ARCHEOLOGY

New Look at Neolithic Sites Reveals Complex Societies

JERSEY, U.K.—In 1924, a team of archeologists dug into the base of a picturesque green hill called La Hougue Bie on the island of Jersey—the largest of the Channel Islands just off the French coast—and discovered the entrance to a long, narrow passage that led into a chamber made from huge granite slabs. The stone tomb was built by Neolithic, or new stone age, peoples who formed the first farming communities along Europe's Atlantic coast between 5000 and 6000 years ago.

The team paid little attention to the hill itself, assuming that it was just a pile of rubble and earth heaped on top of the tomb when it was abandoned at the end of the Neolithic period. But a couple of years ago, Mark Patton, then the Jersey Museum's curator for archeology, had a hunch that La Hougue Bie might have much more to reveal. His hunch paid off: Last year, Patton found an enormous cairn, a dome-shaped structure made up of small, skillfully stacked rectangular stone blocks, lurking just beneath the grass-covered surface and completely enclosing the tomb. Although similar cairns have been found up and down Europe's Atlantic coast from the Iberian peninsula to Scandinavia, many of them were long ago exposed to the elements. La Hougue Bie, hidden beneath its protective mound, is remarkably well preserved and is one of the most magnificent Neolithic monuments in Western Europe.

The Jersey dig is emblematic of a "big explosion" of excavations of large stone, or megalithic, monuments, says Ian Kinnes of the British Museum in London. This explosion was touched off by technical advances in radiocarbon dating in the 1960s, which established that the earliest megalithic monuments in Brittany were almost 6000 years old, putting them in the early part of the Neolithic period. This blew a hole right through the conventional wisdom, which held that such stone tombs arose toward the end of the Neolithic period and that visitors from more advanced Bronze Age peoples from the eastern Mediterranean—who also built stone tombs—brought the idea to northern Europe. The early radiocarbon dates implied that the construction of these massive monuments was an indigenous development and that Neolithic communities were more advanced than thought previously.

This realization has prompted archeologists to reexamine Neolithic sites in Brittany and Normandy in northwest France that, like the one at La Hougue Bie, were originally excavated in the late 19th or early 20th centuries. Instead of just peering into burial chambers and sifting through the remains inside, archeologists are now scouring the structures from top to bottom for new clues to the nature of Neolithic society and religion. As a result, Neolithic communities, once regarded as settlements of subsistence farmers barely eking out a living, are now widely regarded as having complex social structures. And some archeologists argue that recent findings tell of social changes that swept through these communities as hierarchies evolved and later disintegrated.

The new excavations "have given us a whole new outlook on things," says Kinnes. According to archeologist Barbara Bender of London's University College, "We went through a period when we were asking the same old questions and just getting more information along the same lines. But now we are saying, 'Let's examine the context of these chambers and mounds and look at the landscape in which these megaliths are set.'" Adds Kinnes, "We are now asking about what social role they played. It was always rather blithely assumed that their function was for burial. Now there's an increasing feeling that this may be only one aspect, and perhaps in some instances only a minor aspect, of very complex rituals which reflect the preoccupations of an early farming society facing a new environment."

Some of the key excavations that have led to this reevaluation began in the late 1970s and early 1980s, particularly at two Neolithic tombs in southern Brittany, one in the village of Locmariaquer, and the other 3 kilometers away on the island of Gavrinis in the Gulf of Morbihan. In 1984, for example, French archeologist Charles-Tanguy Le Roux stunned his colleagues when he announced that carvings on one of the stone slabs covering the burial chamber at Gavrinis exactly matched those on the capstone of Locmariaquer's most famous megalithic tomb, La Table des Marchands ("The Merchants' Table"). The two slabs appeared to come from the same block, which had once stood in the ground as a decorated upright stone, or menhir.

Le Roux's finding caused a stir because it indicated that one set of religious artifacts was apparently taken down and used to fashion a different type of monument—evidence, perhaps, of a major social change. And more recent excavations at Locmariaquer, carried out by archeologists Jean L'Helgouach and Serge Cassen of France's national research center, the CNRS, provide even more dramatic evidence that earlier standing stones were systematically uprooted and used to make later tombs. These unpublished findings, described to *Science* by Cassen, include a row of between 18 and 20 large pits where the decorated stones used to build the Table des Marchands once stood upright.

Cassen cautions that there are many ways to interpret these findings. "You can adopt a completely utilitarian hypothesis for why these stones were reused. Perhaps they needed the granite, and couldn't easily find it in the area," he says. But "on the other hand, there might have been a religious, political, or economic rupture, a passage from one type of society to another."

Patton, among others, strongly favors the latter interpretation. In a review of evidence garnered from recent excavations in France and the Channel Islands (*Statements in Stone: Monuments and Society in Neolithic Brittany*, Routledge, London, 1993), he speculates that the menhirs, decorated with what are presumed to be religiously significant carvings of axes, plows, oxen, and other farming motifs, once stood in the open where all could see them. But as Neolithic societies evolved they became more stratified; religious elites developed and the symbols were removed from public view into chambers located at the end of long passageways, where only

ASTRID HAYDON

MARK PATTON

Monumental find. Last year, a stone cairn was discovered (*top*) enclosing a Neolithic tomb first excavated in 1924 on the island of Jersey.

tribal elders or priests were allowed.

Such a transformation could not have been undertaken lightly. Patton cites estimates that at La Hougue Bie, 200 people would have been needed to move just the largest stone involved in construction of the tomb. This amount of labor devoted to an activity not involved with subsistence tells us a great deal about the life of the community, he notes. "We tend to imagine that Neolithic people were scraping a bare living from the earth," Patton says. "But I suspect life here was actually pretty good. I think they might have been living on lobsters and oysters and all kinds of things that we pay a lot of money for."

But if Neolithic life was relatively comfortable and organized, then an even greater puzzle remains: Why, after the mammoth effort of construction, were the monuments deliberately sealed up and abandoned? In the past, many prehistorians assumed that the Neolithic farmers sealed up the tombs to protect their dead from Bronze Age peoples who moved into the area and eventually displaced the original communities. Patton argues, however, that accurate radiocarbon dating indicates that many of the tombs were abandoned well before the Bronze Age began. He proposes that the decline of megalithic tombs corresponded with a breakdown in the stratified social structure they represented—possibly because the tribal elders were replaced by a new elite whose status depended more upon accumulated wealth than ancestral lineage. Kinnes takes a somewhat different view. He cites ambiguous but intriguing evidence that abrupt climatic changes and warfare between competing groups also occurred around the time the megaliths were abandoned.

The monument at La Hougue Bie, with its excellent state of preservation, could help provide answers to many of these questions. Next summer, Patton is planning to extend his excavation at the site, exploring the area in front of the tomb entrance for evidence of religious activities that might have taken place outside the tomb, such as ritual fires and perhaps even additional burials. Although access to the inner chamber is thought to have been restricted to a small group of elders or priests, he and other archeologists have become increasingly curious about what role the less-exalted members of Neolithic societies might have played. Patton is enthusiastic about the prospects: The new wave of excavations is "for the first time providing the material evidence on which we can base these [new] interpretations. And I suspect that over the next 5 or 6 years, this will form the basis of what is debated within the field."

–Michael Balter

Michael Balter is a science journalist based in Paris.

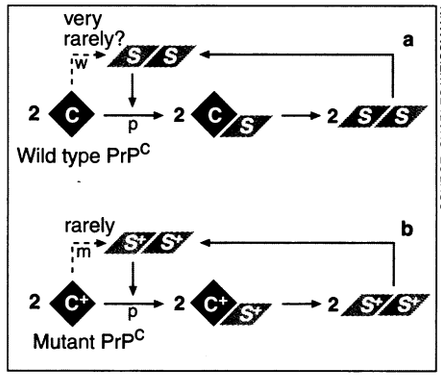
NEUROBIOLOGY

London Meeting Explores The Ins and Outs of Prions

A decade ago, neurologist Stanley Prusiner made a proposal that was nothing short of heresy in the world of infectious disease research. Prusiner was studying a neurodegenerative disease of sheep, known as scrapie, that had puzzled scientists for more than two centuries. While there was good evidence that scrapie could be transmitted from animal to animal, presumably by a virus, nobody had ever been able to get their hands on the putative infectious agent. Prusiner's heretical suggestion: scrapie was caused instead by something he called a "prion"—an infectious particle made up of proteins, needing no nucleic acid for its activity.

At the time, such a thing was unknown and, in fact, it was assumed that no infectious particle could do without nucleic acids to provide a blueprint for its replication. As a result, Prusiner's suggestion met with skepticism, if not out-and-out derision. Since then, however, Prusiner's group, as well as several others, have produced a growing body of evidence to support his challenge to orthodoxy.

What's more, prions may cause at least three rare human neurodegenerative conditions, as well as bovine spongiform encephalopathy, or BSE, also known as "mad cow disease," which caused a stir when it turned up in England in 1986, because of worries that it might be transmitted to people who ate the meat from infected cows. Indeed, prion research has gained sufficient credibility that last month the Royal Society in London was able to devote a 2-day meeting to it, with most participants presenting evidence in favor of the idea that the protein particles can cause neurodegenerative diseases of both animals and humans. "The weight of the evidence is quite heavily in favor of the prion hypothesis," says Charles Weissmann of the University of Zurich, who co-organized the meeting with John Collinge of St. Mary's Hospital Medical School in London.



SOURCE: CHARLES WEISSMANN

Bent out of shape. Scrapie prions (*above*) or mutants (*below*) may multiply by binding to and distorting the normal cellular protein.

Weissmann nonetheless notes that the case for the prion hypothesis is not air-tight. The strongest evidence against it at the moment, he says, is the existence of different "strains" of these agents, each of which causes a different range of disease characteristics when injected into mouse brains. Researchers are hopeful, however, that whether Prusiner proves right or wrong, the work may lead to drug therapies for the human dementias that have been linked to prions.

Although Prusiner, whose lab is at the University of California, San Francisco, has been the driving force behind much of the work that's earned prions their current respectability, the idea that the scrapie agent might be something as unconventional as a nucleic acid-free protein particle actually dates back to a suggestion made in the late 1960s by J. Griffith of Bedford College in London to help explain a problem with which scrapie researchers were then grappling.

Those researchers knew scrapie was transmissible, because when extracts from the brains of sick animals were injected into healthy animals, they caused the disease. But efforts to isolate a virus—or any other standard pathogen—were futile. And, in any case, if the scrapie agent were a virus it was going to have to be a very unusual virus, since treatments, such as exposure to ultraviolet light, that normally destroy nucleic acids and inactivate viruses had no effect on scrapie transmissibility. Therefore, it was necessary to look for something unconventional.

In the early 1980s, Griffith's novel idea began to seem a little less fanciful when Prusiner and his colleagues purified from the brains of infected animals a protein that was apparently capable of transmitting scrapie on its own. What is more, the protein retained this ability despite all nucleic acid-destroying treatments. Proving that this prion, as Prusiner called it, was totally free of nucleic acid was very difficult—like proving any other scientific negative—and acceptance of the radical idea came slowly.

Then, in the mid-1980s, the idea moved closer to its current respectability, when Weissmann's group, working with that of Lee Hood, then at the California Institute of