Americans and French Find the *Titanic*

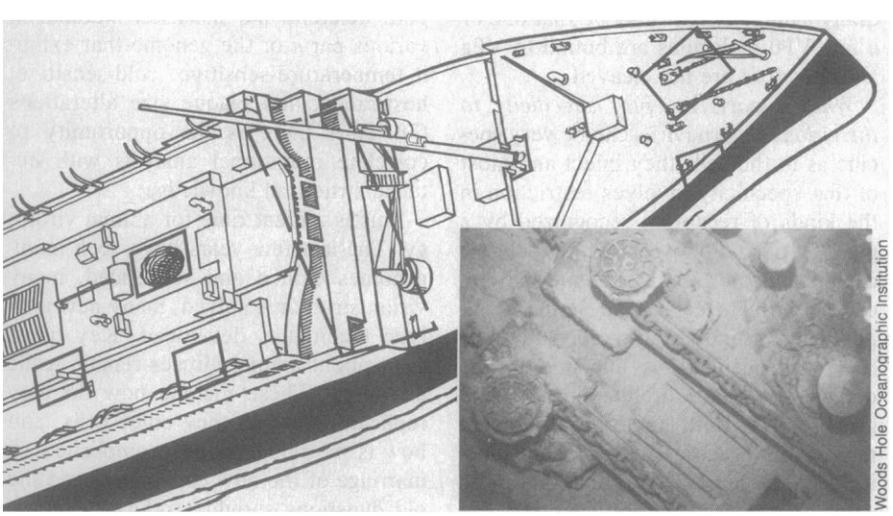
New undersea robots pinpoint the wreck; discoverers want her to remain unmolested

It was 2 a.m. on 1 September. Robert Ballard and other scientists aboard the Navy's research vessel *Knorr* were sitting around listening to music and popping corn while the *Argo*, a robot vehicle carrying sonar and photographic equipment, sent back a stream of pictures of underwater sand dunes. "All of a sudden in the sand dunes we started to pick up debris," said Ballard. Then the end of a huge cylindrical boiler, its rows of rivets clearly visible, swam into view. The HMS *Titanic* had finally been found 73 years after she sank to the bottom of the North Atlantic, gored by an iceberg.

Locating the *Titanic* marked the culmination of a decades-long obsession for Ballard, a marine geologist who heads the Deep Submergence Laboratory at Woods Hole Oceanographic Institution. But it was only a secondary mission for the scientists, who were out to test the capabilities of the *Argo* for the Navy.

The *Titanic*, billed as unsinkable with her double hulls and 16 watertight compartments, took more than 1500 souls with her when she went down the starry night of 14 April 1912, about 370 miles south of Newfoundland. It was 73 years before the technology was developed to find her, entombed in the frigid blackness at 13,000 feet. Ballard said at an 11 September press conference at the National Geographic Society in Washington that, because of the calm seas, the *Knorr*'s 25-year-old echo sounder picked up the wreck. But it probably would never have come close enough to do so without the combined application of the latest in French and American sonar and navigational technology.

As it happens, the French laid the groundwork for the American coup. *Le Suroit*, a vessel operated by the French Institute for Research and Exploitation of the Sea (INFREMER), had been in the area since 28 June testing its new sonar vehicle system, SAR, which is capable of kilometer-wide swaths. It had been "mowing the lawn" in the 100-square-mile target area when the *Knorr*, laden with photographic equipment supplied by the National Geographic Society, arrived on the scene on 5 August.



The Titanic *photographed*

Anchor chains, winches, and capstans on the Titanic*'s bow, seen in the diagram, show up with great clarity in the photograph taken at the bottom of the Atlantic.*

The French left a few days later after having missed the *Titanic*—as it later turned out—by only 300 yards.

The decision about where to look was made after extensive research, often with conflicting data, including work done by William Ryan of Columbia University's Lamont-Doherty Geological Observatory. Ryan was engaged by Texas oilman Jack Grimm who launched several unsuccessful forays, including one in 1983 for which he spent over $2 million. The *Titanic*, which was coming from Southampton, England, was found east of the iceberg barrier, many miles southeast of her "official position."

The *Argo* is the technological hero of the *Titanic* story. Developed in Ballard's lab, it is an automobile-sized robot vehicle, one of the new generation of "swimming eyeballs" that are capable of descending to depths of up to 20,000 feet. The Navy wants to use them for locating lost submarines, investigating enemy sonar arrays, and finding sites for undersea missiles. The *Argo* carries powerful strobe lights and has a camera sensitivity of 200,000 ASA. It is towed along near the bottom by the mother ship and can stay underwater for weeks at a stretch while scientists above monitor its data. Ballard characterized its imaging ability as "revolutionary" but said there was not much in new technology, other than the software. "Anyone can build their own *Argo*," he said.

After the debris had been sighted, the *Knorr* bracketed the *Titanic*'s position with the aid of transponders suspended near the bottom, and got the geometry firmly locked into the computer, said Ballard. Then, on 4 September, with 5 hours left in the expedition another remote camera, the Angus, was sent down to take high-resolution still pictures. In the nearly lifeless environment, the ship appeared to be well preserved, with only a light dusting of sediment. The stern of the vessel was broken off and debris, including unbroken plates, chamber pots, and wine bottles, was spread over an 800-foot area. Ballard was particularly struck by the contrast provided by the wine bottles—"the gentleness of things in some places next to a twisted massively destroyed bulkhead."

Much remains to be learned about the *Titanic*'s cataclysmic descent to the ocean bottom, including the nature of the 300-foot gash on her side, which was not photographed. Ballard hopes he can return next summer for more photography with the *Alvin*, a three-man Navy submarine with a titanium alloy hull that is built to withstand pressures in depths up to 13,120 feet.

The *Titanic* find has proved a bargain for taxpayers, since it was a spin-off of the $2.28-million *Argo* project. A Woods Hole spokesman said the expedition cost about $500,000.

The Woods Hole institution has made it clear that it wants the *Titanic* to remain where it is, unsalvaged, as a memorial to those who died. But although the vessel is protected from scavengers by the technical unfeasibility of large-scale salvage operations, there is the danger that entrepreneurs could come out with grappling hooks and cause considerable damage in attempts to snag artifacts from the debris. To forestall this, Representative Walter B. Jones (D–N.C.) has introduced a bill to designate the *Titanic* as a maritime memorial to be kept intact while the National Oceanic and Atmospheric Administration establishes guidelines for research, exploration, and salvage. It also directs the United States to negotiate with other countries a permanent international agreement to preserve the wreck.

The discovery of the *Titanic* has opened a new era for the many students of the disaster, as well as many potential legal questions. In fact, the day before the press conference—in which Ballard warmly praised the French-American cooperation—INFREMER filed suit in United States District Court in Washington, seeking to block distribution of photographs without its consent and claiming that Ballard was violating a copyright agreement. The Woods Hole institution says everything has been straightened out and that the photos, which were made under a Navy contract, are under no restrictions. Some confusion remains, though. The French announcement of the find described detailed agreements made between the two research teams in June, but the Woods Hole institution says it does not know of any agreements.

Ballard took off for a rest and could not be reached. His next project will be to take the *Argo* on its first scientific mission in December, exploring the mountains and hot vents of the East Pacific Rise.—**CONSTANCE HOLDEN**

The Rise and Decline of Temik

Once hailed as a miracle pest killer and still warmly regarded by farmers, it is being investigated, denounced, and threatened with federal controls

Temik and its pesticide cousin, Sevin, have been at the center of a lot of agony in the last year. Sevin was made in the factory at Bhopal, India that leaked a process gas in December, killing over 2000 people. Temik was implicated in the West Coast's watermelon crisis of July in which 998 people were poisoned. Temik also was the end product of the factory at Institute, West Virginia that leaked several gases in August, sending 135 people to the hospital but causing no serious injuries. Finally, the Environmental Protection Agency says Temik has turned up as a contaminant in ground water in 15 states.

This pesticide family, the carbamates, has come down in the world since their introduction in the late 1950's and early 1960's. They once were regarded as clean, narrowly targeted, even miraculous pest killers. Now they have fallen into the dark tradition of older pesticides. Temik is being reinvestigated, denounced, and threatened with new federal controls.

Temik's fall from grace makes an interesting tale. It deals with the consequences of asking too much of technology. It also hints at the clumsiness of institutions that are supposed to monitor such chemicals. For often they do not begin to face up to problems until extensive damage has been done, when the public is understandably scared. This leads to draconian measures, which in this case could mean removing a valuable and relatively clean pesticide from the marketplace.

The carbamates have a long lineage. The first to exploit a carbamate poison were the Egbo rulers of Nigeria, who used a water extract of the Calabar bean in witchcraft trials. (If you survived, you were demon-free.) The beans were taken to Scotland, sprouted, and studied during the mid 1800's. The toxin was identified in 1863, but the molecular configuration was not established until 1925. A chemist at E. I. du Pont de Nemours in 1931 invented the first insecticide based in the broad carbamate family, but it was overshadowed by more powerful toxins developed during and after World War II. The first modern carbamate insecticide was invented by Hans Gysin of the Geigy Chemical Company in Switzerland in 1947, but it, too, had limited use.

German researchers during the war became aware of the insecticidal power of chemicals related to the phosphoric nerve gases sarin, soman, and tabun. This led to the postwar development of the organophosphate pesticides, which also act on the nervous system. Meanwhile, Paul Müller in Switzerland had discovered DDT (a chlorinated hydrocarbon), a powerful stomach poison. Together, the organophosphates and DDT's family of toxins dominated the market through the late 1950's. They had flaws: they did not degrade quickly and accumulated in the food chain. DDT was banned in the United States in 1973, and many organophosphates have been phased out.

In 1953 Joseph Lambrech of the Union Carbide Company invented the first major carbamate, Sevin, known generically as carbaryl. Because it degraded rapidly and had very low toxicity in mammals, it became an immediate success. By 1971, 55 million pounds were produced annually in the United States.

In 1954 a group of scientists working with Robert Metcalf at the University of California at Riverside published an analysis of the means by which carbamates attack the nervous system, suggesting ways to increase potency. Capitalizing on this and the Swiss data, two scientists at Union Carbide—L. K. Payne and M. H. J. Weiden—in 1962 designed a new carbamate molecule closely modeled on acetyl choline (ACh), an organic substance that transmits impulses across insect and mammal nerve endings. Once ACh has carried a nerve signal, it is removed from the path by an enzyme, acetyl cholinesterase, clearing the way for the next signal.

The effect of organophosphate and carbamate pesticides is to frustrate the path-clearing work of the enzyme by mimicking ACh and "tricking" the enzyme into clinging to the synthetic rather than the true chemical. The nerve endings become loaded with signals, locked in permanent stimulation. This leads to uncontrolled movement, paralysis, and death. A crucial difference between the phosphate and the carbamate molecule is that the former locks into place firmly and refuses to let go, while the latter has a "spontaneously reversible" attachment. A person recovers slowly (weeks) from organophosphate poisoning, but