places), you can send each other coded messages.

MAYA MATH

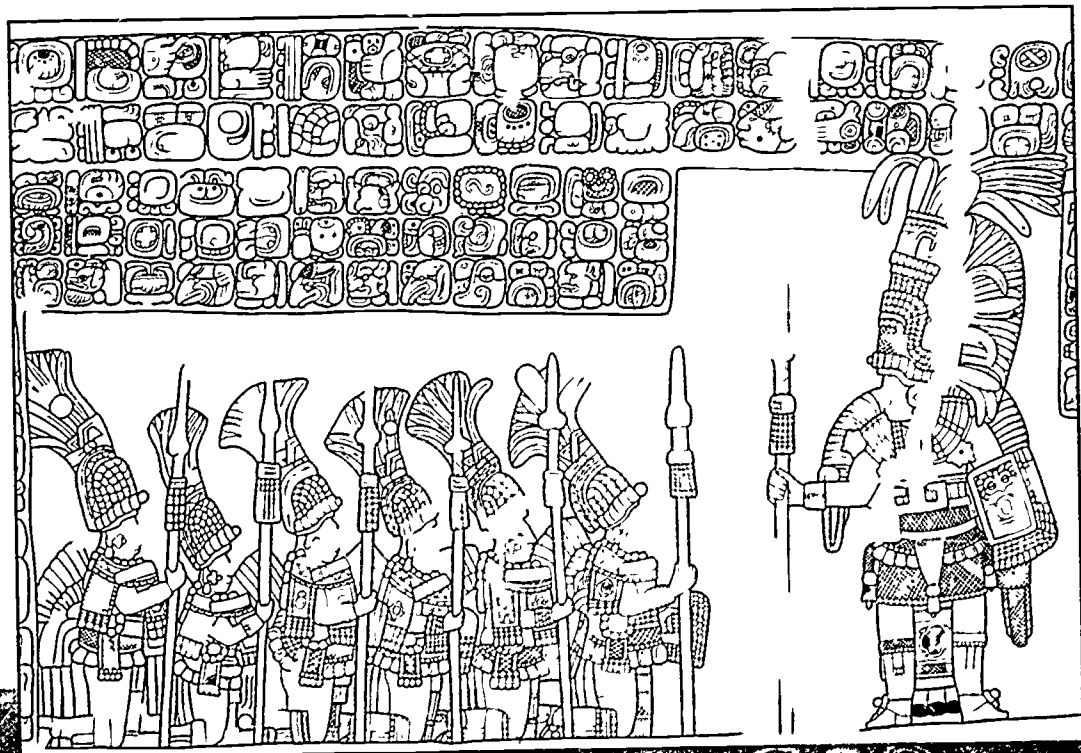
Here are the Maya numbers from one to twenty. Crescents are sometimes used to take up space so the glyph looks symmetrical. They don't stand for any number.

The Maya words for most of the numbers are given. These numbers work just like ours: "Fourteen" is "four" and "ten" in English and it would be "kan la hun" in Mayan. "Kan" is four and "la hun" is ten. Figure out the Mayan words for fifteen through nineteen.



See if you can find and decipher the numbers on this drawing. The picture is of a carving from a Maya temple in Guatemala.

Mayan numbers can be written sideways or up and down . You'll find examples of both in this picture.



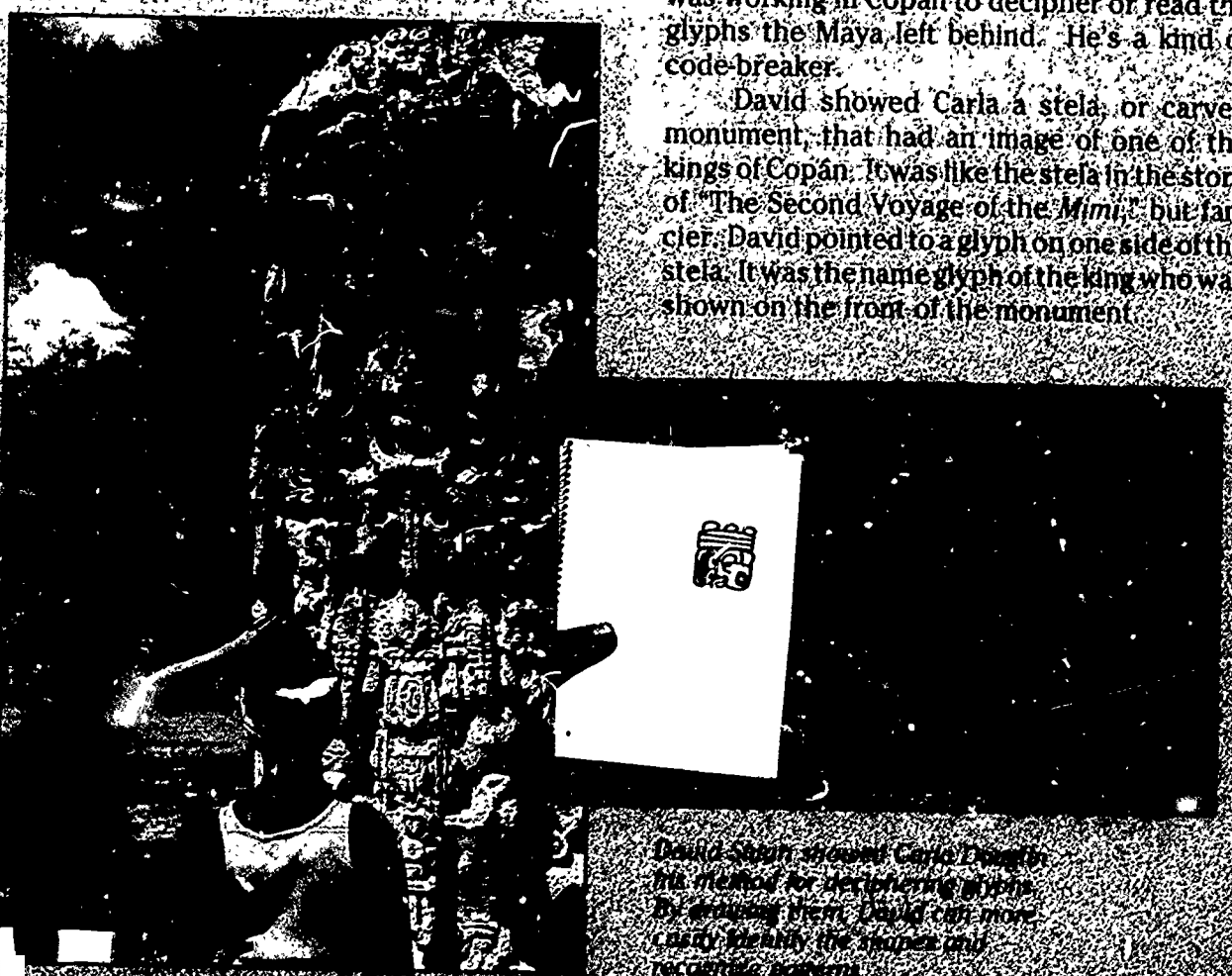
EXPEDITION

Copán was once one of the greatest Maya cities. It was also one of the furthest south, two hundred miles from Palenque and Tulúm. Now it's a spectacular ruin in the country of Honduras. Carla Douglin, the actress who played Quiché in "The Second Voyage of the *Mimi*," and Ben Affleck visited Copán. Archaeologists are studying the ruins to find out more about ancient Maya culture.

One of the people there was a young man named David Stuart. Carla was especially eager to meet him, because David was the model for the character of Quiché in "The Second Voyage of the *Mimi*." David's parents are both archaeologists. As a child, he spent a lot of time in Mexico with them, just as Quiché did. By the time he was eleven he was a real expert on Mayan hieroglyphic writing.

Now David is a college student, and he was working in Copán to decipher or read the glyphs the Maya left behind. He's a kind of code-breaker.

David showed Carla a stela, or carved monument, that had an image of one of the kings of Copán. It was like the stela in the story of "The Second Voyage of the *Mimi*," but fancier. David pointed to a glyph on one side of the stela. It was the name glyph of the king who was shown on the front of the monument.



David Stuart showed Carla Douglin his method for deciphering glyphs. By drawing them, David can more easily identify the shapes and recognize patterns.

"We call this fellow 18-Rabbit," David said. "That's his name." He pointed out some bars and dots on the side of the glyph. "Three bars and three dots. You know the way the Maya wrote numbers: each bar means 5 and each dot means 1."

"Eighteen," Carla interrupted.

"Right," said David. "And the rabbit is actually this part here." He pointed out a mouth, an eye, and the place where the ear would have been. But Carla couldn't really see the shape of the animal.

David also used to have a hard time picking out the details from the rock. He found that by drawing the things he saw, he could more clearly see the lines and begin to understand what they were. He took out a pad and marker and drew the rabbit glyph for Carla. Suddenly, it became easy to pick out the shape of the rabbit and some other details in the glyph.

"So this is his name," David explained, "and the other glyphs in this inscription tell you about the event that happened—sort of like one big sentence."

David showed Carla another important glyph on the stela. This glyph was in the shape of a human hand. There seemed to be dots falling from the hand, between the thumb and forefinger. David said they probably represented blood! "So it's a hand sprinkling blood. That, we think, is the glyph for the rite of bloodletting. The king pierced himself and let his own blood."

This was an important ceremony for Maya kings, though no one is sure why. It may have had to do with offering royal blood to the gods.

Carla was curious about the date the event described on the stela occurred. David said he'd need a computer to figure out what the date was on our calendar. But on the Maya "Long Count" calendar, the date read: 9 *baktuns*, 15 *katuns*, 0 *tuns*, 0 *uinals*, and 0 *kins*. All the zeroes indicated that this was a very important date in the Maya calendar. The king had celebrated the date by letting blood.

There were symbols on the glyph that David didn't know how to read. He and others still have a lot to learn about the written language of the Maya.

They moved to another stela, and Carla was able to pick out the glyph for 18-Rabbit herself. She was beginning to become a code breaker. The trick is finding signs that show up in different glyphs and looking for patterns or meaning in each situation.

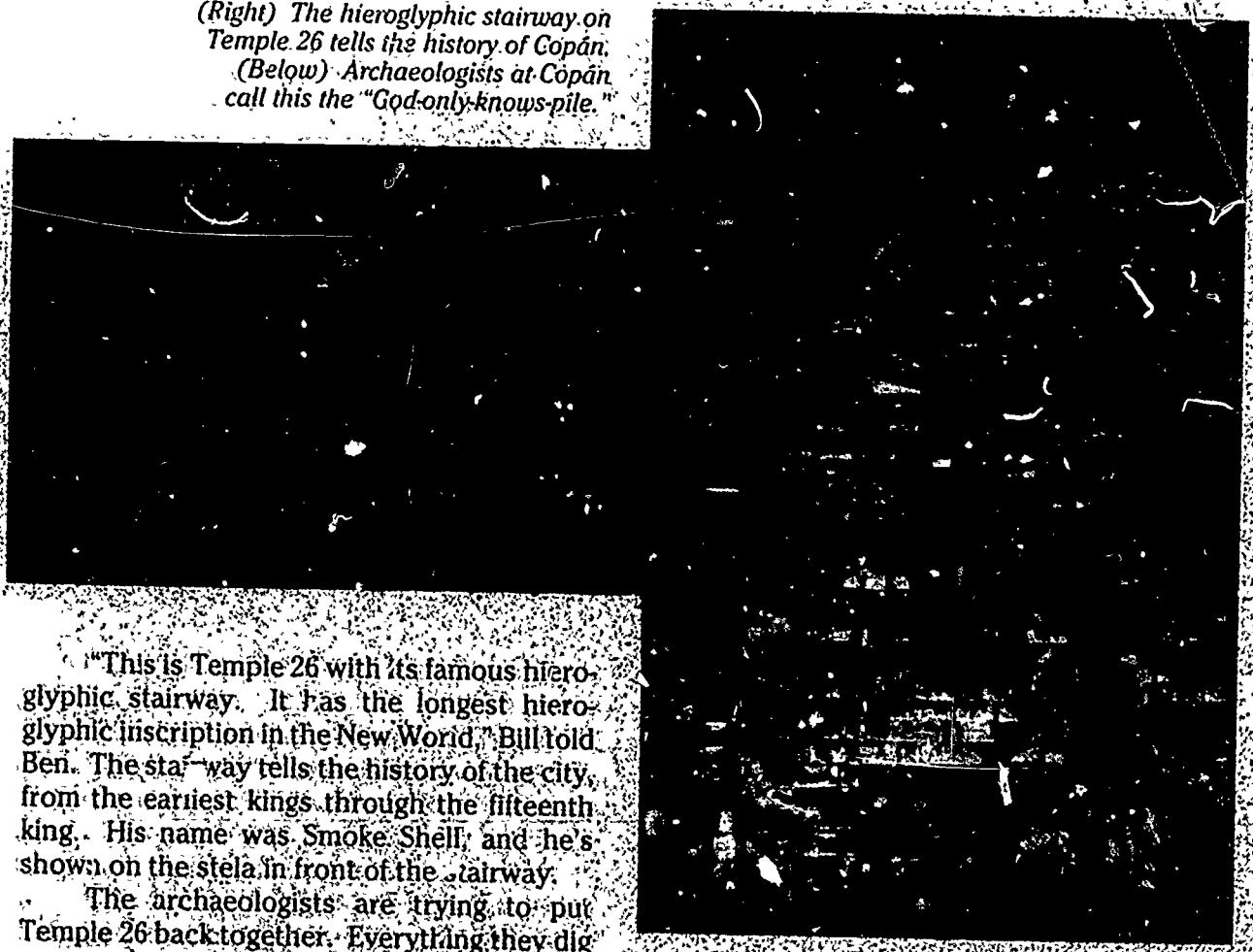
David pointed out another interesting glyph. This one had the face of a bat. The bat was the emblem of Copán, and this was the emblem glyph for the city-state of Copán. The glyph contained several different signs besides the bat. Just above the bat was the sign for the Maya word *ahau* which means "king" or "ruler." In front of the bat was a series of dots.

Carla remembered that dots could mean numbers or blood. David said in this case he thinks they represent blood. Together, the signs for "king," "blood" and the emblem "bat" seem to read, "18-Rabbit was the king of the bloodline or the **dynasty** of Copán."

Though David is an expert on Maya writing, he is just learning about other aspects of archaeology. His teacher at Copán was Bill Fash, the head archaeologist of this expedition. Ben Affleck toured Copán with Bill.

Bill and Barbara Fash use a large scaffold to move pieces of stela and sculpture around in order to figure out how they might have fit together.

(Right) The hieroglyphic stairway on Temple 26 tells the history of Copán. (Below) Archaeologists at Copán call this the "God-only-knows-pile."



"This is Temple 26 with its famous hieroglyphic stairway. It has the longest hieroglyphic inscription in the New World," Bill told Ben. The stairway tells the history of the city, from the earliest kings through the fifteenth king. His name was Smoke Shell, and he's shown on the stela in front of the stairway.

The archaeologists are trying to put Temple 26 back together. Everything they dig up has to be drawn, photographed, and catalogued. Nothing is put into the building unless they are sure it belonged there. Sometimes it's difficult to know where the pieces belong.

Bill pointed to a huge mound of carved blocks of every shape and size. "This stuff came out of five different temples and was piled here by earlier archaeologists," he told Ben. "But we have no idea where any of these things came from."

Bill and his wife Barbara have invented a way to put some of the big pieces of sculpture back together. They put them in a sand box so they can move them around and try different ways. It's like fitting together pieces of a puzzle—a very heavy puzzle.

Most of the workers who are actually rebuilding the temples at Copán are Maya. They've become experts on the archaeology of their ancestors by working on the site for many years.

Archaeologists have been working at Copán for nearly a hundred years. But it's still possible to make some amazing discoveries. In fact, David made one.

Bill had given David the chance to supervise some digging under the hieroglyphic staircase. He had never done that before. He is still a student, after all.

He told Ben and Carla what happened. "All of a sudden one of the workmen called me over and said, *¡Ceramica, ceramica!*—a pot! a pot! And I came down and looked at it and there was just a little piece of it that he had picked away with his pick. It was clear that the thing was whole. And so we spent the rest of the day exposing it. We realized how important it was because it was a really big pot."

In the small lab at Copán, David and Bill showed Carla and Ben what they found inside the pot. There were several pieces of beautiful carved jade. Bill said these treasures left behind by Smoke Shell and discovered twelve hundred years later were the most spectacular ever found at Copán. There was also a plain shell with something brownish inside. The archaeologists think it might be human blood from the bloodletting rite that the king did when he dedicated the building.

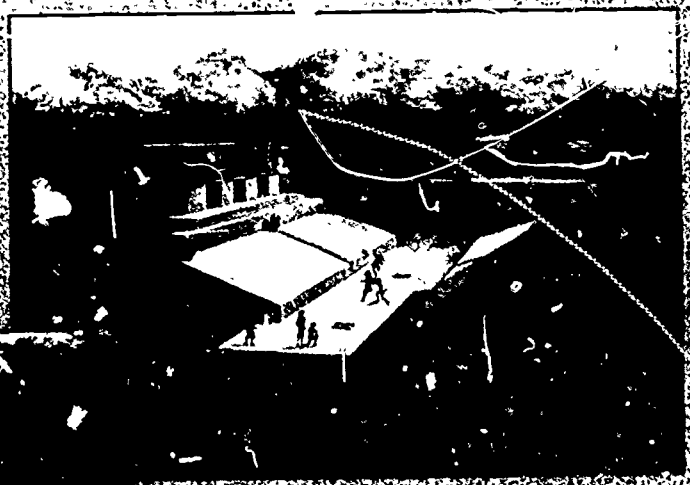
The brown substance in the shell may be human blood from an ancient bloodletting ceremony.

Ben and Carla tried to guess how the court was used. Perhaps the slanted sides were bleachers where people sat. David said he thinks the ball was bounced off the sides and people sat around the court. Big stone parrot heads on the sides of the court might have been markers of some kind.

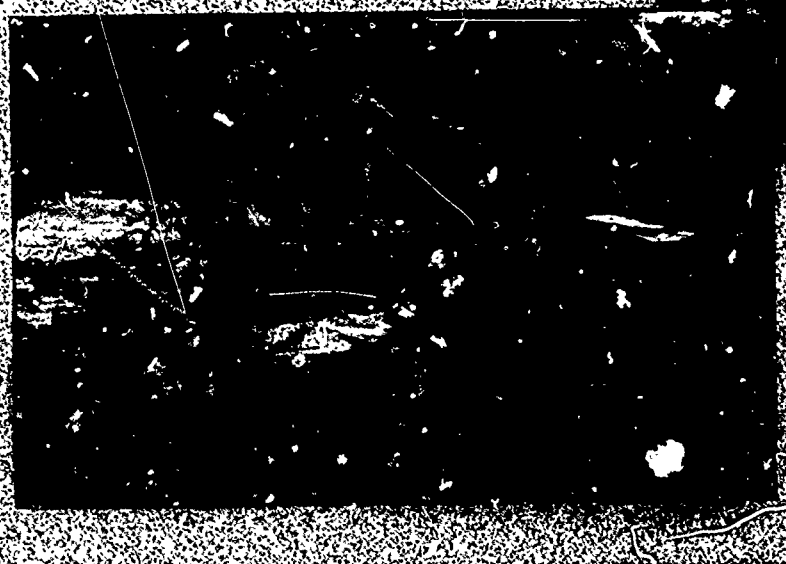
We may never know much more about the Maya ball game. A lot about the ancient Maya will always be a mystery. But for people like David and Barbara and Bill, solving mysteries is what archaeology is all about.

David is as interested in solving puzzles as he is in finding treasure. The last thing he showed Carla and Ben was another puzzle.

The great ball court at Copán is one of the best-preserved anywhere. But no one knows exactly how the game was played. The Maya probably used a rubber ball, and the game might have been between two people. Maybe the kings played each other.



This reconstruction painting by Tatiana Proskouriakoff shows how the ball court at Copán might have looked in ancient times.



The ball court at Copán as it looks today. How the ball game of the ancient Maya was played is one of the puzzles archaeologists are trying to solve.

WHAT'S *NOT* CARVED IN STONE?

"We found a large number of books of these characters [hieroglyphics] and, as they contained nothing in which there were not to be seen superstition and lies of the devil, we burned them all...which caused them much affliction."

This was written by a Spanish priest who governed the Maya. Spanish warriors, known as conquistadors, came to Mexico in the 1500's in search of gold. They conquered the Maya, killing and enslaving many. Spanish priests were horrified at the Maya religion, especially the idea of human sacrifice. They burned all the Maya books they could find. Only three books survived. Except those three books, the only place we have been able to see Maya writing is on ancient monuments and in paintings.

Walk around your neighborhood or a nearby city. Take notes on things you find carved in stone. What information do they give you? What kinds of things would you never learn about from them?

EPISODE

Mimi was tied up at the dock in Playa del Carmen. Everyone was busy with preparations for the trip to Mérida, five hours away by jeep. C.T. helped his grandfather cinch up the sail covers.

"Boy, my vacation sure is turning out different than I planned," he said, tying off a line. "I came down for another voyage on *Mimi*, and now I'm looking for a lost city."

Not that he minded. He was seeing so many new places and people. And he was certainly on a *voyage*, only this time the vessel was a jeep instead of a boat. Quiché had decided to christen the jeep, and was busy stenciling something on the door. C.T. went over to see what she'd done.

It was a homemade hieroglyph. To C.T. it looked like a picture of a giant in a bathtub, blowing bubbles. Quiché explained that the "bathtub" was the way the Maya represented wooden boats; the big head was the god of the number two; and the two big dots, the "bubbles," also signified the number two, or "second." It was Quiché's glyph for "*Mimi II*."

Off they sailed in *Mimi II*, cutting due west across the Yucatán Peninsula. The only waves on this voyage were the friendly ones they got from the people in the villages they passed. C.T. spent part of the time bringing his journal up to date.

This is turning into a real detective story. So far we have two halves of a Maya monument, a lost king, looters, and a pot that could tell us even more. The trouble is, we don't know if the pot was made by the Maya fourteen centuries ago, or fourteen days ago. So here we are, heading for Mérida to visit the government archaeology offices. Maybe someone there can help us solve the mystery.

Mérida was a bustling city, the capital of the state of Yucatán. It looked a lot older than most cities back home, C.T. thought. As they drove around the central plaza, Victor pointed out an old Spanish *hacienda*. There were statues of conquistadors standing on the heads of dead Maya. C.T. didn't say much for a while.

While the others got right to work at the INAH labs, Pepper and Granny headed for the marketplace.

The *mercado* was a busy, colorful place, crammed with vendors and shoppers. The Captain bought a bright yellow hand-woven Maya hammock. He managed to use most of the Spanish he knew: *me gusto mucho*; *muy hermosa*; and, of course, *muchas gracias*.

They saw a machine that made tortillas. It looked like an old press, printing out hundreds of flat, round corn cakes. They smelled great, too. The fruit sellers had set up their oranges and lemons in tidy little piles. Captain Granville was admiring them when he was approached by a man with shifty eyes. "Perhaps you are interested in some **relics** from the past?" the man said in a low voice.

"No thanks," the Captain answered.

"Genuine Mayan," the man insisted.

The Captain repeated that he wasn't interested, but then an idea came to him. Wait," he said. "Ancient Maya? Genuine?"

Shifty Eyes opened a little newspaper bundle to reveal a clay figurine inside. "Very genuine," he said. "Very old. Just found." Granny asked him if he had more. "*Si*," the man whispered, his eyes darting around.

At the lab, C.T. was sitting at a counter, scraping the bottom of the pot with a scalpel. They needed a sample of the clay for the test they were going to run to determine the pot's age. He wondered how much the pot would be worth if it turned out to be **authentic**.

"Fifteen, twenty thousand," Terry said.

"Dollars?" he asked, amazed. She reminded him that it was illegal to sell ancient artifacts. "Keep scraping," she said.

As he worked, Terry explained that they would be conducting a **thermoluminescence** test. It actually wasn't that hard to understand, considering how long the word was.

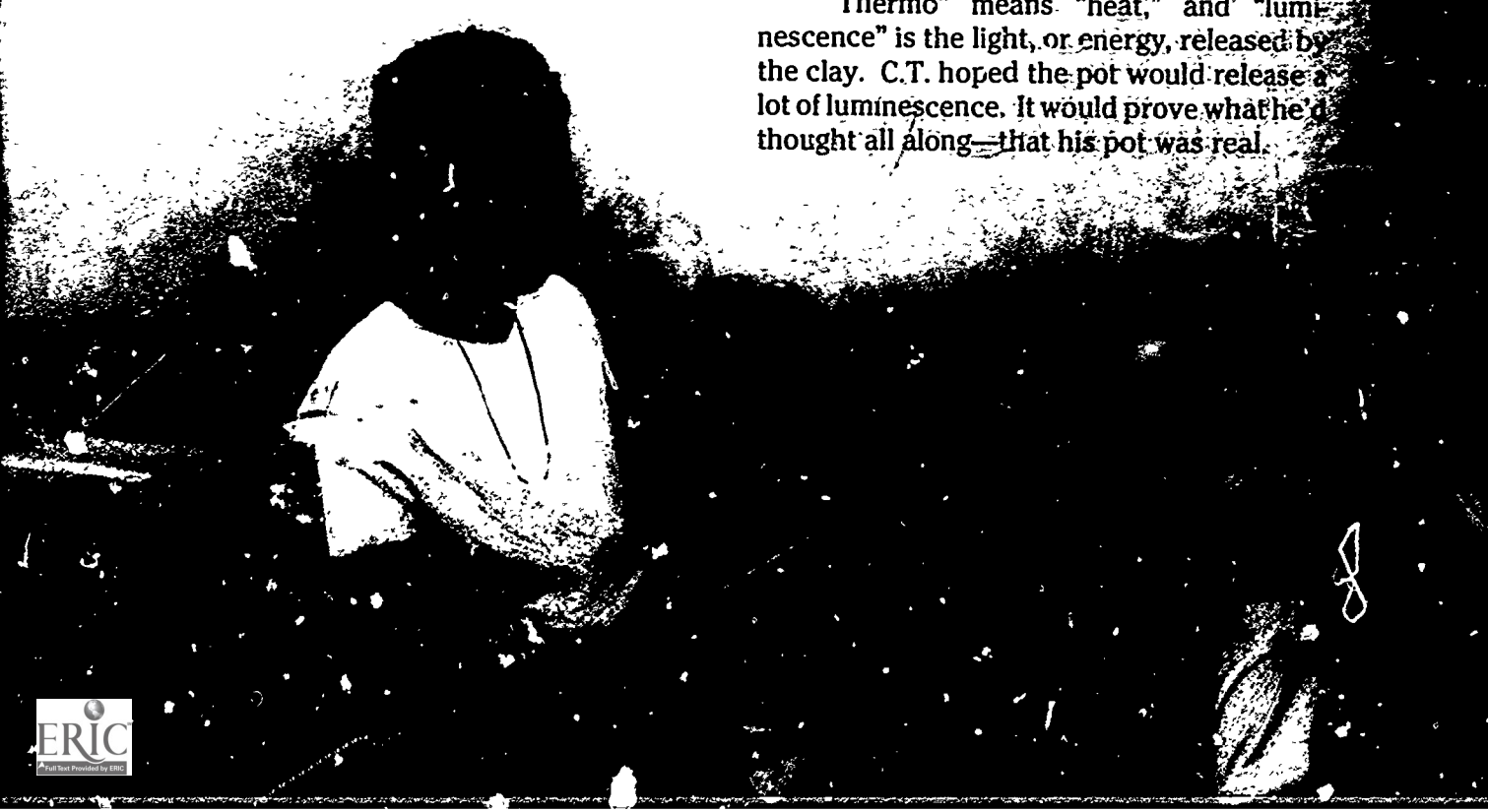
First she explained that clay is made up of different materials. Some of those materials are **radioactive**, but only in tiny amounts—not enough to hurt anyone. Other material in the clay stores energy when it is hit by radiation. So far so good.

Next she described how that energy would be released any time the clay was heated to very high temperatures. Their test would involve heating the clay sample and measuring the energy released.

C.T. didn't see how that would tell them how old the pot was. Terry reminded him that when the pot was made, however long ago, it was fired in a **kiln** to harden the clay. That released all the energy the clay had stored up to that point, so the new pot had zero stored energy when it came out of the kiln.

The pot hadn't lost the radioactive material in the clay, however, so it began storing energy all over again. Any energy in it *now* had been building up since the day it was fired. The more energy they measured, the older the pot. The test could clearly distinguish between an old pot and a new one.

"Thermo" means "heat," and "luminescence" is the light, or energy, released by the clay. C.T. hoped the pot would release a lot of luminescence. It would prove what he'd thought all along—that his pot was real.



Meanwhile, Shifty Eyes led Granny and Pepper to the back room of a **curio** shop near the market. He unlocked a closet, revealing several shelves of Maya pottery and figurines. When a bell summoned him to the front to take care of some customers, Pepper quickly took some pictures of the artifacts. "This looks like the real stuff," Granny whispered, as he acted as lookout.

Soon Shifty Eyes returned. He showed them a figurine, but wouldn't tell them where it was from. Just then they heard footsteps; they turned to find Harvey Westerman standing in the archway, staring at them.

Westerman sent his assistant away and turned to Pepper and Granny. He asked them why they were there, and Granny replied that they were interested in Maya relics. Westerman said his assistant had been trying to cheat them by selling them worthless copies.

"Fakes?" the Captain asked, doubtfully.

"Of course," Westerman replied, locking the closet. "As I'm sure you're both aware, it is *illegal* to deal in pre-Columbian antiquities."

At the INAH lab, Terry spooned the clay sample into the heating chamber. They were ready to start the thermoluminescence test. Victor pushed some buttons on the control panel, and they all leaned in to watch the computer screen. As the temperature increased, the graph line shot up dramatically.

"Well, well, well," Terry said. "Will you look at that!"

The graph indicated that the clay was releasing a lot of energy as it got hotter, suggesting that the pot had been around for a long time. They still had more tests to perform, but even Victor admitted that it was beginning to look like their pot was the real thing.

They tested the sample again, but this time the graph line lay flat at the bottom of the screen. All the energy had been released the first time, proving what Terry had said earlier: a new pot, just fired, wouldn't have any energy stored in it; only as time passed would it begin to store energy again. And that's what made it possible to date the pot.

From the lab they went to visit Jean Andrews, who lived in Mérida when she wasn't at Cobá. She wanted to run all the evidence "through the old brain cells again." One: part of a stela had been stolen from Cobá and dropped in the water off Tulúm, probably by the looters. Two: the stela indicated that Chac Balam, a king of Cobá, had been captured and taken to Site U. Three: they now had a pot, also dedicated to Chac Balam, also found underwater, and also, apparently, looted.

Did that mean the pot was also from Cobá? It didn't look like other pottery they'd found there.

"This might help," Quiché said. She had made drawings of the glyphs on the pot and filled in the lines that had faded. Now she could tell that the "twelve" Pepper had noticed earlier was part of a date glyph.

Victor rushed over to look. She was right. And what was interesting was that the date was two years *after* the date on the stela marking Chac Balam's capture. Next to the date was the glyph for "capture." Victor was getting excited. "Think about it," he said. "This pot celebrates his capture two years *after* it happened."

"But they wouldn't be celebrating that in Cobá," Jean said.

"That means," C.T. announced, beaming, "that the pot must be from the lost city!"

"*¡Exacto!*" Victor said.

"Good work, Quiché," her mother said proudly.

They still had no idea where the lost city was, of course. The first step in finding it would be to analyze the clay in the pot. If they could find out what area the clay was from...

Terry typed in a command on the computer. They had a database of all the locations where the Site U emblem glyph had been found. She scrolled quickly through the data. The glyph, it seemed, had always been found south of Cobá. That didn't exactly pinpoint the site, but it was a lead. At least they now had a general idea of where they should look.

Pepper and Granny soon joined them, and told of their encounter with Westerman. They examined Pepper's photos, and C.T. recognized the Site U glyph on one of the pots.

"That means Westerman has found the lost city," Quiché said.

They would have to [illegible] relics in his shop, Jean argued, [illegible] harm to the [illegible] were suspicious [illegible] stealing as much as [illegible]

There was [illegible] yet. [illegible] where they [illegible] stuff they'd seen in his shop.

"We'd better find that lost city," C.T. said, his voice at [illegible] "and fast. I like you guys, but I'm not [illegible] This is getting [illegible]


87

ACTIVITY

WHOSE POT IS IT?

When C.T. finds out that "his" pot was really made by the ancient Maya, he immediately says, "I guess it's not mine anymore." But maybe a little voice inside him had some doubts.

Write a dialogue between C.T. and an imaginary friend arguing about who owns the pot. Act out the dialogue with a friend. For example:

James: *C.T., you're a sucker. That pot belongs to you.*

C.T.: *No it doesn't. It was found in Mexico's waters. It belongs to Mexico.*

James: *You mean if I catch a fish in Mexican waters, it belongs to Mexico? Give me a break.*

What would you think if you were C.T.?

Cylindrical vase, ritual ball game scene.

Dallas Museum of Art, gift of Mr and Mrs Raymond D. Nasher.

A POT IS WORTH A THOUSAND WORDS

The ancient Maya did not have cameras, most of their books were destroyed and we're just learning to read their hieroglyphics. So we can only try to figure out what their daily life was like. One key is the images of people carved in stone or painted on ceramics by Maya artists. We do our best to interpret these, based on the evidence, but no one knows for sure what happened.

For example, this Maya pot seems to show the Maya ball game. It looks like the players are wearing padding to protect their chests and arms from the massive ball.

The ball itself is black, the color of natural rubber that has been cooked and solidified.

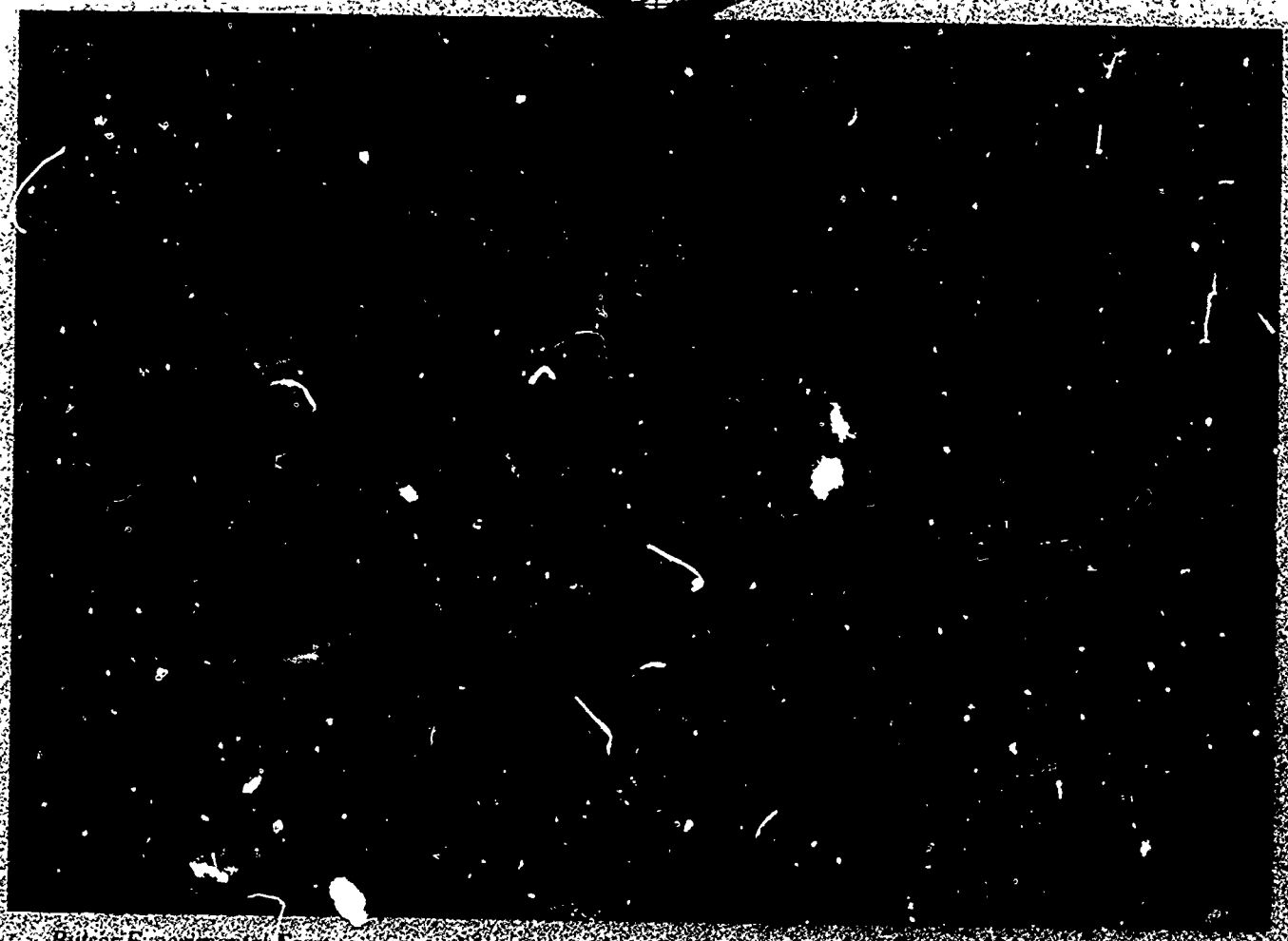
Was the ball bounced off chest pads and along the slanted walls of the ball court? Does the ball moving toward one player's face show that player is about to lose?

In fact, not much is known for sure about the Maya ball game. These interpretations of the scene on the pot could be dead wrong. What else could be happening?

The picture at left shows an event that took place in Clermont, Florida, in 1988. If future archaeologists who knew nothing about this culture found this picture, what are some *wrong* interpretations they might make?

89

EXPEDITION



Butser Experimental Farm is an actual farm where Iron Age farming methods are used.

Archaeologists are like detectives, trying to put together a story based on clues. Often their clues are hundreds or thousands of years old. They can never be absolutely sure if their theories are correct.

Ben Affleck went to England to meet a scientist who is testing some archaeological theories in a different way. Dr. Peter Reynolds is interested in people known as the Celts (pronounced Kelts). The Celts lived and farmed in southern England about two thousand years ago, during the **Iron Age**. That was even before the time of the great Maya civilization.

Peter Reynolds is trying to learn about Iron Age farming by actually doing it. He is the director of the Butser Experimental Farm, an actual farm where Iron Age methods are used.

"You're pretty familiar with the ordinary kind of archaeology, where we dig things up—pots, bits of bones, post holes, pits and all that," said Peter. "An archaeologist digs all that stuff up, then makes up theories about what it means." Peter's job starts there. "We take the information from the archaeologist and say, 'If you think it means this, let's test it to see if you could be right.'"

Peter Reynolds raises farm animals the Celts raised and trains them to do farm work at Butser. These cows are being trained to pull a plow.

There are conflicting theories about Iron Age farmers. Roman historians described them as good farmers, providing wheat and other grains for all of Europe. More recently, archaeologists have suggested the Celts were barely able to raise enough food for themselves.

Peter uses Iron Age farming methods in order to figure out how much food the Celts could have produced. He builds houses and fences using the materials they used. He studies the **fossil** evidence and raises animals similar to those the Celtic farmers raised. Careful records are kept so Peter can figure out what was possible for the Celtic farmer.

Archaeological evidence, scientific knowledge, and common sense guide Peter in building the structures at Butser. For example, circles of post holes found all over England told Peter how big an Iron Age house probably was, how many and how big around were the posts that supported it. Roman historians wrote that the houses were covered with straw thatch. Based on this information, Peter constructed a round house with a cone shaped thatch roof.

Ben wondered how the Celts could have had fires inside this kind of house with no chimney or hole in the roof. Peter explained that a hole in the roof would be dangerous and impractical. There would be such an updraft from the fire that sparks would be drawn up into the thatch, creating a fire hazard. Besides that, it rains a lot in England. The rain would go through the hole and put the fire out.

With no hole in the roof, the smoke from a fire in the middle of the house would rise above the people's heads and **percolate** or filter out through the straw. Peter has tried it and it worked. The smoke also helps kill small insects that live in the straw and keeps mice and rats out.

Ben got a chance to see Peter add a layer of thatch to the building. "How do you know this is what they used in Iron Age times?" Ben wanted to know.

"Well, thatching is a tradition that goes back seven thousand years. Lots of houses in England are still thatched. I'm using the oldest known system of thatching, which is called sewing." He wrapped a bundle of thatch with a string and tied it through to the rest of the roof, then pulled the string tight. "O.K., now we beat that a bit and tuck it down again. If we don't, we're going to get a little river between the two. Then that will go down into the straw and cause it to leak."

Peter conducted an experiment to prove the thatch wouldn't leak. He poured a bucket of water on the thatch. The drops of water moved down one piece of straw and were picked up by the next. The angle of the roof was just right to keep the water moving down along the straws instead of down through them.

The Celts grew wheat mainly for its seeds which were used to make bread. The stalks or straw were just by-products. Peter thinks the fact that they found a use for the straw as well is an example of Iron Age efficiency.

Ben and Peter test how well the "thatch roof sickle" works.

Since the goal of Butser is to find out what kind of crop yields the Celts had, Peter and his staff have gathered the same types of cereals or grains the Celts grew two thousand years ago. Peter explained, "When we excavate sites, we find seeds that have been turned to carbon from fires—bonfires or accidents. And we can actually identify these seeds down to different species of plants. So we've been growing those species over the years."

Peter also uses Iron Age tools or replicas based on Iron Age tools in museums. He sometimes changes archaeologists' theories about them. One sickle has a long, curved blade and a short handle, similar to sickles still used in many places. It works very well to cut grain. Another tool that archaeologists thought was a sickle has a long handle and a short, thick blade. When Ben tried to cut grain with it, the roots of the plants were pulled out of the ground.

"That's no good for thatching," Peter said. "So I've come to the conclusion that that really isn't a sickle." Peter took out a piece of wood and demonstrated that the tool worked very well to split wood for fences and gates. That doesn't prove that Peter is correct, but it does make for an improved theory.

Peter has concluded that Roman historians were probably right. Iron Age Celts were very good farmers. His system produces two to four tons of wheat an acre, depending on the season and the climate. That's a better harvest than many farmers get today—even with the use of chemical fertilizers.

"All the archaeologists thought, that in prehistory farmers struggled to grow enough food for themselves and their families. They couldn't produce any surplus. [illegible]

If Celtic farmers produced a surplus of wheat, they must have had a way to store it. Peter thinks he knows how they did that, too. He showed Ben a pit with a ladder leading down into it. "We find these things all over the Celtic world. You can store grain down a pit like this with ease because all you do is fill it up with grain, put a clay plug on top, and cover it."

As the grain begins to grow, it produces carbon dioxide which fills the pit and stops any further growth. The temperature is kept low by the surrounding rocks. These are ideal conditions for grain storage. Peter has tested this theory for twenty years and it works perfectly every time.

In some countries today, including Australia and Argentina, thousands of tons of grain are stored underground in pits from three to twenty feet deep. Before Peter tried this experiment, most archaeologists thought the Iron Age pits were underground houses built and used by a "primitive" people. Peter is now convinced that the Celts were clever, productive farmers.

Ben had one more lesson at the experimental farm. Peter showed him another way the Iron Age farmers made use of every available resource. He set Ben to digging in the **daub** pit. Daub is used to reinforce the walls of buildings. It's made from clay, fiber, soil—and **dung**. Dung gathered from all the farm animals is an essential ingredient because it acts like glue.

Ben applied the daub to a wall with the best tool possible, his hands. Peter had convinced Ben that the Celts were better farmers than people used to think. But Ben wondered if kids back in the Iron Age liked daubing the walls any better than he did.

Daubing...a hands-on experience.

WHO WERE THE CELTS?

The Celts (pronounced kelts) were tribal people who lived in central and western Europe from about 500 B.C. to 50 A.D. Because the tribes were disorganized, they were eventually conquered by the Romans. Around the same time as the Romans conquered the Celts, the Maya cities were being built in Mexico.

Archaeologists have learned about the Celts from the remains of houses, farms, and tools. However, much of what we know about the daily life of the Celts comes from the writings of Greek and Roman travelers and historians.

For example, Romans who fought the Celts wrote of their terrifying appearance. Celtic warriors would soak their hair in a mixture of water and crushed chalk. Then they scraped it back toward the nape of the neck like a horse's mane. The hair appeared very light in color and dried so stiff and spiky that, according to later Irish folktales, you could spear an apple on it!

It seems that some Celtic men also bleached their hair. A hero named Cu Chulainn appears in one story with hair that is dark at the roots, red in the middle and golden at the ends. The dye he had used must have been growing out.

Julius Caesar wrote, "The British (Celts) tattoo themselves with Woad which produces a blue color and gives them a more horrible appearance in battle." Woad is a yellow wildflower, *Isatis tinctoria*, whose leaves yield a blue dye. The Celts used this dye to tattoo themselves and to dye their clothing. Additional proof of this came when evidence of blue dye was found on the preserved skin of an Iron Age body discovered in a peat bog.

The Celts loved feasting and fighting. Pork was their favorite meat; beer was a common drink.


EPISODE
A

Once we had permission from the INAH director, we were all se C.T. continued in his journal. *We took Mimi back to Tulúm so Pepper would be in range of our radio.*

Pepper would stay with the boat and relay their messages to INAH. It was sad to leave her behind, but it was vital for them to have a link to the outside world. And she wouldn't be all alone. Segovia's daughter Rosa was going to stay with her. They had become good friends when Pepper had been her dive instructor in Cozumel.

We started at Cobá, and we finally met Jean's husband, George. He studies the plants that the ancient Maya used.

George was English. He stood straight as a pole, and he reminded C.T. of the host of a nature show he used to watch back home. He had spent years prowling this jungle in search of his beloved orchids, and had agreed to lead them to the ancient Maya road they hoped to follow. It wasn't marked on any map; Victor had noticed it on an aerial photograph, just the faintest line, like a scratch on the picture.

There wasn't much to see when they finally reached the "road." It was mostly overgrown, but George showed them a few places where it was still visible. C.T. hadn't realized that the Maya had roads. Or ***sacbes***, as Quiché called them.

Sacbes were long, straight highways through the jungle. Sometimes they had connected Maya cities, sometimes they seemed to lead nowhere. They were several meters wide, elevated off the jungle floor. And they had been paved with white plaster. *"Sacbe"* meant "white road."

The most amazing thing was that the ancient Maya didn't use the wheel. They traveled these roads by foot—just as the *Mimi* crew was doing. Or trying to do. The *sacbe* wasn't much of a road anymore. At best it was just a tiny path, occasionally used by local Maya hunters.

"You're on your own from here," George announced, after they'd gone about three kilometers. He would have enjoyed accompanying them on their search, but his own orchid hunt came first. He told them that the *sacbe* should lead to the area they were looking for, but added that it was easy to lose the trail. "It's rough going," he warned.

Thick jungle was a new experience for C.T. It wasn't like Ohio. It was hot, even though it was almost Christmas. The trees still wore their leaves. And he'd never even seen most of the plants before.

Quiché was a good guide. She showed him a plant called *sac na'b* he could chew on when he got thirsty; the stem was filled with water. She pointed out an army of leaf-cutter ants, each carrying a piece of leaf several times its size. They marched up and down the tree, bringing the leaves to their underground colony. The ants ate the fungus that grew on the leaves.

"They can strip a whole tree bare in one day," Quiché stated.

C.T. wondered if the ants had been doing their job. The vegetation seemed to be closing in on him. The path had petered out a way back, and now the undergrowth was getting thicker and thicker. Soon they were hacking their way through it with machetes. He was relieved when they finally decided to call it a day and set up camp.

It was nice to lay in his hammock and look up at the stars. The night sounds were so new and strange, to him at least, that it seemed almost as if he had arrived on another planet. Even the sky looked different.

"Do you like it here?" C.T. asked his grandfather, who was lying in the hammock next to him.

"Can't think of any place I'd rather be," his grandfather answered. "On land, that is."

"Me either," C.T. said. "How come I can't see the Big Dipper?" he asked after a moment.

"It's low on the horizon. It's a different sky here. Different view, that is. You won't find anything in the same place as you do in Ohio."

Ohio. Boy, did that seem far away. He couldn't keep his eyes open a second longer. An animal was howling, deep in the jungle. Must be a...

He was asleep.

Loud birdsong awoke him the next morning. He sat up in his hammock and started to put on his hightops. Quiché saw him and called out to him. "C.T., wait."

"Wait for what?"

"Shake out your shoes before you put them on," Quiché answered. He'd already put the left one on, so he shook out the [illegible]. Something fell out. A big bug. It didn't look like [illegible]

"[illegible]'s a scorpion," Quiché informed him, flicking it away with a stick. "It has a poison stinger."

Close call! C.T. thought. He looked in his sneaker and [illegible] a couple more times before [illegible] on.

[illegible]


was left off by herself,
leaned against a tree to watch a
centipede crawl a branch. Suddenly, she felt a
sharp sting on her arm. She looked down to
find out what it was, and saw a scorpion
screamed.
"Mom! A scorpio me!"
"Mom!!"
Everyone turned.
"Mom!!"

ACTIVITY

Mini-beasts

- There are four million of them in an acre of land. In one square yard of soil, you can find 500 to 2,000 of them.
- They live almost everywhere on earth, from deserts to icebergs, from mountaintops to caves.
- Their legs are jointed and they have six of them.
- Their bodies are divided into three sections: the head, **thorax** and **abdomen**.
- Some chew their food, some suck it up, some lap it up, and others don't eat at all.
- They travel by wriggling, squirming, flying, crawling, hitchhiking, burrowing, swimming underwater or scudding on its surface.
- Most undergo remarkable physical transformations that the best magicians and the best scientists will probably never match.

WHO ARE THEY?

They are the insects, the most common animals on earth. The leaf-cutter ants C.T. and Quiché see are insects. So are butterflies, beetles, dragonflies, mosquitoes and thousands of other six-legged creatures.

MAKING AN ANT NEST

One easy insect to get to know is the ant. Ant nests are pretty easy to set up and keep.

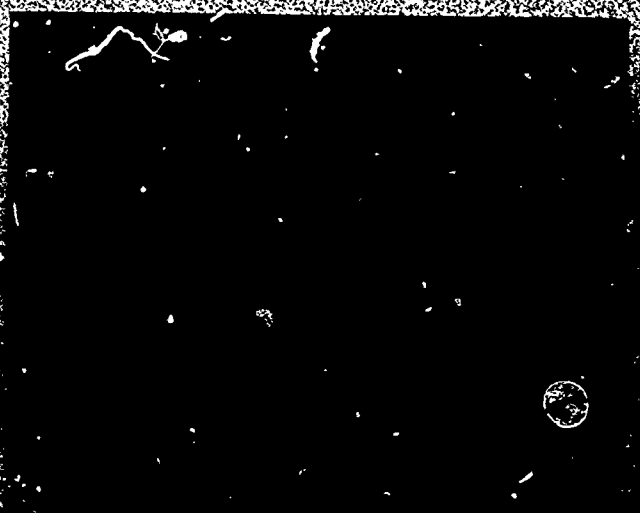
- You need: a clear 2-liter plastic soda bottle, a short 1-liter plastic soda bottle, a thick rubber band, some clear plastic wrap, a big spoon, a plastic bag, a pin, a small bag of **vermiculite**. (Vermiculite is sold in dime stores and florist shops.)
- Peel the label off the large bottle. Have an adult cut the top off the large bottle, so you can fit the smaller bottle inside it. Fill the space between the two bottles with moist (not wet) vermiculite and pack it down.
- To find ants, take a plastic bag and a big kitchen spoon to a place you've seen ants before. Look under rocks and in sandy places. (Ants are hard to find in cold weather.)
- When you find an anthill, gently scoop around it with the spoon. Try to get ants, eggs and **pupae**. Put them all into the plastic bag. If the ants are very active, putting the bag in a cool place for a few hours will slow them down. Then gently put them in the nest and cover the large bottle tightly with clear plastic wrap and a rubber band. Use the pin to make many air holes in the plastic wrap. To prevent escapes, put your ant nest in a shallow basin of water. (Ants hate to swim.)
- Twice a week feed the ants a little sugar, fruit, bread, or vegetable scraps. Ants eat very little. Don't let the food rot. Use a straw to add a few drops of water twice a week.
- When you're not observing the ants, cover the nest with a small, brown paper bag.

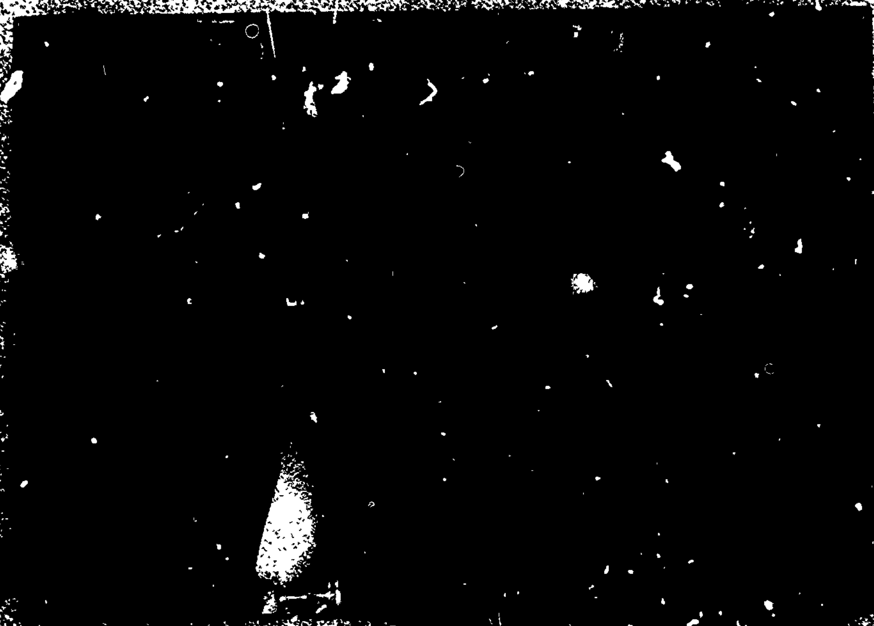
Scorpions, however, are not actually insects. Because they have eight legs and their bodies are divided into only two sections, they are in a class of animals called **arachnids**, not insects. Spiders are also arachnids.

EXPEDITION

The scorpion that stung Quiché in "The Second Voyage of the *Mimi*" was as harmless as a bee. Quiché got sick because she was allergic to it. But some scorpions in central Mexico can be deadly. Carla Douglin traveled all the way to Cuernavaca, Mexico, to visit Dr. Alejandro Alagón, an expert on scorpions. Dr. Alagón is trying to find a way to protect people from scorpion stings.

Carla's visit started out in the countryside where she helped Alejandro hunt specimens for his research. The landscape was dry and sparse, dotted with cactus.





Carbon dioxide temporarily paralyzes the scorpions so that they can be handled safely. Carlo was relieved to know the scorpions would fully recover in about [illegible] minutes.

Scorpions range in size from one-inch to five inches. The smaller they are, the more poisonous they are. Small scorpions must count on their poison or venom to paralyze or kill their enemies. Larger scorpions can count on their own strength to fight their enemies.

Carlo was surprised to learn that scorpion mothers take good care of their babies. [illegible]

venom, [illegible] and his assistants [illegible] collect it by [illegible] the scorpions. It's not the same as milking a cow. To milk a scorpion, [illegible] a small electric current through [illegible].

[illegible]

In this part of Mexico nearly a thousand people die of scorpion stings each year, and most of them are small children.

Alejandro explained that scorpions are not insects. They have eight legs and belong with the spiders to the class of animals called arachnids.

"They look a lot like lobsters," Carla said.

"In fact, a friend of mine ate one once," Alejandro said. "He cooked it. He told me that scorpions taste just like shrimps or lobsters."

"He ate one?" Carla looked disgusted. "Wouldn't the poison kill him?"

"He just removed the tip of the tail—the **telson**," said Alejandro. "That's the place where the poisonous gland is. The rest of the scorpion is harmless."

Carla described how they filmed the scorpion scene in "The Second Voyage of the *Mimi*." A scorpion breeder took the stinger off a scorpion. Then they filmed the harmless scorpion crawling on Carla's arm.

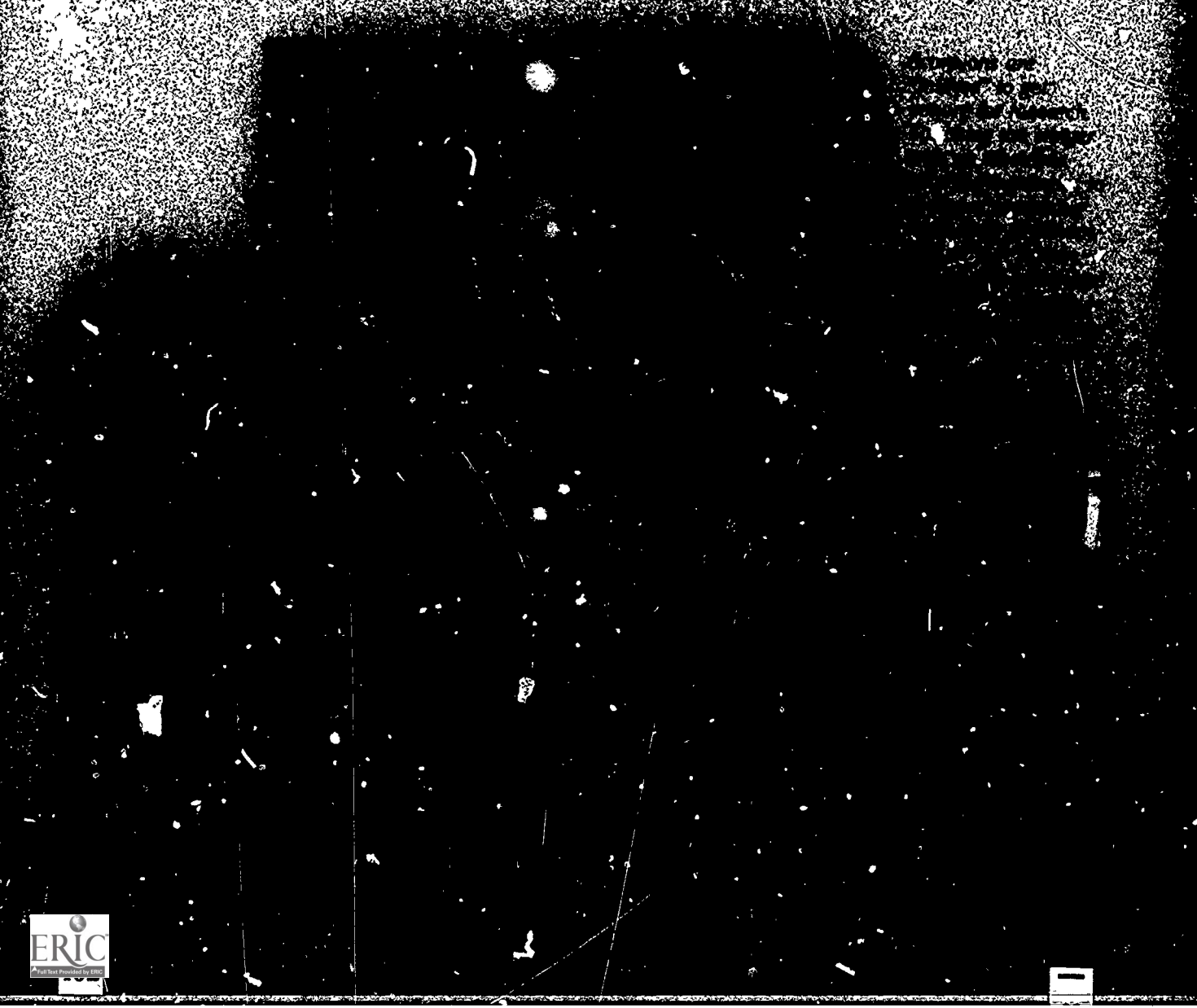
Now, Carla tried milking a scorpion. She touched the electrode to the scorpion's telson. A small drop of venom appeared.

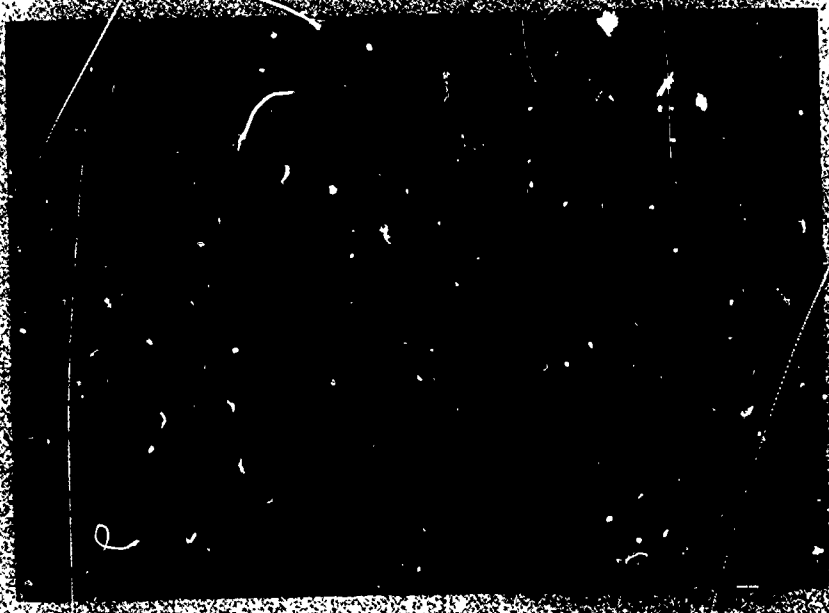
"Hey, it worked!" Carla exclaimed.

The electricity makes the muscles around the telson squeeze the venom out. It doesn't seem to hurt the scorpions. At least they recovered right away.

Carla was amazed at how little venom they had collected when they were finished. She learned it takes two to three thousand scorpions to make just one gram of poison.

Next, Rocilio used water to wash the venom out of the container—called a petri dish—and collected the solution in small vials. At this point it still wasn't pure venom. It was water. Rocilio [illegible] there were lots of little particles in it. It looked cloudy.





Alejandro also studies Gila monsters, venomous lizards from the Gila Desert in Arizona. His work with venomous animals of all kinds may someday save many lives.

A machine called a **centrifuge** is used to get the solids out of the venom. It spins the vials around at high speed. That causes the particles in the liquid to fly out to the ends—sort of like your clothes fly out against the sides of a washing machine when it spins.

It only took a few seconds. When the machine stopped, all the particles were at the bottom, and the liquid was clear.

"And the clear part is the part we want," Carla thought aloud. "It looks just like water, but it's still poisonous, right?"

"Oh, very poisonous," said Alejandro.

The clear liquid is actually made up of many different kinds of poison—called toxins—in each drop of venom. In fact, the venom contains more than twenty different poisons.

Scorpions need special poisons for each of the different animals they feed on, such as insects, arachnids, lizards—and for different kinds of creatures.

Before a vaccine can be made, the different toxins have to be separated out so their effects on humans can be studied. The first step is to run the venom through a long column filled with a special kind of gel. The toxins with the heaviest molecules fall to the bottom faster and come out first. The toxins with lighter molecules follow.

This separating work might take many more years, but already it may save many thousands of lives.

Alejandro studies poisonous animals of all kinds. He's worked with a type of scorpion called the giant hairy desert scorpion, and with Gila monsters, which are large, venomous lizards found in the desert in Arizona.

Carla quietly studied the scorpion and lizard as Alejandro talked. [illegible]

Carla [illegible] one of the [illegible] glass [illegible] for [illegible] poison [illegible] for [illegible] different [illegible].

SCORPIOLOGY

Are the following statements true or false? For help, re-read Expedition 8, "A Scorpion Tale."

1. A 1-inch scorpion is more poisonous than a 5-inch scorpion.
2. Scorpions feed on humans and other mammals.
3. Scorpions make good mothers.
4. The scorpion injects poison through its claw-like pincers.
5. Antivenin is the opposite of uncle-venin.
6. A Gila monster is a large slimy monster that lives in a swamp.
7. Scorpions have udders to give milk to their young.
8. Carla could have been killed by the scorpion used in the "sting" scene in Expedition 8.
9. Scorpions are actually helpful to people.
10. A vaccine protects you before you're stung; an antivenin protects you after you're stung.

Answers: 1. True 2. False 3. True 4. False 5. False 6. False 7. False 8. True 9. True 10. True


EPISODE

Quiché stared at the spot on her arm where the scorpion had stung her. "Help, Mom!" she called again. She could see the scorpion on the ground where it had landed when she brushed it off her arm.

"Are you sure it was a scorpion?" Victor asked when he and Terry reached her. Yes, she told them, she had seen it clearly.

Terry put her arm around her, and lead her to a hammock. Victor dashed over to his knapsack and pulled out the first aid kit.

Pepper's voice came over the radio. "Hey C.T., what's going on there?" He had forgotten all about her. He told her what had happened to Quiché, then Granny got on and asked her to stand by in case they needed help.

"Ow, ouch!" Quiché muttered. It hurt! "Am I going to be O.K.? I'm not going to die, am I?" she asked, starting to get scared.

"No, sweetheart, you're not going to die," her mother reassured her. She stroked Quiché's forehead. "Now just calm down."

Calm down? She could see Victor approaching with a needle in his hand. "I thought I was going to be *O.K.*," she groaned.

"You are, kiddo. I am more worried about that poor scorpion that bit you. They hate the taste of *gringa*," Victor joked.

"They don't bite," Quiché corrected him, "they *sting*."

Victor explained that he had to give her a shot of **cortisone**, in case she had an allergic reaction. Quiché said she *was* allergic—to needles. He didn't buy it. She felt the sharp jab of the needle.

C.T. was about thirty yards away when he heard the "ouch!" He was going to look for firewood, because now they would have to spend the night there. Poor Quiché. He kept thinking about that scorpion in his sneaker.

"That didn't hurt so much," Victor said.

"Didn't hurt who?" Quiché said.

Victor grinned. "Me, who else?"

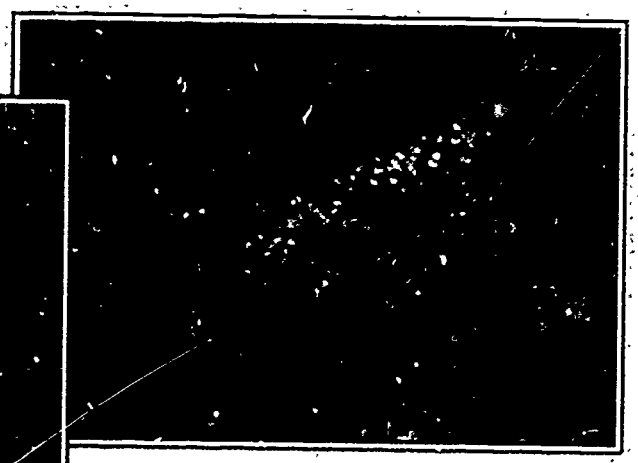
Quiché was beginning to feel weak. Terry told her she would probably get a little sick. "What about the lost city?" Quiché said.

"It hasn't gone anywhere for fifteen hundred years," Victor said. "I'm sure it will wait another day."

Soon she fell asleep. Victor was worried. If she *was* allergic, he told Terry, it could be bad. But it was too late to go anywhere.

C.T. was gathering firewood when he saw a small figure through the brush. It was a young Maya boy, dwarfed by the bundle of wood he carried on his back by means of a sling that looped around his forehead. They stared at each other.

"Hi," C.T. said, finally. No response. The boy just stood there, wide-eyed. C.T. tried again. *"¿Hola?"*



Terry sat next to the hammock, cradling her daughter's head. Quiché's forehead was beaded with sweat. "How're you feeling now, honey?" Terry asked. Quiché looked up, but didn't say anything.

"This is the doctor for the village," Victor told her. "He is going to make you feel better. *¿Entiendes?*"

"*Si,*" Quiché answered weakly.

The boy led them to his village. Granny and Victor carried the homemade stretcher with Quiché in it. Terry walked along next to the stretcher, carrying Quiché's knapsack as well as her own. C.T. brought up the rear, a machete in each hand.

It was a small village, just a cluster of small round houses with thatched roofs. A dog barked. Children watched them in silence. A couple pigs foraged around in the shade of a big tree.

Victor spoke to a young man in Mayan. The man went over to the stretcher and looked at Quiché. There was sweat on her brow, and her eyes were closed. She moaned. He said something to Victor, then spoke to a boy, who ran off towards one of the houses.

"It's all right," Victor told the others. "We're taking her to the ***curandero***."

"What's a *curandero*?" C.T. asked.

"It's like a doctor," Victor replied. "Like a medicine man."

The *curandero* ground up some leaves with a rolling pin made of stone. He gave Quiché a leaf to chew on, then applied a green **poultice** to the wound. It was a combination of two local plants.

The villagers invited them to stay in a house they kept for visitors. They lit a fire and strung up the hammocks. Granny asked Victor if he really believed in herbal medicine.

"The Maya have been using these plants for a few thousand years," Victor replied.

"They use plants for medicine?" C.T. asked.

"Sure, mostly," Victor said. "Our so-called modern doctors have learned a thing or two from folks like this. And anyhow, the more you believe in a medicine, the better it works."

They were relieved when Terry returned from the *curandero's* house and said that Quiché was going to be all right. "Somebody's medicine, yours or the *curandero's*, did the trick," she said to Victor, smiling.

"I told you she was too much for any scorpion," Victor said. They all felt better now that they knew Quiché was on the road to recovery.

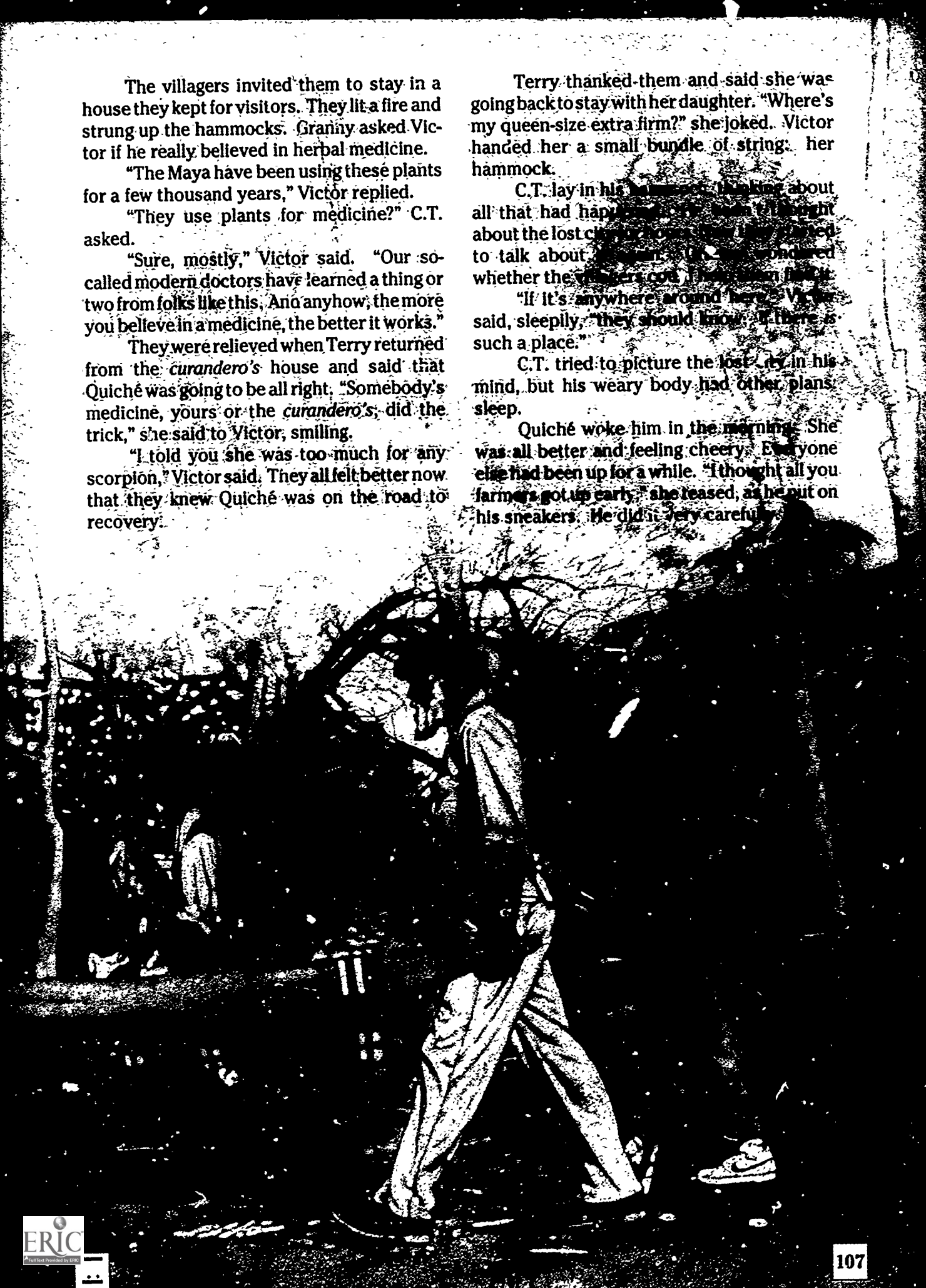
Terry thanked them and said she was going back to stay with her daughter. "Where's my queen-size extra firm?" she joked. Victor handed her a small bundle of string: her hammock.

C.T. lay in his [illegible] thinking about all that had happ[illegible] thought about the lost c[illegible] planned to talk about [illegible] wondered whether the [illegible]

"If it's anywhere around here," Victor said, sleepily, "they should know. If there is such a place."

C.T. tried to picture the lost city in his mind, but his weary body had other plans: sleep.

Quiché woke him in the morning. She was all better and feeling cheery. Everyone else had been up for a while. "I thought all you farmers got up early," she teased, as he put on his sneakers. He did it very carefully.



Terry and Victor were meeting with the [illegible] them the day before.

Ma' dios botic, Terry said—Mayan for "Thank you." Don Esteban said that he too was thankful that Quiché was better.

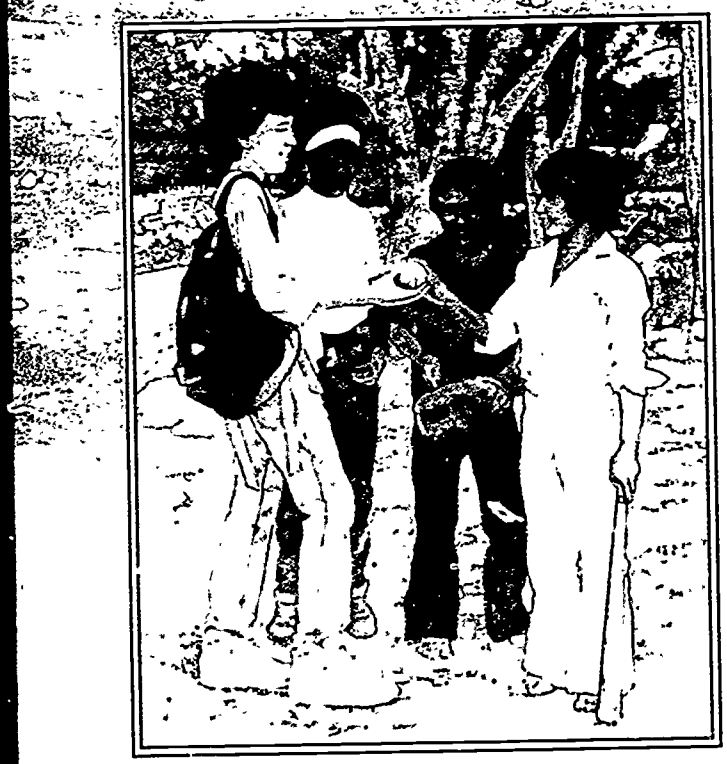
After that they spoke in English, with Juan translating. It was a polite and formal exchange. Terry and Victor explained that they were archaeologists looking for a lost city. The head man became withdrawn when they asked if he knew of any ruins in the area. He got up, invited them to join him for a meal in the afternoon, and quickly retired to his house.

Juan suggested they were thinking of Cobá. But Terry and Victor said they'd just come from Cobá. "I wish I could help you," Juan said, evasively. Terry decided it was best not to press him. Something didn't seem right.

They told Captain Granville about their strange meeting. "I hesitate to say this, but could they be your looters?" he asked. Terry looked doubtful, but said it was possible. She pointed out that you could argue that they rightly *owned* their ancestors' things.

"I can't believe these people would steal," Victor said. "But, something smells like fish."

C.T. and Quiché were playing baseball with the village kids. The field was at the center of town. You had to run over a big mound of dirt to get from first to second. A huge old tree sat in the middle of the outfield.



C.T. felt great. It was nice to be doing something familiar for a change. When it was his turn at bat, he got a good pitch and walloped it. It hit a branch of the tree, bounced and fell, right down the village well. Talk about hitting it out of the park!

Quiché translated for him when he apologized to the kids for losing their ball. "That Maya sure sounds a lot like Spanish," he said, when she was through. It *was* Spanish, she said. The kids learned it in school.

"Am I the only person in the world who only knows one language?" C.T. muttered.

He remembered that he had a baseball in his pack, and gave it to one of the guys. It was sort of a good luck charm, but so far they hadn't been real lucky. Maybe it would bring them some luck if he gave it away.

It did. That afternoon they sat in a big circle with the villagers, eating a traditional Maya meal. The guy C.T. had given the ball to tapped him on the shoulder and pulled him from the group. Quiché joined them.

C.T.'s new friend handed him a little bundle wrapped in cloth. *"Esto es un regalo para ti,"* he said.

"He wants to give you a present," Quiché translated. "I think it's because you gave him the baseball."

C.T. unfolded the cloth. He couldn't believe his eyes. There lay a little jade head beautifully carved. It was green and smooth as glass, and C.T. figured it was probably real. *"Muchas gracias,"* he stammered.

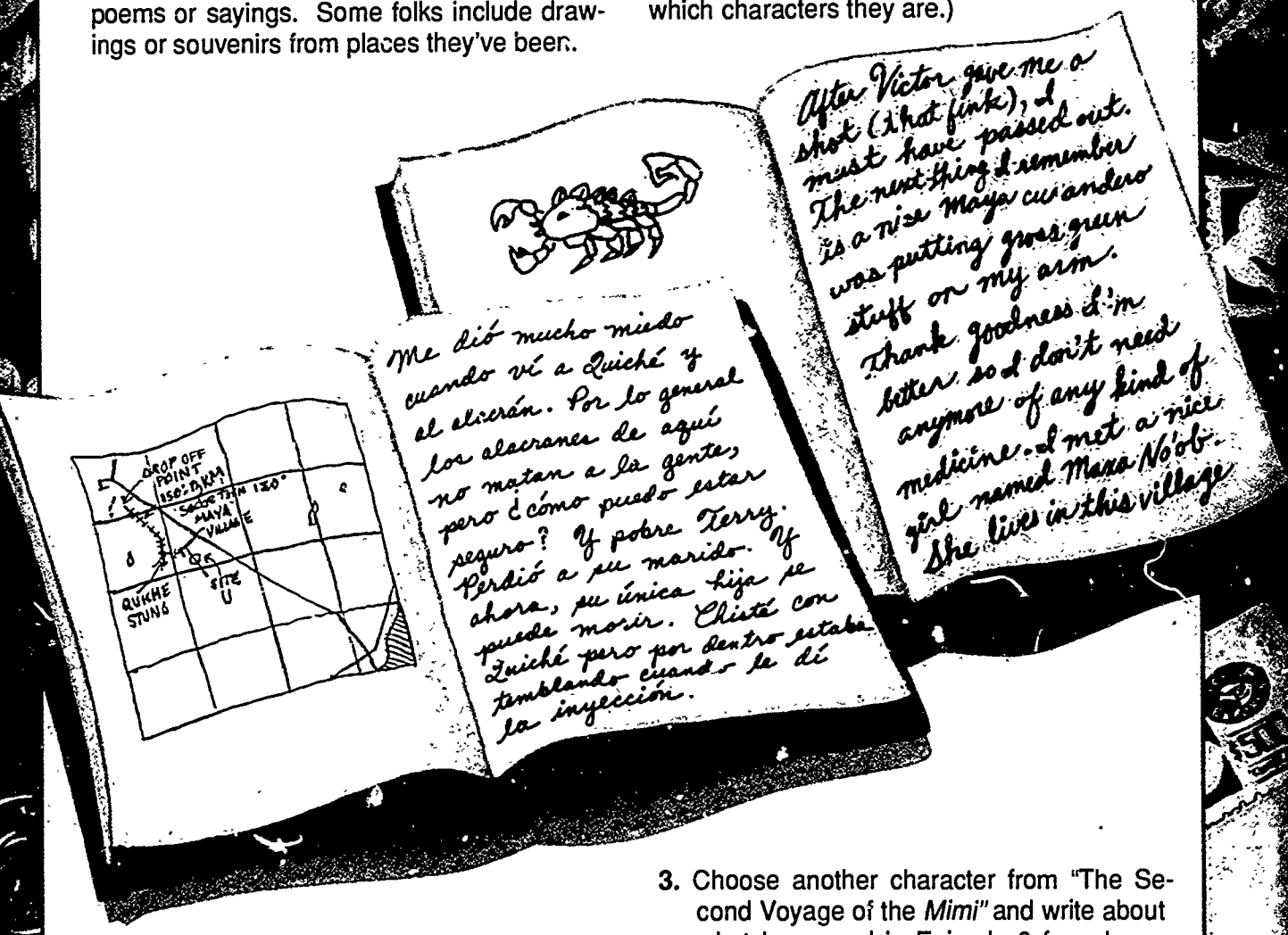
He took it over to show to Victor and [illegible] They stared at the jade figurine, then

ACTIVITY

Dear Diary

Keeping a journal really helps you remember things that go on in your life. Many people write about things that happen to them, thoughts, feelings, dreams, hopes, favorite poems or sayings. Some folks include drawings or souvenirs from places they've been.

In "The Second Voyage of the *Mimi*," C.T. writes in his journal almost every day. If some of the other *"Mimi"* characters kept journals, they might be like this. (You can probably guess which characters they are.)



Here are some journal writing ideas:

1. Complete one of these journal entries.
2. Write your own journal entry about what happened in your life today.
3. Choose another character from "The Second Voyage of the *Mimi*" and write about what happened in Episode 9 from her or his point of view.
4. Keep a journal for one of the characters for the rest of "The Second Voyage of the *Mimi*."
5. Keep your own journal, starting now. Try to write in it every day.

EXPEDITION

When Quiché gets stung by a scorpion in "The Second Voyage of the *Mimi*," she is treated by a *curandero*, a Maya medicine man who uses medicine made from plants. Quiché might have gotten better from that, or because of the shot Victor gave her, or she might have gotten better all by herself. But it is true that plants can be medicinal. About half of all the drugs in our modern pharmacies are made from chemicals first discovered in plants.

Edel Bye is a **botanist** who studies traditional plant cures used by the Indians in central Mexico. Edel wants to find out which plant cures work and why they do. Carla Douglin went to central Mexico to meet her.

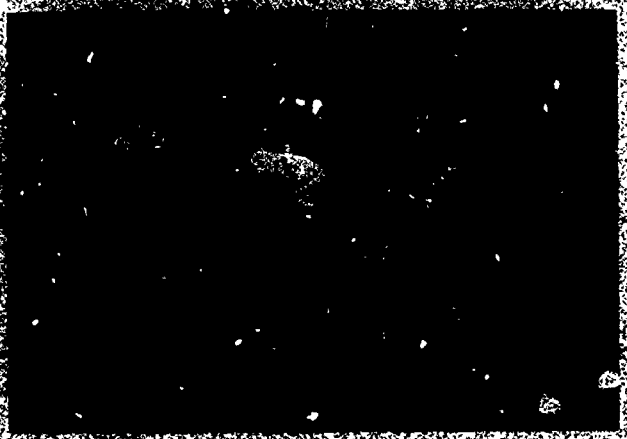
Before the Spaniards came, this part of Mexico was inhabited by the Aztec Indians, not by the Maya. Edel and Carla headed for the mountains outside Mexico City to meet an Indian healer, or *curandera*, who is descended from the ancient Aztecs. "We are going to meet doña Sebastiana. People come from all over Mexico to be treated by her," Edel told Carla.

They passed many gardens along the way. Edel told Carla that archaeologists have found traces of ancient gardens in this area—gardens where the Aztecs grew medicinal plants.

They pulled up on a dusty road and knocked on the door of a small, white house. Doña Sebastiana greeted them warmly. She spoke Spanish and Edel translated for Carla.

Doña Sebastiana treats people for many different ailments. She usually makes a tea to be drunk or a paste that's rubbed on. Sometimes she gives her patients a "sweat bath" in one of the small mud huts in her back yard.

She brings different plants into the hut along with the patient. The kinds of plants used



Selecting medicinal plants.

depend on the illness. Water is thrown onto stones that have been heated in a fire. The hut fills with fragrant vapor. The people inside sweat a lot as they inhale the delicious vapor, and doña Sebastiana feels this helps heal them.

Doña Sebastiana and her daughter both go inside the hut with the patients. Doña Sebastiana massages people and directs the treatment. Her daughter helps her. That's how the daughter learns to be a *curandera*.

Many cultures, including the Maya, have used sweat baths for centuries. People in the United States and in Europe also think steam baths and saunas are healthful.

During Carla's visit, someone came to doña Sebastiana for help. He had an eye irritation. Doña Sebastiana showed him how to soak a certain kind of root, chosen in waxing half of the moon, in water. [illegible] Edel said he [illegible] especially [illegible]

When doña Sebastiana pointed out a plant Edel was not familiar with, Edel collected a sample to take back to the lab. There, she will identify it and have it analyzed. She is careful not to take all of the plant so it can keep growing. The people of the village consider the forest above their town to be sacred. That's partly because it is a source of so many medicinal plants. They protect the forest from harm by [illegible]rs and developers.

On the way back to Mexico City, Carla asked, "Where do the *curanderas* learn how to use these plants?"

"It's a tradition," Edel explained. "The mother teaches the daughter and the grandmother teaches the granddaughter. You don't learn how to do it in school. It's only in the family," she said.

Next Edel took Carla to the *Mercado Sonora*, the largest medicinal herb market in Mexico. The huge indoor market was filled with dozens of sellers. Each had a booth full of colorful flowers and herbs. A group of musicians played as conversation and [illegible] shoppers, vendors, and curiosity seekers [illegible] to this market to find cures for everything from heart disease to hair loss.

[illegible] stopped [illegible] to rest. Carla's closer look [illegible] beautiful, [illegible] mended [illegible]

"These plants are still in use by our people in Mexico today. Now we're studying them with modern science and technology," Dr Lozoya continued.

He gave Carla an example. "We find a plant here. We read all the information the Aztecs had about it. Then we go to the country-side to collect the plant to prepare the same products as the Aztecs did. Then we take those products to the laboratory and study how they act in animals and humans to cure them."

This kind of research has led to many medical discoveries. A common plant called foxglove was used for centuries to treat heart problems. A bacteria, the source of an important drug, was discovered called Digitalis. The main [illegible] the earth was found in the bark of the [illegible] before modern medicine [illegible] "primitive" healers [illegible] fever.

[illegible] shows that we can still [illegible] people and learn [illegible] people we [illegible] developed [illegible] of plants we [illegible]

In Dr. Lozoya's lab, teas are made from medicinal plants. The teas are separated into different chemicals which are tested to see how they work.

Some of the tested chemicals make

(Speaking of poison, it's not a good idea to eat or drink tea made from just any plant. Some of them can be very poisonous.)

After the chemicals are separated, they are tested in different animals to find out what they are, the side effects and how they work.

Each [illegible]

"What we're [illegible] medicine."

[illegible]

Lots [illegible]

or [illegible]

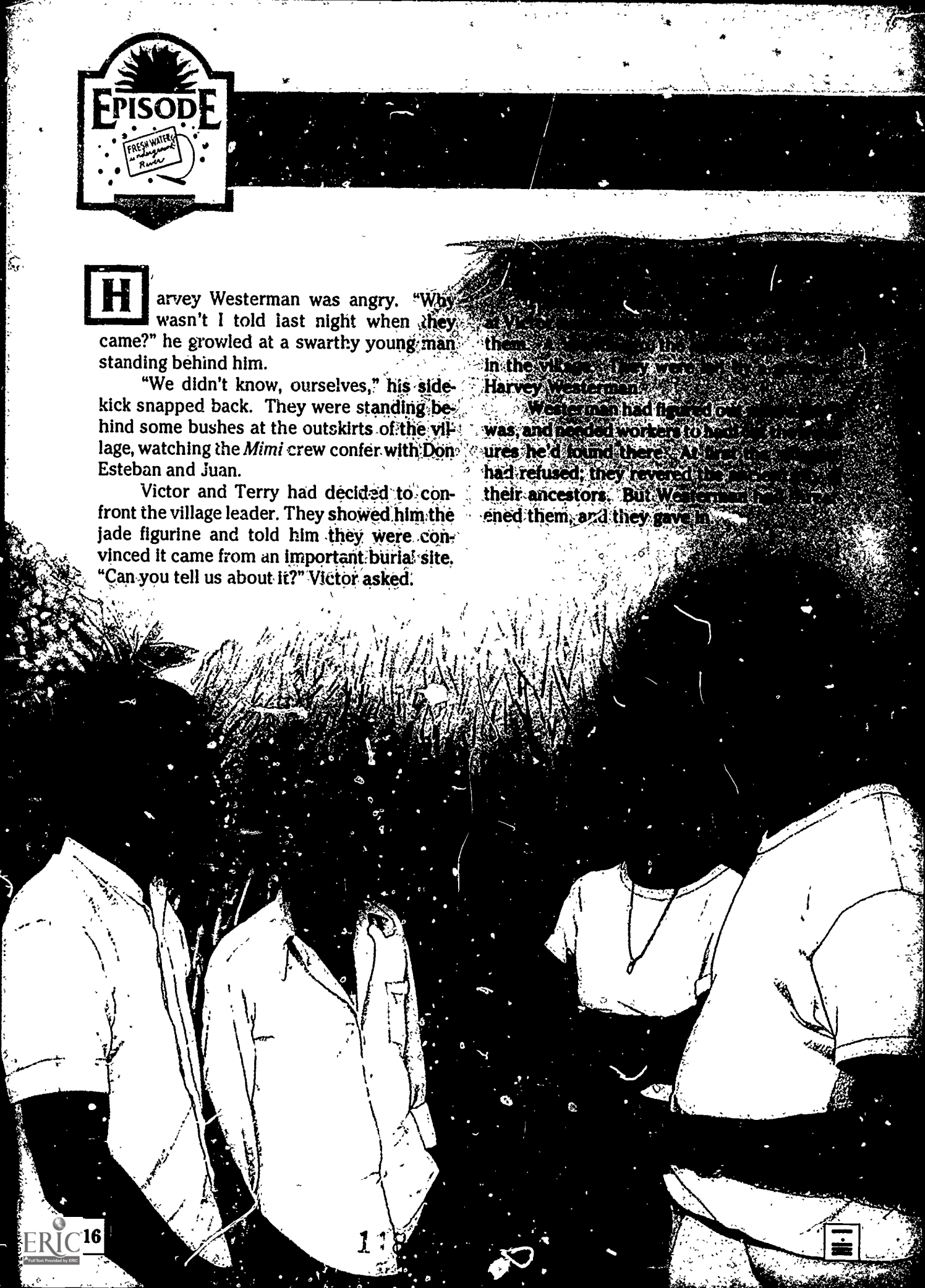
[illegible]

[illegible]

PLANT POWER

- Many [illegible] come from plants [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

- Only 1% of the plants in the world have been studied to see if they [illegible] food or [illegible] could carry the [illegible] that will be extinct [illegible]
- Can you think of examples of foods that are roots, stems, seeds, flowers or leaves?
- Plants provide much more than food. Name 20 things you use that come from plants.



Harvey Westerman was angry. "Why wasn't I told last night when they came?" he growled at a swarthy young man standing behind him.

"We didn't know, ourselves," his sidekick snapped back. They were standing behind some bushes at the outskirts of the village, watching the *Mimi* crew confer with Don Esteban and Juan.

Victor and Terry had decided to confront the village leader. They showed him the jade figurine and told him they were convinced it came from an important burial site. "Can you tell us about it?" Victor asked.

[illegible] them [illegible] in the village. They were [illegible] Harvey Westerman.

Westerman had figured out [illegible] was, and needed workers to help [illegible] ures he'd found there. At first [illegible] had refused; they revered the [illegible] their ancestors. But Westerman [illegible] ened them, and they gave in.

a?" Quiché asked.
Westerman had
not to tell anyone about the
temples, especially not archaeologists. He
had frightened them.

"Don Esteban," Terry said, when he finished his story, "will you lead us to the lost city?" He conferred with his son. Tomorrow morning, Juan said, he would take them there.

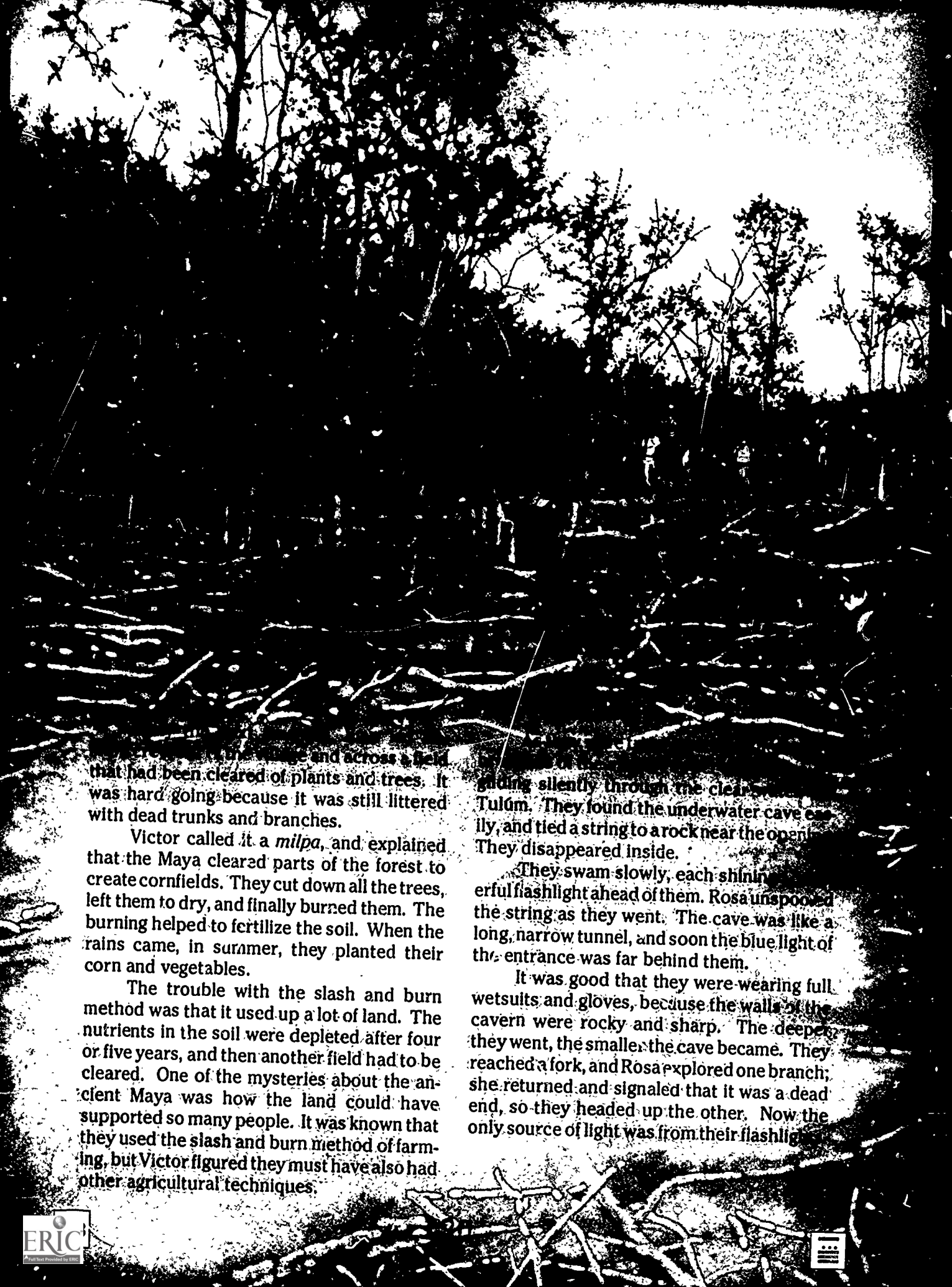
"They'll be calling the *federales* now," Westerman's henchman whispered. But Westerman wasn't worried. They had all night, time still for a lot of digging.

"We'll haul everything out through the tomorrow night," he said, "after th and tourists have left Tulúm."

ck at the *Mimi*, Pepper was singi Rosa, accompanying herself on sh I could do that," Rosa said nished. "You can do everything l. I'm not so hot at lip d. Rosa was surprised that like that, but Pepper had a attitude about her di that when she discovered cancer five years ago, she d ined to beat it.

you angry?" Rosa asked, adding be both angry and depressed. never really been ar- how he made was able to

Like cave-diving. They were both looking forward to the next day, when they planned to explore the underwater cave Pepper had



[illegible] and across a field that had been cleared of plants and trees. It was hard going because it was still littered with dead trunks and branches.

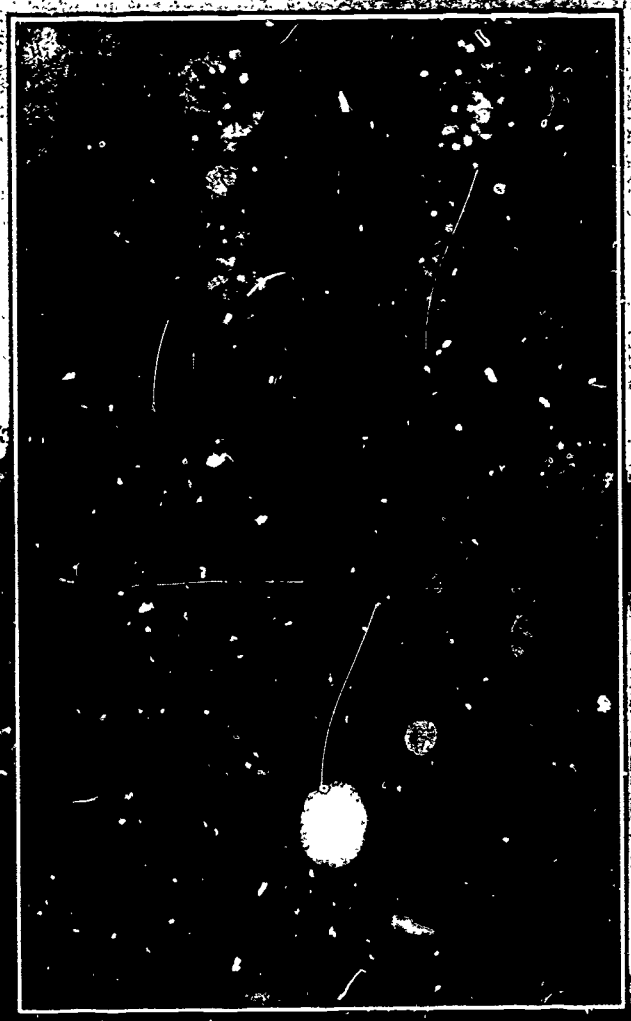
Victor called it a *milpa*, and explained that the Maya cleared parts of the forest to create cornfields. They cut down all the trees, left them to dry, and finally burned them. The burning helped to fertilize the soil. When the rains came, in summer, they planted their corn and vegetables.

The trouble with the slash and burn method was that it used up a lot of land. The nutrients in the soil were depleted after four or five years, and then another field had to be cleared. One of the mysteries about the ancient Maya was how the land could have supported so many people. It was known that they used the slash and burn method of farming, but Victor figured they must have also had other agricultural techniques.

[illegible] gliding silently through the clear [illegible] Tulúm. They found the underwater cave easily, and tied a string to a rock near the opening. They disappeared inside.

They swam slowly, each shining a powerful flashlight ahead of them. Rosa unspooled the string as they went. The cave was like a long, narrow tunnel, and soon the blue light of the entrance was far behind them.

It was good that they were wearing full wetsuits and gloves, because the walls of the cavern were rocky and sharp. The deeper they went, the smaller the cave became. They reached a fork, and Rosa explored one branch; she returned and signaled that it was a dead end, so they headed up the other. Now the only source of light was from their flashlights.



Meanwhile, the rest of the *Mimi* crew followed Juan toward the lost city. C.T. was surprised when they found a murky pond in the middle of the jungle. He was even more surprised when he heard a loud barking overhead and looked up to see a howler monkey ambling along a branch high in the treetops.

"Wow! Did you see it?" he asked Quiché.

"Yeah," she said. "There aren't many monkeys around here anymore. They keep cutting down their homes."

"Seems like a safe home here, on the pond," C.T. said.

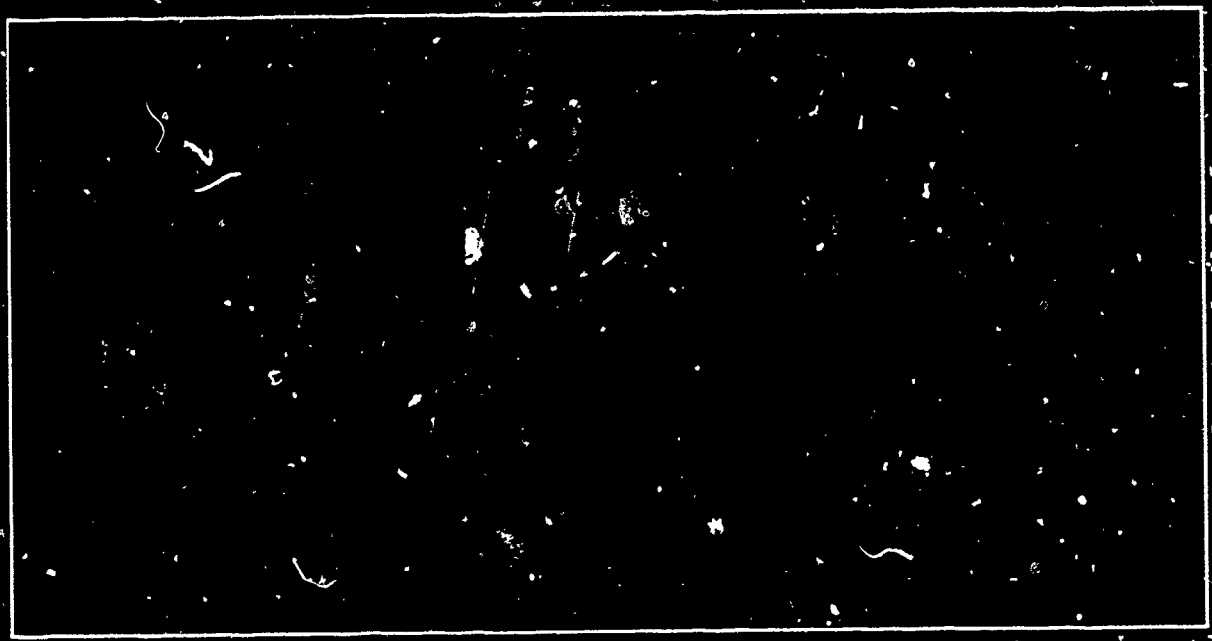
"It's called a *cenote*," Quiché said.

C.T. had the sinking feeling that he was going to learn all about *cenotes*. It seemed everybody knew so much more about the Yucatán and the Maya than he did.

His grandfather pointed at the pond. "*Cenotes* are like natural wells," he announced. "Under the topsoil in this area, there is a layer of limestone. In some places water runs under the limestone and wears it away enough that it collapses, like here."

Now how did he know that? C.T. wondered.

The monkey howled again. With Juan in the lead, the group walked past the *cenote* and continued on through the jungle.



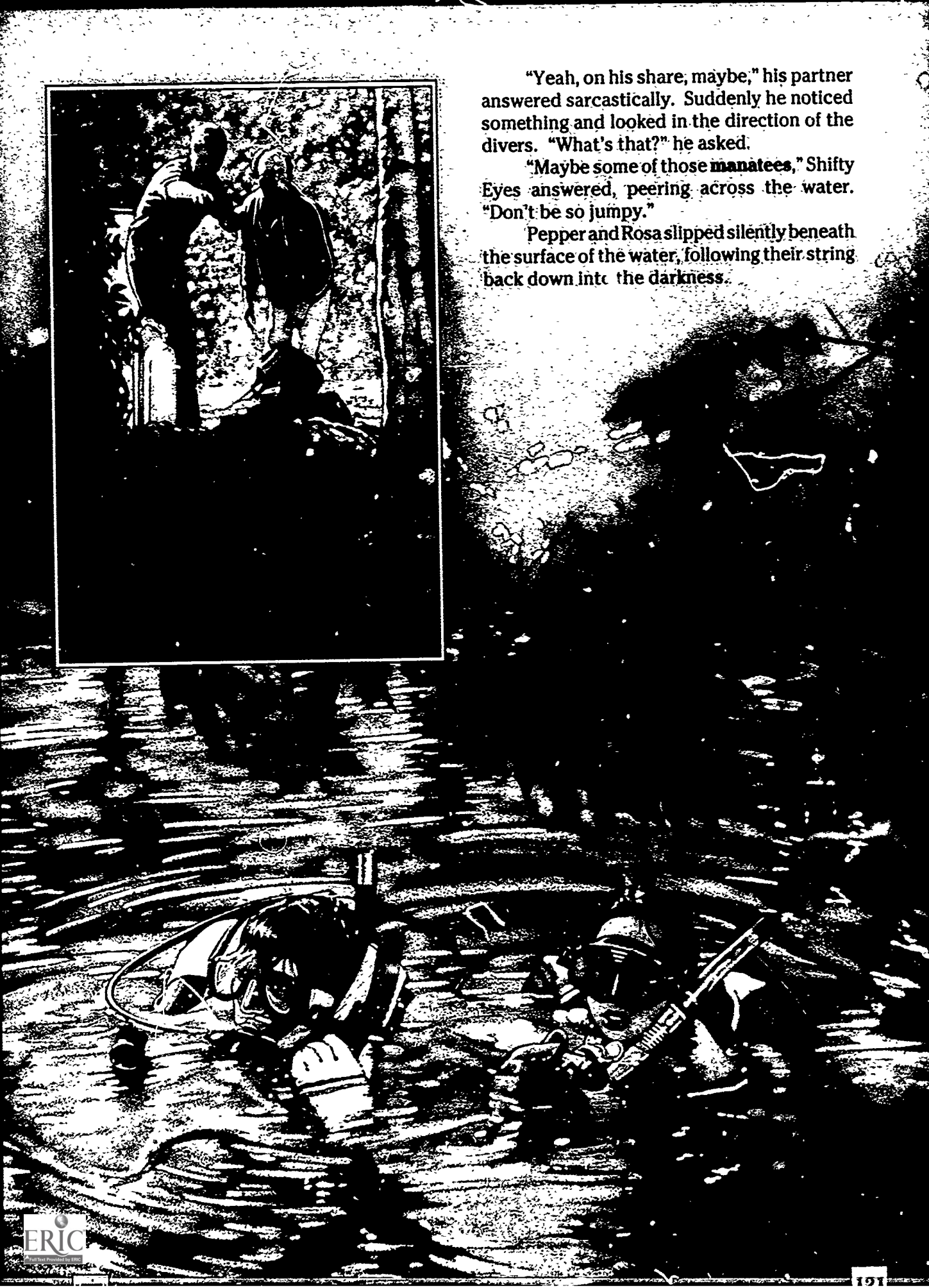
Something seemed different, Pepper thought. She took her regulator out of her mouth and licked her lip. Rosa did the same thing, then reached for their writing tablet. She wrote something and passed it to Pepper. "Fresh water?" it said.

"Underground river," Pepper wrote. They looked at each other and nodded. They swam on.

Soon they emerged from the tunnel and found themselves in a large pond. It was light again. They could see the sky and trees as they rose upwards through the fresh water. In a moment they broke the surface and looked around. They were in a *cenote*.

They heard sounds on the far side and looked over. Two men were moving air tanks from the back of a truck to the edge of the water. Pepper recognized one of them. It was that weasel from the curio shop. Their voices carried over the water.

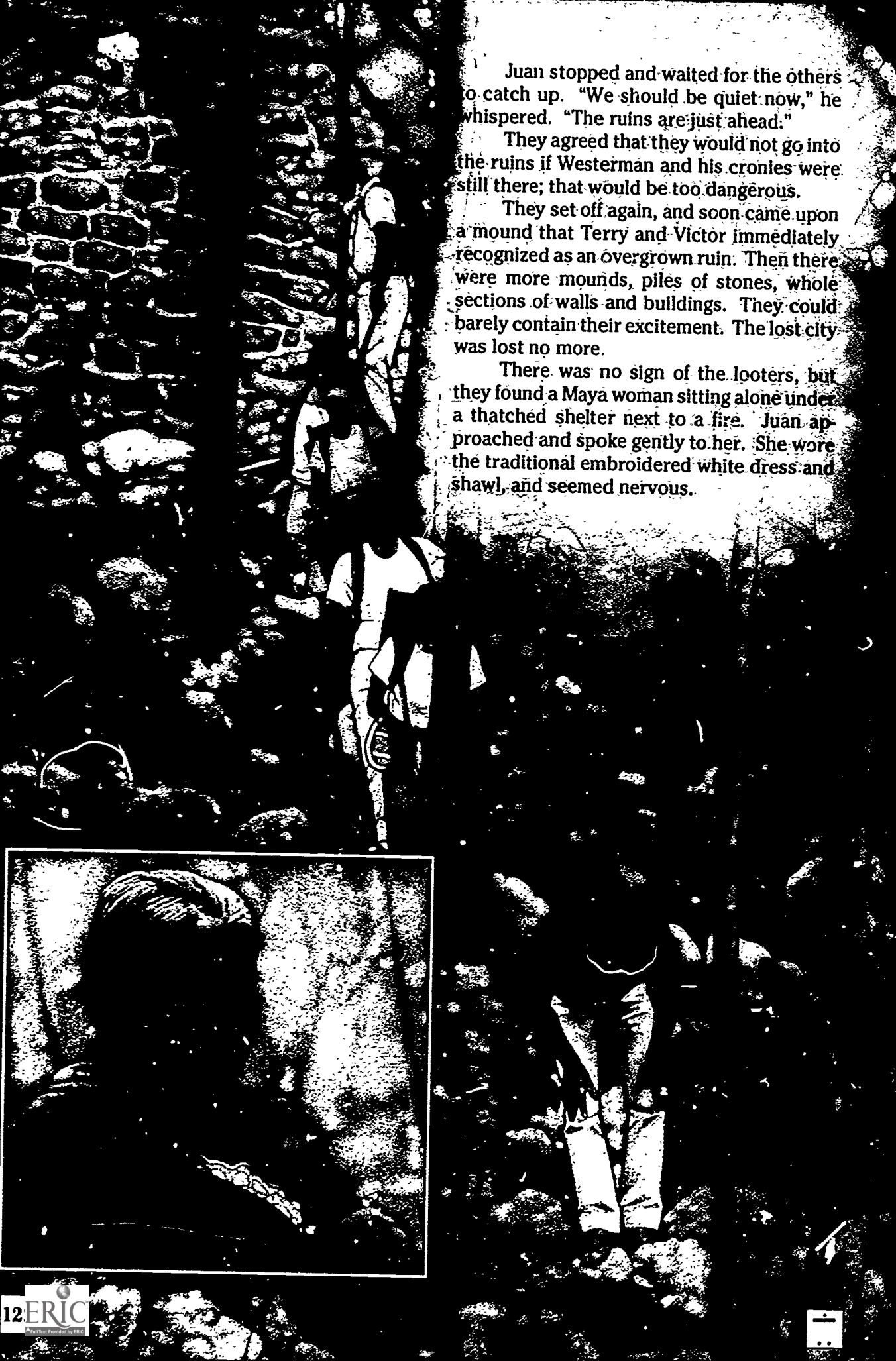
Shifty Eyes was saying that Westerman had called to instruct them to get the beacon fire going. They were taking everything out [illegible] night. "He says we can all retire on what [illegible] out tonight!" Shifty Eyes crowed.



"Yeah, on his share, maybe," his partner answered sarcastically. Suddenly he noticed something and looked in the direction of the divers. "What's that?" he asked.

"Maybe some of those **manatees**," Shifty Eyes answered, peering across the water. "Don't be so jumpy."

Pepper and Rosa slipped silently beneath the surface of the water, following their string back down into the darkness.



Juan stopped and waited for the others to catch up. "We should be quiet now," he whispered. "The ruins are just ahead."

They agreed that they would not go into the ruins if Westerman and his cronies were still there; that would be too dangerous.

They set off again, and soon came upon a mound that Terry and Victor immediately recognized as an overgrown ruin. Then there were more mounds, piles of stones, whole sections of walls and buildings. They could barely contain their excitement. The lost city was lost no more.

There was no sign of the looters, but they found a Maya woman sitting alone under a thatched shelter next to a fire. Juan approached and spoke gently to her. She wore the traditional embroidered white dress and shawl, and seemed nervous.

She told them that the looters had made her stay out there as their cook. Last night they had forced the Maya workers to work until sunrise. Westerman knew that the *Mimi* crew would soon be there, so he had left that morning, taking the Maya villagers along as porters.

She pointed out the trail they had taken. "*Muy malos*," she muttered somberly.

"*Si.* Very bad men," Terry agreed. "I'm trying to decide whether to laugh or cry. Westerman may have beat us here, but look what he led us to."

They slipped off their packs and gazed around in wonder. "Hey, you guys," Quiché called. "Look!" She was looking at something through the trees, and they all came over to see what she had found.

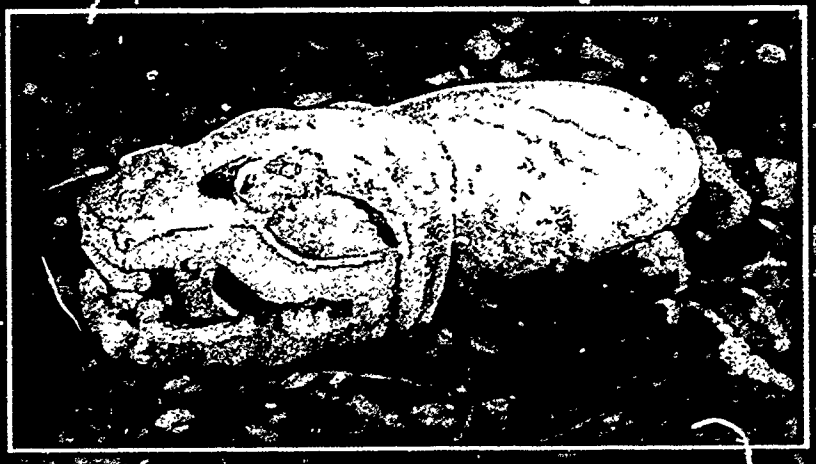
There, in a clearing, stood a pyramid, towering over the forest. They stared at it, awestruck, disbelieving, then ran over to put their hands on it. Not only was it real, it seemed to be in good shape, and some of the rubble and vegetation had already been cleared off by the looters.

C.T. bounded up the steep steps. Quiché was about to follow, but noticed a large carved stone lying on the ground. It was the head of a snake.

"Why didn't they take this?"

"They can only carry so much," Victor replied. "If they left this behind, the stuff they did take must have been incredible."

He looked up at the steep pyramid. Site U was no longer *un*discovered, he thought, but it was *un*believable—an unbelievable sight.



ACTIVITY

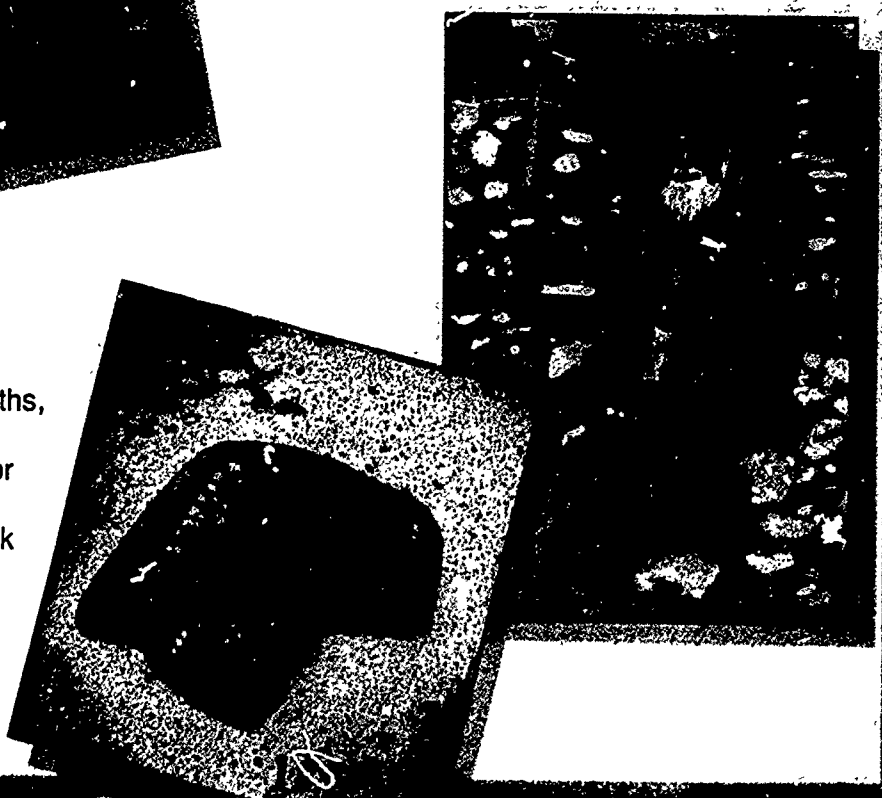
The Plot Thickens

"The Second Voyage of the *Mimi*" has been full of discoveries about the Maya, archaeology, science, math, nature and people. The pictures on these pages show some of the important things members of the *Mimi* crew learned or discovered. Each line of dialogue belongs to a picture. Try to match each picture with the dialogue.

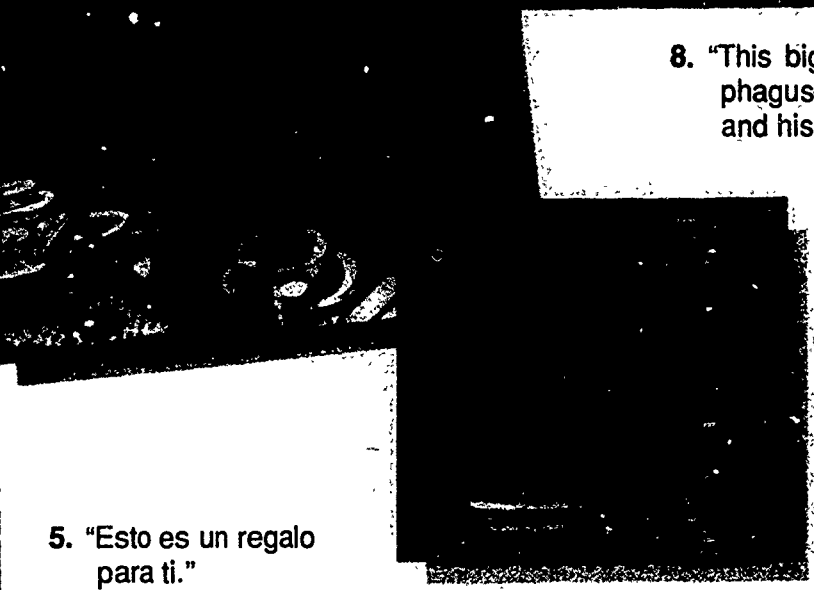
2. "How could one half of a 500-pound monument get from here to Tulúm?"

3. "When I saw a bunch of leaves walking around, I really thought the heat was getting to me."

4. "As the clay got hotter, it gave off a lot of luminescence, light energy."



1. "Well, if it had been down there for even a few months, it would have something growing on it, like algae or even coral. You can imagine what it would look like after a thousand years or so."



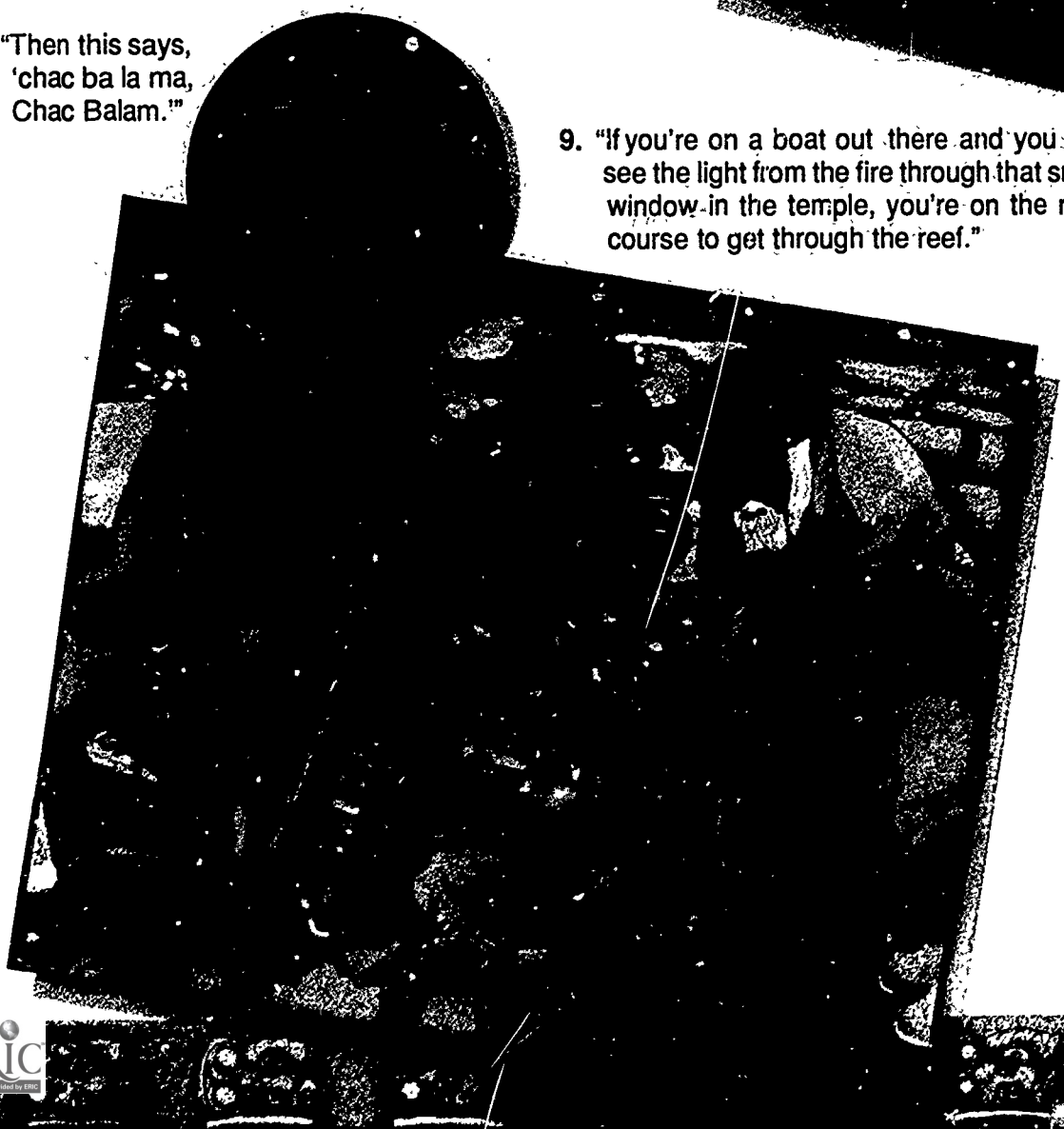
5. "Esto es un regalo para ti."

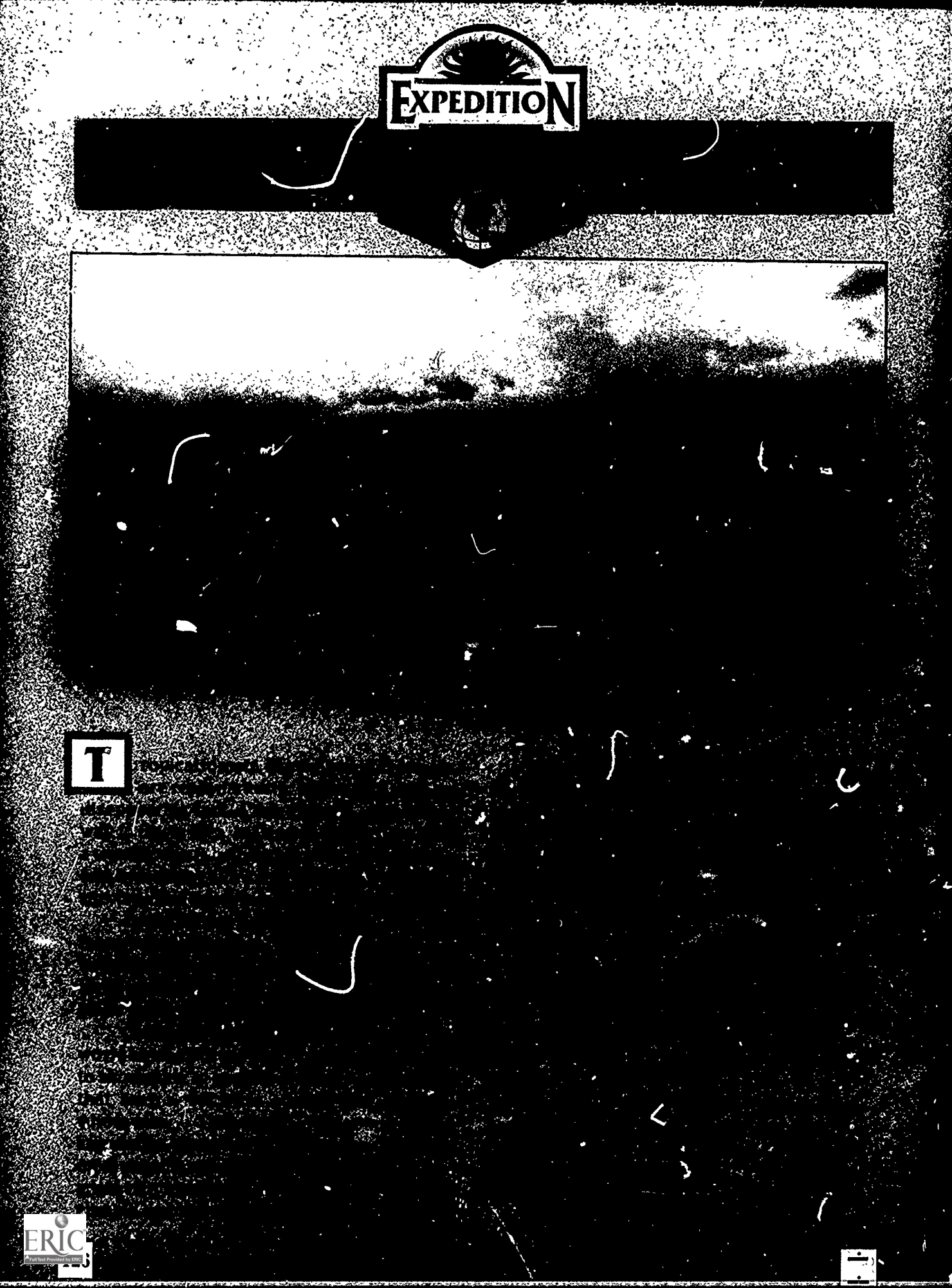
6. "We shouldn't move it 'til my mom sees where it is."

7. "Then this says, 'chac ba la ma, Chac Balam.'"

8. "This big stone was on top of the sarcophagus—the coffin. It tells all about Pacal and his ancestors."

9. "If you're on a boat out there and you can see the light from the fire through that small window in the temple, you're on the right course to get through the reef."




EXPEDITION

"Epiphytes is a very general name for any plant that grows on another plant. We're trying to understand how they interact with other parts of the forest," Nalini explained. "In tropical rainforests, the interactions between plants, animals and soil are very complicated and really important, but we still don't know much about them. Learning more about those relationships may help save rain forests that have been damaged by humans."

"The best way for you to find out about them is to climb a tree yourself," said Nalini. She handed Carla a coil of climbing rope and picked up the rest of the tools herself. They walked through the forest and into a clearing where a few huge trees stood. Nalini pointed at a giant tree that was covered with mosses, vines and other plants growing on its trunk and branches.

"I thought this tree would be a super one for climbing. I expected lots of [illegible] a nice and [illegible] lots of big branches," Nalini said, grinning.

"It certainly has them," Carla said. "What kind of a tree is it?"

[illegible]

[illegible]

again. This time, the weight and line sailed over the branch.

"Now comes the fun part, in which we 'twingle' the line down," Nalini said. With a graceful motion she sent a ripple through the line. At the other end, the fishing weight slipped down a little. She kept rippling the line, and bit by bit the weight pulled the line over the branch and toward the ground, until Nalini could reach it on the other side.

Then Nalini removed the weight and tied a heavier, stronger line onto the fishing line, using a strong knot called a [illegible]. When she had pulled that heavier line up over the branch, she was able to use it to haul her heavy climbing rope. Finally, the climbing rope was [illegible] over a big [illegible]. Nalini [illegible] that one end [illegible] the tree [illegible]

[illegible]

[illegible]

(Facing page) Carla and Nalini were 100 feet above the forest floor in another world where no humans had ever been.

Carla quickly learned the technique for climbing. It was an exciting—and scary—experience.

The most ingenious piece of equipment is the **ascender**. This is a small metal clamp with a triangular or wedge-shaped piece that has teeth on one side. The ascender slides easily up the rope, but when you pull down on it, the teeth "bite" onto the rope and hold it in place.

Nalini attached one ascender to the leg loops so Carla could move it with her legs and one to the seat harness which she could move with her hands. So with the two ascenders clamped onto the rope, Carla could inch her way up the rope like an inchworm.

"Stand up, and in one smooth coordinated motion slide the ascender up the rope," instructed Nalini.

Carla stood up, sliding the ascender up the rope. She pulled her knees up, which brought the other ascender up. She straightened her knees as if she were standing up and used her hands to push the top ascender up again. She picked the technique up quickly.

When Nalini saw Carla was safe and confident, she put on her own harness and started climbing up the second rope they had rigged. As they were inching their way up into the canopy, Nalini and Carla chatted.

"There's no way you can fall," Nalini assured Carla.

"Are you sure?" Carla asked nervously.

"This is always the exciting part, because you never know what you're going to find up there," Nalini said. "Just think, nobody has ever been up there except monkeys and birds and plants. So you're the first human who has ever walked up there."

Carla looked around appreciatively as she hung suspended like a spider on a piece of silk, fifty feet above the forest floor. It was neat to see the ground from a different perspective, the way birds see the world.

As they continued to inch their way up, Nalini pointed out some plants that were growing out of the tree trunk. They looked like pineapples and there were pools of water collected in the center of each one. "Those are tank bromeliads. From the top you can really see the way they are put together. They're really good at collecting and holding onto rain water. They act like little ponds. Birds come and drink water from them and actually take baths in them. The bromeliads are a very important group of epiphytes."

WHERE HAVE ALL THE FORESTS GONE?

[illegible] story about the [illegible] are cut, [illegible] room, [illegible] animals [illegible] trees [illegible] a year? [illegible] square miles of [illegible] and now? At the current rate of [illegible] how many years [illegible] will [illegible] trees [illegible] left in the world have been [illegible]


EPISODE
C
SALDE TURN
120°
KMAYA
LEAGE
CAMP
JIVE
QUICHE
STUNG
SITE
3KM

s on us, C.T.," Vic-

t not be too much," Captain
He pointed at the map he and
n keeping. It was a log of their
rting their southerly progress along
be to the place where Quiché was stung
he scorpion, then on to the village, and
ally to where they now stood, Site U.

Granny pointed out a road that lay a few miles east of their present position. Westerman had gone in that direction, and the Captain figured he had a truck waiting for him there. From there he would drive to Tulúm, but he would have to wait until dark to move the loot out to his boat.

"If we hustle [illegible] hitchhiking, we could get to Tulúm in time to stop him," the Captain concluded.

Everyone was up for that. They quickly collected their backpacks. The Maya woman gave them some tortillas for their hike. "*Yum botik*," they said to Juan, thanking him for his help. Then they left the lost city and disappeared into the jungle.

Meanwhile, Pepper and Rosa followed their string back towards the cave's entrance. "Who were those men?" Rosa asked, as soon as they surfaced next to *Mimi*.

"Cronies of that guy Westerman I told you about," Pepper answered. "I'm beginning to see how they operate."

At that very moment, Westerman w
leading his Maya porters through the jungle
a rapid clip. It was easy for him; he wasn
carrying anything, and he was on his way to
the biggest payday of his life. The Maya were
burdened with heavy burlap packages con-
taining the looted artifacts from Site U. The
carried the packages on their backs, supported
by a strap that strained against their fore-
heads. That wasn't the only way they wer

using their heads, though. They were snap-
ping twigs along the way, marking their trail.

Victor was leading his party along the same path. They were making good progress until they arrived at a fork. Which way to go?

For once C.T. had the answer. He'd spent a lot of time out in the woods in Ohio, and he knew how to follow a trail. He'd been noticing the broken twigs and he looked for one now. When he saw one a few feet down one of the trails, he knew he was right. The break was so fresh that the leaves hadn't even died. He was sure the villagers were marking the way for them.

Victor was impressed. "Why don't *you* lead us for a while, *amigo*," he said.

They took a water break an hour later. They finally managed to get through to Pepper on the radio. She was relieved to hear that Quiché was O.K., and amazed that they had actually found the lost city. But Granny didn't have time to go into details. He warned her that Westerman was on his way, and would probably try to take the loot out that night.

Pepper had a pretty good idea how he got it out to the boat without being seen. She started to tell Granny, but he was more concerned with her safety. He wanted her to get *Mimi* out of there and to play it safe. She should call INAH and see if they could get the federal police there.

"Don't start trying to play detective," he said, "and that's an order. Understood? Over."

"*Si*, understood. *Buena suerte*. Over."

"Good luck to you too. Over and out."

Pepper stood in thought for a moment, then turned to Rosa. "I think I've got an idea that might stop Westerman," she said.

Rosa gave her a worried look. "I hope you know what you're doing."

"Me too," Pepper said.

Westerman arrived at the road. It stretched out straight and empty in both directions. When the truck finally did arrive, Westerman blew his lid. He bawled the driver out while the Mayas loaded their heavy cargo into the back of the truck.

"You know, Pedro, I could learn to hate that man," the driver whispered to Shifty Eyes, who had accompanied him from Tulúm.

"You are a slow learner, then," was all Pedro had to say.

Back in the jungle C.T. suddenly came to a dead stop. "What are we going to do if we happen to catch Westerman?" he asked as the others pulled up behind him. It had just occurred to him that they were chasing a serious criminal, probably a dangerous one.

"*I'm* not afraid of Harvey Westerman," Quiché announced bravely, causing the Captain to grin.

"Catching him is not our purpose. *Tracking* him is," Victor emphasized.

"We'll leave the catching part to INAH and the *federales*," Granny added, still amused at the picture he had in his mind of a showdown between Quiché and Westerman.

"Sure," C.T. said, though he really wasn't sure. What if Pepper didn't get through to the police? Would they just stand by as Westerman sailed off with invaluable chunks of Maya history?

Back on *Mimi*, Pepper cut the engine and threw the anchor over the side. "Do you think we'll be safe here?" Rosa asked her.

"*Mimi* will be safe," Pepper answered. "We're going back to Tulúm."

"We are? But Captain Granville..."

Pepper cut her off. "I know, but I think your father can help us. Let's get going."

Westerman dropped his crew and cargo off near the *cenote* in Tulúm. "It's against my better judgment, but I'll have to trust you two to get the stuff out of here," he grumbled to Pedro and his partner. "I'll be at the reef with the boat at nine."

"We'll light the fire on the cliff," Pedro said obediently.

"Yes, you will," Westerman said, giving him a hard look. "Now pay off these Indians and tell 'em to take a walk."

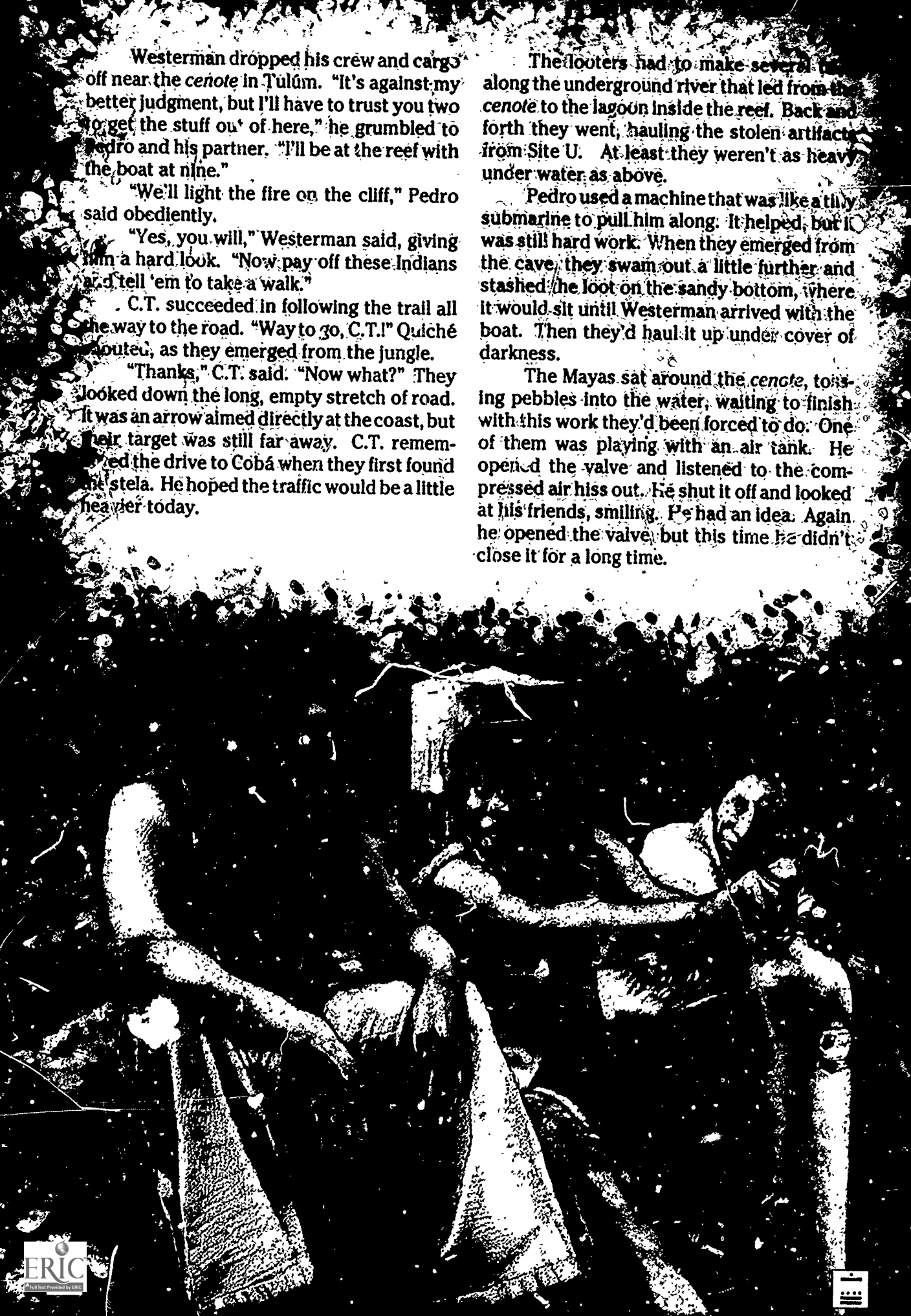
C.T. succeeded in following the trail all the way to the road. "Way to go, C.T.!" Quiché shouted, as they emerged from the jungle.

"Thanks," C.T. said. "Now what?" They looked down the long, empty stretch of road. It was an arrow aimed directly at the coast, but their target was still far away. C.T. remembered the drive to Cobá when they first found the stela. He hoped the traffic would be a little heavier today.

The looters had to make several trips along the underground river that led from the *cenote* to the lagoon inside the reef. Back and forth they went, hauling the stolen artifacts from Site U. At least they weren't as heavy under water as above.

Pedro used a machine that was like a tiny submarine to pull him along. It helped, but it was still hard work. When they emerged from the cave, they swam out a little further and stashed the loot on the sandy bottom, where it would sit until Westerman arrived with the boat. Then they'd haul it up under cover of darkness.

The Mayas sat around the *cenote*, tossing pebbles into the water, waiting to finish with this work they'd been forced to do. One of them was playing with an air tank. He opened the valve and listened to the compressed air hiss out. He shut it off and looked at his friends, smiling. He had an idea. Again he opened the valve, but this time he didn't close it for a long time.



Soon the divers returned. Pedro ordered the Maya to hand him the last of the wrapped stones. His partner climbed out of the *cenote* and removed his tank; he needed a new one. This was the last trip, so Pedro shouted at the Mayas that they should clear out now. They looked at him coldly, and slowly turned to go.

It didn't take long for the diver to realize he was in trouble. He was following Pedro through the underground river, daydreaming about his share of the profits, when he suddenly ran out of air. He snatched the regulator from his mouth and shook it, thinking it must be blocked somehow, but no bubbles emerged. He sucked on it again. Nothing. He flailed around until his hand found his pressure gauge. The needle was on zero.

Pedro couldn't hear the muffled scream behind him. His partner turned, panicking now, and swam as hard as he could. He resurfaced in the *cenote* with a huge gasp, and collapsed on the nearest rock, groaning and struggling for air.

The Maya villagers were waiting. They grabbed him and wrapped a line around his arms and chest. He was too weak to resist. They tied the rope off tightly.

Meanwhile, the *Mimi* gang trudged on. It seemed hotter on the road than in the jungle. No traffic. *Nada*. Not even a donkey. Finally a minibus passed them, but it was going in the wrong direction. It didn't even stop.

At this rate they'd be walking all night, Quiché figured. It wasn't a pleasant idea. Just then she heard an engine in the distance. They all turned. It looked like Jean and George's jeep. It *was* Jean and George! They couldn't believe their luck. They piled into the jeep, all talking at once.

At the same time, in the water off Tulúm, Pedro was tying the bundles of looted relics together, so Westerman could haul them out of the water and onto the deck of his boat.

Meanwhile, George drove the overloaded jeep as fast as it would go, but it seemed as if they'd never get there. It was dark by the time they pulled into Tulúm.

scrambled out of the jeep and ran to the edge of the cliff. They got there just in time to hear the throttle of a powerful inboard motor.

They peered out into the night, straining their eyes. Moonlight was glittering on the water. The sound of the motor led their eyes to a dark shape moving slowly towards the open water beyond the reef.

already knew.

"I'm afraid so," Captain Granville said. "He's running dark."

"Oh no," Quiché groaned.

"We just missed," C.T. said, his heart sinking. They stood in silence, watching helplessly as a few more pieces of the Maya puzzle disappeared from view.

ACTIVITY

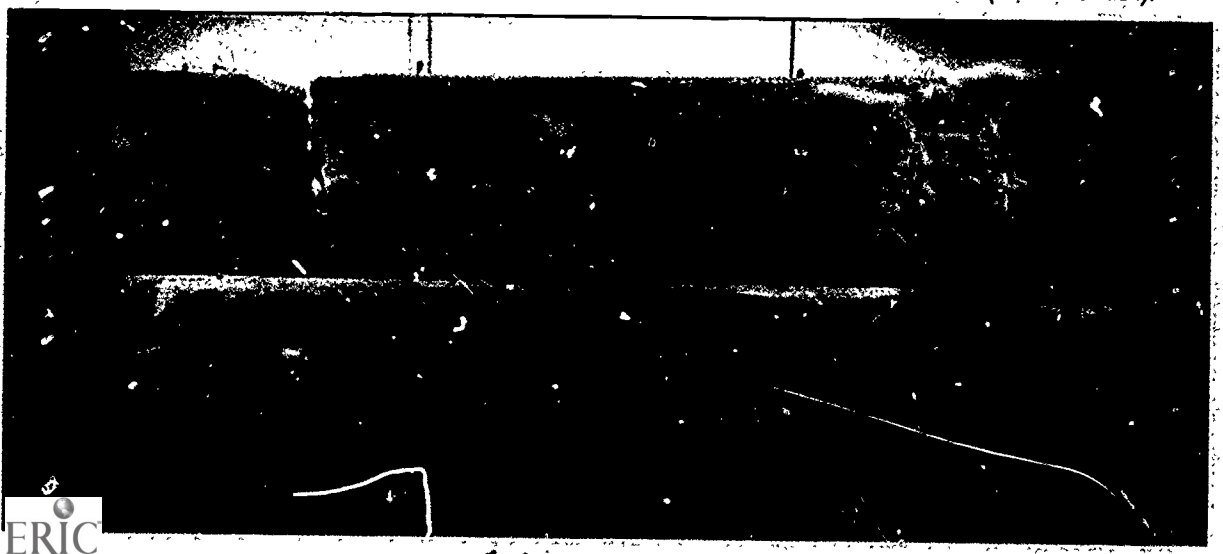
STAMP IT!

The Maya carved limestone and jade using blades made of obsidian. Obsidian is a kind of volcanic glass that can be chipped to form a very sharp edge. With these simple tools, they created beautiful detail on their buildings, monuments, and jewelry.

Jade portrait pectoral, Middle Pre-Classic Period (1000-600 B.C.).

Cylindrical vessel, Late Classic Period (600-800 A.D.).

Sculpted bench panel, Temple 11, Copán, Late Classic Period (circa 775 A.D.).

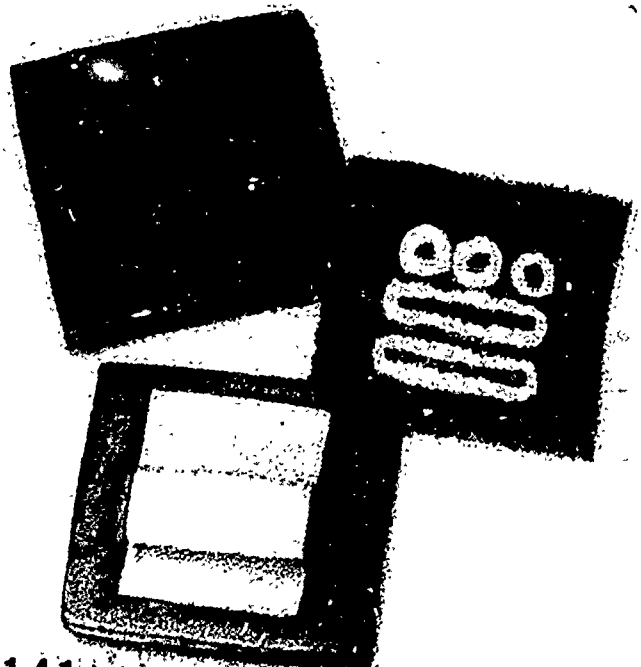


Bird Jaguar dressed for battle, Late Classic Period (circa 760 A.D.), Yaxchilán, Chiapas, Mexico.

You, too, can make carvings using simple tools. With a styrofoam meat tray and a pencil, you can "carve" stamps and use them to make beautiful patterns.

Here are some examples of Maya design. Take ideas for your designs from these and from Maya art you see throughout "The Second Voyage of the *Mimi*." Then follow these simple instructions:

1. Cut the curving sides off the meat tray, so you have a flat piece of styrofoam.
2. Plan your stamp on a separate piece of paper. Think about designs that are from 1" to 3" square.
3. Use a pencil (the point should not be too sharp) to draw your design on the styrofoam. Remember that when you print with your stamp, the image will come out backwards. This may only matter if you plan to print words.
4. Cut off the extra styrofoam so there is only a small border around your design.
5. Make a handle for your stamp with a piece of masking tape.
6. You can ink your stamp in a few ways. One way is to buy a stamp pad at a stationery store. Another way is to mix tempera paint with a squirt of liquid soap. Paint this mixture onto a sponge and use the sponge as a stamp pad. Another way is to buy special ink and a "brayer," and roll the ink onto your stamp. A brayer is a small roller, especially made for printing by hand.
7. Experiment with your stamps. You can make many different ones. Use them to create patterns or to illustrate stories.




EXPEDITION

"Aren't we actually sitting in an epiphyte?" asked Carla.

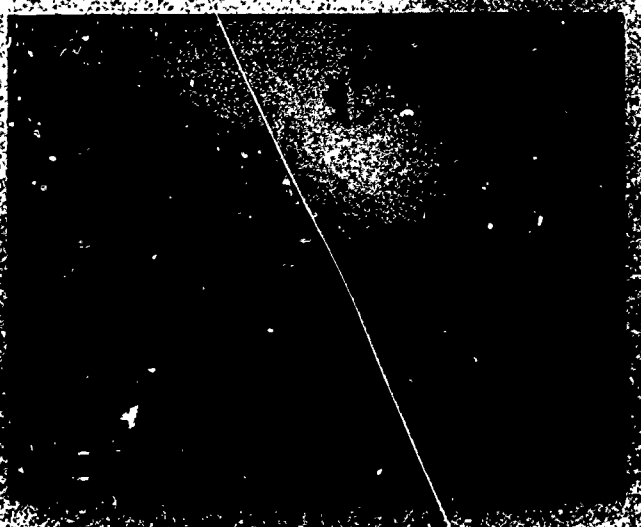
"That's true. It was a little fig tree or fig seed that some bird deposited on a tree. It started out its life by being an epiphyte perched on the branch of that tree. Then it started growing down. Now its roots are in the ground, so it's not really considered an epiphyte anymore," answered Nalini.

As the epiphytes grow and die, they create a kind of soil under them that gets several inches thick in some places. It's similar to soil on the ground. One of the things Nalini is trying to find out is how the soil in the trees is different from soil on the ground.

When Nalini was still a student she made a very surprising discovery. In among the roots of the epiphytes she found other roots. These roots grow right out of the branches of the tree itself. It seems a tree like this strangler fig can actually use the soil that the epiphytes build upon its branches.

"It seems from a nutrient standpoint that the epiphytes might really be helping the trees. The trees give support to the plant up here in the canopy. In return the epiphytes are providing a nutrient source that the trees can get into directly. So it's sort of a symbiotic or mutually beneficial relationship," said Nalini.

It was Nalini who discovered that a tree could grow roots from its branches. When she first found the roots she realized they were coming from the tree [illegible] She showed [illegible]



[illegible]

The canopy is like a separate world. The forest floor is covered in [illegible] for a long time, there's a really good chance that a [illegible] howler monkeys will come through. Nalini said. "They just scream at us and run. They don't seem to like us. They sort of yell at first and growl. After a while, they just kind of stand and look at me, sort of like they're trying to figure out what I'm doing here."

"Do they ever yell back at them?" asked Carla.

"Sure, that's what's fun. Sometimes when I do that, they answer. They'll keep [illegible] yeah. I wonder what I said to them."

Like the [illegible] Nalini is fascinated [illegible]

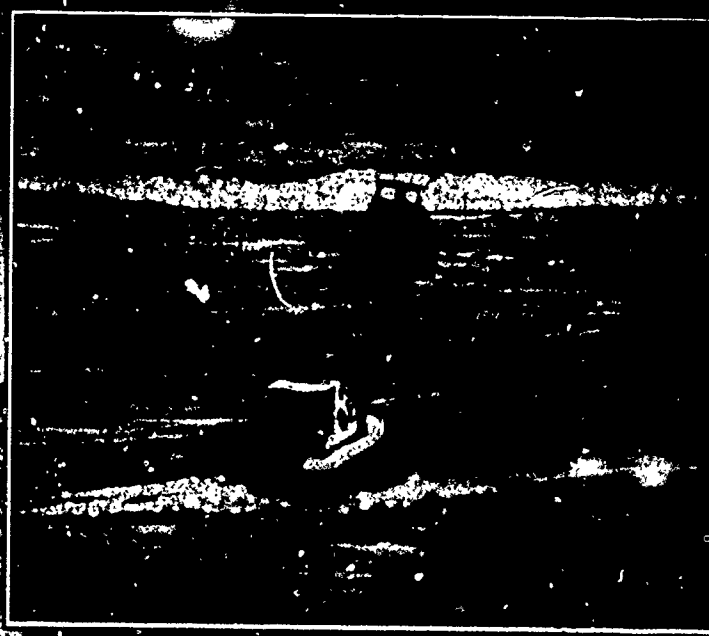
Coming down by rappelling was faster but also a lot scarier. If Carla let go, she could fall all the way to the ground.

The insect's amazing camouflage makes it almost impossible among the epiphytic mosses where it lives.

ADOPT A TREE

Choose a tree that you especially like. Make sure it's near your home or school so you can visit it all through the year. Make a book of your observations. Hug your tree. Can your arms fit around it? Draw your tree from different points of view: from far away, from underneath, looking up. Make rubbings of the bark or a leaf. Collect samples of things you find under your tree. Can you tell which came from your tree? Observe and draw the creatures that visit your tree in one hour. Do any creatures live in the tree? Look for tiny insects as well as birds and squirrels. Are there nests in your tree? What kinds of animals built them? Are there other plants growing on your tree—lichens, mosses, or vines? Write a story about a day in the life of your tree in every season. You may want to learn what species your tree is and read more about it.

EPISODE



The waves were breaking out on the reef, catching the moonlight. Once the boat crossed that shimmering silver line, Westerman would gun his engines and vanish into the night forever. They watched from the cliff, waiting in gloomy silence for that moment to arrive.

"Isn't there something we can do?" Quiché finally asked.

"It's too late," Captain Granville answered. "They'll be through that reef soon, free and clear."

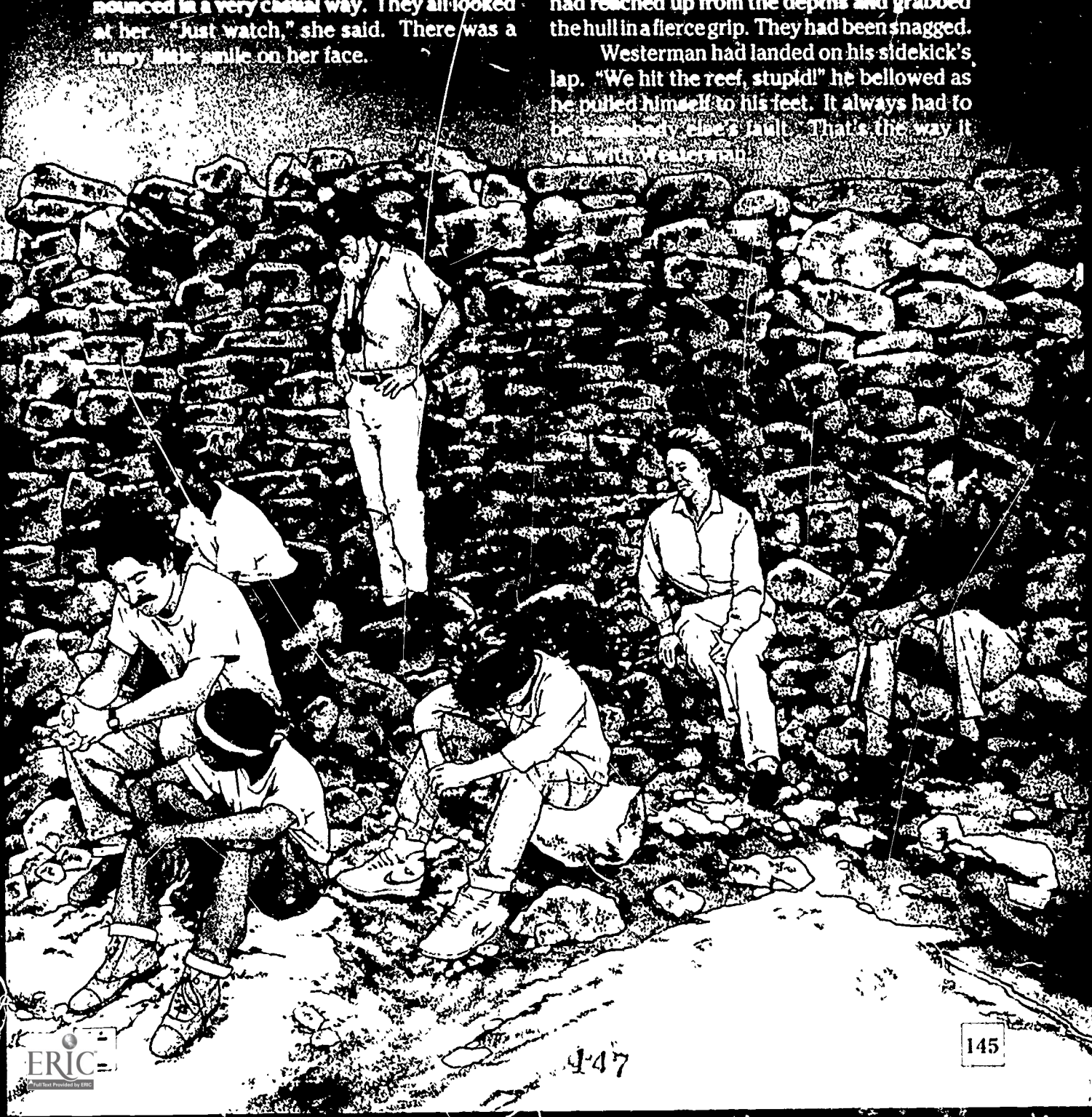
Terry sighed. "There goes a boatload of Maya history," she said in dismay. They didn't know exactly what Westerman had on board, but they knew it was valuable. Not only in terms of money, which was all that Westerman saw when he looked at the relics, but in terms of knowledge. Buildings, monuments, and artifacts were all that was left of the ancient Maya, and each looted relic was another page ripped from the only diary they left behind.

Westerman was concerned with less weighty matters. He just had to steer his boat through the reef. His sidekick was navigating for him, setting their course by lining them up with the light on the cliff, but it didn't feel right to Westerman. He cursed and turned to take a look. There was the fire, all right, so they *had* to be on course. Still...

nounced in a very chilled way. They all looked at her. "Just watch," she said. There was a funny little smile on her face.

had reached up from the depths and grabbed the hull in a fierce grip. They had been snagged.

Westerman had landed on his sidekick's lap. "We hit the reef, stupid!" he bellowed as he pulled himself to his feet. It always had to [illegible] "That's the way it [illegible] with Westerman.



moved Westerman's fire—just a few feet, enough to put him on the wrong course when he lined the boat up with his "lighthouse."

"Aren't you clever!" George exclaimed, and the others chimed in with their congratulations. Rosa and Pepper beamed.

said to Westerman. "Guess that's what you get when you play with fire."

"That's what he gets when *we* play with fire," Rosa quipped.

We spent the next few days in Mérida, making our report to the authorities. Then we came back here to take a closer look at the Lost...I mean...Found City.

C.T. was sitting at the base of the pyramid, bringing his journal up to date. He heard Victor calling him. *Terry and Victor say it was definitely a major city!* he concluded, and ran off to find the others.

Victor had found an entrance to the pyramid. They entered quietly and followed a vaulted passageway deep into the interior until they came to a dry wall that closed off the corridor.

"Could it be a tomb?" Quiché asked.

"Maybe," was all Victor would say, but [illegible] the excitement in his voice.

[illegible] while to dislodge [illegible] once they'd [illegible] to look through, Victor [illegible] "It is a tomb," he said, [illegible] ing off the stone walls.

[illegible] ed together to get a peek. [illegible] revealed a [illegible] lying on the [illegible] by [illegible] gonial vases. [illegible] ful jade [illegible] onderful [illegible] ped, she [illegible] e of the [illegible] was Chac

There was a hush as Quiché studied the other glyphs. "There's a calendar date," she said, pointing. She paused again, struggling to interpret what she was seeing. "On the day, 11 *cauac*, 2 *mac*, was captured Chac Balam of Cobá," she read, very slowly. "Count forward 1 *uinal* and 2 *tun* to his...what do you call that word when somebody becomes king?"

"Accession," Terry answered, her eyes dancing. "His accession as Lord of Site Q!" she exclaimed [illegible] recognizing [illegible] last glyph. "[illegible] for about [illegible]

C.T. [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] to [illegible] ravaged.

It was all [illegible] for [illegible] stressed, but it certain[illegible] sible that [illegible]

Terry added, "A [illegible] some [illegible] their years [illegible] as. And maybe in [illegible] luck—they'll [illegible]

"I [illegible] a hundred [illegible]

They were overjoyed by their discovery. And amazed that Westerman hadn't found it first. Later in the afternoon, they sat on the steps of the pyramid. The jungle extended in all directions as far as the eye could see. They were still discussing their good luck when a visitor appeared. It was Avram, C.T.'s friend from the village. He greeted them shyly, then handed C.T. a package.

It was a pot, a perfect replica of the pot that led them to Site U in the first place. They figured C.T. deserved it, since he hadn't been allowed to keep the first pot or the jade head Avram had given him.

It was Quiché's idea, but Terry had made it for him. It looked just like the original, except that it didn't have a hole in it. And it had something extra: the *Mimi II* glyph.

"It's your going-away present," Quiché announced.

Going away! C.T. realized he'd lost track of the days, and he'd be leaving soon. It wasn't going to be easy to say goodbye to all the great friends he'd made in the Yucatán.

Now we're back in Tulúm, C.T. wrote in the journal. *They were all back on Mimi again,* in the calm waters inside the reef off Tulúm. He munched on a tortilla from his new souvenir pot. *Terry and Victor will be picking up where they left off when we found the stela. Tomorrow, I go home. Mañana, voy a casa. I sure am going to miss everybody.*

"Last one in swabs the decks!" his grandfather shouted. Terry and Victor were already in the water. Pepper and Quiché were about to dive off the side.

"Wait a minute!" C.T. shouted. He rushed to finish the line he was writing. *Hasta luego,* he wrote in bold letters.

His grandfather had his shirt off, and all the others were in already. C.T. threw down his journal and tore off his T-shirt. He hated swabbing the decks.

He hit the water a second after his grandfather. "I guess you swab the deck one more time," Granny laughed.

"Hey, no way. It was a tie!" But his shouts were doused by a splash in the face. They fooled around in the clear emerald water near *Mimi* for a long time, swimming and laughing and splashing. C.T. didn't want to get out. He was going home to a lot of [illegible]


Hasta Luego!

ACTIVITY

Time Travel

Artifacts can be thought of as time machines. They don't really take you back in time. But by studying them and imagining how people made them and used them, you can imagine what life might have been like in another time. It's tricky because people don't deliberately leave artifacts around. Archaeologists usually study odds and ends—things that happened to have been preserved.

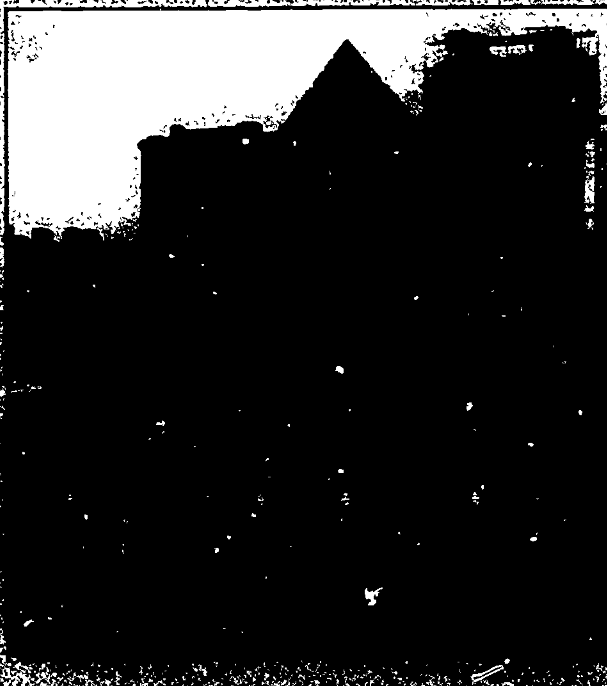
You could help future archaeologists. Make a time capsule filled with artifacts that tell the story of your everyday life. Include as many details as possible. For objects too big or valuable to bury, use photographs.

Bury the artifacts in a waterproof, air-tight container, because in those conditions, they will not decompose for thousands of years. A container made of glass or plastic will work.* Make a map showing exactly where you buried your time capsule. You, yourself, may want to excavate it a few years from now. It will tell you about your own past life. Or, you may want to leave it for future people to find.

*Compare these instructions to Activity 5, where you buried artifacts so they were exposed to the soil, soil creatures and water. Why are these instructions different?

EXPEDITION

A modern-day limestone temple



Nobody really knows just what all the ancient Maya buildings were used for. They do know that some of them were temples, probably for religious ceremonies. Ben Affleck visited a modern-day temple, the Cathedral of St. John the Divine, in New York City.

A **Gothic** cathedral may not look much like a Maya temple, but in one way they are similar. Like all Maya temples, St. John is built of thousands of limestone blocks.

Limestone was formed at the bottom of great seas. Over thousands of centuries, the shells and skeletons of millions of sea creatures piled up on the bottom. As the pile got bigger and heavier, the shells crushed and compacted into solid rock. Sometimes you can still find the fossils of these tiny creatures in the stone.

The limestone for the Cathedral comes from Indiana. Huge chunks of it are cut from quarry walls and trucked all the way to New York. No one knows how the Maya did this. They didn't even use animals to help with their work. Even now, with all kinds of machinery, it takes a long time to complete a cathedral. This one's been under construction for nearly a hundred years.

When it's finished it will be the largest Gothic cathedral in the world. [illegible]

"I think the best way for me to [illegible] what happens here in the stoneyard is to follow the life of one stone—right from the quarry until we actually set it on the tower," said [illegible].

For each piece there's a card with a [illegible]

Ben operated the smaller saw to cut the block to manageable size.

blade from overheating from all the friction. It also helps keep the dust down.

Once a block small enough to manage had been cut, Alan drew the actual shape of the block on each of its sides using life-size patterns or **templates** made of zinc. Then a smaller saw cut out large chunks of the stone that were not needed.

The next stop was the cutting banker or bench where the handwork began. First, big chunks of stone were chipped away with a large chisel. "This is called pitching," said Alan. He let Ben use an electric chisel to knock off some unwanted stone.

The block still looked pretty rough and raggedy. Carol Hazen, one of Alan's **apprentices**, used hand tools to smooth the stone into the exact shape required.

Alan started learning to cut stone when he was just sixteen. He wasn't doing well in school until he was sent to college as part of his apprenticeship. "When I was young and in school, I couldn't see much purpose to what I was being taught. But doing work at a craft like stonecutting showed me there was a reason for it all. Working with a piece of stone makes me realize that things like geometry and algebra really matter a lot of sense. I wish I could get a lot of that" for out of it and a lot of love for what I do," he said.

Once the cutting was finished, the block was ready to have a design carved on it. To move it to the carving shed, they had to put a hole in it first. Then a [illegible] was put in the hole and [illegible]. This was [illegible] made of [illegible] gauge. [illegible] a tool [illegible] idea to [illegible] under the [illegible] to [illegible] to the [illegible]

She spread out an array of tools: an old wooden mallet, a rubber mallet and a variety of chisels of different sizes.

Before she learned to carve, Cynie spent four years in the cutting shop. She was Alan's first apprentice. "Sometimes I miss being over there," she said, "because this is a lot of little work, little tapping. Over there, you can really pound away at what you're doing. There you have templates and you know exactly what you're supposed to come out with. You can measure it and check it all along the way."

"Do you ever make really big mistakes?" asked Ben. It looked like one false stroke of the hammer could destroy the work of days.

"Not too often," Cynie replied. Ben watched, fascinated. Cynie kept tapping away as she talked. Slowly, a pattern of graceful curves emerged from the square stone. At the end of two days, the stone was smooth and a delicate "leaf" pattern had been carved in it.

When a block is finished, it's marked off on a large drawing of the Cathedral tower. Each person's work is represented by a different color. Cynie's color is purple.

The block was getting to be an old friend, so Alan suggested Ben carve something on it where it wouldn't show. He showed Ben how to use a hammer and chisel to carve "Mimi" on the back of the block.

Next the block was lifted by outdoor elevator to the top of the Cathedral. They were up about a hundred and sixty feet. Ben looked at [illegible] and wondered how [illegible] years ago or how [illegible]

Will future archaeologists wonder about this limestone temple and the block with "Mimi" etched on the back?

[illegible] cutting and shaping, it went into place high on the south tower of the Cathedral of St. John the [illegible]. Maybe fifteen hundred years from now [illegible] will wonder about this temple and [illegible] the strange inscription in ancient English: "Mimi."

BE A ROCK-A-PHILE

Check out the stone buildings in your town. Take a magnifying glass and look closely.

If the building is made of limestone, look for fossils. If it is made of sandstone, look for individual grains of sand, cemented together by nature. Granite has wonderful patterns created by its minerals. Are there carvings in the stone? Is the stone eroding?

Find out whether the stone is local or came from far away. Have you seen outcroppings of the same kind of stone? Is there a quarry in your town?

MAYA STELA

(Prop from "The Second Voyage of the *Mimi*")

Approximate dimensions 5'4" high, 2'8" wide, 7" thick

Material: fiberglass and resin

In "The Second Voyage of the *Mimi*," the *Mimi* crew finds part of an ancient Maya monument, called a stela, on the bottom of the lagoon at Tulum. Hieroglyphic writing on the fragment concerns a great (fictitious) Maya ruler named Chac Balam ("Strong Jaguar" or "Red Jaguar"), Lord of Coba. When the other half of the stela is found and the two pieces are fitted together, the carved inscription on the monument can be read, and the story of Chac Balam ends in a tantalizing mystery. After only four years as King of Coba, Chac Balam was captured by "Bird Skull," ruler of Site "U," a major Maya site long known to exist because of monumental references like this one but never found by archaeologists.

To design the picture to be carved in relief on the stela and the accompanying hieroglyphic text, the "Mimi" producers turned to George Stuart, chief archaeologist for the National Geographic Society and a world-renowned Maya scholar. George, in turn, recruited his son David, youngest winner of the MacArthur Award and expert in Maya hieroglyphs.

The stela was fabricated out of fiberglass and resin by Sr. Juan Martinez Montemayor, a Mexican sculptor experienced in making prop artifacts for films and television programs. He first modeled the two pieces of the monument in clay, then made latex molds to form the final product. Gray pigment added to the final coat of resin gives the appearance of weathered stone. Concealed openings in each hollow piece allow sand to be added to provide credible weight.

GLYPH TRANSLATION

A

abdomen: the hind part of an insect's body

absorb. to suck up or drink in (a liquid)

accession: the act of attaining power or a throne

amputate: to cut off, usually by surgery

anaesthesia: partial or total loss of the sense of pain

antivenin: a serum that counteracts the poisonous effects of venom

apparatus: instruments or tools used for a specific purpose, like an experiment

apprentice: a person who works for another in order to learn a trade

arachnid: type of arthropod with four pairs of legs and breathing tubes, including spiders, mites, ticks, and scorpions

archaeoastronomer: one who studies the astronomical knowledge of ancient civilizations

archaeobotanist: one who studies ancient plants

archaeologist: one who studies the life and culture of ancient people by studying their monuments, artifacts and inscriptions

artifact: any object made by human work

ascender: a thing that goes up or helps one to go up

astronomer: one who studies stars, planets and other heavenly bodies

atmospheric pressure: the pressure on the earth due to the weight of the earth's atmosphere, an envelope of gases that extends to a height of about 22,000 miles; at sea level, atmospheric pressure is equal to about 14.69 pounds per square inch

authentic: genuine, real

B

ballast: anything heavy carried in a ship or aircraft to give it stability or to control the depth or altitude

barometer: a device for measuring pressure

bearing: a direction, relative to a particular position

bends: pain or paralysis caused by the formation of nitrogen bubbles in the blood because of a sudden lowering of atmospheric pressure (also called caisson disease and decompression sickness)

biologist: a scientist who studies plants and animals

botanist: a person skilled in botany (plant science)

bowline knot a knot used to tie off a loop so it won't slip

C

calibrate: to establish or correct the measurement markings on a measuring instrument, like a thermometer

camouflage: device or technique to disguise or hide something from an enemy

carabiner: a strong metal ring with a hinged gate that automatically closes itself; used in mountain climbing

carbonated: filled with carbon dioxide

Cartesian coordinates: a pair of numbers that locate a point by its distance from two intersecting lines

cenote (Spanish, from the Mayan *tzonot*): a deep natural well carved out of limestone; sinkhole

centrifuge: a machine that separates particles of different densities by means of centrifugal force–a force that tends to pull a thing outward when it is rotating rapidly around a center

compress: to press together, to force into less space

condense: to change to a denser form, as from a gas to a liquid

conquistador (Spanish). one of the Spanish conquerors of the Americas during the 16th century

coral head: a large piece of coral

coral polyp: a small marine animal with a soft, tube-shaped body and a mouth surrounded by tentacles; some make hard skeletons that form coral reefs

core temperature. the temperature deep inside the body of a mammal

cortisone: a hormone often used to treat certain allergies and arthritis

curandero/curandera (Spanish): healer

curio. any unusual article (from curiosity)

D

daub. a soft, sticky mud or plaster used to cover or coat something (also used as a verb)

decipher: to figure out the meaning of; to translate

decompose: to break down or separate into basic parts

decompression: gradual return to normal atmospheric pressure after being in deep water or compressed air

detritus: build-up of disintegrated material

diagnose: to identify an illness by medical examination

dung: animal excrement; manure

dynasty: a series of rulers from the same family

E

ecology. the study of relationships among living things and their environment

electrode: a terminal that conducts an electric current into or away from a substance

emblem glyph: a hieroglyph that identifies a particular ancient Maya city

epiphyte: a plant that grows on another plant but is not a parasite

equator: an imaginary circle around the earth that is equal in distance from the North and South Poles

esophagus: a tube connecting the mouth with the stomach

Eustachian tube: a slender tube between the middle ear and the back of the throat that helps equalize air pressure on both sides of the eardrum

evaporate: to change from a liquid or solid into vapor (gas)

evolve: to develop gradually by a process of growth and change

expand: to grow bigger; to spread out

extinct: no longer in existence; having died out

fluent: able to write or speak easily and smoothly

fossil: hardened remains of animal or plant life from a past geological age

friction: rubbing of one object against another

gablet: triangular stone used in building, usually above an entrance or window

galvanize: to coat metal, usually iron or steel, with zinc

Gila monster: a slow-moving venomous lizard with a short tail and covered with orange and black scales; found in desert regions of Mexico and the United States

glyph: a symbolic character, usually carved

graduated cylinder: a long thin container used by scientists to measure liquids

Gothic: related to a style of architecture developed in Europe in the 12th through 16th centuries; characterized by flying buttresses, pointed arches, steep roofs

gram: basic unit of weight in the metric system; equal to about 1/28 of an ounce

guacamole: sauce or dip made from avocados

guinea pig: a small, fat mammal of the rat family, often used in biological experiments; a person or thing used in an experiment or test

hieroglyphics: system of writing in which a picture or symbol represents a word, syllable or sound

humidity: dampness; moisture in the air

hypothermia: the condition of a body when it loses so much heat that the core temperature drops dangerously low

hypothesis: a theory or proposition which has not yet been proven

implode: to burst inward

insulate: to cover, surround or separate with material that will prevent or reduce the transfer of heat, electricity, or sound

Iron Age: the period in history when people began to use iron to make tools and weapons; occurred in Europe around 700 B.C. to 50 A.D.

kiln: a furnace or oven for baking or drying things like bricks and pottery

lead: a wire carrying current to or from a piece of apparatus

lichen: small plant made up of a fungus living symbiotically with an alga; often grows on rocks or other plants

loot: to steal artifacts from an archaeological site

machete: large knife with a heavy blade used to clear underbrush and to cut sugar cane

manatee: large plant-eating mammal that has flippers and a wide, flat tail; found in shallow tropical waters

Maya: group of people native to the Yucatán Peninsula and parts of Central America whose highly developed culture flourished between 300 and 900 A.D., and then collapsed

meridian: any of the lines of longitude running north and south on a globe or map, passing through the north and south poles

metabolize: to carry on the physical and chemical processes by which the bodies of living creatures are built up and kept going

midden: a garbage heap

molecule: the smallest bit of an element or compound that has the qualities of the element or compound

mortar: a hard bowl in which softer substances are ground, usually with a pestle; a mixture of cement or lime with sand and water, used between bricks or stones in building

mucous membrane: a mucous-making tissue lining inside parts of the body that come into contact with air, keeping them moist

nitrogen narcosis: loss of the ability to think clearly, caused by the inhalation of too much nitrogen, as by deep sea divers; also called **rapture of the deep**

nutrient: anything having value as food

obsidian: hard, usually dark-colored glass formed by volcanos; can be worked to form extremely sharp edges

percolate: to pass a liquid through small spaces or a porous substance

parasite: a plant or animal that lives in or on the body of another plant or animal, getting nourishment from it, and usually harming it

pestle: a tool used to pound or grind a substance; usually used with a mortar

petri dish: a very shallow, clear dish with a loose-fitting cover, used to grow micro-organisms

phantom pain: pain sometimes experienced by amputees in parts of their body that have been amputated; the result of nerve endings that remain in the brain, even if part of the body has been amputated

polar coordinates: mathematical system for locating a point on a plane, using distance and bearing from a central, fixed point on a fixed line

poultice: a soft moist mixture put on the body as medicine

prosthesis: an artificial replacement for part of the body

pupae (plural of pupa): insects in the stage between larva and adult; usually enclosed in a cocoon

Q

quarry: a place where stone for building is excavated by cutting or blasting

R

radiation: the process in which energy (like heat, light, or x-rays) is given off, moves through space or another substance, and is absorbed by another body; radiation therapy is a cancer treatment which involves bombarding the cancerous part of the body with certain kinds of radiation to kill the cancer cells

radioactive: giving off energy in the form of rays or particles as a result of the breakup of atoms

rapture of the deep (see **nitrogen narcosis**): so-called because of the intoxicated feeling that accompanies it

rappel: to descend (a cliff face or a tree) using a rope tied above and wrapped around the climber's body to control the rate of descent

reef: a ridge of coral or sand near the surface of the water

regulator: a device on a scuba tank that adjusts the pressure of the air the diver gets from a tank to match the pressure of the water he or she is in

relic: an object or custom that has survived from the past

replica: a copy of a work of art or other object

rite: a formal, ceremonial act, usually part of a religion

rotate: to turn around a center point or axis

S

sac: a structure in a plant or animal that's shaped like a bag or sack

sacbe (Mayan): an ancient Maya footpath or road

salvage: to rescue a ship or cargo at sea

sarcophagus: a stone coffin or tomb, often decorated with carvings

sauna: a bath in hot, dry air

scuba: equipment used by divers for breathing underwater; usually includes one or two compressed air tanks and a hose connecting them to a mouthpiece

sensor: a device to detect and measure temperature or light and transmit the information to a recording machine

sherds: pieces of broken pottery (same as shards)

shunt: to change the path of blood in the body

snorkeling: swimming just under the surface of the water with a breathing tube, called a snorkel, that extends above the surface of the water

solstice: the two times of the year when the sun is furthest from the celestial equator; summer solstice occurs around June 21 and winter solstice occurs around December 22

solution: a uniform mixture formed by combining a gas, liquid, or solid with another gas, liquid, or solid

sonar: a method for finding objects underwater by means of the scund waves they reflect

species: a biological grouping for members of a group of plants or animals which are very similar, and can usually only interbreed among themselves

specimen: one individual of a class or group, used as an example of the whole group; a typical individual

sphere: a solid round figure with all points on the surface equally distant from the center; a ball or globe

stele: an upright stone slab, carved with inscriptions

stonemason: a person who cuts stone to shape and uses it in making walls, buildings, etc.

subsistence: surviving with the barest of necessities

succulent: having thick, fleshy tissues for storing water

sundial: a device that indicates time by the position of the shadow cast by a vertical object at its center

symbiotic: a relationship in which two kinds of organisms live together, each helping the other in some way

symmetry: similarity in form and arrangement of things on opposite sides of a center line

synchronize: to set to the same time; to cause to happen at the same time or the same rate

T

telson: the stinging segment at the end of the body of a scorpion

template: a thin piece of metal, wood, or paper used as a pattern for making a copy of an object or shape

tentacle: a long, slender, flexible growth, used for grasping, feeling, or moving, usually around the head or mouth of an invertebrate animal

thermoluminescence: the release of stored energy in the form of light from a substance that has been heated

thorax: the middle segment of an insect's body

toxin: a poison created by an animal or plant

transit: an instrument used to measure angles on land, to determine boundaries and make maps

trawler: a boat for fishing by dragging a heavy net along the sea bottom

tropical forest: forest growing in the warm, rainy parts of the area between the Tropic of Cancer and the Tropic of Capricorn, which includes the equator; characterized by tremendous variety of plant life

tuber: a thick, fleshy part of an underground stem of a plant, like a potato

tumor: an abnormal or diseased swelling in the body, usually caused by overgrowth of new, useless cells

V

vaccine: a preparation of weak or dead germs put into the body so the body develops immunity to a disease

vapor: the gaseous form of a substance that is usually found as a solid or liquid

venom: a poisonous liquid secreted by some animals, usually injected into victims by bite or sting

vermiculite: a fine-textured, scaly mineral that is often used in potting soil

volume: the amount of space that an object or substance occupies, measured in cubic units


Gulf of Mexico
QUINTANA ROO
CAMPECHE
MEXICO
Caribbean Sea
GUATEMALA
UAXACTUN
TIKAL
BELIZE
CHIAPAS
YAXCHILAN
BONAMPAK
Gulf of Honduras
HONDURAS
COPAN
BURST COMMUNICATIONS
63

Appendix 16

END

U.S. Dept. of Education

Office of Education
Research and
Improvement (OERI)

ERIC

Date Filmed

March 21,1991

DOCUMENT RESUME

ED 324 233 SE 051 624

AUTHOR Black, Christine Kahan; And Others
TITLE Good Minds at Work. A Resource Guide for the "Science Abled" Video Program.
INSTITUTION Agency for Instructional Technology, Bloomington, IN.; Michigan Univ., Ann Arbor. School of Dentistry.
SPONS AGENCY Women's Educational Equity Act Program (ED), Washington, D.C.
PUB DATE 89
NOTE 48p.; For related documents, see SE 051 623-625.
AVAILABLE FROM Agency for Instructional Technology, Box A, Bloomington, IN 47402 (video $150.00, two for $250.00, plus shipping; free preview with return postage).
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052) -- Guides - Classroom Use - Materials (For Learner) (051) -- Audiovisual Materials (100)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Career Awareness; Demand Occupations; *Disabilities; Engineering; Physical Sciences; *Role Models; *Science Careers; Science Education; Secondary Education; *Secondary School Science; Videotape Recordings

ABSTRACT

Historically in the United States, few people with disabilities have enrolled in science-related courses or entered scientific careers in part because high schools and colleges have not offered accessible training to this population. This document is the teaching and resource guide that accompanies a 40-minute video program in career development for junior high, high school, and adult students and their teachers and counselors. The program features female and male scientists of various ethnic backgrounds, disabilities, and lifestyles as role models. Varied science careers are represented: science teacher, computer programmer, psychiatrist, physicist, medical technologist, systems engineer, and chemistry professor. The goals of the program are to encourage students with physical or sensory impairments to consider careers in mathematics and science; and to encourage teachers, parents, and counselors to support disabled people in their efforts to achieve successful careers in these areas. Included in this guide are descriptions of the materials, a program summary, discussion questions to follow the program, a career interest checklist for students, and career summaries for each of the highlighted areas. Lists of resources for obtaining information and support concerning careers in these areas are attached. (CW)

R E S O U R C E G U I D E

SCIENCEABLED

Good Minds at Work

Agency for Instructional Technology

Project Staff

Principal Investigator/Project Director
Christine Kahan Bluck

Project Coordinator/Writer-Producer
Judith Greenbaum, Ph.D.

Television Director/Videographer/Editor
Matthew Hieber

Project Consultant
Geraldine Markel

Project Secretary
Diane Pasma

Research Assistant/Production Assistant
Joyce B. Williams

Evaluation Assistant
Susan Tranquilla

Evaluation Consultant
Patricia O'Connor

Educational Consultant
David Starks

Science Abled was produced by the University of Michigan School of Dentistry with a grant from the U.S. Department of Education, under the auspices of the Women's Educational Equity Act. The opinions expressed herein do not necessarily reflect the position or policy of the Department of Education. The content of this program is the responsibility of the grantee, and no official endorsement should be inferred.

Commercial products discussed or shown in this presentation are for demonstration purposes only and should not be construed as endorsements by the Department of Education.

Front cover photos courtesy of the American Association for the Advancement of Science Project in Science, Technology, and Disability

A resource guide for
the ***Science Abled*** video program

Good Minds at Work

A 40-minute video program in career development
for junior high, high school, and adult students

All inquiries should be directed to
Agency for Instructional Technology, Box A, Bloomington, IN 47402

Acknowledgements

We would like to thank the ***Science Abled*** Advisory Committee and the many individuals and groups who participated in the formative evaluation of the series. We appreciate the time and effort of everyone who helped evaluate the preliminary versions of the programs and guides. Thank you for your enthusiasm and encouragement. We would also like to thank Senator Bob Dole of Kansas for his support.

"You have been watching a group of outstanding scientists at work in such diverse fields as computer programming, biochemical research and the teaching of science. You have heard testimony about how good they are at what they do. But the people you have just seen are the tip of the iceberg. They represent thousands of other productive disabled Americans. But millions of others who are also challenged by physical and sensory impairment are unemployed.

Our handicapped scientists and science students need an environment in which they can thrive and contribute. It is up to us to make certain science labs can be adapted, work stations are made accessible, and routines modified. It requires creativity, novel solutions, and a commitment of the challenge. Together we can ensure the economic and scientific future of our society. Let's do it and do it now."

Senator Bob Dole, Kansas, 1986

Contents

Photo courtesy of the American Association for the Advancement of Science Project in Science, Technology, and Disability

A hearing-impaired scientist communicates with her co-workers. Disabled scientists can work effectively with co-workers, particularly when work assignments are designed to correspond with the special abilities of each individual—disabled or nondisabled.

Introduction to the *Science Abled* Series

Overview and Purpose

The ***Science Abled*** series consists of two video programs and two accompanying resource manuals. The first program,"Good Minds at Work," is addressed to students and their counselors, parents, and teachers. The program features female and male scientists of various ethnic backgrounds, disabilities, and lifestyles as role models. A variety of science careers are represented: science teacher, computer programmer, psychiatrist, physicist, medical technologist, systems engineer, and chemistry professor.

The second program, "Return on Equity," is intended primarily for potential employers. This program presents the opinions of supervisors, coworkers, and other employers on the experience of working with disabled scientists. The program also addresses many general concerns employers frequently have about hiring disabled people.

"Return on Equity" and its accompanying resource guide are also available from AIT.

The goals of the ***Science Abled*** series are to

- encourage students with physical or sensory impairments to consider careers in science or technology
- encourage teachers, parents, and employers to support disabled people in their efforts to achieve successful careers in these areas

Historically in the United States, few people with disabilities have enrolled in science-related courses or entered scientific careers, in part because high schools and colleges have not offered accessible, hands-on science training. This lack of student aspiration and educational opportunity harms both the country and its disabled citizens.

According to a recent survey, two-thirds of all disabled Americans between the ages of 16 and 64 are not working (International Center for the Disabled and Louis Harris and Associates 1986).

Why do physical disabilities and low employment rates seem to be related? Research has indicated a number of barriers that prevent disabled people from realizing their career potential.

1. Early influences can discourage disabled individuals from accepting goals that require competitive training (Weinberg 1982).
2. Teachers and counselors do not provide enough helpful feedback to disabled students (Chandler 1981).
3. Classroom planning and activities are insufficient (Damborg 1981).
4. The general life environment often discourages such expectations (Pati and Adkins 1981).

If we hope to increase the potential of disabled people to accomplish professional work in the sciences, we must confront these and other barriers. The developers of the ***Science Abled*** series tried carefully to address a variety of specific barriers, including the double barriers facing disabled women. The series was designed to help compensate for the paucity of disabled role models in science and for the lack of classroom, counseling, and inservice materials.

With the passing of federal laws in the 1970s, such as the Education for All Handicapped Children's Act (PL 94-142) and the Rehabilitation Act, more students with physical or sensory limitations are being graduated from high schools and colleges. The impact of these laws is significant, because the association between higher education and the employment of disabled people is great.

The 1986 International Center for the Disabled survey concludes that "about four times as many working disabled people have a four-year college education as those who don't work." Those who do work are more satisfied with life and much less likely to say that their disabilities have prevented them from reaching their full potential. Ideally, through counseling that stresses academic opportunities, the education of disabled people focuses on career preparation.

Due to the increasing need for scientifically trained graduates, educators must address certain issues. In spite of expanded educational

opportunities, few students with disabilities are receiving the academic training that would enable them to enter the nation's scientific work force. This project is designed to help increase the number of students with disabilities who choose science as a course of study and a career. As Betty Vetter, Director of the Commission on Professionals in Science and Technology has said, "With fewer people eligible for training at the college level, the need to utilize the best minds in science and technology is obvious. We won't have the best unless we utilize *all* of the available talent pool."

References

Chandler, T. A. 1981. Don't handicap the handicapped. *Education* 102:2 (Winter).

Dahl, P., O. Baker, and L. Harrison. 1981. Career stereotypes: What they are and how they can be addressed. *Journal of Career Education* 8:1 (September).

Damborg, L. 1981. Mainstreaming: Classroom complexities for the regular teacher. *Education* 86:4 (May).

International Center for the Disabled and Louis Harris and Associates. March 1986. *The ICD Survey of Disabled Americans: Bringing Disabled Americans into the Mainstream.* New York.

Makowski, T. F. 1982. Slice of life. *Journal of Career Education* 8:4 (June).

Pati, G., and J. Adkins, Jr. 1981. *Managing and Employing the Handicapped.* Lake Forest, IL: Brace-Park Human Resource Press.

Weinberg, N. 1982. Growing up physically disabled: Factors in the evaluation of disability. *Rehabilitation Counseling Bulletin* 25:4 (March).

Introduction to 'Good Minds at Work'

Materials

The ***Science Abled*** video program, "Good Minds at Work," consists of the following segments.

Part 1: Work and Accommodations

Part 2: Preparation for a Career in Science and Technology

Each segment is approximately 20 minutes in length.

Using the Materials

The two segments of "Good Minds at Work" can be shown separately or together as one 40-minute video.

The program and this resource guide can be used in a variety of settings, such as

- individual career counseling in schools or colleges, in an independent living center, or in a vocational rehabilitation agency
- part of the classroom curriculum on prevocational and vocational education in junior and senior high schools
- workshops and training sessions for parents, teachers, counselors, community leaders, and university and community college personnel—these workshops might be given by schools, public agencies, chambers of commerce, individual corporations, or businesses
- local cable stations
- career fairs

Before the Program

Note: You may choose to ask students to complete the "Career Interest" checklist on page 10 before the program and to conduct a discussion about their responses afterward. The checklist could also be used as a follow-up activity for another day.

Program Summary

The narrator opens the program by talking about the many exciting and challenging careers in science and technology that are possible for bright young people with disabilities. She introduces seven disabled scientists, who, acting as role models, discuss many aspects of their careers and lives.

In part 1 of the program, "Work and Accommodations," the scientists are shown performing various duties at work and at home with their families. They talk candidly about the influences in their lives—teachers, parents, and others who encouraged them to pursue a career in science and those who discouraged them. They describe their jobs and share which aspects they find most challenging and rewarding. Dealing with skeptical or discouraging employers and colleagues is also discussed by several of these scientists; others mention the acceptance and encouragement they feel from their co-workers.

The program shows that many of the accommodations and adaptations that employers have made to enable these scientists to perform their jobs comfortably and efficiently are minor and inexpensive. One employer provided a small lap-top computer, so that the disabled employee could take notes in meetings. Another employer removed a rest room wall to provide access for a wheelchair.

In part 2 of the program, "Preparation for a Career in Science and Technology," the narrator suggests that preparation for a science career should begin in high school or sooner. She stresses the importance of support from counselors, parents, and teachers. Many of the featured scientists discuss their educations and training—particularly how they succeeded in challenging courses, or met the physical demands of attending classes and labs.

Students interested in science careers are encouraged to take as many mathematics and science courses as possible, to find role models who can give advice and support, and to take advantage of support services that exist on campuses and in communities. Several disabled students, some in high school and some in college-level science courses, discuss their educations and plans for the future.

Biographies of the Scientists

The following scientists appear in "Good Minds at Work." Their biographies are arranged in order of their appearance in the program.

Lorraine Poor works as a medical technologist in California. She works on the afternoon shift at the medical laboratory, so that she can spend mornings with her baby daughter. She and her husband share child care and housekeeping responsibilities. Lorraine uses a wheelchair because of post-polio paralysis of her legs. Because she has scoliosis (a curvature of the spine), she practices weight lifting at a local college to strengthen her upper body. Lorraine enjoys scuba diving, hiking with the Sierra Club, and skiing.

Jeff Peters manages a six-person team of systems engineers. "It took me 32 years to be able to afford a van, a family, and Geoffrey Beene suits," Jeff says. He has cerebral palsy, which affects his arms and, to a greater extent, his legs. He uses an Amigo wheelchair, which functions somewhat like an electric scooter. Jeff's special interests are skydiving, playing chess blindfolded, playing with his kids, barbecuing, and fishing. He wants to be the first disabled scientist on the space shuttle.

Anne Swanson was born with osteogenesis imperfecta or "brittle bones." She is 43 inches tall and walks with a cane. Anne has had many operations to correct and stabilize this condition. A university professor once told her that girls didn't belong in a chemistry class; now she is a chemistry professor. Through her practice of what she calls "creative disobedience," Anne has proven the experts wrong throughout her life. When she was

an infant, the doctors told her parents that she would be mentally retarded and would never be able to attend school, yet she earned a Ph.D. in biochemistry. Common stereotypes suggested that she would never experience romance, sex, or marriage, yet she has been happily married for 17 years. In her leisure time, Anne enjoys playing the piano. She has traveled all over the United States and Europe.

David Hartman is a psychiatrist. He is married and has three young children. David describes himself as persistent. His persistence, along with this sense of humor, helped him when he tried to get into medical school. He has written an autobiography, *White Coat, White Cane*, from which the television movie "Journey from Darkness" was made. David has been blind since the age of eight, when he underwent a series of eye operations. He has always loved sports. He was a wrestler in high school and enjoys swimming. He recently broke his foot playing baseball with his kids.

Jeff Himmelstein teaches biology and environmental education in a New Jersey high school. He also conducts student tours of the Yucatán jungle in Mexico. His classroom is filled with cages of small animals, snakes, and spiders. He became deaf from unknown causes in the first few years of his life. He uses a hearing aid, which is attached to an amplifier that he wears under his shirt, and reads lips. In large groups he must use an oral interpreter. He is married and has two teenaged children, both of whom attend the high school in which he teaches.

Martha Burks is an associate programmer at a university computing center in Ohio. She describes her athetoid cerebral palsy in this way: "Every action on my part causes an unpredictable reaction that I can or cannot control, depending on how relaxed I am. I cannot speak normally, but I can make myself understood." Martha's best friend, Helen Jones, encouraged her to become more independent. Helen, who is also disabled, runs her own business. Martha is currently on the board of directors of Total Living Concepts, Inc., an independent living agency for disabled people. For relaxation, Martha goes to plays and shows, listens to records, and reads voluminously.

June Rooks works as a physicist for a naval weapons center in California. Because of her post-polio paralysis, June wears leg braces and uses metal canes with sleeves for her arms, carrying her weight mainly on her arms and shoulders and swinging her legs between her canes. June, who grew up in Mississippi, was not able to attend school until she was 10 years old because they were not accessible to disabled children at that time. During her college years, June decided to run for campus queen. She came in second runner-up, traveled with the football team, and participated in the homecoming parade.

After the Program

Discussion Questions

1. Jeff Peters said it is important to take risks. What does this mean? Have you taken any risks in the last month? In the last year? How did it turn out?

2. Jeff Peters also said that he makes mistakes. Were you surprised that he said this? How do you think he feels when he makes a mistake?

3. How did Anne Swanson take control of the interview situation she described in the program? What does "taking control" mean? Have you ever been in a similar situation? What did you do?

4. What did Jeff Himmelstein say is behind all scientific advances?

5. What did June Rooks mean when she said that her background in physics has trained her to think?

6. What did Jeff Himmelstein mean when he said, "I know that I am disabled, but I won't allow my students, or anyone else, to make me handicapped"?

7. Martha's father adapted her wheelchair so that the control box would fit under her desk. Have you ever had your wheelchair adapted? How? Who did the work? Martha hired a personal care attendant. Would you know how to do this? Have you ever designed your own adaptations? What did you do?

8. Lorraine Poor is married and has a small child. Does this surprise you? Why?

9. Are you responsible for any chores around your house? What are they?

10. How did David Hartman's sister affect his development? Do you and your brothers and sisters share things, help one another, fight, or argue?

11. What is your favorite course? Why? What course is the most difficult for you? Why are mathematics and science courses important for all students? What other courses are important for students in junior high and high school?

12. Have you ever received a bad grade? How did you feel about it? What did you do? Are any of the students in the program taking difficult courses? How do they deal with them?

13. Why are extracurricular and volunteer activities important? What extracurricular activities do you participate in? What do you gain from them?

14. What is a mentor? What can a mentor do for you? Has anyone ever acted as your mentor? Where might you find a mentor?

15. Are you planning to go to college? Where? What do you want to study? Are there places to turn for support in college, if you need it?

16. How did Jeff Himmelstein, David Hartman, and June Rooks deal with discouragement? Have you ever experienced discouragement? What happened?

17. Anne Swanson said that women who are disabled and want to become scientists face "double barriers." What did she mean by this? Do you agree? What can they do about it?

18. Have you ever examined your own prejudices about people? Have you ever prejudged the capabilities of another person, only to find out that you were wrong?

19. How do you think these scientists feel about themselves? Why?

20. Are you considering a career in science or technology? What field in particular do you prefer? Why? How will you prepare for this career?

Supplementary Activities

1. Invite local scientists and technologists, especially those with disabilities, to speak to the class about their educations and careers.

2. Invite members of your local independent living center to discuss independent living, adaptations, and accommodations, and other topics of interest to the students.

3. Suggest that students interested in science and technological careers form a club. Explore the possibility of affiliating the club with a national group (see "Science Organizations," pages 34–35). A local scientist might serve as the leader. If science clubs already exist in your school district or community, make sure they are accessible to all of your students.)

4. Organize field trips to local laboratories and research facilities. Check in advance for accessibility.

5. Maintain a bulletin board of current information on science and technology. Post a list of current television programs on various science topics.

6. Send for the career information resources listed in this guide ("Career Information in the Sciences," pages 28–33). Rent or purchase media material on science and technology to inform students about career options.

7. Encourage students and parents to participate in acquiring career information. Have them write for free career materials.

8. Investigate extracurricular opportunities in science: summer programs, science fairs, industry-based special projects for students, and other programs appropriate for your students.

9. Utilize such programs as Science Activities for the Visually Impaired (SAVI) and Science Enrichment for Learners with Physical Handicaps (SELPH) to plan science activities and projects that are interesting and accessible to disabled students. (For more information on these and other programs, see "Additional Resources," pages 36–39.)

10. Invite program advisors and students from your local college or university to speak about educational preparation for college entrance, academic options, support services, and financial aid.

11. Keep parents informed of science activities. Invite them to special events and meetings when appropriate. Develop career planning sessions for parents using the ***Science Abled*** series and resource guides.

An Introduction for Teachers, Counselors, and Workshop Leaders

It is important to stress that most students do not make career choices in high school, and those who do often modify their choices as they mature. However, high school is an appropriate time to consider career possibilities. High school students should be encouraged to consider a range of appropriate vocational possibilities, rather than to make final career decisions.

"Good Minds at Work" seeks to convince students to keep their options open by building a solid academic background in high school. Many students with disabilities may require more than the usual four years to complete the high school curriculum suggested below. Flexibility in programming based on individual needs and strengths and "realistically high" expectations are crucial to their success.

High school students should be encouraged to focus on a mathematics and science curriculum in the context of a well-rounded education. Computer literacy is also strongly encouraged. The following curriculum is recommended.

mathematics:	four years
science:	four years
English:	four years, including oral and written communications
foreign language:	one to two years

The program also seeks to persuade disabled students that careers in science and technology can be rewarding, exciting, and attainable. The featured role models deliver this message effectively. Encouraging students to consider college education is a secondary goal. The "Science Career Summaries" on pages 11–14 inform students about the types of post-secondary education needed and the kinds of jobs available in several scientific and technological fields.

As an incentive, students should be informed of the financial worth of a college education. A college graduate earns about $8,000 dollars a year more than a high school graduate. The more education students attain, the more money they will probably earn. In addition, college graduates entering scientific and technological fields can earn up to twice the beginning salaries of graduates with degrees in the humanities or social sciences. Students should also understand the strongly positive effect that having a job can have on the quality of their lives—not just in terms of money earned, but in terms of "life satisfaction" and "reaching their full abilities as a person." (International Center for the Disabled and Louis Harris and Associates 1986)

Most career counselors suggest that students consider the employment outlook when they choose a career. What will be the fastest growing fields in the next 10 to 20 years? The Bureau of Labor Statistics reports that jobs for scientists, computer programmers and analysts, engineers, health technologists, physicians' helpers, registered nurses, and electronic technicians will increase in the coming decades.

Students should understand that forecasting—whether for the stock market, the World Series, or the job market—has never been an accurate science, and completely accurate predictions of vocational demand are impossible to attain. World politics, economic conditions, population demographics, and new technologies are all variables that influence the employment outlook. According to current estimates, 60 percent of the jobs people will hold in 10 years do not exist today. Because a particular job or specific financial rewards cannot be guaranteed, students' career choices should also depend upon other anticipated rewards such as intellectual excitement, the fulfillment of a desire to help others, or a chance to participate in scientific discoveries.

It is clear that employment opportunities in general will continue to open up for disabled people due to the continuing elimination of physical and attitudinal barriers.

Individuals trained in science and technology are needed in administrative, policy-making, and practitioner roles in many scientific fields. According to the Commission on Professionals in Science and Technology (1984), "A bachelor's degree in science or engineering continues to be an

excellent stepping stone to careers in medicine, law, business, and other occupations."

Some of the best career information available is listed under "Career Information in the Sciences," on pages 28–33 of this resource guide. Information about financial aid for college students is listed under "Information Sources for Disability Concerns," on pages 25–27 of this guide. Encourage students to take advantage of these resources.

Young adults and college students in need of accessible housing and transportation should contact their local vocational rehabilitation agency for the nearest independent living center.

References

Commission on Professionals in Science and Technology. 1984. *Opportunities in Science and Engineering.* Washington, DC.

International Center for the Disabled and Louis Harris and Associates. March 1986. *The ICD Survey of Disabled Americans: Bringing Disabled Americans into the Mainstream.* New York.

Career Interest: A Checklist for Students

Goal: This checklist is designed to help you assess your interest in science and technology. There are no right or wrong answers. Your answers should help you become more aware of your own interests. Discuss the results with a family member, friend, counselor, or teacher.

Directions: Think about each question and answer each one by checking either **Yes**, **No**, or **Not Sure**.

	Yes	No	Not Sure
1. Do you like to play games of strategy (chess, hearts, backgammon) or solve puzzles?			
2. Do you enjoy the challenge of a new task?			
3. Do you like to watch science shows on television?			
4. Would you like to visit a scientist at work?			
5. Have you ever had a science-related hobby?			
6. Do you sometimes question what you read or hear?			
7. Do you like trying to figure out how things work?			
8. Have you ever come up with ideas for new ways to do things, or new uses for common objects?			
9. Have you ever tried to repair a broken machine or appliance?			
10. When a problem is difficult to solve, do you like to keep at it until you've found the answer?			
11. Are you good at solving problems?			
12. Are you able to work on your own, with little guidance from others?			
13. Do you enjoy watching and studying the habits of fish, birds, or other animals?			
14. Do you enjoy working with computers?			

Science Career Summary

Computer Science

by Marilyn Edwards Leese

Academic Preparation

Students interested in computer science can choose from a variety of degrees and programs. Community colleges and business colleges offer two-year associate degrees in fields such as data processing, computer repair, and computer programming.

A Bachelor of Science (B.S.) requires four years of college, including courses in mathematics, natural and social sciences, English, and foreign language. In addition, a student will take a number of computer science courses, such as computer languages, artificial intelligence, computer graphics, digital computer engineering, data base systems, logic, statistics, and learning theory.

Undergraduates interested in this area can also choose to enter a program that relates computers to another discipline. A student may choose to elect two majors, for example: one in computer science and the other in the sciences or humanities. Business majors can study commercial applications of data processing. Engineering majors might concentrate on computer engineering, specializing in hardware design or nuclear medicine.

Career Options

Professionals in computer science can choose from a number of career options. They can work as programmers or systems analysts, or accept increased responsibility in management positions. They can become computer sales representatives, teachers of computer skills, researchers of new designs for computer systems, or consultants for computer installations.

Many private industries—manufacturing and wholesaling companies, data processing services, telecommunications networks, banks, and insurance companies—employ computer professionals. In government, computer scientists play a role in key functions such as research, planning, and administration. Computer scientists also work as teachers and researchers in universities.

Because of its flexibility, a degree in computer science can allow graduates to enter many fields. Financial analysts, economists, statisticians, actuaries, urban planners, and engineers all use computer skills. As computers become increasingly important in a number of areas, the need for the computer scientist's skills will become even more broad-ranging.

Science Career Summary

Physics

by Marilyn Edwards Leese

Academic Preparation

Students interested in physics may choose from several degrees, though many physics-related occupations require advanced university training.

A Bachelor of Science (B.S.) requires four years of college, including courses in mathematics, natural and social sciences, English, and foreign language. Physics majors are expected to take courses in various branches of physics: mechanics, electricity and magnetism, thermodynamics, modern physics (atomic, nuclear, solid state), and electronics. Courses in mathematics are required, and courses in chemistry and biology are strongly recommended.

Undergraduate students can often benefit from summer programs sponsored by government or private industry laboratories. Moreover, universities themselves often hire students during the summer to work on special research projects under the supervision of a faculty member.

The Master of Science (M.S.) degree requires two to three years of study, including advanced courses, research within an area of interest, and preparation of a thesis.

The Doctor of Philosophy (Ph.D.) requires four to six years of work beyond the bachelor's degree, including courses, research, and a written dissertation based on independent research. Professors and independent researchers generally must possess this degree.

Career Options

Physicists conduct research, provide consultation, and supervise or teach in laboratories, universities, hospitals, private industries, or government agencies. The following list represents some of the branches of physics and examples of its applications.

Acoustical physics is the study of sound and its transmission, including shock and vibration, underwater sound, and speech. The design of symphonic auditoriums and the development of the stereo tape deck and the medical ultrasound scanner are all accomplishments of acoustical physicists.

Atomic and **molecular physics** is the study of the interaction of the electrons and nucleus in the atom and of the formation of molecules from atoms. Work in this area provides assistance in the manufacture of chemicals and pharmaceuticals and enables identification of unknown materials.

Biophysics is the use of the ideas and methods of physics and chemistry to study and explain the structure and processes of living organisms. Biophysical investigations focus on understanding DNA, the effects of X-ray and nuclear particles on cells and tissues, and the conduct of nerve impulses.

Electronics is the study, design, and application of devices with operations dependent upon the characteristics and behavior of electrons. Television, radar systems, and telephones are all electronic inventions.

Electromagnetism is the study of electrical and magnetic phenomenon. Physicists working in this area have aided in the development of huge generators that provide electricity for heating, lighting, and air-conditioning.

Geophysics is the study of the earth through the use of principles and practices of physics. Geophysicists are involved with petroleum production and the dynamics of earthquakes.

Medical physics is the application of physics principles and techniques to the problems of medicine. Developments in this area include the use of X-rays, radioisotopes, and scanning in diagnostic procedures.

Nuclear physics is the study of the interactions and properties of the atomic nucleus. Nuclear physicists have developed uses for nuclear

energy as well as radiation therapy for cancer patients.

Optical physics is the study of light. Optical physcists have developed surgical lasers, fusion power, and holography.

Plasma physics is the study of the behavior and use of high temperature ionized gas. Plasma physicists are working toward the development of controlled thermonuclear energy.

Solid state physics is the study of the crystallographic, electronic, and magnetic properties of solids—primarily of crystalline solids. These physicists have applied their results to produce the transistor, integrated circuits, and computer memories.

Space and **planetary physics** is the study of nuclear particles, atoms, molecules, meteorites, and radiation that pass through the region between the planets. This study aids in weather forecasting and in the functioning of satellites.

Thermodynamics is the study of the various forms of energy (including heat) and the process of transferring energy from one form to another.

Science Career Summary

Biomedical Fields

by Kathleen Hannon

Academic Preparation

Students interested in biomedical fields may choose from many degrees and programs, though many biomedical occupations require advanced university training.

Community and junior colleges offer many one- or two-year allied health programs. These programs combine classroom and laboratory study with clinical practice. Graduates receive certificates or associate degrees, which enable them to secure positions as medical technicians, nurses, and dental assistants.

The Bachelor of Science (B.S.) requires four years of training, including courses in mathematics, natural and social sciences, English, and foreign language. Students interested in positions as biomedical technologists often complete a specialized four-year training program, which requires extensive laboratory work. Students should consider majoring in one basic science such as biology, chemistry, physics, statistics, or engineering.

Undergraduate students can often benefit from summer programs sponsored by government or private industry laboratories. Universities may also hire students during the summer to work on research projects under the supervision of a faculty member.

The Master of Science degree (M.S.) requires two to three years of study, including advanced courses, research, and preparation of a thesis.

The Doctor of Philosophy (Ph.D.) requires four to six years of work beyond the bachelor's degree, including courses, research, and a written dissertation based upon independent research. University professors and independent researchers must possess the Ph.D.

The Doctor of Medicine (M.D.) requires a four-year program of medical education beyond the bachelor's degree, followed by several years of clinical training (residency or internship).

Career Options

Biomedicine is rapidly expanding beyond medicine, dentistry, and veterinary medicine to include a diverse range of employment opportunities.

Practitioners diagnose, treat, and prevent illness and disease. The specialties include radiology, public health, nursing, podiatry, and optometry.

Specialized biomedical scientists conduct research to develop equipment, materials, and techniques to assist physicians in treating disease and promoting health. Biomedical engineers, microbiologists, geneticists, pathologists, industrial hygienists, pharmacologists, and physiologists are among the field's many professionals.

Technologists, who assist with laboratory and research techniques and operate and monitor biomedical equipment, work in areas such as laboratory medicine, radiation therapy, environmental health, nuclear medicine, and cardiology.

Technicians, who assist highly skilled practitioners and professionals, include surgical technicians, electrocardiograph (EKG) technicians, electroencephalogram (EEG) technicians, and medical laboratory technicians.

Biomedical scientists and technicians may choose to work in

- hospitals, clinics, medical centers, health maintenance organizations, and private practice
- federal, state, and local departments, commissions, and health regulatory agencies
- independent research and development organizations—basic and applied research with private corporations and nonprofit foundations
- industrial laboratories doing production and quality control, technical writing, and professional representative positions
- colleges, universities, and medical schools doing research and teaching

An Introduction for Teachers, Counselors, and Workshop Leaders

"The ideal goal of vocational adjustment is participation in an occupation in which the physical disability does not constitute a handicap. This...is an ideal; it cannot always be achieved. Some severely disabled people may not be able to compete on an equal basis with the nondisabled, or find an occupation in which their disabilities are not a handicap. The objective in these cases is to utilize as much of the potential of the individual as possible in the most suitable occupation which can be found." (Foster, Szoke, et al., 1979)

Disabled adults, like other adults, should strive to function relatively independently (in reality, interdependently) to fulfill their needs and interests. To progress toward this goal, young people with disabilities need the support of influential others: counselors, parents, teachers, and other adults who might be a positive force in their lives.

An understanding and supportive influential other asks questions, listens carefully, helps with setting goals and making choices, provides information and opportunities for skill development, encourages independence, and often acts as an advocate. Influential others should pay attention to the results of these actions. They can provide support by promoting self-esteem, by understanding specific needs, and by providing appropriate educational, prevocational, and vocational opportunities.

The effectiveness of an influential other depends on the amount of understanding, trust, respect, and caring that is communicated to, and felt by, the young person. The young person with a disability must be seen as an individual with values, goals, strengths, and needs.

Influential others need to ask questions and listen carefully for answers and feelings that underlie the responses. Typical questions might be: How do you feel about _____ ? Why do you think you're heading in this direction? At what point do you think you will be ready to try _____ ?

It is important to separate giving advice to young people from making decisions for them. The influential other might say, "I understand why you are heading in this direction, but why don't you get some more information from a different source?" Listening carefully enables young people to express their ideas and to clarify their own values and goals before making career decisions.

Asking yourself questions is part of being a good model and supportive influential other: What does independence mean to me? Am I being overprotective? What are "realistically high" academic expectations? Do I know how to cope with failure? Am I really listening?

How to Use the Career Preparation Materials

This section of the resource guide contains two checklists: "Helping Students Prepare for Careers," for authority figures such as teachers, parents, and counselors; and "Career Decisions," for students. This section also contains the discussion guide, "Preparing for a Career," for students to consider and discuss with each other and with influential others.

Students can complete their checklist and go through the discussion guide after they see "Good Minds at Work," or independently of the program, or as a part of a curriculum on career preparation. Adults can complete their checklist in a group setting such as a parent meeting or teacher inservice, or at home.

As with all the checklists in this resource guide, each person should have a copy to complete, discuss, and keep for reference. The teacher, counselor, or leader should guide students' use of both the checklist and the discussion guide. The leader should prepare thoroughly and allow adequate time for each activity.

References

Foster, J., C. Szoke, et al. 1979. *Guidance Counseling and Support Services for High School Students with Physical Disabilities: Visual, Hearing, Orthopedic, Neuromuscular, Epilepsy, Chronic Health Conditions.* Cambridge, MA: Technical Education Research Centers, Inc.

Helping Students Prepare for Careers: A Checklist for Parents, Teachers, and Counselors

Goal: This checklist is designed to help you support and guide students with handicaps so they can prepare for a career. It identifies three activities and poses several questions related to each activity.

Directions: Answer each item by checking **Yes, No,** or **Not Sure.** Think about examples from your experience that might be related to each item. Circle items you feel should be stressed with your student(s).

Activity I: Promote self-esteem.

	Yes	No	Not Sure
1. Do you act as a model and guide by			
a. emphasizing students' strengths?	_____	_____	_____
b. helping students cope with failure?	_____	_____	_____
c. expecting students to show responsibility at home or school?	_____	_____	_____
d. promoting good physical health, weight control, etc.?	_____	_____	_____
e. encouraging students to look their best?	_____	_____	_____
2. Do you ask questions and really listen to the answers?	_____	_____	_____
3. Do you set both short- and long-term goals and monitor progress by			
a. making sure that students are active participants in decision making?	_____	_____	_____
b. giving students opportunities to exercise choice?	_____	_____	_____
c. discussing with students their progress toward goals?	_____	_____	_____

Activity II: Understand the needs of adolescents and young adults.

1. Do you act as a model and friend by			
a. understanding their need for physical and emotional independence?	_____	_____	_____
b. questioning your own protectionism?	_____	_____	_____

	Yes	No	Not Sure
c. allowing them to choose their own role models?	_____	_____	_____
d. allowing for changing roles in the family?	_____	_____	_____
e. balancing controls against freedom to explore?	_____	_____	_____
2. Do you set both short- and long-term goals and monitor progress by			
a. helping students focus on their future adult status?	_____	_____	_____
b. comparing students' status or progress with their previously stated goals?	_____	_____	_____
c. readjusting their goals or activities as necessary?	_____	_____	_____
3. Do you encourage social development and emotional growth by			
a. providing opportunities for social interaction with handicapped and nonhandicapped peers?	_____	_____	_____
b. providing opportunities for students to be away from home overnight, at camp, on trips with the class?	_____	_____	_____
c. providing opportunities within the family for students to develop as individuals?	_____	_____	_____
d. encouraging independence?	_____	_____	_____
e. allowing students to take risks, make mistakes, and experience trial-and-error learning?	_____	_____	_____
4. Do you act as an advocate by			
a. arranging for accessible transportation to social and recreational events?	_____	_____	_____
b. organizing or arranging accessible recreational programs?	_____	_____	_____

Activity III: Provide educational, prevocational, and vocational opportunities.

1. Do you act as a model and guide by			
a. encouraging students to take all necessary preparatory courses, particularly mathematics, science, and computer science?	_____	_____	_____

	Yes	No	Not Sure
b. having "realistically high" academic expectations of students?	_____	_____	_____
c. encouraging them to develop hobbies and special interests?	_____	_____	_____
d. giving students responsibilities for household tasks, baby-sitting, school responsibilities, or tutoring?	_____	_____	_____
e. encouraging participation in school-related extracurricular activities?	_____	_____	_____
f. providing opportunities for artistic and recreational activities?	_____	_____	_____
2. Do you set goals and monitor progress by			
a. giving students opportunities to exercise choice?	_____	_____	_____
b. discussing their progress toward goals?	_____	_____	_____
c. readjusting goals as necessary?	_____	_____	_____
3. Do you provide information and/or opportunities for skill development by			
a. encouraging students to find part-time jobs, volunteer, or participate in civic activities?	_____	_____	_____
b. providing information on career opportunities?	_____	_____	_____
c. providing information on academic prerequisites for college entrance and on specific careers?	_____	_____	_____
d. providing training in socialization skills and assertiveness?	_____	_____	_____
e. providing current information on assistive devices, financial aid, and civil rights?	_____	_____	_____
f. helping students find mentors and role models in scientific and technological careers?	_____	_____	_____
4. Do you act as an advocate by			
a. ensuring that science and mathematics courses are included in disabled students' curricula?	_____	_____	_____
b. ensuring that all educational, prevocational, and vocational programs that your school district offers are accessible to students with disabilities?	_____	_____	_____
c. meeting with other adults to build group support?	_____	_____	_____

Career Decisions: A Checklist for Students

Goal: This checklist is designed to help you know how ready you are to decide about a career. There are no right or wrong answers. The answers should help you become more aware of your interests. Discuss the results with a family member, friend, counselor, or teacher.

Directions: Think about each question. Answer by checking either **Yes, No,** or **Not Sure.** A "Yes" answer indicates readiness to make career decisions. "No" or "Not Sure" answers indicate issues that need more thought, training, or experience.

Personal Characteristics

	Yes	No	Not Sure
1. Have you and a counselor or teacher discussed your strengths, values, interests, or needs and goals?	_____	_____	_____
2. Have you decided to work hard to achieve your goals?	_____	_____	_____
3. Do you feel you can cope with the pressure of college or a job?	_____	_____	_____
4. Do you feel comfortable with nondisabled people?	_____	_____	_____
5. Have you ever been responsible for helping at home?	_____	_____	_____
6. Have you ever had part-time jobs, done volunteer work, or joined after-school activities?	_____	_____	_____

Functional Living Skills

1. Do you have a way to share your ideas with others?	_____	_____	_____
2. Using whatever method is necessary, can you write or type information so that others can read and understand it?	_____	_____	_____
3. Have you tried to take the major responsibility for caring for your personal needs?	_____	_____	_____
4. Are you aware of special aids and accommodations that will help you to succeed in school? Examples include note-taking assistance, a reduced course load, modified test-taking procedures, interpreters, and typewriters.	_____	_____	_____
5. Are you aware of any specialized transportation you might need?	_____	_____	_____
6. Do you know how to locate any support services and assistance that you might need?	_____	_____	_____

Academic Skills

	Yes	No	Not Sure
1. Do you have a high school diploma or the equivalent?	_____	_____	_____
2. Is your academic record satisfactory for college admission? Examples of colleges include universities, community colleges, junior colleges, and technical schools.	_____	_____	_____
3. Do you know the admissions requirements of the community college, university, or vocational/technical program in which you are interested?	_____	_____	_____
4. Have you taken the necessary tests for college admission?	_____	_____	_____
5. Are you learning to manage your time?	_____	_____	_____
6. Are you learning good work habits?	_____	_____	_____
7. Can you tell someone what you're planning to study and why? Example: "I am studying _____ in order to _____."	_____	_____	_____
8. Do you have the reading and communication skills necessary for college?	_____	_____	_____

Growth and Management Skills

1. Do you do things to make your daily life easier?	_____	_____	_____
2. Do you know ways to pace yourself physically and conserve your energy?	_____	_____	_____
3. Have you experimented with various aids to see which are best for you?	_____	_____	_____
4. Have you tried to create your own aids?	_____	_____	_____
5. Do you look for ways to increase your mobility?	_____	_____	_____
6. Do you try to extend your ability to communicate?	_____	_____	_____
7. Are you trying to learn ways to be a better problem-solver?	_____	_____	_____
8. Are you accepting your disability as only one aspect of your life?	_____	_____	_____
9. Do you express your emotions, including feelings of frustration and anger as well as happiness and enjoyment?	_____	_____	_____
10. Are you attempting to get support and friendship from nondisabled as well as other disabled people?	_____	_____	_____

Support and Assistance

	Yes	No	Not Sure
1. Have you identified other resources or people to talk to such as			
a. high school guidance counselors?	_____	_____	_____
b. state vocational rehabilitation agencies?	_____	_____	_____
c. reference librarians for books and guides to careers?	_____	_____	_____
d. career counselors at community colleges or vocational/technical centers?	_____	_____	_____
e. family and friends?			
f. teachers, psychologists, social workers, occupational or physical therapists?	_____	_____	_____
g. independent living centers?	_____	_____	_____
h. organizations and agencies: United Cerebral Palsy Association, National Foundation for the Blind, Alexander Graham Bell Association for the Deaf, or others?	_____	_____	_____
i. the list of resources in this guide?	_____	_____	_____
2. Have these people or organizations helped you by			
a. providing more information on which to base your objectives and goals?	_____	_____	_____
b. assessing and evaluating your strengths, needs, interests, and skills?	_____	_____	_____
c. matching your abilities and interests to possible career opportunities?	_____	_____	_____
d. assisting you in deciding on a course of study or training to prepare you for your career choices?	_____	_____	_____
e. giving you a chance to meet disabled people in the community?	_____	_____	_____
f. matching your abilities and interests to possible schools?	_____	_____	_____
g. giving you a chance to meet someone already working in your field?	_____	_____	_____

Preparing for a Career: A Discussion Guide for Students

Goal: This discussion guide is designed to help you prepare for a career. It identifies five steps toward that goal and lists questions or suggestions regarding each one. Answers to the questions can be written and/or discussed. Many of the questions refer to long-term goals you can only begin to work toward. Discussing the answers will help you become more aware of how ready you are to prepare for a career.

Directions: Review the steps and discuss the answers to each question with a teacher, counselor, or parent to understand how you can prepare for a career.

Step I: Think about who you really are.

a. What are my strengths?
b. What do I value about myself, or what is special about me?
c. What are my special interests or hobbies?
d. Do I belong to any organizations or groups?
e. What areas do I need to improve?
f. What are my goals in the next year? In the more distant future?
g. What do I really like to do to have fun?

Step II: Identify ways that you take responsibility for your physical well-being.

a. Do I try to eat nutritiously?
b. Do I try to get regular exercise?
c. Do I try to maintain an appropriate weight?
d. Do I keep myself looking attractive?
e. Do I avoid the use of drugs and alcohol?
f. What are the easiest ways to get things done for myself considering my particular disability?
g. What types of aids and modifications do I need in school or at home for mobility, communication, or self-care?

Step III: Identify ways in which you try to take responsibility for your mental health.

a. Can I make decisions and plans for myself?
b. Am I open to new experiences?
c. Do I try to create a balance between doing things that I know I can do successfully and things that require risk taking?
d. Do I know how to handle stress most of the time?
e. Have I developed a sense of humor?
f. Do I let people know how capable I am?
g. Do I share my feelings, opinions, and ideas?
h. Do I ask for help if it is needed?
i. Do I say "no," when I need to?

Step IV: Identify ways in which you take responsibility for relationships with others.

a. Do I act positively by encouraging others and being polite?
b. Do I have positive expectations of others, thereby influencing others to act positively?
c. Do I really listen to what others say and ask questions if I don't understand?
d. Do I try to understand the feelings of others?
e. Do I do my part and share the work load?
f. Am I decisive when I accept or reject help?
g. Do I take the initiative in suggesting ways in which I can be included in social activities through accommodation and modification?
h. Do I remind myself that it is not necessary to be liked by everyone?

Step V: Identify strategies that help you handle problems on the job.

To get and keep a job, you may need to cope with discouragement, stereotyping, and other negative situations. There are many ways to handle negative situations. Read the situation below and discuss the 12 possible ways you could handle it. Identify the strategies you feel most, and least, comfortable using. Afterward, identify other negative situations and ways you might handle them.

Situation: You are applying for a job. Another applicant says, "What are you doing here? Someone like you can't do this kind of job." The following are possible ways to manage the situation.

1. **Minimize the impact on yourself.** Say to yourself, "There's always someone in the crowd like this. I won't let him or her shake my confidence."
2. **Maximize your own worth.** Say to the person or to yourself, "I've trained for this job—I know I can do it."
3. **Use humor.** Try comic relief to lessen the tension: "You mean they don't hire people with blue eyes here?"
4. **Use sarcasm.** You might say, "You are right. Because I have a handicap, I shouldn't work. I should let you work, and I'll live off welfare."
5. **Take control.** "I'm well-trained for this kind of work," you might say. "What experience do you have?"
6. **Dispel a myth.** Tell the person: "It's just a myth that people with my kind of disability can't do this type of job."
7. **Give information.** Tell the person: "The law says that all qualified applicants must be considered for this job."
8. **Try to understand.** Ask the person, "What makes you say that? Have you ever known someone like me?"
9. **Tell the person how you feel.** You might say, "I feel really frustrated when people who don't know me think they know what I can or can't do."
10. **Ignore the person.** Just turn away and don't answer.
11. **Give the person a cold stare.** Stare at the person, but don't answer.
12. **Say something negative.** You might say, "What a rude thing to say."

Step VI: Identify strategies to help you handle problems and disappointments.

a. Identify people you can count on to support you when disappointments occur.

b. Identify and try to solve problems by talking about them with other people.

c. Remember that, even if you cannot solve some problems now, you may be able to work them out at a later date.

d. Remember: "Not all people with disabilities will be able to make it on their own. Those of us who can't should not feel guilty or devalued." (Hale 1979)

References

Hale, G., ed. 1979. *The Source Book for the Disabled.* New York: Paddington Press. (Grosset and Dunlap, distributors).

Information Sources on Disability Concerns

The following organizations can provide extensive resources, services, and information concerning disability topics such as education, employment, independent living, and self-care. Call or write these organizations directly.

ABLEDATA System
Adaptive Equipment Center
Newington Children's Hospital
181 E. Cedar St.
Newington, CT 06111
800/344-5405

Source for information on commercially available rehabilitation aids and equipment.

American Association for the Advancement of Science
Project on Science, Technology and Disability
1333 H St., N.W.
Washington, DC 20005
202/326-6400, or 202/362-6667 (Voice and TDD)

American Association for Counseling and Development
5999 Stevenson Ave.
Alexandria, VA 22034
703/823-9800

American Foundation for the Blind (AFB)
15 W. 16th St.
New York, NY 10011
212/620-2000

Association of Handicapped Student Service Programs in Postsecondary Education (AHSSPPE)
P.O. Box 21191
Columbus, OH 43221
614/488-4972

Source of information and services available at colleges throughout the country.

Commission for the Blind
(your state Department of Labor)

Developmental Disabilities Program
(your state Department of Mental Health)

EDC/WEEA Publishing Center
55 Chapel St.
Newton, MA 02160
800/225-3088, or 617/969-7100
(Education Development Center/Women's Educational Equity Act)

Provides grants to develop programs and materials that promote educational equality for girls and women. Offers information on curriculum materials, career development, and staff development.

Foundation for Science and the Handicapped
236 Grand St.
Morgantown, WV 26505
304/293-5201

A network of disabled scientists that advises government, industry, and education on accessibility and support.

Gallaudet College
800 Florida Ave.
Washington, DC 20002
202/651-5000 (Voice and TDD)

A liberal arts college for the deaf. Includes a model elementary and secondary school. Also, a source of information for deaf persons, parents, employers and educators.

G.T.E. Education Services, Inc./Special Net
2021 K St., N.W. Suite 215
Washington, DC 20006
202/835-7300

A computer-based information network on varied topics for special educators.

HEATH Resource Center
One Dupont Circle, Suite 800
Washington, DC 20036
202/939-9320 (Voice and TDD); 800/544-3284 (outside the District of Columbia)

HEATH (Higher Education and Adult Training for People who are Handicapped) is a national clearinghouse on postsecondary education for disabled people.

Independent Living Research Utilization Project
The Institute for Rehabilitation and Research
1333 Moursund Ave.
Houston, TX 77030
713/797-1440, Ext. 504

Job Accommodation Network
President's Committee on Employment of the Handicapped
P.O. Box 468
Morgantown, WV 26505
800/JAN-PCEH (TTY and TTD)

Mainstream
1030 15th St., N.W., Suite 1010
Washington, DC 20005
202/898-1400
Employment-related services, technical assistance, job referral services

National Alliance of Business
1015 15th St., N.W.
Washington, DC 20005
202/457-0040

Information for employers on varied topics such as accessibility and tax incentives.

National Council on Independent Living
C/O Access Living
815 W. Van Buren, Suite 525
Chicago, IL 60607
312/226-5900

An organization of independent living centers. Provides information and referral services.

National Easter Seal Society
2023 W. Ogden Ave.
Chicago, IL 60612
312/243-8400
312/243-8880 (TDD)

Provides information on accessibility, aids, recreation, attitudes, independent living, rehabilitation.

National Federation of the Blind
1800 Johnson St.
Baltimore, MD 21230
301/659-9314

National Information Center for Handicapped Children and Youth
P.O. Box 1492
Washington DC 20013
703/522-3332

Provides information to parents and teachers on a variety of personal concerns and state and national issues.

National Library for the Blind and Physically Handicapped
Library of Congress
1291 Taylor St., N.W.
Washington, DC 20542
202/287-5100

National Organization on Disability
910 16th St., N.W., Suite 600
Washington, DC 20006
202/293-5960; 202/293-5968 (TDD)

A network of 1700 community organizations across the country. Helps groups and individuals on topics such as education, recreation, employment, accessibility, and accident and disease prevention.

National Rehabilitation Information Center
8455 Colesville Rd., Suite 935
Silver Spring, MD 20910
301/588-9284, or 800/345-2742

National Technical Institute for the Deaf
Rochester Institute of Technology
One Lomb Memorial Dr.
P.O. Box 9887
Rochester, NY 14623
716/475-6400

Provides technical training to deaf and severely hearing impaired students. Trains interpreters, employers, and educators. Provides information, materials, and services related to employment.

Paralyzed Veterans of America
801 18th St., N.W.
Washington, DC 20006
202/872-1300

An information and advocacy agency for persons with all types of disabilities. Publications and information for employers and families on topics such as workplace accommodations and accessibility.

President's Committee on Employment of People with Disabilities
1111 20th St., N.W., Suite 636
Washington, DC 20036
202/653-5044

Provides accessibility information, workplace accommodation networks of employers.

Recording for the Blind
20 Roszel Rd.
Princeton, NJ 08540
609/452-0606

Records and lends educational books to blind and visually impaired individuals.

Rehabilitation International
22 E. 21st St.
New York, NY 10010
212/420-1500

Provides a link between the rehabilitation communities in the United States and other countries. Provides information on travel for disabled persons and audiovisual materials on disabled people and the rehabilitation process.

Services to Crippled Children
(your state Department of Public Health)

Sister Kenny Institute
Division of Abbott-Northwestern Hospital
800 E. 28th St. at Chicago Ave.
Minneapolis, MN 55407
612/863-4457

Provides a continuum of rehabilitation services, research, education information, and audiovisual materials for health professionals, patients and their families.

Social Security Administration
6401 Security Blvd.
Baltimore, MD 21235
301/594-7700; 800/325-0778 (TDD)

Information on disability insurance, benefits, and payments; programs and eligibility. Publishes over 100 booklets and research reports.

Stout Vocational Rehabilitation Institute
Materials Development Center
School of Education and Human Services
University of Wisconsin-Stout
Menomonie, WI 54751
715/232-2195

Rehabilitation services and information for employers and prospective employers.

United Cerebral Palsy Associations
66 E. 34th St.
New York, NY 10016
212/481-6300

United States Department of Housing and Urban Development
Office of the Special Advisor for Disability Issues
Suite 10140, 451 Seventh St., S.W.
Washington, DC 20410-0001
202/426-6030

Vocational Rehabilitation Services
(your state Department of Education)

Career Information in the Sciences

Compiled by
the Office of Opportunities in Science
American Association for the Advancement of Science (1986)

Sources of information about occupations and training requirements in the biological, physical, social, mathematical, and engineering sciences are listed alphabetically by field. Unless a price is noted, single copies of the booklets are free. Some publishers offer a discount for bulk orders.

Acoustics

"Acoustics and You" (21 pages)
Acoustical Society of America
500 Sunnyside Blvd.
Woodbury, NY 11797
516/349-7800

Aerospace

"Careers in Aerospace Within Your Lifetime" (14 pages)
Student Programs
American Institute of Aeronautics and Astronautics
370 L'Enfant Promenade, S.W.
Washington, DC 20024
202/646-7400

Anthropology

"On Becoming an Anthropologist" (11 pages)
American Association of Physical Anthropologists
Department of Anthropology
C/O Dr. A. Theodore Steegman, Jr.
SUNY Buffalo
479 Spaulding Quad, Bldg. 4
Buffalo, NY 14261
716/636-2240

Astronomy

"A Career in Astronomy" (23 pages; 25¢)
American Astronomical Society
C/O Dr. Peter Boyce
2000 Florida Ave., N.W. #300
Washington, DC 20009
202/328-2010

Biological Sciences

"Dieticians: The Professional in Nutritional Care" (15 pages)
The American Dietetic Association
208 LaSalle St., Suite 1100
Chicago, IL 60604
312/899-0040

"Careers in Animal Biology" (21 pages)
American Society of Zoologists
Box 2739
California Lutheran College
Thousand Oaks, CA 91360

"Microbiology in Your Future" (third edition) (32 pages; 25¢)
American Society for Microbiology
1913 I St., N.W.
Washington, DC 20006
202/833-9680

"Your Career in Ecology" (6 pages)
Ecological Society of America
Center for Environmental Studies
Arizona State University
Tempe, AZ 85287
602/965-3000

"Career Opportunities in Ornithology" (8 pages)
Division of Birds, E-607
National Museum of Natural History
Smithsonian Institution
Washington, DC 20560
202/357-1300

Botany

"Plant Pathology: A Scientific Career for You" (16 pages)
American Phytopathological Society
3340 Pilot Knob Rd.
St. Paul, MN 55121
612/454-7250

"Careers in Botany" (19 pages; 25¢)
School of Bio-Sciences
University of Kentucky
Lexington, KY 40506-0225
606/257-4711

Chemistry

American Chemical Society
1155 16th St., N.W.
Washington, DC 20036
202/872-4600

"Careers in Chemistry: Questions and Answers" (6 pages)

"Futures Through Chemistry: Charting a Course" (16 pages)

"A Career as a Chemical Technician" (6 pages)

"Internships for Chemistry's Chemical Engineering Students" (26 pages)

Earth Sciences

Career Information (packet) (64 pages)
American Geological Institute
4220 King St.
Alexandria, VA 22302
703/379-2480

"Women Exploring the Earth" (8 pages)
Society for Exploration Geophysicists
P.O. Box 702740
Tulsa, OK 74170
918/493-3516

"Future Employment Opportunities in the Geological Sciences" (20 pages)
The Geological Society of America
P.O. Box 9140
Boulder, CO 80301
303/447-2020

"Geology-Science and Profession" (32 pages)
American Geological Institute
4220 King St.
Alexandria, VA 22302
703/379-2480

"Careers in Geology" (10 pages)
American Geological Institute
4220 King St.
Alexandria, VA 22302
703/379-2480

"Careers in Exploration Geophysics" (16 pages; 50¢)
Society for Exploration Geophysicists
P.O. Box 702740
Tulsa, OK 74170
918/493-3516

"Your Career in Archeology" (30 pages; $1.50)
Society for American Archeology
1511 K St., N.W., Suite 716
Washington, DC 20005
202/638-6079

"Careers in Geography" (47 pages; $1.00)
Association of American Geographers
1710 16th St., N.W.
Washington, DC 20009
202/234-1450

"Your Career in Ecology" (6 pages)
Ecological Society of America
Center for Environmental Studies
Arizona State University
Tempe, AZ 85287
602/965-3000

"Career Opportunities in Ornithology" (8 pages)
Division of Birds, E-607
National Museum of Natural History
Smithsonian Institution
Washington, DC 20560
202/357-1300

Energy

"Energy Careers for Minorities and Women" (16 pages)
The National Urban Coalition
1120 G St., N.W., Suite 900
Washington, DC 20005
202/628-2990

Engineering

"Careers in Chemical Engineering" (40 pages; $5.95)
National Textbook Company
4255 W. Touhy Ave.
Lincolnwood, IL 60646
312/679-5500

"Careers for Engineers in the Minerals Industry" (13 pages)
Society of Mining Engineers of AIME
P.O. Box 625005
Littleton, CO 80162
303/973-9550

"Solving Problems: Engineers At Work" (5 pages)
American Telephone and Telegraph Company
Room 3355C3
295 N. Maple Ave.
Basking Ridge, NJ 07920
201/221-2000

"Making It Engineering" (11 pages; 35¢)
American Association of Engineering Societies
415 Second St., N.E.
Washington, DC 20002
202/546-2237

"Engineering—A World of Possibility" (19 pages)
Committee on Minorities in Engineering
National Research Council
2101 Constitution Ave., N.W.
Washington, DC 20418
202/334-2000

"A World for Women in Engineering"
American Telephone and Telegraph Company
Room 3355C3
295 N. Maple Ave.
Basking Ridge, NJ 07920
201/221-2000

"Careers in Petroleum Engineering" (16 pages)
Society of Petroleum Engineers
P.O. Box 833836
Richardson, TX 75083
214/669-3377

"Planning a Career in Metallurgical Engineering, Metallurgy, and Materials Science"
Metallurgical Society of AIME
410 Commonwealth Dr.
Warrendale, PA 15086
412/776-1535

"A Career for the Future" (14 pages; 40¢)
American Society of Mechanical Engineers
United Engineering Center
345 East 47th St.
New York, NY 10017
212/705-7722

"The Engineering Team" (16 pages; 30¢)
American Association of Engineering Societies
415 Second St., N.E.
Washington, DC 20002
202/546-2237

"Engineering: Creating a Better World" (20 pages; 50¢)
American Association of Engineering Societies
415 Second St., N.E.
Washington, DC 20002
202/546-2237

"Industrial Engineering, The Humanized Profession" (14 pages)
Institute of Industrial Engineers
25 Technology Park/Atlanta
Norcross, GA 30092
404/449-0460

"Engineering—A Goal for Women" (6 pages)
American Association of Engineering Societies
415 Second St., N.E.
Washington, DC 20002
202/546-2237

"Make Your Career Choice...Engineering" (19 pages; 75¢)
American Association of Engineering Societies
415 Second St., N.E.
Washington, DC 20002
202/546-2237

"Spaceship Earth: An Instruction Book Didn't Come With It. A Career in Metallurgy, Metallurgical Engineering and Materials Science" (8 pages)
The Metallurgical Society of AIME
410 Commonwealth Dr.
Warrendale, PA 15086
412/776-1535

"WOMENGINEER" (16 pages; 75¢)
American Association of Engineering Societies
415 Second St., N.E.
Washington, DC 20002
202/546-2237

"Take It from Us...You Can Be An Engineer" (20 pages)
General Electric Company
Educational Communications Program
W1D2
Fairfield, CT 06431
203/373-2211

"Why Ceramic Engineering?" (8 pages; 20¢)
American Ceramic Society
757 Brooksedge Plaza Dr.
Westerville, OH 43081
614/890-4700

"Is Civil Engineering for You?" (14 pages)
American Society of Civil Engineers
345 E. 47th St.
New York, NY 10017
212/705-7496

"Minorities in Engineering" (14 pages; 50¢)
National Action Council for Minorities in Engineering
3 W. 35th St.
New York, NY 10001
212/279-2626

"Careers in Electrical/ Electronics Engineering" (14 pages)
The Institute of Electrical andElectronic Engineering
345 E. 47th St.
New York, NY 10017
212/705-7900

Health Sciences

"Pathology as a Career in Science" (16 pages)
Intersociety Commission on Pathology Information
4733 Bethesda Ave., Suite 735
Bethesda, MD 20814
301/656-2944

"Dentistry: Is It for You?" (20 pages)
Council on Dental Education
American Dental Association
211 East Chicago Ave.
Chicago, IL 60611
312/440-2500

"Podiatric Medicine—The Challenges and Rewards of an Established Profession" (8 pages)
American Association of Colleges of Podiatric Medicine
6110 Executive Blvd.
Suite 204
Rockville, MD 20852
301/984-9350

"Career in Physiology" (24 pages)
American Physiological Society
9650 Rockville Pike
Bethesda, MD 20814
301/530-7164

Information Sciences

"Careers in Technical Writing" (8 pages)
Society of Technical Communication
815 15th St., N.W., Suite 506
Washington, DC 20005

"Careers in Health Sciences Librarianship" (7 pages)
Medical Library Association
919 North Michigan Ave., Suite 3208
Chicago, IL 60611
312/266-2456

"Challenging Careers in Information" (18 pages)
American Society for Information Sciences
1424 16th St., N.W., Suite 404
Washington, DC 20036
202/462-1000

"A Guide to Careers in Science Writing" (10 pages)
National Association of Science Writers
P.O. Box 294
Greenlawn, NY 11740
516/757-5664

"What's It Like to Work With Computers?" (28 pages)
General Electric Company
Educational Communications Program
W1D2
Fairfield, CT 06431
203/373-2211

Mathematical Sciences

"Mathematics at Work in Society: Opening Careers" (32 pages)
Mathematical Association of America
1529 18th St., N.W.
Washington, DC 20036
202/387-5200

"Profiles in Applied Mathematics" (10 pages; 30¢)
Society for Industrial and Applied Mathematics
1400 Architects Building
117 South 17th St.
Philadelphia, PA 19103
215/564-2929

"Careers in Mathematics" (7 pages)
Mathematical Association of America
1529 18th St., N.W.
Washington, DC 20036
202/387-5200

"Careers in Operations Research" (17 pages)
Operations Research Society of America
Education Committee
Mount Royal and Guilford Ave.
Baltimore, MD 21202
301/528-4146

Pharmaceutical Sciences

"This Is the Profession of Pharmacology" (20 pages)
American Society for Pharmacy and Experimental Therapeutics
9650 Rockville Pike
Bethesda, MD 20814
301/530-7060

"Shall I Study Pharmacy?" (32 pages)
American Association of Colleges of Pharmacy
1426 Prince St.
Alexandria, VA 22314
703/739-2330

Psychology

"Careers in Psychology" (28 pages)
American Psychological Association
1200 17th Street, N.W.
Washington, DC 20036
202/955-7600

Social Sciences

"Careers in Demography" (16 pages)
Population Association of America
1429 Duke St.
Alexandria, VA 22314
703/684-1221

"Careers in Sociology" (19 pages)
The American Sociological Association
1722 N St., N.W.
Washington, DC 20036
202/833-3410

Technology

"What's It Like to Be a Technician?" (14 pages)
General Electric Company
Educational Communications Program
W1D2
Fairfield, CT 06431
203/373-2211

Multidisciplinary

"I'm Madly in Love With Electricity" (37 pages; $2.00)
Lawrence Hall of Science
Attention: Careers
University of California
Berkeley, CA 94720
415/642-1823

"Careers Nontraditional" (34 pages)
American Chemical Society
Department of Educational Activities
1155 16th St., N.W.
Washington, DC 20036
202/872-4600

"Making Choices Today That Count Tomorrow" (8 pages)
Office of Admissions
Montana Hall
Montana State University
Bozeman, MT 59717
406/994-2452

"Choices, Decisions, Actions" (10 pages)
Standard Oil Company (Indiana)
Corporate Social Policy Department
P.O. Box 0910-A
Chicago, IL 50580
312/856-6111

"Petroleum Engineering--Career Choice for the Future" (16 pages)
Society for Petroleum Engineers
P.O. Box 833836
Richardson, TX 75083
214/669-3377

Other Fields

"Careers in Quality Sciences" (10 pages)
American Society for Quality Control
310 W. Wisconsin Ave.
Milwaukee, WI 53203
414/272-8575

"Science Education for You?" (20 pages)
National Science Teachers Association
1742 Connecticut Ave., N.W.
Washington, DC 20009
202/328-5800

"Speech-Language Pathology and Audiology Career Information" (6 pages)
American Speech and Hearing Association
Publication Sales
10801 Rockville Pike
Rockville, MD 20852
301/897-5700

Science Organizations

The following is a list of organizations that can provide a wide variety of information, services and/or publications. Write or call to find out how they can help with your individual needs. Ask if there is a director or special committee to deal with disability concerns, women's issues, or minority affairs. Many publish newsletters or brochures and present special seminars and programs.

Agricultural Science

Agricultural Research Service
U.S. Department of Agriculture
Independence Ave. and 14th St., S.W.
Washington, DC 20250
202/447-8732

Astronomy

American Astronomical Society
2000 Florida Ave., N.W., Suite 300
Washington, DC 20009
202/328-2010

Chemistry

American Chemical Society
Women Chemists' Committee
1155 16th St., N.W.
Washington, DC 20036
202/872-4600

Computer Science

American Federation of Information Processing Societies
1899 Preston White Dr.
Reston, VA 22091
703/620-8900

Dentistry

American Dental Association
211 East Chicago Ave.
Chicago, IL 60611
312/440-2500

Earth Sciences

American Geological Institute
Women Geoscientists Committee
4220 King St.
Alexandria, VA 22302
703/379-2480

American Meteorological Society
45 Beacon St.
Boston, MA 02108
617/227-2425

National Oceanic and Atmospheric Administration
6001 Executive Blvd.
Rockville, MD 20852
301/443-8374

Engineering

American Institute of Industrial Engineers, Inc.
25 Technology Park/Atlanta
Norcross, GA 30092
404/449-0460

American Nuclear Society
555 North Kensington Ave.
La Grange Park, IL 60525
312/352-6611

Biomedical Engineering Society
P.O. Box 2399
Culver City, CA 90231
213/206-6443

National Society of Professional Engineers
2029 K St., N.W.
Washington, DC 20006
202/684-2800

Society of Women Engineers
345 E. 47th St.
New York, NY 10017
212/705-7853

General Science

American Association for the Advancement of Science
Office of Opportunities in Science
1776 Massachusetts Ave., S.W.
Washington, DC 20036
202/326-6680

Association for Women in Science
2401 Virginia Ave., N.W., Suite 303
Washington, DC 20037
202/833-1998

National Science Teachers Association
1742 Connecticut Ave., N.W.
Washington, DC 20009
202/328-5800

Mathematics

American Mathematical Society
Committee on Women in Mathematics
Department of Mathematics
Wellesley College
Wellesley, MA 02181
617/235-0320

National Council of Teachers of Mathematics
1906 Association Dr.
Reston, VA 22091
703/620-9840

Medicine and Life Sciences

American Medical Association
535 N. Dearborn St.
Chicago, IL 60610
312/645-5000

American Society for Medical Technology
2021 L St., N.W., Suite 400
Washington, DC 20036
202/785-3311

Physics

American Association of Physics Teachers
5112 Berwyn Rd., Suite 101
College Park, MD 20740
301/345-4200

American Physical Society
Commission on the Status of Women in Physics
335 E. 45th St.
New York, NY 10017
212/682-7341

Additional Resources

The following list includes a variety of resources including catalogs, brochures, books, and periodicals organized under a series of alphabetized topics. For other specialized materials and further resources, see "Information Sources on Disability Concerns," pages 25–27.

Accessibility, Aids, and Appliances

Consumer Care Products, Inc. *Consumer Care Products, Inc.* (catalog) Available from CCP, Inc., 6405 Paradise Lane, Sheboygan Falls, WI 53085; 414/467-2393.

Paralyzed Veterans of America. *Access Information Bulletins*: "Wheel Chair Bathrooms," "Workplace Accommodations," and "Ramps, Stairs and Floor Treatments." Washington, DC: Paralyzed Veterans of America.

Sears, Roebuck, and Co., *Home Health Care.* (catalog) Available from Sears, Roebuck, and Co., Sears Tower, Chicago, IL 60684; 312/875-2500.

Awareness and Theory

Blatt, J., A. Brightman, and M. Sullivan. *Feeling Free.* Reading, MA: Addison-Wesley, 1979.

Bowe, F. *Handicapping America: Barriers to Disabled People.* New York: Harper and Row, 1978.

Browne, S., D. Connors, and S. Sterns. *With the Power of Each Breath: A Disabled Women's Anthology.* Pittsburgh: Cleis Press, 1985.

Cohen, S. *Special People.* Englewood Cliffs, NJ: Prentice-Hall, 1977.

DeLoach, C. and B. G. Greer. *Adjustment to Severe Physical Disability: A Metamorphosis.* New York: McGraw-Hill Book Company, 1981.

Duffy, Y. *All Things Are Possible.* Ann Arbor, MI: A. J. Garvin and Associates, 1981.

International Center for the Disabled and Louis Harris and Associates. *The ICD Survey of Disabled Americans: Bringing Disabled Americans into the Mainstream.* New York: International Center for the Disabled, 1980.

Kushner, H. *When Bad Things Happen to Good People.* New York: Schocken Books, 1981.

National Easter Seal Society. A collection of rehabilitation literature on a variety of topics. Available from N.E.S.S., 2023 W. Ogden Ave., Chicago, IL 60612; 312/243-8400, or 312/243-8880 (TDD).

United Cerebral Palsy Association and Associates. *Programming for Adolescents with Cerebral Palsy and Related Disabilities.* New York: United Cerebral Palsy Association, Inc., and Catherine Lyle Murray Foundation, 1983.

U.S. Government Printing Office. *Directory of National Information Sources on Handicapping Conditions and Related Services.* Publication No. E-82-22007, Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Vash, C. L. *The Psychology of Disability.* New York: Springer Publishers, 1981.

Wolfensberger, W. *The Principle of Normalization in Human Services.* Toronto: National Institute on Mental Retardation, 1972.

Wright, B. *Physical Disability: A Psychological Approach* (2nd. ed.). New York: Harper and Row, 1983.

Career Counseling

Bolles, R. N. *What Color Is Your Parachute?* Berkeley, CA: Ten Speed Press, 1985.

College Placement Council. *The CPC Annual 1988–89: The Career Planning and Placement Guide for College Graduates.* Bethlehem, PA: College Placement Council.

Commission on Professionals in Science and Technology. *Opportunities in Science and*

Engineering. Washington, DC: Commission on Professionals in Science and Technology,1984.

Foster, J., C. Szoke, et al. *Guidance Counseling and Support Services for High School Students with Physical Disabilities: Visual, Hearing, Orthopedic, Neuromuscular, Epilepsy, Chronic Health Conditions*. Cambridge, MA: Technical Education Research Centers, Inc. 1979.

Girls' Club of Santa Barbara. *Choices: A Teen Woman's Journal for Self-Awareness and Personal Planning*. El Toro, CA: Girls' Club of Santa Barbara, Inc.,1984.

Hopke, W. E., ed. *Encyclopedia of Careers and Vocational Guidance*. (6th ed.) (2 vols.) Chicago, IL: J.G. Ferguson Publishing Co., 1984.

Lobodinski, J., D. McFadden, and A. Markowica. *Marketing Your Abilities—A Guide for the Disabled Job Seeker*. Washington, DC: Mainstream, 1984.

Stern, V., and M. Redden. *Scientific and Engineering Societies: Resources for Career Planning*. Washington, DC: American Association for the Advancement of Science, 1980.

University of California. *Careers in Science: A Guide for the Counselors, Teachers, and Parents of Students with Disabilities*. Irvine, CA: University of California, Irvine, 1981.

U.S. Government Printing Office. *Occupational Outlook Handbook*. (1986–1987 ed.) Washington, DC: U.S. Government Printing Office. (029-001-02863-6)

Disability Issues in Science

American Association for the Advancement of Science. *Resource Directory of Scientists and Engineers with Disabilities*. 2nd ed.). Washington, DC: A.A.A.S., 1987.

American Association for the Advancement of Science. *Within Reach: Out of School Science Opportunities for Youth*. Washington, DC: A.A.A.S., 1982.

American Chemical Society. *Teaching Chemistry to Physically Handicapped Students*. Washington, DC: The American Chemical Society Committee on the Handicapped, 1981.

Center for Multisensory Learning. *Science Enrichment for Learners with Physical Handicaps*. Berkeley, CA: Lawrence Hall of Science, University of California, 1978.

_____ . *Science Activities for the Visually Impaired,*. Berkeley, CA: Lawrence Hall of Science, University of California, 1976.

_____ . *Center for Multisensory Learning (CML) Newsletter*. Berkeley, CA: Lawrence Hall of Science, University of California. Periodical.

Heath Resource Center. *Access to the Science and Engineering Laboratory and Classroom*. Washington, DC: Heath Resource Center, 1986.

Smith, L.M. *A College Student with a Disability: A Faculty Handbook*. Washington, DC: Superintendent of Documents, U.S. Government Printing Office, 1980.

Stearner, Phyllis S. *Able Scientists—Disabled Persons: Biographical Sketches Illustrating Careers in the Sciences for Able Disabled Students*. Clarendon Hills, IL: Foundation for Science and the Handicapped, Inc., 1984.

U.S. Department of Commerce. *Science for the Physically Handicapped in Higher Education*. Washington, DC: U.S. Department of Commerce, National Oceanic and Atmosphere Administration, 1979.

University of California. *Careers in Science: A Guide for the Counselors, Teachers and Parents of Students with Disabilities*. Irvine, CA: University of California, Irvine, 1981.

Employment

American Foundation for the Blind. *Visually Impaired Professional Personnel*. New York: American Foundation for the Blind, 1984.

Bowe, F. *Employment Trends: 1984 and Beyond: Where the Jobs Will Be*. Hot Springs, AR: Arkansas Rehabilitation Research and Training Center, 1986.

Bowe, F., and J. Rochlin. *The Business-Rehabilitation Partnership*. Hot Springs, AR: Arkansas Rehabilitation Research and Training Center, 1986.

Greenwood, R., ed. *Designing Jobs for Handicapped Workers: Conference Proceedings.* Hot Springs, AR: Arkansas Rehabilitation Research and Training Center, 1985.

Heath Resource Center. *Tax Incentives and Tax Benefits for the Employers of Disabled Persons.* Washington, DC: Heath Resource Center, 1987.

Occupational Outlook Quarterly. Washington D.C.: U.S. Department of Labor, Bureau of Labor Statistics. Quarterly.

The President's Commission on Employment of Disabled People and the Dole Foundation. *Disabled Americans at Work.* Washington, DC, 1985.

Rochester Institute of Technology. *Tips You Can Use When Communicating with Deaf Employees.* Rochester, NY, 1985.

Terzian, A., and M. E. Saari. *Deafness: A Guide for Employers and Employment Counselors.* Trenton, NJ: New Jersey Department of Labor, 1985.

Parents

Board, M. A., J. Cole, et al. *Independent Living with Attendant Care: A Message to Parents of Handicapped Youth.* Houston: The Institute for Rehabilitation and Research, 1980.

Dinkmeyer, D., and G. McKay. *Systematic Training for Effective Parenting.* Circle Pines, MN: American Guidance Services, 1976.

Greenbaum, J., and G. Markel. *Parents Are to Be Seen and Heard.* Ann Arbor, MI: Greenbaum and Markel Associates, 1985.

Self-help

Board, M. A., J. Cole, L. Frieden, and J. Sperry. *Independent Living with Attendant Care: A Guide for the Person with a Disability.* Houston: The Institute for Rehabilitation and Research, 1980.

Gordon, S. *Living Fully: A Guide for Young People with a Handicap, Their Parents, Their Teachers and Professionals.* New York: John Day Company, 1975. (c/o Harper and Row)

Hale, G., ed. *The Source Book for the Disabled.* New York: Paddington Press, 1979 (Grosset & Dunlap, distributors).

The President's Committee on Employment of People with Disabilities. *Worklife: A Publication on Employment and People with Disabilities.* Washington, DC. Quarterly.

University of California. *Making the Transition: College and Disabled Students.* Irvine, CA: Disabled Students Services, University of California, Irvine, 1985.

Women in Science

Agency for Instructional Technology. ***Women In Science.*** (eight-part video series with resource guide) Bloomington, IN: Agency for Instructional Technology and the University of Michigan, 1988.

American Association for the Advancement of Science. *Bibliography on Women in Science, Engineering, and Mathematics.* Available from the American Association for the Advancement of Science, 1776 Massachusetts Ave. N.W., Washington, DC 20036.

American College Testing Program. *Women in Science and Technology: Careers for Today and Tomorrow.* Available from American College Testing Program Publications, P.O. Box 168, Iowa City, IA 52240.

Center for Sex Equity in Schools. *Women, Math, and Science: A Resource Manual.* 1982. Available from the Center for Sex Equity in Schools, 1046 School of Education, University of Michigan, Ann Arbor, MI 48109.

EQUALS. *An Annotated Bibliography to Assist Elementary and Secondary School Teachers in Sex-Fair Counseling and Instruction.* Available from EQUALS, Lawrence Hall of Science, University of California, Berkeley, CA 94720.

Ehrhart, Julie Kuhn, and Bernice R. Sandler. *Looking for More than a Few Good Women in Traditionally Male Fields.* Project on the Status and Education of Women, 1987. Available from the Association of American Colleges,1818 R. St. N.W., Washington, DC 20009; 202/387-1300.

Emberlin, Diane. *Contributions of Women: Science.* Minneapolis: Dillon Press, 1977.

Gornick, Vivian. *Women in Science: Portraits from a World in Transition.* New York: Simon and Schuster, 1988.

Guidance Associates, Inc. *Challenging Careers: New Opportunities for Women.* Catalyst. Filmstrip and guide available from Guidance Associates, Inc., Communications Park, Box 300, White Plains, NY 10602.

Humphreys, S., ed. *Women and Minorities in Science: Strategies for Increasing Participation.* Boulder, CO: Westview Press, 1982.

Modern Talking Pictures. *Science: Women's Work.* Film available from Modern Talking Pictures Service, 5000 Park St. North, St. Petersburg, FL 33709.

National Council of Teachers of Mathematics. *Equity in Mathematics Project Resource List.* Available from the National Council of Teachers of Mathematics, 1906 Association Dr., Reston, VA 22091.

National Women's History Project. Numerous resources for curriculum and project ideas. Contact National Women's History Project, Box 3716, Santa Rosa, CA 95402; 707/526-5974.

Osen, Lynn. *Women in Mathematics.* Cambridge: MIT Press, 1974.

Research Triangle Institute. *Exploring Careers in Science and Engineering.* Slides, audiocassette, posters, activity guide. Available from Iris Weiss, Research Triangle Institute, P.O. Box 12194, Research Triangle Park, NC 27709.

Smith, W., and K. Stroup. *Science Career Exploration for Women.* Available from the National Science Teachers Association, 1742 Connecticut Ave., N.W., Washington, DC 20009.

Thomas, John W. *Making Changes: A Futures-Oriented Course in Inventive Problem Solving.* Available from ETC Publications, Palm Springs, CA 92263.

Tobias, Sheila. *Overcoming Math Anxiety.* Boston: Houghton Mifflin, 1978.

University of Kansas. *COMETS: Career-Oriented Modules to Explore Topics in Science.* Twenty-four modules including biographical sketches of women in science careers and accompanying language arts activities for junior nigh school-age students. Available from the Department of Curriculum and Instruction, University of Kansas, 205 Bailey Hall, Lawrence, KA 60045. ERIC: 226-984-1983.

END

U.S. Dept. of Education

Office of Education
Research and
Improvement (OERI)

ERIC

Date Filmed

March 21,1991