

VOL. 172, NO. 6



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KNOWN
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SEASONS TIBET TREK SLEEP RED CRABS

AS THE National Geographic Society ends its hundredth year with this issue, it's appropriate that we lead with a report of an important archaeological discovery funded in part by your dues. Such a study would have been impossible a hundred years ago, but it is just as adventurous and dangerous as any we have ever reported, for it involves an ancient shipwreck lying 140 to 170 feet down on the Mediterranean floor. Always at risk at this depth, Turkish and U. S. scientists and students have excavated as meticulously as on any land site. Man's knowledge of the Bronze Age takes a great leap forward as a result.

Last summer another group drew fire for retrieving objects from another important shipwreck—the R.M.S. *Titanic*. A French team backed by investors led by a former U. S. car dealer was accused of looting the site. Columnist William F. Buckley, Jr., represents the view that salvaging *Titanic* memorabilia is justified as “retrieving from utter uselessness artifacts that, for some people, exercise an alluring historical appeal.” For me their appeal was dramatically diminished when those objects—commercially valuable as they may be—were removed for glass-case display.

If everybody who admires the Great Wall of China took one stone home as a souvenir, there would soon be no Great Wall, and the stones would be just tragic reminders of what was.

Just as not all old buildings and monuments should be saved, not all shipwrecks should be inviolate, but the *Titanic* has become an icon; it is the Cheops Pyramid of shipwrecks. It has become a symbol of man's arrogant trust in technology, a monument to an era of opulence and ostentatiousness and to an elegant way of travel long since replaced by airplanes.

Though submarine technology someday will permit tours of the site and extended archaeological study, a case can be made for satisfying curiosity now and making a few bucks by displaying *Titanic* objects. However, a better case can be made for leaving them undisturbed. The Senate obviously thought so in voting to bar their sale or display for profit in the U. S. To paraphrase a sign seen in many national parks: “Take only photographs, leave no footprints.”

That the *Titanic* wreck is a reasonably recent artifact makes it no less historic, and that it may contain valuable jewels makes it no less a monument that should be protected from all but the slow natural erosion of the sea that claimed it.

Wilbur E. Garrett

EDITOR



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Oldest Known Shipwreck Reveals Bronze Age Splendors 693

Sailing an ancient trade network, a ship sank off Turkey some 3,400 years ago. Now marine archaeologist George F. Bass excavates and, with photographer Bill Curtsinger, reports on an unprecedented trove of pottery, weapons, and copper and tin ingots.

Sea Change in the Sea Islands 735

Cultural traditions brought from Africa and a Creole language called Gullah erode under the impact of resort development along the South Carolina and Georgia coast, Charles L. Blockson finds. Photographs by Karen Kasmauski.

Nomads' Land: A Journey Through Tibet 764

Sorrel Wilby, a young Australian, walks 1,800 miles across western Tibet and gets more than she bargained for in snow blindness, blisters, and understanding.

What Is This Thing Called Sleep? 787

Familiar yet mysterious, sleep still baffles the experts. Michael E. Long and photographer Louie Psihoyos investigate crib death, breathing disorders, nightmares, narcolepsy, and other ailments that make sleep hazardous to your health.

Red Crabs of Christmas Island 822

Swarming over a tiny island in the Indian Ocean, millions of crustaceans undertake an annual march to the sea, tidying the landscape and invading houses along their route. By conservationist John W. Hicks.

COVER: Raw material of the Bronze Age, a four-handed copper ingot concreted to a round one is removed by an archaeologist off Turkey from the site of the world's oldest shipwreck yet found. Photograph by Bill Curtsinger.

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Oldest Known Shipwreck Reveals
**SPLENDORS
OF THE
BRONZE AGE**



Golden wings outstretched, a falcon adorns the face of a Bronze Age pendant. The priceless relic, probably of Canaanite design, was recovered from a 14th-century B.C. trading vessel lost off the Turkish coast, at Ulu Burun. At a depth of 150 feet a Turkish excavator (left) cleans debris from one of some 200 four-handled copper ingots retrieved from the wreck's cargo, which represents seven civilizations that flourished in the eastern Mediterranean area in Late Bronze Age times. Thousands of other items provide an astonishing portrait of an era symbolized by the reign of Egypt's Tutankhamun and the fall of Troy.

By **GEORGE F. BASS**
Photographs by **BILL CURTSINGER**

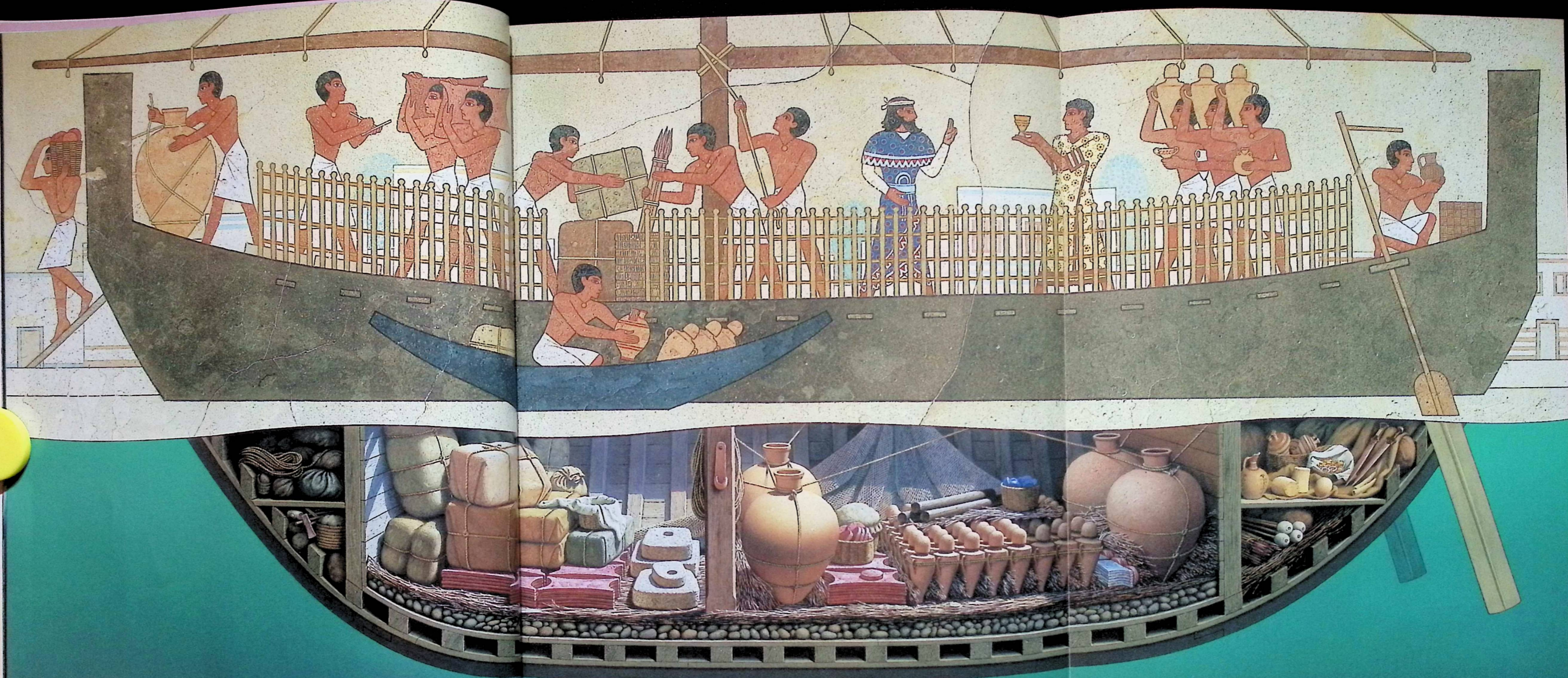
Oldest Known Shipwreck Reveals

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By GEORGE F. BASS
Photographs by BILL CURTSINGER



First look at a merchantman 34 centuries old

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IT WAS A STAGGERING LOSS when this 50-foot vessel, laden with valuable goods and vital commodities from around the Mediterranean and beyond, sank near the sheer promontory called Ulu Burun. But now it has become a find of tremendous significance for the author's team from

the Institute of Nautical Archaeology (INA) in Texas.

Since a Turkish sponge diver first located a trove of ingots on the seabed in 1982, the INA team has spent four years excavating and studying the vessel, developing an idea of how she may have looked in life. Elements of the ship

above the waterline are based on a 14th-century B.C. Egyptian tomb painting showing the arrival of a Syrian fleet. Cargo is based on items recovered from the wreck.

An immense storage jar, called a *pithos*, awaits unloading, at left. Raw materials of the Late Bronze Age, four-

handled ingots of copper were melted with tin to make bronze tools and weapons, such as spearheads unpacked amidships. A bearded Canaanite merchant and a Mycenaean Greek admire a gold chalice. Those two nationalities, as well as Cypriot, are possible for the vessel, whose

origin is still uncertain. The crew may have been a mix of cultures.

Unlike the vessel's upper features, which have dissolved, some of those below the waterline have been preserved by sediment, and precise mapping takes over from archaeological speculation. Hull planks

are fastened with mortise-and-tenon joints.

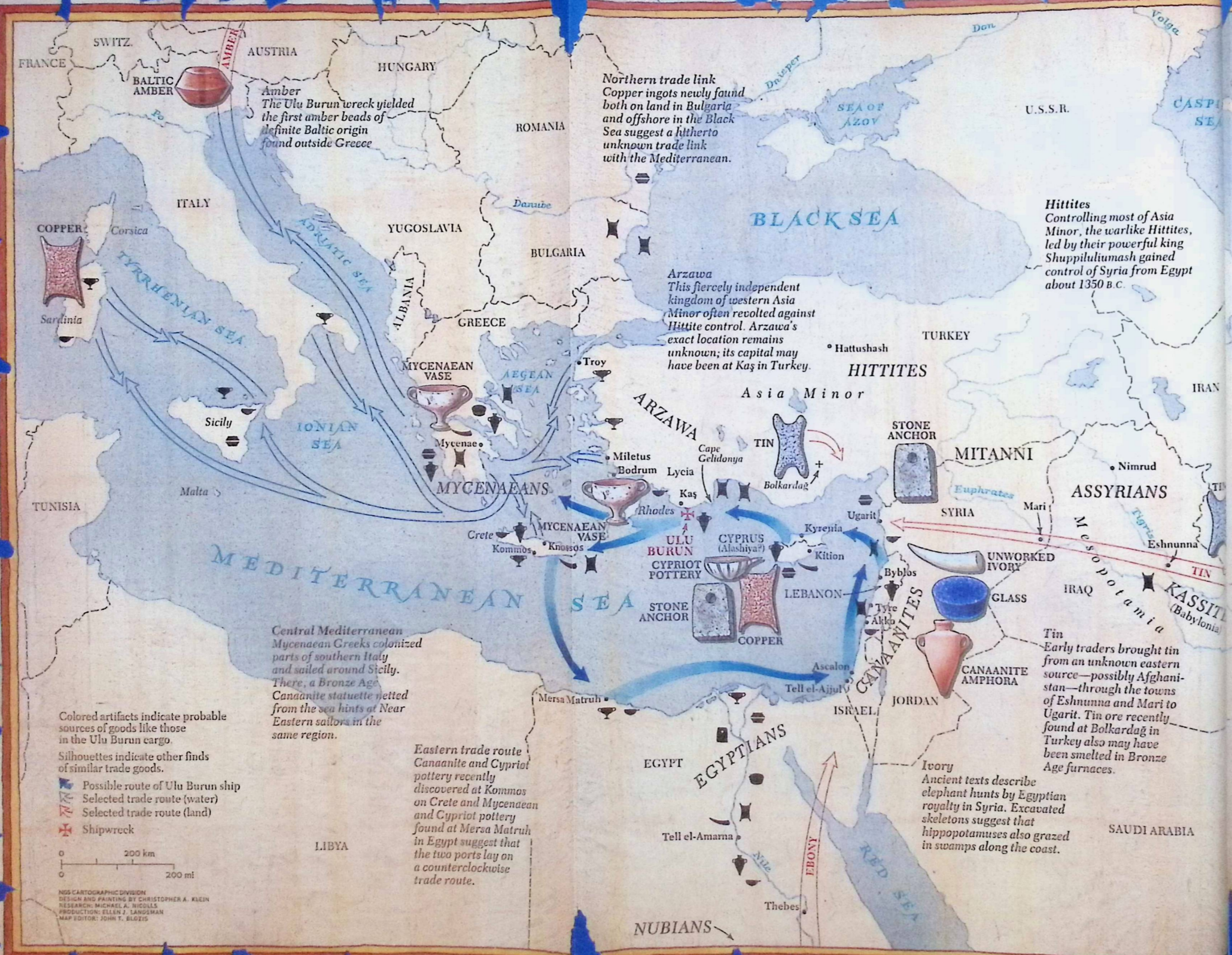
Valuables in the stern, far right, include bronze swords and arrowheads, stone mace heads, ostrich eggshells, ivory, and Mycenaean pottery. The hold at center stores fishing nets, blue glass ingots, logs of exotic wood, and amphorae

filled with aromatic resin, flanked by storage jars. Copper and tin ingots are also stowed here, with more copper forward of the mast, where stone anchors are stacked in pairs. Atop the ballast stones the goods were cushioned by thorny burnet, a common Mediterranean shrub.

PAINTING BY NED AND ROSALIE SEICLER

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BRONZE AGE TRADE

BY THE TIME the Ulu Burun ship sank in the 14th century B.C., a vast trade network was well established among various racial and linguistic groups centered on the Mediterranean, from subtropical Africa and the Near East to northern Europe. The loss represented by the wreck is revealed in the great distances the cargo was transported by land and sea before being loaded aboard for the voyage.

Ore for the ship's copper ingots almost certainly was mined on the island of Cyprus, believed to be ancient Alashiya. Yet the distinctive shape of the ingots, with four "legs," or handles, may represent Near Eastern influence: The only known casting mold for such shapes was excavated at a ruined palace near the ancient city of Ugarit on the Syrian coast.

Similar ingots have been found as far west as the island of Sardinia. While I believe those ingots were cast from local ore, their shape may suggest a Near Eastern presence in the western Mediterranean in the Late Bronze Age. The same type of ingots arrived in Egypt in great numbers, as evidenced by Egyptian tomb paintings that show them stacked in royal storerooms or borne by Syrian porters bringing tribute.

Suggested sources of Bronze Age tin range from Cornwall in England to as far east as China and Thailand, though I believe neither area supplied the tin we have found on the Ulu Burun wreck. Clay tablets dating four centuries earlier mention tin being brought westward overland through the Near Eastern city of Eshnunna to the Syrian coast for shipment. Our tin may have come from Afghanistan or perhaps from Turkey, where fieldwork by Aslihan Yener, supported by the National Geographic Society, recently located another source.

The design of many jars on the wreck was obviously Canaanite, a term applied

to the Bronze Age culture that flourished along the extreme eastern Mediterranean coast.

More exotic trade goods included ebony-like wood, which grew in Africa to the south of Egypt. Other finds included amber, which has since been identified as a type found in northern Europe, known as Baltic amber. There was also ivory in the form of elephant and hippopotamus tusks, both probably originating along the Syro-Palestinian coast, and ostrich eggshells.

Certainly goods of all types were widely distributed during the Bronze Age. The distinctive pottery of the Mycenaeans, or Bronze Age Greeks, is found in every country from Cyprus to the Nile Valley and from Syria to as far west as Sardinia. Canaanite amphorae have been found in both Greece and Egypt, and Cypriot pottery has been identified at Kommos in Crete and in various parts of Egypt.

It seems likely that Bronze Age ships such as the one at Ulu Burun plied the Mediterranean in a circular pattern, sailing from Syria-Palestine to Cyprus, to the Aegean and occasionally to Sardinia, then back by North Africa and Egypt.

Bronze weapons and tools recovered from the Ulu Burun wreck represent a variety of designs, including Mycenaean, Canaanite, and Egyptian. Jewelry seems mostly Canaanite.

Mesopotamian cylinder seals such as the ones we found on the ship have been discovered in Cyprus and Greece and are known to have been sent as gifts to the Egyptian pharaohs.

Finally, stone anchors similar to the 16 so far uncovered on the Ulu Burun wreck have been found in Cyprus, Egypt, and Syria.

Thus the Ulu Burun wreck provides a detailed and colorful chart of trade routes and cargoes in the Mediterranean more than 3,000 years ago.

Colored artifacts indicate probable sources of goods like those in the Ulu Burun cargo. Silhouettes indicate other finds of similar trade goods.

Blue arrow: Possible route of Ulu Burun ship
 Red arrow: Selected trade route (water)
 Black arrow: Selected trade route (land)
 Red X: Shipwreck

Central Mediterranean Mycenaean Greeks colonized parts of southern Italy and sailed around Sicily. There, a Bronze Age Canaanite statuette netted from the sea hints at Near Eastern sailors in the same region.

Eastern trade route Canaanite and Cypriot pottery recently discovered at Kommos on Crete and Mycenaean and Cypriot pottery found at Mersa Matruh in Egypt suggest that the two ports lay on a counterclockwise trade route.

Northern trade link Copper ingots newly found both on land in Bulgaria and offshore in the Black Sea suggest a hitherto unknown trade link with the Mediterranean.

Arzawa This fiercely independent kingdom of western Asia Minor often revolted against Hittite control. Arzawa's exact location remains unknown; its capital may have been at Kas in Turkey.

Hittites Controlling most of Asia Minor, the warlike Hittites, led by their powerful king Shuppiliumash gained control of Syria from Egypt about 1350 B.C.

Tin Early traders brought tin from an unknown eastern source—possibly Afghanistan—through the towns of Eshnunna and Mari to Ugarit. Tin ore recently found at Bolkaradağ in Turkey also may have been smelted in Bronze Age furnaces.

Ivory Ancient texts describe elephant hunts by Egyptian royalty in Syria. Excavated skeletons suggest that hippopotamuses also grazed in swamps along the coast.

NGS CARTOGRAPHIC DIVISION
 DESIGN AND PAINTING BY CHRISTOPHER A. KLEIN
 RESEARCH: MICHAEL A. NICHOLS
 PRODUCTION: ELLAN J. LANGSMAN
 MAP EDITOR: JOHN T. BLOZIS

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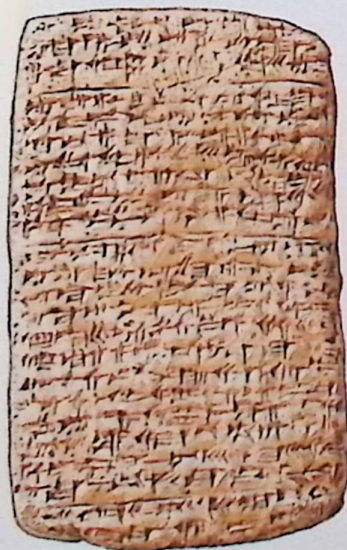
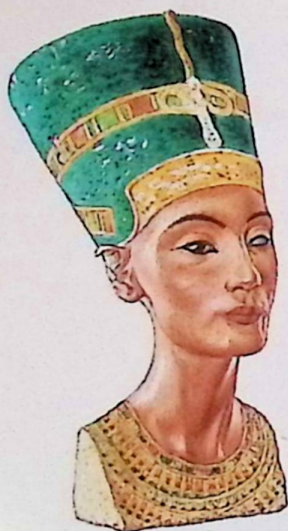
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COSMOPOLITAN WORLD



BUST OF QUEEN NEFERTITI AND 377 CLAY TABLETS, INCLUDING THE ONE ABOVE, WERE FOUND AT TELL EL-AMARNA, EGYPT. AGYPTISCHES MUSEUM, WEST BERLIN (TOP), BRITISH MUSEUM. ARTIFACTS PAINTED BY CHRISTOPHER R. KLEIN.

THE DISCOVERY that copper and tin could be combined to form a new and stronger metal—bronze—dramatically changed the course of human history.

From around 3000 B.C., tools and weapons made of this remarkable alloy began to replace crude implements of stone, wood, bone, and copper. What had once taken a farmer days to cultivate could now be done in a matter of hours. With relative speed shipwrights using bronze tools could build hulls capable of carrying bulk cargoes vast distances with only the energy of the wind to drive them. Such advances allowed trade to expand throughout the eastern Mediterranean world.

The ship excavated at Ulu Burun sank during the heyday of the Late Bronze Age—from about 1600 B.C. until 1050 B.C., when iron began to replace bronze as the preferred metal.

The ship carried products of at least seven cultures—Mycenaean Greek, Canaanite, Cypriot, Egyptian, Kassite, Assyrian, and Nubian. These varied products emphasize the economic ties that existed among Bronze Age kingdoms too often studied today as separate geographic entities.

During the 14th century B.C., when the Ulu Burun ship most likely sailed, Bronze Age Greeks were constructing their great palace at Mycenae, from which their name is drawn—Mycenaeans. They set up trading outposts and colonized the islands and shores of the Aegean and Ionian Seas from Asia Minor to southern Italy. They were the forebears of the fabled Homeric heroes—Agamemnon, Achilles, and Odysseus—who sailed to Troy a century later.

In the 14th century, however, the Mycenaeans sailed more for trade than conquest. Their ceramics reached virtually every city in the eastern Mediterranean and areas as far west as Sardinia. But the nature of Mycenaean maritime trade is unknown. There are no depictions of Mycenaean ships or sailors in contemporary Egyptian art, and we have not yet found a word for “merchant” in the Mycenaean language. Perhaps Mycenaean goods were often carried in foreign vessels.

Although the Mycenaeans had colonies along the coast of western Asia Minor, they seem to have had little contact with their linguistic cousins, the Hittites, who controlled much of the interior. An inland people who lived in fortresses no less imposing than those of the Mycenaeans, the Hittites already knew the secret of iron.

Hittite kings vied with Egyptian pharaohs over the land inhabited by the Canaanites. The term Canaanite is generally used to denote peoples living during the second millennium B.C., on the Syro-Palestinian coast, a strip of land that

OF THE LATE BRONZE AGE

controlled trade routes connecting Egypt, Mesopotamia, and the Hittite Empire, and whose ports controlled trade with Cyprus, Crete, and lands beyond. Seafaring Canaanite ships are depicted in 14th-century Egyptian art.

Farther east, Babylonia was ruled by the Kassites, a people who have left so few records we know little about them.

The figure of an early 12th-century B.C. bronze warrior standing on a four-handed ingot (right) found on Cyprus perhaps represents a deity protecting the island's copper supply. But the figure, like Cyprus, is enigmatic. Scholars can read documents left by Egyptians, Hittites, Canaanites, and Mycenaeans, but they have deciphered only a few words of the Bronze Age Cypriot language. And though we know the appearance and clothing of Hittites, Canaanites, Egyptians, Mycenaeans, and Nubians, we lack detailed depictions of the Cypriots.

During the 14th century Egypt's foreign influence waned under Pharaoh Akhenaten, whose queen was the beautiful Nefertiti. At a site on the Nile known as Tell el-Amarna the famous bust of Nefertiti (opposite) was discovered, as were 377 priceless clay tablets inscribed in cuneiform that offer a portrait of Egypt's diplomatic relations in the Late Bronze Age. The tablet (opposite, below) was sent to a pharaoh, probably by the king of Cyprus, apologizing for the small size of a copper shipment.

In 1361 B.C., one year after Akhenaten's death, Tutankhamun took the throne at the age of eight or nine. He died ten years later and would be little remembered had not his opulent tomb been discovered in 1922.

The exact nature of international trade in the 14th century B.C. is not fully understood. Private enterprise is suggested by clay tablets that list prices of various commodities. Trade was also conducted as exchanges of "royal gifts."

Many of those exchanges are recorded on the clay tablets found at Tell el-Amarna. Although most are royal documents from Egyptian vassals in Syria and Palestine, they include correspondence to Egyptian kings from Cypriot, Hittite, Kassite, Assyrian, and other rulers.

This tightly knit world would soon unravel. Around 1200 B.C. civilization in Greece came to a violent end, at whose hands we do not know.

The Hittite Empire was overrun, again by unknown forces, followed by wholesale destruction on Cyprus and along the Syro-Palestinian coast. Only Egypt repelled the incursions.

We do not yet know the reason for this violent ending to the Bronze Age, but the Ulu Burun shipwreck provides a fascinating portrait of that great era before its death. * * *



BRONZE STATUE OF AN ARMED GOD, EARLY 12TH CENTURY B.C., CYPRUS MUSEUM, NICOSIA.

I FELT no emotion as I scanned the cargo for the first time that summer of 1984. I was standing upright, my diving fins resting on a rock outcrop 150 feet below the surface of the Mediterranean.

The world's oldest known shipwreck lay before me—the shapes of jars and copper ingots dated back to the 14th or early 13th century B.C. But I had no more than five minutes to plan its excavation.

Five minutes to estimate the lie of the ship's hull beneath its cover of sand and cargo. Five minutes to decide where to place

our air-filled Plexiglas dome—dubbed the “phone booth”—in which our divers might take refuge in an emergency or telephone the surface. Five minutes to decide what mapping techniques we would use. Five minutes spent fighting nitrogen narcosis caused by breathing at such depth.

Thousands of dives over more than a quarter of a century had trained me to fight the dullness clouding my mind. But the effort left no room for fancy or romance. Quickly I drew up a mental plan of action and a list of priorities, then started for the surface.

Decreasing water pressure lifted the fog of narcosis as I swam upward to our research vessel, *Virazon*, moored just 50 yards from Ulu Burun, a rocky finger protruding from Turkey's southern coast into the Mediterranean (map, pages 697-98).

As I climbed aboard, I was met by my Turkish assistant, Cemal Pulak. “That's the most exciting dive I ever made,” I said. Then I turned to two American colleagues, Don Frey and Jack Kelley, and added, “You two sure do find good wrecks.”

In a sense the wreck had been found for us rather than by us. For 27 years I have been excavating ancient shipwrecks along the coast of Turkey.* In 1973, to help support that work, I founded what we now call the Institute of Nautical Archaeology—INA, for short—at Texas A&M University in College Station. Don Frey is the president of INA, and Jack Kelley is one of its founding directors.

Long experience has taught us that the best sources of information about ancient shipwrecks are the divers on Turkey's sponge boats. For search purposes the divers are far more valuable than the most sophisticated sonar and magnetometers in existence. Cemal and Don recently calculated that in a single four-month summer season the

(Continued on page 708)

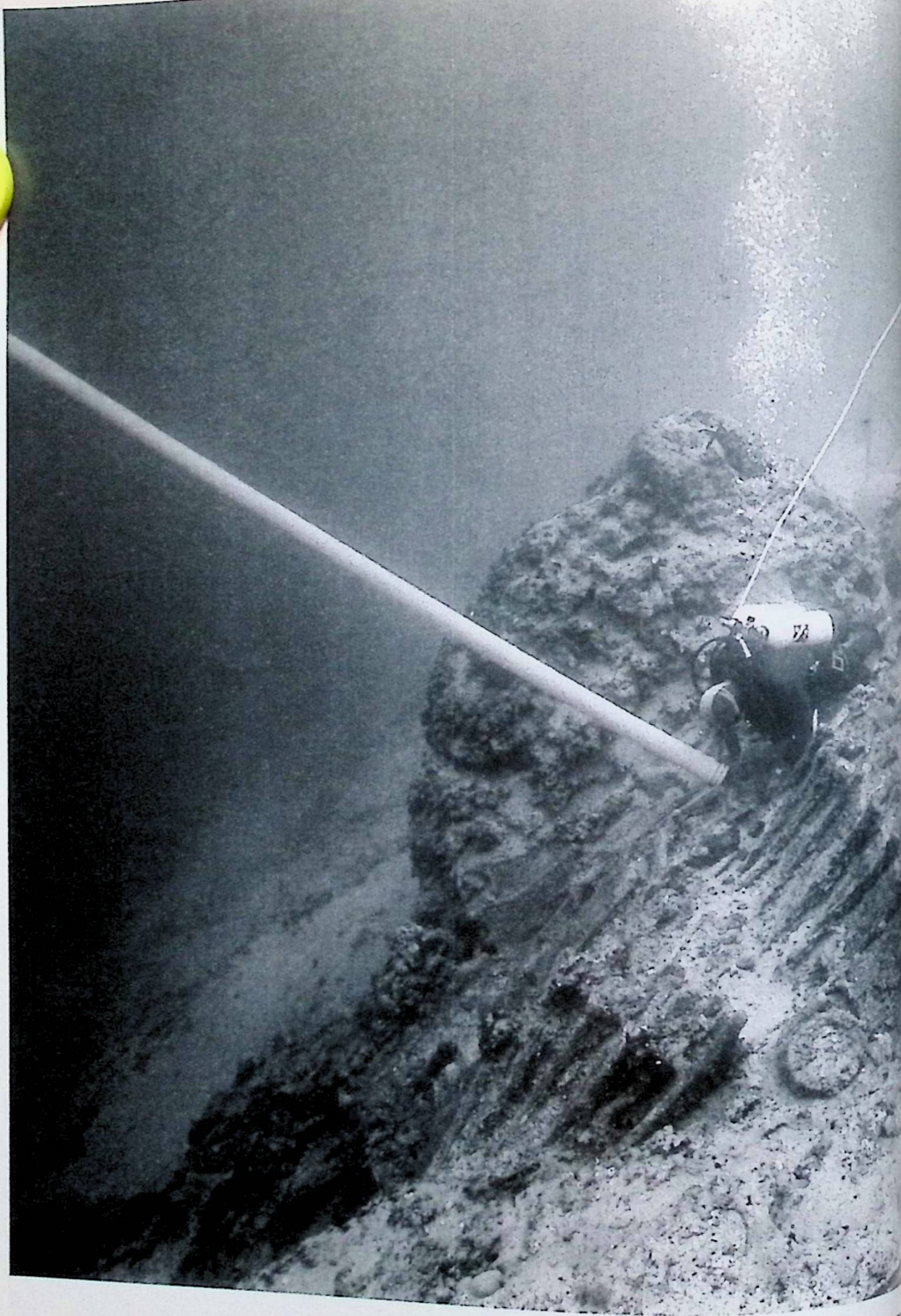
*See “Glass Treasure From the Aegean,” June 1978; “New Tools for Undersea Archeology,” September 1968; and “Underwater Archeology: Key to History's Warehouse,” July 1963, all by George F. Bass.



EVER SO HUMBLE in appearance, tin artifacts were among the most exciting finds. A round bun ingot and one-quarter of a four-handled ingot (above, at top)—the earliest known—were mixed with copper to make bronze. A mug, pilgrim flask, and bent plate (at bottom) double the total of Bronze Age tin artifacts ever found.

In front of a 60-pound copper ingot (opposite), a bronze dagger, a sword, spearheads, and cutting tools such as chisels are a mix of Canaanite, Mycenaean, Cypriot, and Egyptian designs. The ship must have groaned under its six tons of copper—enough, alloyed with tin, to equip a small army.



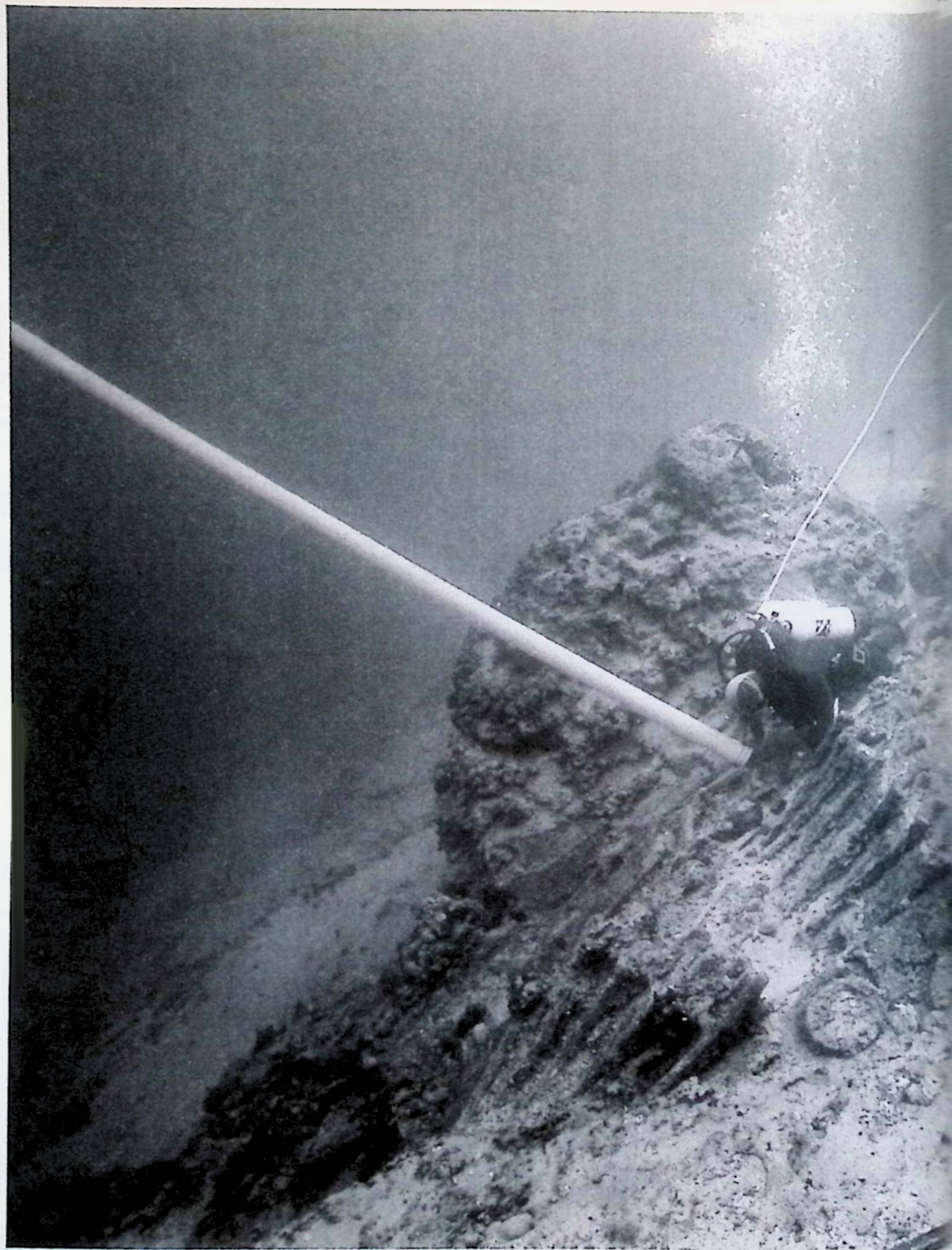


BARING THE BONES of the 14th century B.C., assistant excavation director Cemal Pulak, at left, uses an air lift to remove sediment from a long row of copper ingots. The vessel came to rest on a steep slope, one end about 170 feet deep, near the large rock outcrop. Nitrogen buildup at such depths



ROBIN PIERCY, INSTITUTE OF NAUTICAL ARCHAEOLOGY

not only fogs thinking but can also cause the bends, so dives were limited to a maximum of 20 minutes. Tufan Turanlı, foreground, vacuums sediment near stone anchors. Old anchors were used during the same period as building materials in Syria and Cyprus.



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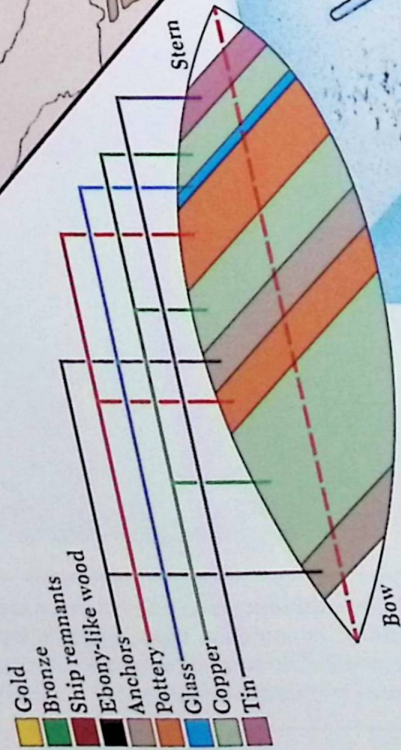
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The painstaking art of marine archaeology

A THOUSAND DIVES a season for four seasons—a demanding schedule for the archaeological team—have yielded rewards beyond all expectations.

Before artifacts can be raised, their positions must first be mapped so that their relationship to the plan of the vessel can ultimately be determined. Mapping the wreck by stereophotography was hampered by the steep,

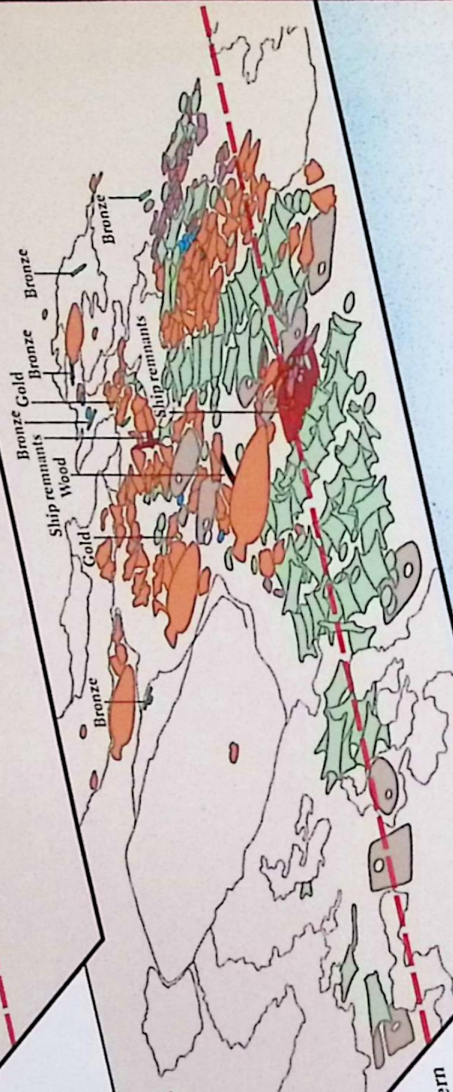


1984-season site plan



Alignment of ship's keel

1987-season site plan



Balloon helps divers raise heavy objects such as ingots. At left, in an air-filled Plexiglas "phone booth," divers can talk to colleagues at the surface or find shelter in an emergency.

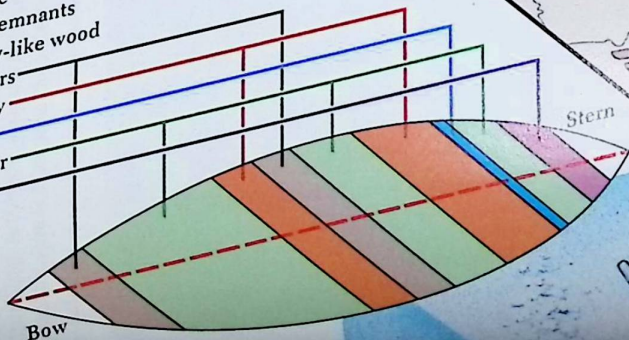
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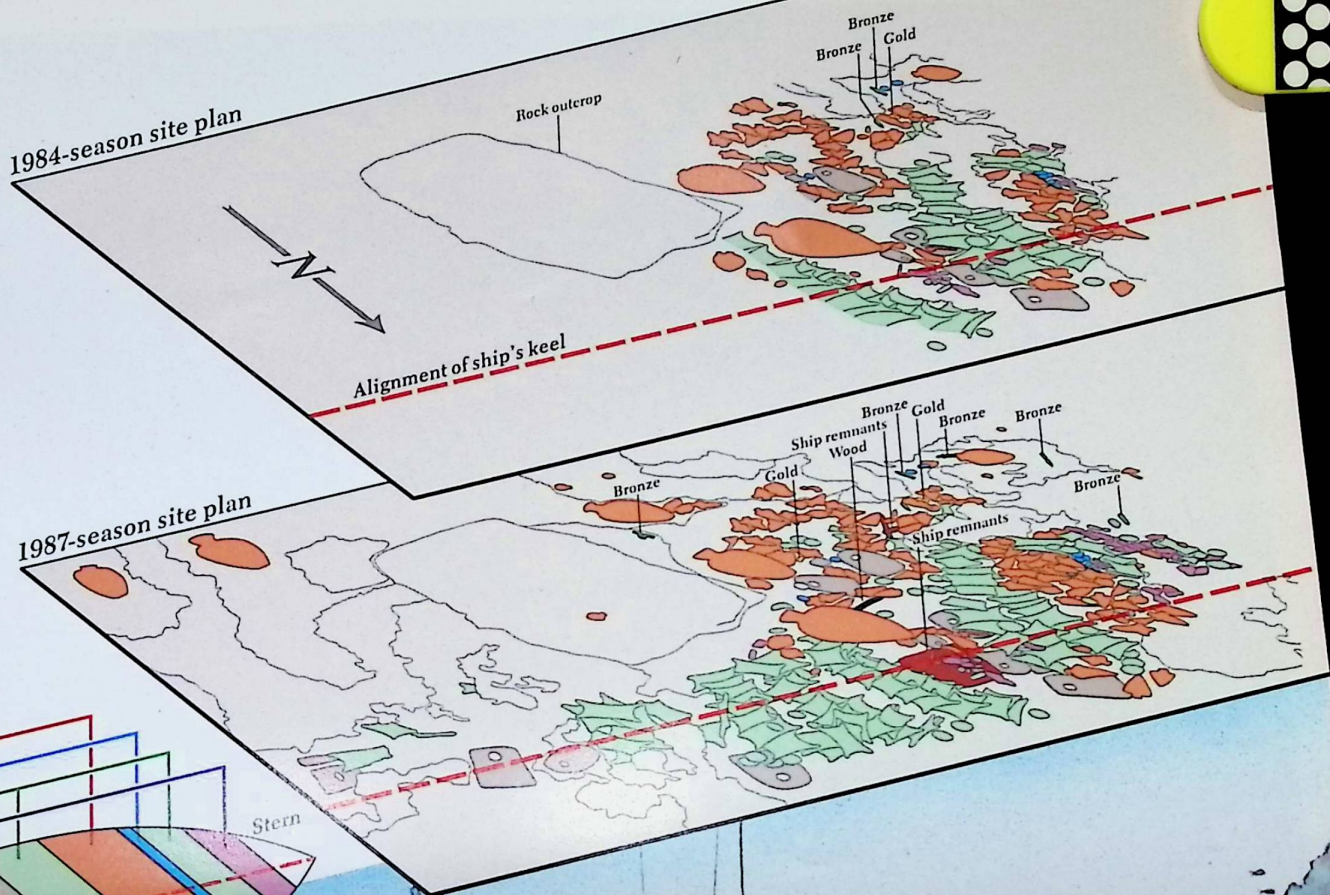
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- Gold
- Bronze
- Ship remnants
- Ebony-like wood
- Anchors
- Pottery
- Glass
- Copper
- Tin



1984-season site plan

1987-season site plan



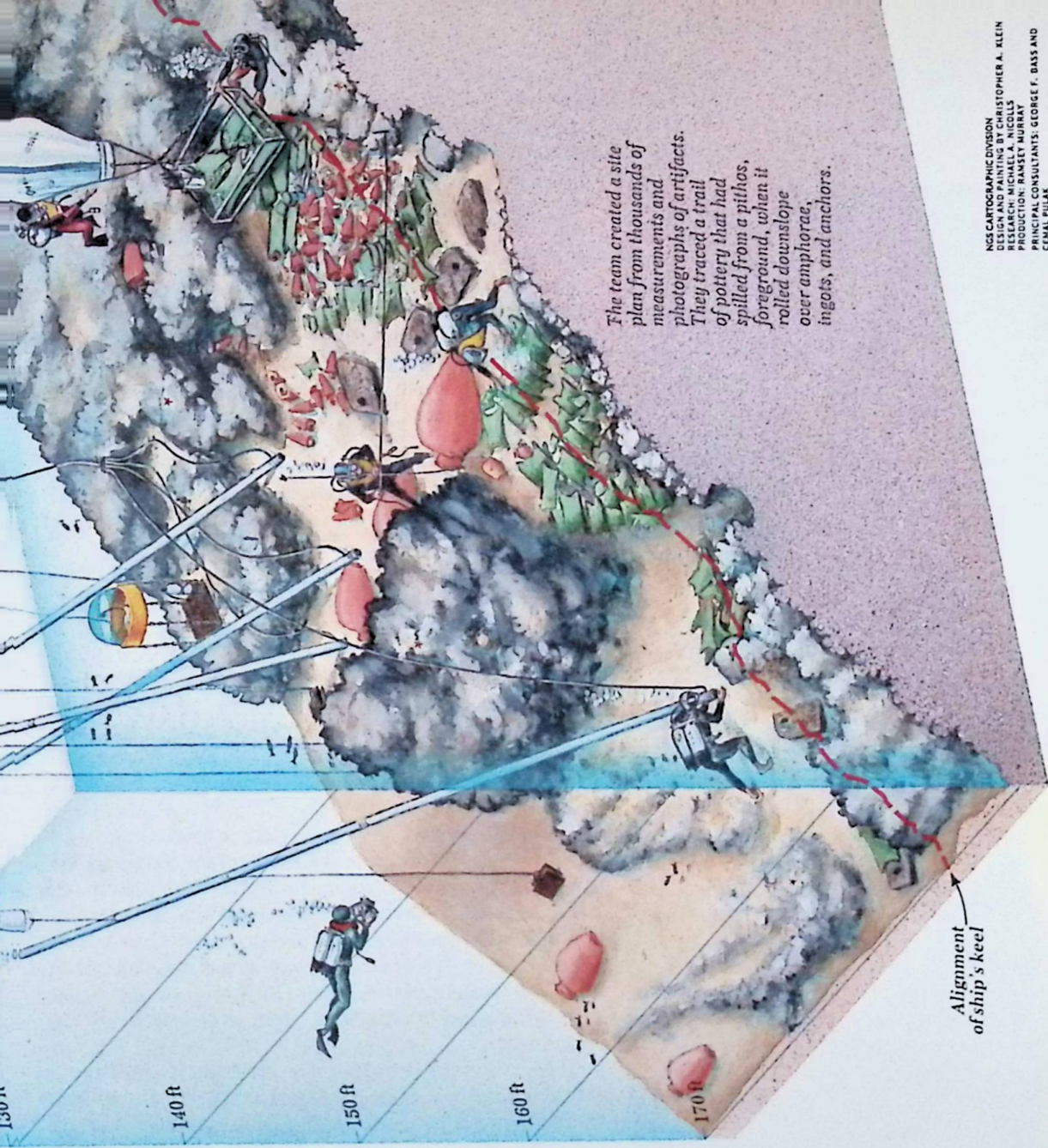
Balloon helps divers raise heavy objects such as ingots. At left, in an air-filled Plexiglas "phone booth," divers can talk to colleagues at the surface or find

uneven slope where she lies (bottom right). Nevertheless, precise results were achieved by triangulation with measuring tapes.

The dashed line locates the ship's keel. In nearby sandy areas excavation was relatively easy. The site's upper end proved to be a solid concretion of cargo, such as amphorae and ingots, that had to be meticulously chiseled free.

Site plans compare progress from the 1984 season with that of early 1987 (above right). Artifacts are color coded, and some are positioned relative to the ship's hull (key above). Many of those whose locations are shown have not yet been recovered. Excavation in 1984 concentrated on the shallower portion of the site and uncovered copper ingots, stone anchors, amphorae, and large storage jars. One sandy gully there yielded extraordinary treasures including raw ivory, jewelry of gold, silver, and amber, glass ingots, and a gold chalice.

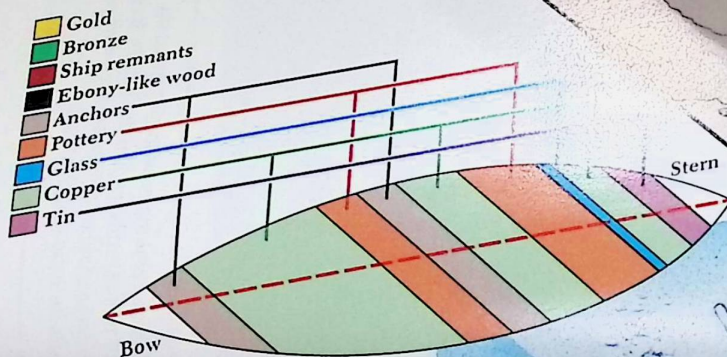
Two years later the inventory had increased dramatically. Egyptian connections surfaced in the form of scarabs and ebony-like logs. And an accumulation of crushed or defaced jewelry suggests precious scrap metal.



The team created a site plan from thousands of measurements and photographs of artifacts. They traced a trail of pottery that had spilled from a pithos, when it rolled downslope over amphorae, ingots, and anchors.

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of ship's keel

was hampered by the steep,

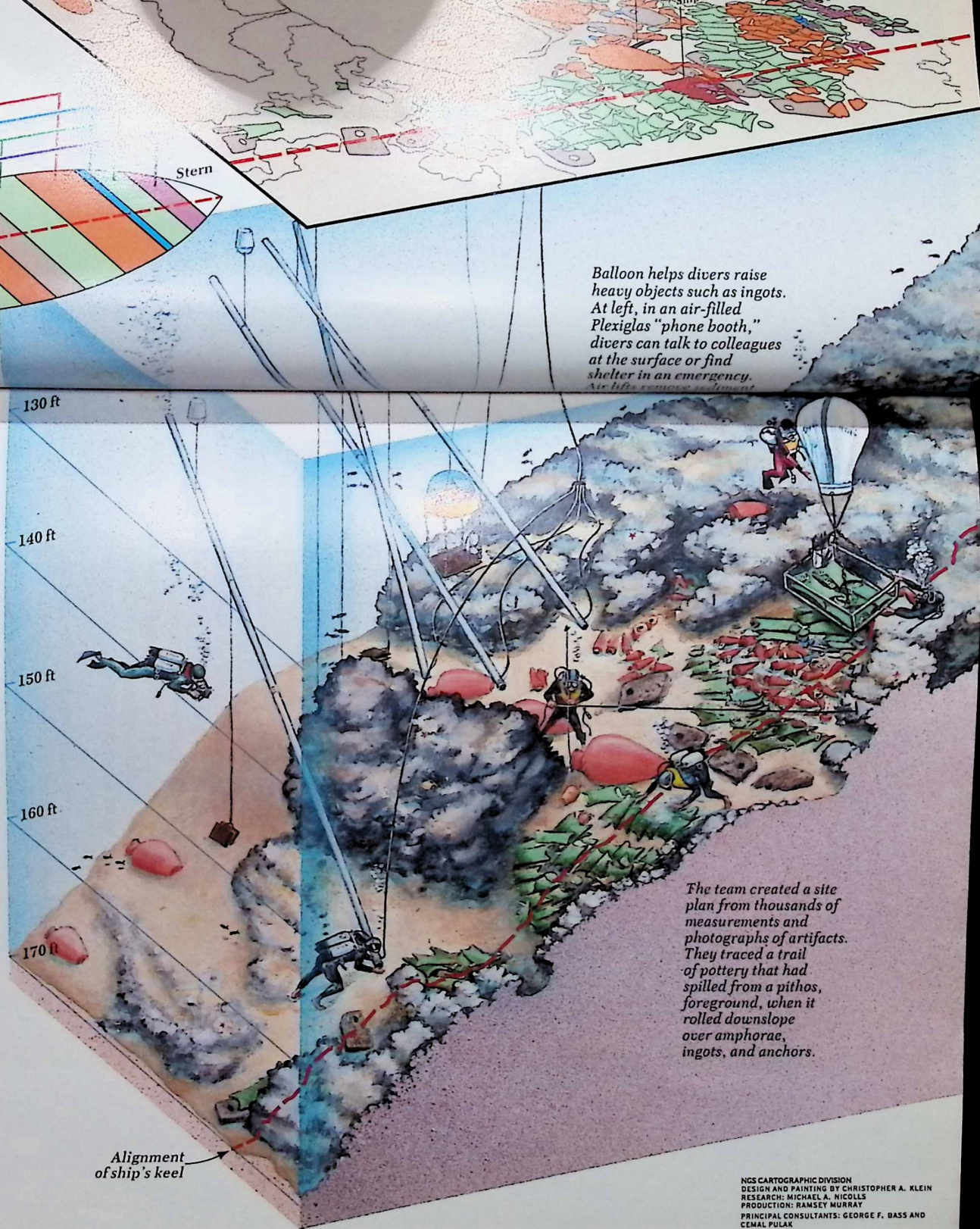


uneven slope where she lies (bottom right). Nevertheless, precise results were achieved by triangulation with measuring tapes.

The dashed line locates the ship's keel. In nearby sandy areas excavation was relatively easy. The site's upper end proved to be a solid concretion of cargo, such as amphorae and ingots, that had to be meticulously chiseled free.

Site plans compare progress from the 1984 season with that of early 1987 (above right). Artifacts are color coded, and some are positioned relative to the ship's hull (key above). Many of those whose locations are shown have not yet been recovered. Excavation in 1984 concentrated on the shallower portion of the site and uncovered copper ingots, stone anchors, amphorae, and large storage jars. One sandy gully there yielded extraordinary treasures including raw ivory, jewelry of gold, silver, and amber, glass ingots, and a gold chalice.

Two years later the inventory had increased dramatically. Egyptian connections surfaced in the form of scarabs and ebony-like logs. And an accumulation of crushed or defaced jewelry suggests precious scrap metal.



Balloon helps divers raise heavy objects such as ingots. At left, in an air-filled Plexiglas "phone booth," divers can talk to colleagues at the surface or find shelter in an emergency. Air lifts remain in contact.

The team created a site plan from thousands of measurements and photographs of artifacts. They traced a trail of pottery that had spilled from a pithos, foreground, when it rolled downslope over amphorae, ingots, and anchors.

Alignment of ship's keel

(Continued from page 702)

divers on 25 boats spend a combined total of about 20,000 hours roaming the seabed in the quest for sponges. The figure works out to the equivalent of about two years' underwater search by one marine archaeologist—without coming up for air!

As a result we have come to know the sponge divers well, and during the winter Don and his Turkish colleagues give slide-show lectures in the divers' villages to teach them what to look for in the way of ancient wrecks. One of the most distinctive clues to a wreck is an exposed Bronze Age copper ingot. These ingots were frequently cast in a shape resembling an oxhide, with a "leg," or handle, at each of the four corners.

We found 34 such ingots in 1960 on a wreck off Turkey's Cape Gelidonya—the first underwater site I ever excavated.* The artifacts recovered at Cape Gelidonya dated from around 1200 B.C., but unfortunately we found few remains of the ship's hull. Here at Ulu Burun in 1984 we were soon to uncover whole sections of beautifully preserved hull as well as the archaeological treasures it had carried.

"Metal biscuits with ears. . . ."

—Turkish sponge diver, Mehmet Çakır

LUSTY SEAFARER may have hoisted this ram's head drinking cup called a rhyton, recovered from sand near the rock outcrop. It was crafted of faience, powdered quartz fused by heat with an alkali. The maker's nationality remains a mystery. Although the cup resembles others from Cyprus and Syria, it does not match them exactly.



The first hint of a wreck at Ulu Burun came in the summer of 1982. A young diver named Mehmet Çakır told his captain that he had seen strange "metal biscuits with ears" on the seabed while working at a depth of 150 feet off the point.

The captain recognized the description as that of a Bronze Age copper ingot from a drawing Don had circulated among the sponge boats. Çakır's discovery was reported to Turkey's Museum of Underwater Archaeology in the town of Bodrum, where INA has its Turkish base. Divers from the museum and from INA quickly visited the site. They confirmed the existence of a wreck and estimated its date as the 14th or 13th century B.C.

The following summer my assistant Cemal led a preliminary survey of the Ulu Burun site along with Don Frey and Jack Kelley. They returned to Texas in September with sketches and photographs to show me, and they were literally breathtaking.

Beginning at a depth of 140 feet and stretching another 30 feet down a steep slope lay a total of 84 copper ingots, many of them still in neat rows as they had been stowed nearly 34 centuries ago. Many more ingots lay partly obscured beneath the upper rows.

Other exposed items included six enormous storage jars, each as large as the ones that hid the thieves in *Ali Baba and the Forty Thieves*. There were also dozens of terra-cotta amphorae, obviously of Canaanite design.

*See "Oldest Known Shipwreck Yields Bronze Age Cargo," May 1962; and "Thirty-three Centuries Under the Sea," May 1960, by Peter Throckmorton.

Scattered among the larger containers were several small two-handled jars known today as pilgrim flasks, because their shape made them convenient to carry on long journeys.

Examining all the sketches and photographs, I could only agree with Don Frey: "We're looking at an archaeologist's dream."

In the end that proved an understatement, for Ulu Burun held undreamed-of treasures. The next summer, 1984, we mounted a full-scale expedition to map and excavate the site. That was when I had my first exciting view of the wreck.

"I will bring to thee as a present two hundred talents of copper."

—Letter in the form of a clay tablet from the king of Alashiya to an Egyptian pharaoh, found at Tell el-Amarna, Egypt

As we carefully surveyed the site, we found that the ship's principal cargo had been copper ingots. There were about 200 of them—more than six times the number we had found at Cape Gelidonya. Each of the ingots weighs around 60 pounds, the equivalent of an ancient talent.

Months later I ran across a passage in one of the tablets from Tell el-Amarna mentioning a promised gift of 200 talents of copper from the king of Alashiya to an Egyptian pharaoh. The coincidence was stunning, and I could only speculate: Was the promised shipment ever sent from Alashiya, which we believe to be Cyprus? Did it reach Egypt? Or is it possible that the gift ended up on the seafloor off the point known today as Ulu Burun?

The chances that we had found that very cargo seemed remote, though I was soon convinced that the Ulu Burun ship nonetheless carried a royal consignment of some sort dating from the 14th century B.C.—in the Late Bronze Age, a period roughly between 1600 and 1050 B.C.

SUPPORT for our 1984 expedition came from INA and the National Geographic Society, later joined by the National Science Foundation, the Institute for Aegean Prehistory, and the National Endowment for the Humanities. I had assembled a crack team of excavators. Most had worked with me a decade or more on various wrecks along the Turkish coast. They included Aşkın Canbazoglu and Yaşar Yıldız of the Bodrum museum staff, INA's Don Frey, Cemal Pulak, and Jack Kelley, along with Tufan Turanlı, Robin Piercy, and Murat Tilev, and archaeologists Faith Hentschel, Feyyaz Subay, and Lisa Shuey. Archaeobotanist Cheryl Haldane took on the job of identifying any plant remains we discovered.

As we had done in past years, we built a base camp ashore and moored *Virazon* directly over the wreck. Because of the dangerous depth—140 to 170 feet—we limited our initial time on the



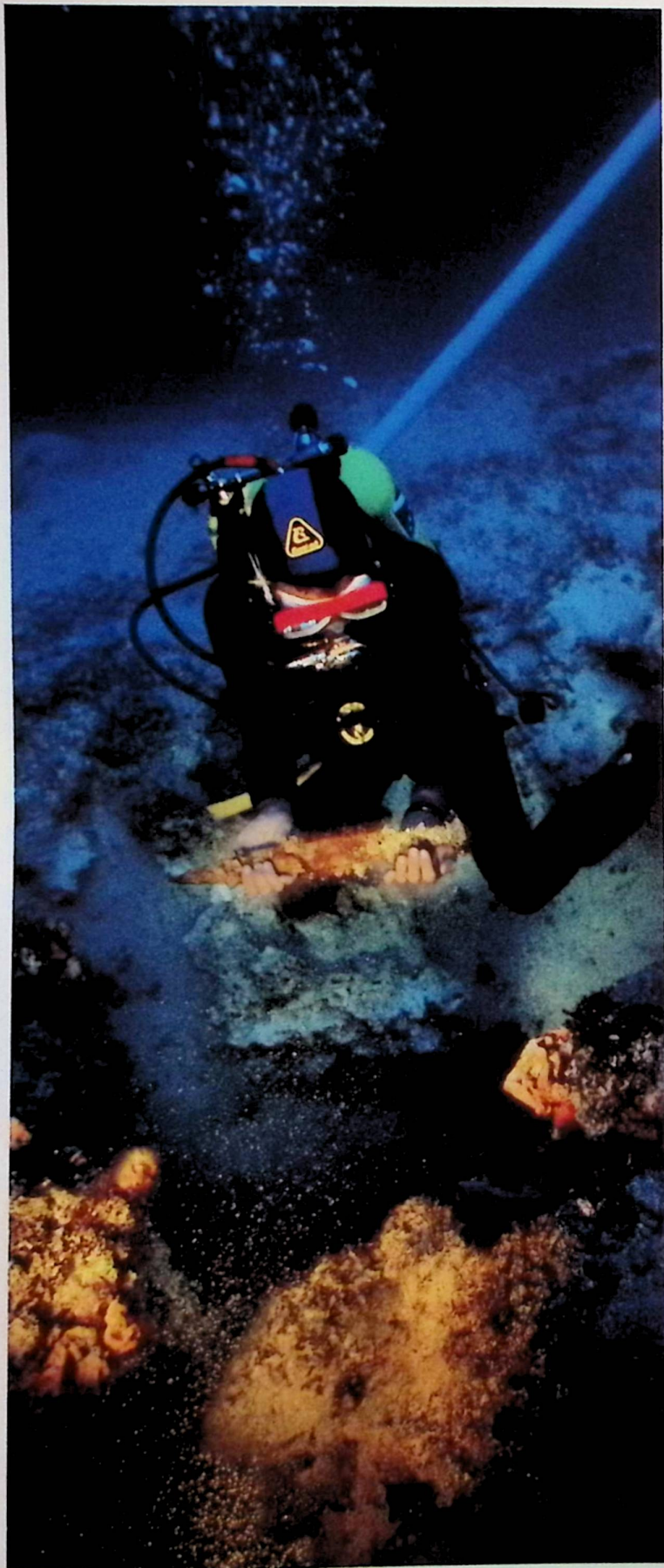
LUMP SUM of yellow terebinth resin might have fetched a fortune, the author believes. More than a hundred Canaanite amphorae were recovered, and most contained chunks of this resin. It has been found in Egyptian graves, but its purpose remains unknown. Its abundance among the cargo is second only to copper, suggesting the loss of another valuable consignment.





CHINA BARREL: As divers began to raise one pithos, they were amazed when pottery poured from its mouth. The author (opposite, above) and Aşkın Canbazoğlu of Turkey's Bodrum Museum of Underwater Archaeology inspect the storage jar. From it Canbazoğlu removes a juglet, one of 18 pieces of Cypriot pottery still packed inside. Except for the

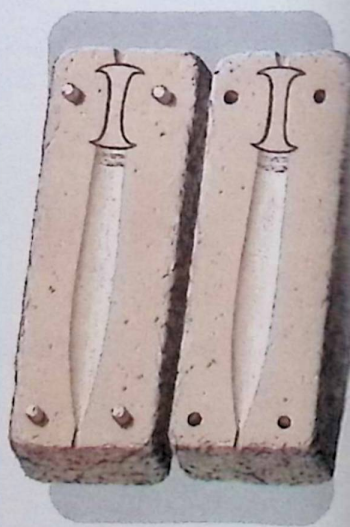
Cypriot pitcher at upper left, which was found nearby, all the pottery shown above came from the pithos, including two juglets, oil lamps with pinched nozzles to hold wicks, wishbone-handled bowls of different types, and a small bucchero jug. The pottery's rough-hewn, rustic style may have made it popular export ware, especially to Syria and its neighbors.



Casting a Bronze Age sword

SEAMAN'S SIDE ARM, an 18-inch-long bronze sword, excellently preserved by a mantle of encrustation, is examined by Faith Hentschel (left). A nearly identical short sword has been found at Akko, a Canaanite city on the Mediterranean. The sequence below, left to right, illustrates how such weapons were probably cast in one piece.

First a two-part stone mold was shaped, including two decorative bands for the base of the blade. Molten bronze was then poured into the mold. To the hardened sword's hilt were added inlays of wood, a long central ivory piece, and small adjacent bands of wood and ivory. The finished sword is also in the arms display on page 703.



wreck to only five minutes a dive. We gradually increased the time to 20 minutes twice a day, though it required long periods of subsequent decompression on pure oxygen.

ALMOST AT ONCE the wreck fulfilled our expectations. The first dives yielded disk-shaped copper ingots as well as the familiar four-handled style, a mace head of stone, a Canaanite amphora full of glass beads, and a second amphora filled with orpiment, a yellow sulfide of arsenic once used as pigment.

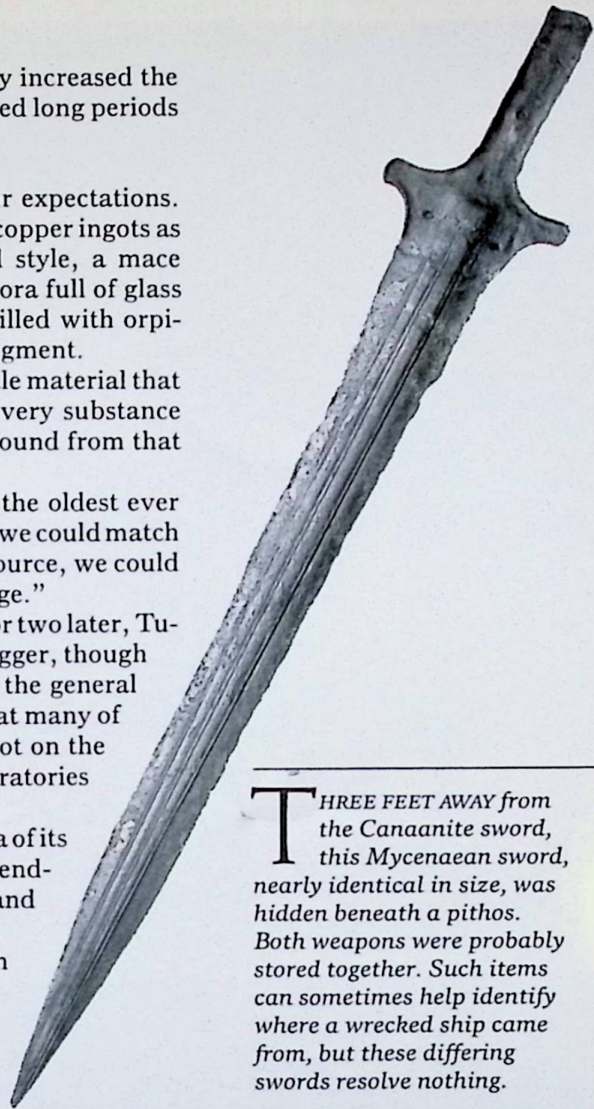
We also brought up samples of a grayish, brittle material that later proved to be 99.5 percent pure tin—the very substance that spurred on the Bronze Age but is seldom found from that period in raw form.

“If these are remnants of tin ingots, they’re the oldest ever found,” I told the staff over dinner one night. “If we could match such ingots chemically with tin from a known source, we could solve one of the great mysteries of the Bronze Age.”

Soon afterward we did find tin ingots. A day or two later, Tufan brought up what appeared to be a bronze dagger, though the concretion surrounding it disguised all but the general shape. The story of the dagger demonstrates that many of our most exciting discoveries often are made not on the seafloor but in libraries, museums, and laboratories long after our expeditions end.

The dagger was so encrusted that I had no idea of its date or origin. We stored it wet until the season ended, and then conservator Jane Pannell cleaned and preserved it at our laboratory in Bodrum.

Under Turkish law all our finds must remain in Turkey, so INA staff illustrator Netia Piercy made a precise drawing of the dagger, whose exact shape and inscribed decoration were now



THREE FEET AWAY from the Canaanite sword, this Mycenaean sword, nearly identical in size, was hidden beneath a pithos. Both weapons were probably stored together. Such items can sometimes help identify where a wrecked ship came from, but these differing swords resolve nothing.



A cup fit for a king—but whose?

THE INSURERS took a pounding when this ship sank, I'll tell you that!" joked Robin Piercy, an INA archaeologist, as he climbed aboard the research vessel *Virazon* with electrifying news: He had discovered a gold chalice.

Piercy discovered the treasure on the wreck's western edge, an area believed to be nearly barren. The chalice, made of two cones fastened by three rivets, with a thin strip as a collar to hide the junction, came to light among a cross-cultural group of artifacts (below). Surrounding the chalice, gleaming at center, lie a Canaanite amphora, at left, a Canaanite pilgrim flask, above—so called by archaeologists because it was suitable for a journey—and a two-handed Mycenaean cup called a kylix.

The juxtaposition ironically

illustrates an archaeological scale of values. Although many authorities have now studied the precious gold chalice, nothing

is yet known of its place of origin or date. However, the unpretentious terra-cotta kylix is of a style popular in the early 14th century B.C., and it thus serves as a relatively accurate dating tool, although the artifact could already have been several decades old when the ship went down.

The kylix, which may have been made on the Greek island of Rhodes, stands front and center in a collection of the wreck's Mycenaean pottery (right) that also includes a cup, a jug dated by its shape and faded decoration to the time of Pharaoh Akhenaten or earlier, and a pair of vessels, at left, called stirrup jars. All save the large stirrup jar, which may have stored oil, were probably tableware, suggesting that perhaps some of the crew were Greeks.





Glass glitters in the cargo

"MEKKU-STONE" mentioned in Bronze Age letters of trade was almost certainly another of the wreck's commodities—blue glass ingots. Colored by cobalt, the six-inch-wide ingots are shown inverted. Chemical analysis reveals them to be identical to Egyptian and Mycenaean glass of the same era. Did one blue-glass maker have a monopoly?

His products could have been used in one of several glassmaking techniques (below right).

First, molten glass was wound onto a core of clay and animal dung inside a furnace. Glass of a second color was then wound over the first. When reheated, the surface layer was worked to create a design. After the handles, rim, and foot were added, the core was broken up and removed from the vessel's mouth.



clear, and Don Frey photographed it from different angles.

The following winter, back in Texas, I was reviewing hundreds of archaeological reports when I turned a page and suddenly there was a photograph of our dagger. It was not the same dagger, of course, but one identical to ours. It had been excavated along with several others just like it at Tell el-Ajjul, the site of a Canaanite city in southern Palestine. I learned that the Canaanites had adapted the shape from earlier Egyptian daggers. The information offered strong evidence that our own dagger was probably Canaanite and dated from the Late Bronze Age.

If one multiplies the story of the dagger by 1,224—the number of artifacts we have so far raised and cataloged from the wreck at Ulu Burun—one begins to understand what underwater archaeology is really all about. On the average we devote two years to conservation and research for every month of diving on site. In short, nautical archaeologists spend comparatively little time in wet suits!

"... tribute to [Tutankhamun] offered by Syria."

—Inscription beneath a painting in the tomb of Huy, Egyptian viceroy of Nubia, showing a Syrian bearing a four-handled copper ingot

The great number of copper ingots at Ulu Burun could support a theory I had held for more than a quarter of a century: that the Canaanites, or Bronze Age Phoenicians, played a major role in the maritime commerce of the eastern Mediterranean.

Many scholars insist that the Mycenaeans held a virtual monopoly on seaborne commerce during the Bronze Age. As proof they point to the widespread distribution of Mycenaean pottery throughout the Mediterranean. Where, they ask, is the evidence of Canaanite trade in the Mediterranean or the Aegean?

My answer is simple: On land, at least, that evidence quickly



vanished. Mycenaean pottery tells only half the story. It wasn't given away; *something* had to have been traded in return. That something, I felt sure, came back to Greece from the Near East—something that has so far eluded archaeologists on land.

I have long believed that that something was Bronze Age raw materials such as copper, tin, ivory, glass, and other substances that were quickly converted on arrival into tools, weapons, ornaments, and household goods. Egyptian tomb paintings depict such raw materials in the hands of Canaanite merchants delivering them to the pharaohs, but the commodities themselves are seldom if ever found. Only a disaster such as a shipwreck would preserve them in their original form.

We had found such raw materials—the copper ingots, for example—at Cape Gelidonya in 1960. Careful study convinced me later that the ship had been Canaanite. I had dreamed that one day someone would discover a wreck with even richer evidence. Perhaps at last that day had come.

“The king, my lord, has written to me about the mekku-stone that is in my possession, but I have already given one weighing one hundred [units] to the king, my lord. . . .”

—Clay tablet from Prince Abi-milki of Tyre to Egyptian Pharaoh Akhenaten, found at Tell el-Amarna

Even from underwater we recognized the importance of our next discovery—a pair of opaque, cobalt blue glass disks, each six inches in diameter and two and a half inches thick. They were slightly rounded on their bottom edges. During the weeks that followed, we were to find many more such disks, some still stowed as neatly as they had originally been loaded aboard.

The secrets of the Bronze Age glass trade apparently were well kept. The late Leo Oppenheim, a renowned Near East



scholar, suggested in 1972 that what are called *mekku* and *ehli-pakku* in the Tell el-Amarna tablets were actually ingots of glass sent from Tyre and Ascalon to Egypt during the 14th century B.C. But Oppenheim's translation of the two words was not universally accepted. Where was the physical evidence of such ingots? Not in Egypt, Greece, or the Near East. Now we held that evidence in our hands—160 feet beneath the sea.

Much later Robert H. Brill, research scientist at the Corning Museum of Glass in Corning, New York, analyzed one of our glass ingots. He found it identical in content to blue glass in Egyptian bottles and Mycenaean medallions dating from the same period as the shipwreck.

Did Canaanite glassmakers—keeping their formula secret—ship ingots of this marvelous and mysterious substance to all parts of the eastern Mediterranean? Once more the wreck at Ulu Burun demonstrated what faint traces, if any, raw materials leave on land.

WE TURNED our attention next to the huge storage jars, known as *pithoi*, that Cemal had seen during his 1983 survey. "Let's bring up one of them so we can excavate underneath," I suggested at one of our regular staff meetings.

Tufan and Murat, both skilled at rigging heavy objects, wrestled a net under the jar I had chosen. They attached the net to a large balloon, partly filled the balloon with air to provide buoyancy, and left the jar on its side ready for lifting. Cemal and Robin, who were scheduled for the next dive, went down to raise it.

I thought someone was in trouble when they broke the surface later with surprise on their faces.

"Pottery's pouring out of the pithos!" Cemal exclaimed, and Robin chimed in: "The whole thing's full of pottery—look at these."

They handed up a basket full of intact pots and fragments. I removed a shallow bowl with a handle shaped like a wishbone. The piece was unmistakably Cypriot.

Unlike pottery produced elsewhere in the eastern Mediterranean during the Late Bronze Age, most Cypriot pottery was not wheel-made. It was therefore not quite symmetrical. Its rustic charm may have led to its popularity as an import to the Near East, where it has been found in such quantity that archaeologists originally thought it was made there. Recent neutron analysis of the clay, however, proves all of it was made on Cyprus.

Standing on *Virazon's* deck with the bowl in my hand, I remarked to nobody in particular, "One thing I can say—this ship definitely was coming from Cyprus."

I quickly dived with Aşkın and Yaşar to look at the pithos, and we removed more pottery from inside it. In the end we



found nearly every major type of pottery made on Cyprus during the Late Bronze Age.

Equally surprising, however, was that the pottery was shipped in a pithos. Such large, open-mouthed jars appear on the decks of Canaanite merchant ships in a 14th-century Egyptian tomb painting. If asked their purpose, I would have guessed they were for fresh water. Now we know better: This pithos, at least, was used like a modern-day china barrel.

“... *this ship [is] the king's.*”

—Tablet from Tell el-Amarna from the minister of Alashiya to the minister of Egypt

Normally I assigned each diver to a specific area of the wreck, so that he or she would become familiar with it. I had kept our expedition doctor, Karl Ruppert, on the seemingly barren western edge of the wreck, thinking that as a newcomer he could do no harm while gaining experience.

After several weeks Karl had to return to his practice in the States, and an old hand, Yancey Mebane, took over as expedition doctor. To my sorrow, Karl never had the thrill of making a major discovery in his area, but he had come close. On his departure I asked Robin Piercy to explore his sector.

Within an hour Robin made the first in a series of spectacular finds that were to come from this area. As Robin fanned away sand from the bottom, something caught his eye that sent him heading for our underwater phone booth. Once inside he removed his mouthpiece and telephoned *Virazon*, 150 feet above him. Don Frey answered.

“Get George from shore to the ship,” Robin said. “I’ve got something really interesting. I’m leaving it in place, and I’m coming up.”

I reached *Virazon* just as Robin surfaced, and we all leaned over the rail to hear his news.

“I’ve never seen gold like that underwater. Never, ever,” he said, pausing halfway up the diving ladder. “It’s a large cup, I’m sure of it.”

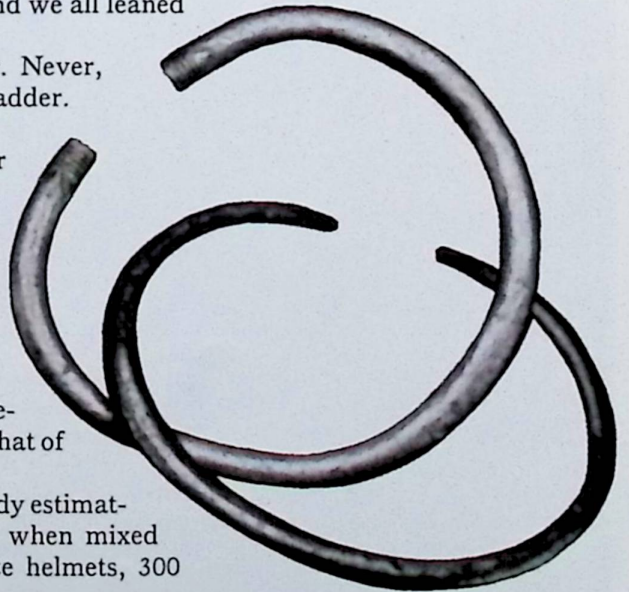
We were jubilant. In itself gold is of no greater value than lead or wood to the archaeologist, but this discovery was a further indication that we were on to something far more important than the Cape Gelidonya wreck we had excavated in 1960. That ship had carried 34 four-handled copper ingots and some scrap bronze weighing in all no more than a ton. At the time I had concluded that the vessel represented a modest commercial venture, perhaps that of an itinerant seagoing smith.

But here at the Ulu Burun site we were already estimating that we had six tons of copper—enough when mixed with tin to manufacture a total of 300 bronze helmets, 300



PRECIOUS METAL FINDS accumulated steadily, including both intriguing artifacts and scrap destined to be melted down. A gold pendant bears a nude goddess grasping a gazelle in each hand (facing page). Her identity is unknown, but a similar pendant has been found in Syria.

A gold medallion (above), three inches in diameter and adorned with a Canaanite star design, resembles others known to have been worn by Syrian merchants and sailors. A pair of silver bracelets (below) are probably also Canaanite.



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bronze corselets, 3,000 spearheads, and 3,000 bronze swords!

And now the gold cup. Although not quite proof of a royal shipment, it strengthened my belief that the ship had been carrying something of the sort. I summed up my feelings to Robin: "This is no tramp steamer we're dealing with."

As we cleared away more sand, we found that the cup was shaped like a chalice, formed of two gold cones riveted together at their apexes. Almost touching the chalice was a common Mycenaean terra-cotta stemmed cup known as a *kylix*, which has since proved of greater historical value than the chalice. The date and origin of the chalice remain unknown, but the humble *kylix* is of a distinctive shape in vogue only at the end of, and shortly after, the reign of Egyptian Pharaoh Amenhotep III,



DINING ALFRESCO at their camp on Ulu Burun, which includes dormitories and a conservation laboratory, the crew gets a briefing from Dr. Bass, at far end of table. Their meals often included

typical Bronze Age fare (right), such as round bread loaves, cheese, chick-peas, garlic, goat, olives, and figs. Lead weights (opposite, above) caught supper for Bronze Age sailors.



who ruled from 1417 to 1379 B.C. So our ship probably sank during the early 14th century, or shortly after, for we have no way of estimating how old the kylix was when it was lost.

"Now, as a present for thee . . . one elephant's tusk . . . I have sent."

—Tablet from the minister of Alashiya to the minister of Egypt, found at Tell el-Amarna

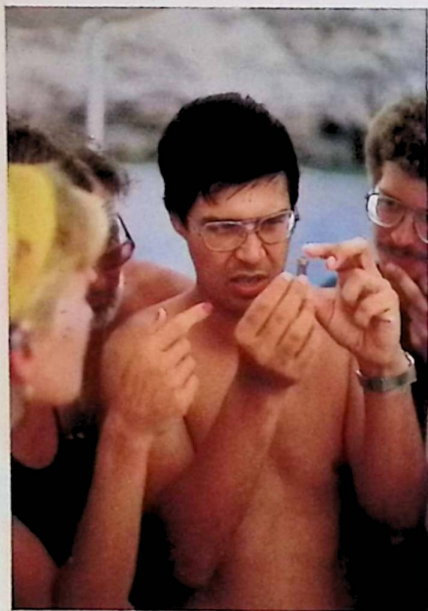
I assigned the area of the chalice permanently to Cemal, because of his uncanny ability to understand exactly what he sees underwater. On one of my dives to the chalice I had noticed a



pointed object—a stick of wood, I thought—protruding from the sand nearby. After a single glance at the object Cemal surfaced and announced happily: “We have a hippopotamus tooth on the wreck!” Once again he was correct.

From the area of the hippopotamus tooth we brought up an eight-inch length of elephant tusk neatly sawed at both ends, possibly to fashion a cosmetic box (pages 726-7). Now we could add ivory to copper, tin, and glass as raw materials in our cargo.

Near the elephant tusk we uncovered several silver bracelets that I later identified as probably Canaanite, followed by a gold pendant shaped like a falcon clutching baglike objects in its talons. Months later when I saw the same design on a pair of Canaanite earrings from a museum in the Netherlands, I realized that the “bags” were hooded cobras.



DONALD FREY

INDELIBLE SIGNATURE, a quartz cylinder seal is examined by Cemal Pulak (above). To close a deal, traders rolled such seals on a clay tablet, leaving an impression of their personal motif.

This one depicts three figures, probably gods, approaching a fourth, perhaps a king. The seal (facing page), with its gold caps, may have been worn as jewelry. Dominique Collon, a specialist in seals, dates the artifact to about 1350 B.C. It is similar to seals used by the Kassites, rulers of Babylonia during that era.

THE RAW MATERIALS on board the Ulu Burun ship, together with the Cypriot pottery and Canaanite amphorae, weapons, and jewelry, all had eastern Mediterranean connections, establishing that our ship was sailing from east to west when it sank.

But the discovery of several carved amber beads presented a problem. Amber, or fossil resin, occurs naturally in Sicily and other areas of the Mediterranean, but the Ulu Burun beads were later identified by Curt Beck of Vassar College as Baltic amber, which occurs in an arc sweeping across northern Europe from the Baltic south to the Black Sea. Our beads, which were carved in typical Mycenaean shapes, seemed to be moving in the wrong direction for the ship's cargo—that is, from west to east instead of east to west. Were they simply worn by a Mycenaean Greek merchant making a return voyage from some port in the Near East? The discovery nearby of a stone seal carved with a Mycenaean design strengthened that possibility.

“ . . . then he bored through [the planks] and fitted them to one another, and next hammered [the boat] with pegs and joints.”

—*Odyssey*, Book V, lines 247-248

The question of the ship's nationality, always on our minds, became even more intriguing when we raised one of the 16 stone anchors we eventually uncovered from the wreck. Beneath the anchor we found an assortment of bronze axes, sickle blades, adzes, balance weights, and ballast stones. And below that lay an exposed portion of the ship's hull.

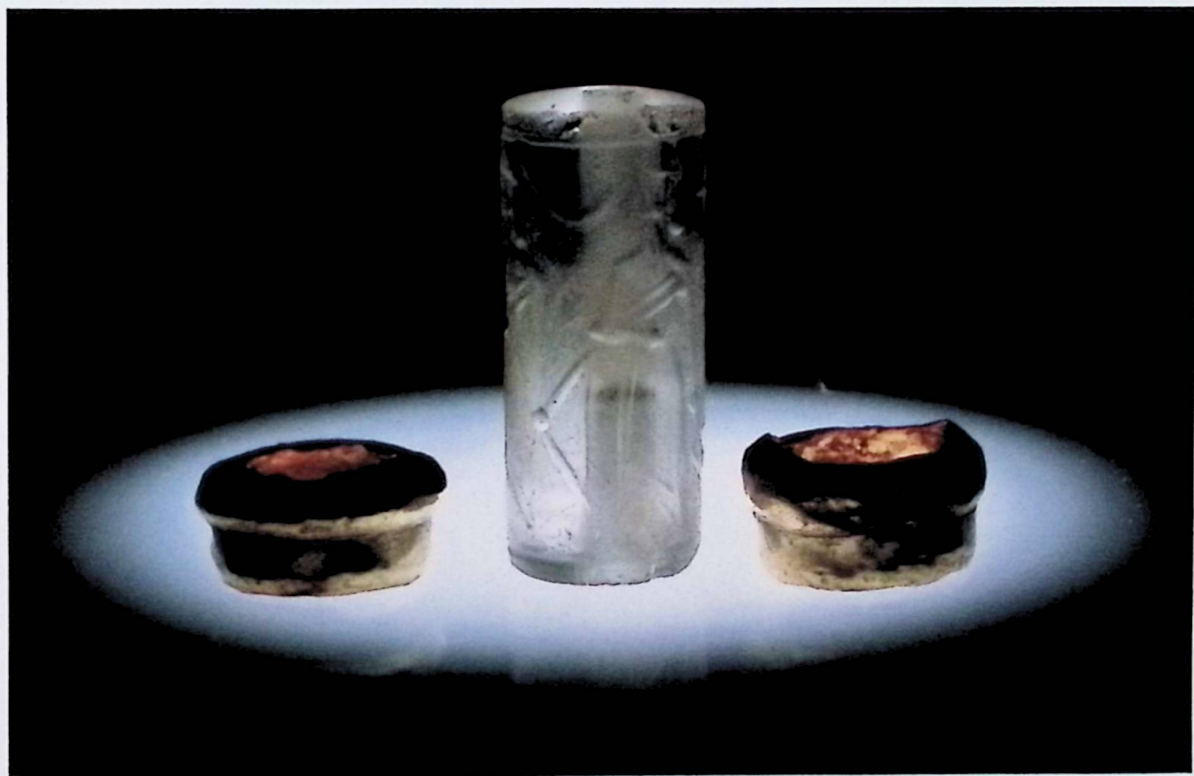
The hull section consisted of fir planks, each about ten inches wide and two inches thick, fastened together and to the fir keel by mortise-and-tenon joints pinned with hardwood pegs. This was the same method of construction used in a fourth-century B.C. ship excavated by my colleague Michael Katzev, off Kyrenia, Cyprus, between 1967 and 1969.*

*See “Resurrecting the Oldest Known Greek Ship,” by Michael L. Katzev, June 1970 and “Last Harbor for the Oldest Ship,” by Susan W. and Michael L. Katzev, November 1974, NATIONAL GEOGRAPHIC.

In thus pushing back our knowledge of seagoing ship construction by nearly a thousand years, we now know that ships at the time of the mythical Greek heroes such as Odysseus and Achilles were built in the same manner as later Greek and Roman vessels. And we know too that Homer's description of Odysseus' constructing a boat was accurate.

At the end of the 1984 season we covered the fragile planks of the ship's hull with sand to protect them during the coming winter, dismantled our camp ashore, and sailed for Bodrum.

The following summer Cemal directed nearly all of the excavation while I visited museums and archaeological sites on



Cyprus and in the Near East. I was eager to see and study Canaanite and Cypriot materials firsthand for comparison with those we had recovered. Finally in late August I returned to Ulu Burun and was delighted with the summer's results. Cemal took me through an impressive collection of newly excavated weapons, tools, beads, and pottery, and then said with a grin, "Guess what else we have?"

I grinned in return. "You haven't surprised me yet."

But in fact he did: For the first time we had recovered Egyptian artifacts from the wreck! Cemal proudly handed me a scarab of bone or ivory framed in gold and carved with ornamental hieroglyphs on its base (page 732).

By contrast, the hieroglyphs on the next artifact—a small rectangular plaque of greenish stone—could be read: "Ptah, Lord of Truth." Is it possible that someone on this voyage worshiped Ptah, who was not only an Egyptian creator of the



DRAMATIC CHANGES IN STYLE left contrasting motifs on a hematite seal. The original Mesopotamian design, cut about 1750 B.C., shows a king, a goddess, and a small priest, at left and right. Four centuries later a frightful griffin-demon and a warrior were added at center by an Assyrian artisan.



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Raw ivory for the workshop

ROYAL HUNTS in Syria are evoked by a section of elephant tusk. Artisans fashioned the ivory into decorative containers to hold ointments and cosmetics. In a possible sequence (lower right) a bottom and lid were cut first. A bow drill then removed the solid interior, yielding a cylinder available for another use. When carving was complete, the bottom was attached with ivory pegs, and a disk was carved inside the lid to fit the rim.

Two hippopotamus teeth were also found on the wreck.



universe but also the patron god of craftsmen, especially metalsmiths?

THAT SEASON added as many questions as it did clues to the nationality and character of our ancient ship's crew. Cemal showed me an Egyptian gold ring that had been cut in half with a chisel, thus rendering the text of the inscription on its bezel illegible. Our crew had already guessed why a damaged ring was on board. They had found other deliberately damaged jewelry such as halves of ornate gold pendants, some of them crumpled like pieces of paper, and a crushed gold flower. Twisted fragments of silver bracelets added proof that the ship carried a hoard of precious scrap metals.

I had hoped that the type and design of weapons, which might represent personal items of defense, would give us some hint at the nationality of our ship's crew. Two bronze swords of nearly identical size had been found that summer on the wreck, lying only a few feet apart. But one was distinctly Mycenaean and the other Canaanite!

Perhaps the crew of our ancient merchantman was as mixed as those aboard modern tramp steamers.

When we began the 1986 season at Ulu Burun, we thought we

might have run out of archaeological firsts. We needn't have worried. As usual some of the surprises came from laboratories half a world away.

Most of the hundred Canaanite amphorae we had so far excavated had been filled with a yellow resin. Analysis by John S.



Mills of the National Gallery in London indicated that most or all the resin was from *Pistacia terebinthus* var. *atlantica*, a tree common throughout the eastern Mediterranean.

The resin was used for unknown purposes in Egyptian burial rites. How is it possible, I wondered, that the second most abundant substance in our ship's cargo, after copper, is something scarcely recorded in the Bronze Age?

"Payment to the palace, 1,320 liters of ki-ta-no; still owed, 240+ liters."

—Record of payment to royal stores, written in Mycenaean Greek on a clay tablet found in the palace at Knossos, Crete

By pure chance I later learned that a Spanish scholar named José L. Melena had interpreted the Mycenaean word *ki-ta-no* as meaning *Pistacia terebinthus*. Scholars were puzzled by the enormous quantities of *ki-ta-no* inventoried on tablets excavated in Crete—more than 10,000 liters on one record alone. They presumed that the term *ki-ta-no* referred to nuts of the tree, which are related to our pistachio nuts. But no large quantities of *Pistacia* nuts have ever been found at a Bronze Age site.

Weeks later my colleague Cynthia W. Shelmerdine, a specialist in Mycenaean Greek at the University of Texas at Austin, told me that the word *ki-ta-no* was written with a symbol suggesting that it was an aromatic or a condiment.

It therefore appears that since the Ulu Burun ship was carrying a very large consignment of *Pistacia* resin—not nuts—the tablets at Knossos likewise refer to huge quantities of the resin. Was it used millennia ago just as it is today, in the making of perfume, and was it thus considered a very valuable substance? If so, we have one more indication of the enormous loss represented by the shipwreck at Ulu Burun.

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"One hundred pieces of ebony I have dispatched."

—Tablet from Amenhotep III to King Tarkhundaradu of Arzawa,
found at Tell el-Amarna

EARLY IN THE 1986 SEASON Cemal showed me another of those uncanny discoveries of his. He had seen hundreds of tiny opercula, the button-like plates attached to the feet of murex and many other mollusks. Although the shells were absent, I argued that the opercula were natural to the seabed, like countless shells we removed routinely from the wreck.

But Cemal knew better. He showed me that the opercula were arranged in recognizable patterns and thus had been stowed by human hands.

We later learned that opercula were an ingredient of ancient incense. Perhaps they were also a by-product of the Canaanite industry that extracted the legendary Tyrian purple dye from murex glands.

The 1986 season also produced fragments of tortoiseshell from the wreck—perhaps part of the sound box for a lute, the stringed instrument popular in ancient Egypt. We had already recovered a pair of small bronze cymbals only slightly larger than the finger cymbals used by modern belly dancers. Did musicians sail aboard ancient merchant ships? We know from records that they accompanied donkey caravans on overland treks in the Near East.

In 1985 we had found a number of dark logs on the wreck, the largest a yard long. I assumed they were ebony, one more of those raw materials shown in Egyptian tomb paintings being brought as tribute to the pharaoh, from lands to the south such as Nubia. But not till 1986 did we send a sample to Donna Christensen at the Center for Wood Anatomy Research of the U. S. Forest Products Laboratory in Madison, Wisconsin. Within a week Donna was on the telephone.

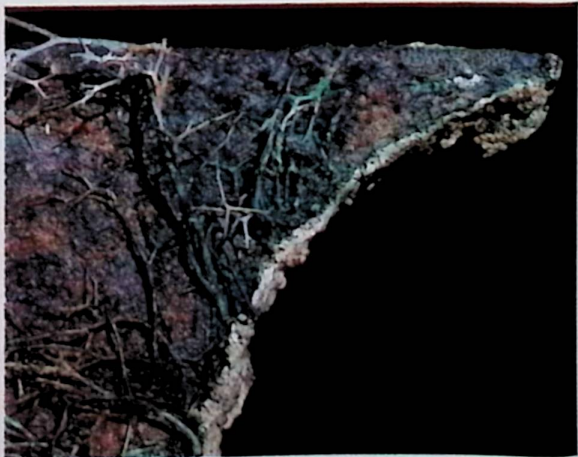
"Your logs aren't true ebony," she said, "they're African blackwood. The scientific name is *Dalbergia melanoxylon*, and the tree grows from Sudan as far south as Mozambique and Angola."

I was disappointed. I'd wanted badly for our logs to be ebony. But I later turned to my library and got a surprise. I found that what the Egyptians called *hbny*, or ebony—the same word we use today but for a different tree—was in fact *Dalbergia melanoxylon*. It is the same wood used in an elegant bed, a chair, and a stool in Tutankhamun's tomb. So we had our Egyptian connection after all.

GENTLY ASCENDING a staircase of copper ingots, Nicolle Hirschfeld removes an amphora from the wreck (facing page). The underside of an ingot found at the bottom of one stack still bears strands of thorny burnet (bottom), a shrub used as dunnage. Ashore in a storage basin Michael Halpern (below) empties a Canaanite pilgrim flask, as amphorae already inspected for their contents soak in water to prevent splitting. All artifacts are moved to their permanent home in the Bodrum Museum of Underwater Archaeology.



BOTH BY DONALD FREY



“... fourteen seals of beautiful hulalu [stone], overlaid with gold.”

—Gifts listed on a tablet from King Tushratta of Mitanni to Pharaoh Akhenaten, found at Tell el-Amarna

Tufan Turanlı's area of the wreck now became the center of attention. Working in the space of only a few square feet, he first recovered a gold pendant with the figure of a nude goddess holding a gazelle in each hand (page 718). The pendant is remarkably similar to one found at the ancient site of Ugarit in Syria.

Tufan continued working, removing the sand almost a grain at a time with a paintbrush and sucking it away with a tiny air lift. He soon found a second, smaller pendant with the lightly scratched figure of a woman wearing a dress with a flounced skirt. The figure reminded me of a portrait of a Canaanite merchant's wife I had seen in an Egyptian tomb painting.

Many a Near Eastern merchant carried a cylindrical seal that he could roll out on clay documents as his signature. Tufan's area soon yielded a seal made of quartz, or rock crystal (page 723), its gold caps reminiscent of those favored by the Kassites, the foreign invaders who ruled Babylonia around the period when our ship sank.

Tufan's second seal was made of hematite, an iron ore (pages 724-5). I sent drawings and photographs of it to Dominique Colton, an authority on seals at the British Museum, and some weeks later she gave me her report.

“I believe the seal was first cut in Mesopotamia in the 18th century B.C.,” she said. “The original scene is quite worn and depicts a king facing a goddess, with the small figure of a priest between them.

“Much later,” Dominique added, “probably in the 14th century B.C., in Assyria, a new scene was engraved over part of the old one. The new scene shows a winged griffin-demon and a warrior with a sickle-shaped sword. The later engraving has all but erased a cuneiform inscription alongside the old scene.”

“... he sent him to Lycia and gave him baneful signs in a folding wooden tablet.”

—*Iliad*, Book VI, line 169

In all of Homer the only certain reference to writing is that single, puzzling line. Hinged wooden writing tablets, or diptychs, could be folded shut to protect the writing inscribed on their waxed inner surfaces. But no diptych had ever been found as early as the Bronze Age about which Homer wrote.

I thought it only a routine task when I asked one of our students from Texas A&M, Nicolle Hirschfeld, to remove and bring up the sediment from one of the remaining huge storage jars. Cheryl Haldane found that the jar had contained mostly whole pomegranates. But Cemal, sifting through the sediment in camp, found tiny fragments of wood that he began to piece together.

“It's a writing tablet, George,” he declared, “the kind they spread wax on.”



OLDEST “BOOK” ever found, a folding tablet called a diptych—the first from the Bronze Age—is cleaned by INA conservator Robert Payton (above). Two ivory-hinged wooden leaves (facing page) were recessed to hold beeswax, scribed with a stylus. Folded leaves protected the writing. Alas, the message from antiquity that might have been was not to be, for no wax remained. Library research showed that in later times orpiment, a mineral that had been found in one amphora, was mixed with writing wax for consistency and color.

The painstakingly assembled fragments formed two wooden leaves joined by an ivory hinge (below). The recessed inner faces of the leaves were scored with crosshatched lines, obviously to hold the beeswax, which was inscribed with a stylus. But no wax remained on the fragments of tablet.

Later in the United States my old friend Professor David I. Owen of Cornell University, who has excavated a number of sites with me, told me of several similar tablets that had been found in a well at Nimrud in Assyria and that until now had been considered the world's oldest known "books."

The wax on the Nimrud tablets had been inscribed with an



astrological text in cuneiform writing. Analysis of the wax showed it was mixed with 25 percent orpiment, or a yellow sulfide of arsenic, to give it the proper consistency and color. One of the first things we had recovered from the Ulu Burun wreck was the Canaanite amphora filled with orpiment. Now we may surmise its purpose on the wreck.

"The Beautiful One is come"

—Literal translation of the name Nefertiti

Tufan saved the best for last. One morning he surfaced with the small plastic box he stored his treasures in and lifted out a

GOLD IS AS PLENTIFUL as dust" in Egypt, a king wrote Pharaoh Amenhotep III in a plea for gifts. A scarab, top left—the first found in gold—bears the title of the next pharaoh's queen, Nefertiti. Other scarabs bear only decorative signs, and a gold ring fragment was scrap.



DONALD FREY

Cemal Pulak measures mortise-and-tenon joints in planks near the keel (facing page). From this oldest known shipwreck may come secrets as precious as the pharaoh's gold.

Specializing in underwater photography, Bill Curtsinger has photographed more than a dozen magazine articles. He most recently described the sea life beneath the ice at McMurdo Sound in Antarctica.

solid gold scarab (below). As we do with all our finds, we photographed the scarab, and I later took the slides back to Texas.

It has been more than 30 years since I studied hieroglyphics, but with the help of an Egyptian dictionary I translated the end of the inscription on the base of the golden beetle: "Nefertiti."

Nefertiti! Is there a more beautiful face from antiquity than that of Pharaoh Akhenaten's great queen? Her timeless features have been captured for eternity in the exquisite bust from Tell el-Amarna (page 700).

Temple inscriptions record the fact that Nefertiti was an important figure in her husband's reign, but just how important has been a question in modern times. Some scholars believe she was immensely powerful, possibly the co-ruler of Egypt.

I sent photographs of the scarab to James Weinstein, a distinguished Egyptologist at Ithaca, New York, who has always been enormously kind in sharing his expertise. After weeks of

careful research he called me with the startling news: Not only was this the first gold scarab ever found of "the Exquisite Beauty of the Aten [sun disk] Nefertiti," as her full name is translated; it also was the first artifact found in Asia Minor or the Aegean that names either the famous Akhenaten or his beautiful wife.

Even more important, the form in which Nefertiti's name is written on the scarab strengthens the theory that she ruled alongside her husband. What Egyptologist, enduring a cruel sun in pith helmet and desert boots, could have imagined such a discovery coming from the cool blue sea?

Was the scarab carried by an envoy of Nefertiti? We can only guess. The scarab is well worn. Cemal's map of the wreck site shows that it was found near the scrap gold, suggesting that it may have belonged to the same hoard. If it did, the ship sank after Nefertiti's death, for one cannot imagine her scarab's being discarded during her reign. That would date the ship much later in the 14th century B. C. than suggested by the Mycenaean cup we had found in 1984.

WE TRY NOT to speculate on the exact date or nationality of the wreck. It's hard not to, but after all, we've dug only half the site so far. For the moment it's enough to savor the ship as an archaeologist's dream come true. But even I would never have imagined a site with such an abundance of new information for scholars from so many fields—Egyptologists, geographers, Homeric scholars, students of ancient metallurgy, glass, ship construction, sea trade, agriculture, art, and religion.

In short, we are salvaging the greatest of all treasures—the treasure of knowledge. □

