Early Farmers of the North European Plain

Excavations in Poland have revealed the remains of the people who farmed, herded and hunted in the area some 7,000 years ago. It was a time of transition, but in the end agriculture had come to stay

by Peter Bogucki and Ryszard Grygiel

One of the major events in human prehistory—the rise of agriculture and animal husbandry—took place at different times in different parts of the Old World. In southern Europe knowledge of this new way of life may have first diffused gradually from those parts of the Near East where the Neolithic Revolution had taken hold earlier. In Europe north of the Carpathians and the Alps, however, the Neolithic advance was a movement of people rather than ideas and one of the few such migrations clearly documented in the archaeological record.

Even so, after generations of field work not nearly enough is known about the people who left the valley of the middle Danube and carried the first cultivated plants, along with a number of domesticated animals, deep into the forested plain of northern Europe. The lack of data is due in part to the fact that the acid soils of the north quickly destroyed both human and animal remains and in part to the fact that archaeologists have preferred to work on larger and later Neolithic sites rather than on smaller and earlier ones. Nevertheless, in the 1930's early Neolithic sites on the Polish plain some 150 kilometers northwest of Warsaw had begun to yield valuable information until World War II halted the work. The same sites are continuing to yield information today. Before we describe them and their contents we should acquaint the reader with the physical nature of this broad transmontane belt and with the opportunities it offered to the first migrant farmers from the south.

Broadly considered, central Europe can be divided into three major ecological zones. The southernmost of them, the mountain areas of the Carpathians and the Alps, were generally not settled by farming communities until well into Neolithic times. Therefore that zone will not be discussed here. To the north beyond the mountains is a zone of rolling uplands extending from Slovakia and southern Poland through central Germany and into France. The region is largely covered with loess, the fertile but dry blanket of soil deposited by the winds that blew across Europe late in the Ice Age. The loess fills the river basins of the region and blankets the hills between them, reaching a depth of 100 meters in some places.

The third and northernmost zone consists of the flat lowlands of the north European plain, extending from the western U.S.S.R. across Poland, northern Germany and Denmark on into the Netherlands. The ice sheets of the last ice age covered this zone until some 15,000 years ago; their advance scraped out deep finger lakes and their retreat left a terrain of marshes, lake-filled hollows and a soil cover of sands, clays and gravels. Some of these new soils came to be very fertile; others remained marginal in fertility. All of them, however, supported a diverse and productive forest cover, and the lakes and streams were rich in aquatic life.

The farmers who entered the uplands from the south at first moved northwest along the major rivers of central Europe: the Danube, the Elbe, the Main and the Rhine. They settled in the richest upland ecological regions, the loess-filled river basins, where wild plants and animals were nonetheless relatively scarce. That left the newly established Neolithic communities largely dependent for their livelihood on their own imported animals (cattle, sheep, goats and pigs) and plants (barley and wheat). In time, however, some of the immigrants pushed farther north along the Vistula and Oder rivers and out onto the north European plain.

There they encountered terrain and soils considerably different from those of the uplands. The new ecosystem held more than 450 species of edible plants, fishes, turtles and mussels in the lakes and streams and red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), wild cattle, wild pigs and even wild horses in the forest. This zone of tremendous natural productivity had only one drawback. Its yield was not constant throughout the year and was much reduced in the winter months. How the early Neolithic settlers adjusted to this unevenly productive ecosystem is one major question for which the Polish sites are yielding an answer.

Of a total of more than 20 Neolithic sites now known in the vicinity of Brześć Kujawski, a town in the Włocławek district of Poland, two (designated Site No. 3 and Site No. 4) were discovered in 1933 when farmers digging gravel near the shoreline of a dry lake bed came on artifacts and human bones. Konrad Jażdżewski of the State Archaeological Museum in Warsaw learned of the discovery and spent seven seasons (1933–39) at the sites, excavating a total area of more than 10,000 square meters. His work exposed the outlines of many Neolithic houses, more than 50 human burials, some of them richly furnished with copper, bone and bead ornaments, and antler pickaxes. Both human and animal bones were excellently preserved in the non-acidic soil. The copper artifacts were some of the earliest to be found in that part of central Europe; the metal had probably come from mines south of the Carpathians. The war halted Jażdżewski's research, and the artifacts uncovered in the 1939 season were destroyed when the Warsaw rail depot was bombed, but his work had already established the importance of the sites to an understanding of early Neolithic life on the north European plain.

Both Jażdżewski's work, done in the years before carbon-14 dating was known, and later research in the area left a number of chronological and economic questions unanswered. As a result one of us (Grygiel), of the Łódź Museum of

OUTLINE OF LONGHOUSE WALLS, exposed by the removal of plow-zone topsoil, guided the excavators at one early Neolithic site at Brześć Kujawski as they sectioned the discolored clay soil where the timber uprights had stood. Similar subsoil stains indicated the presence of trash pits filled with discarded artifacts and animal bones. The irregular excavation in the foreground led to a bed of clay the Neolithic settlers used to "plaster" their house walls and make pottery. This is the later of the two main settlements, established by people of the Lengyel culture. Calibrated carbon-14 dates indicate they came here between 4500 and 4400 B.C. and abandoned the site in 3900 B.C.

THREE BURIALS were associated with the longhouse remains seen in the top photograph. Skeletons are those of a man, at the left, lying on his right side, and two women, lying on their left side. The orientation of the bodies at burial placed the heads in a south-southeasterly direction. More than 70 Lengyel burials have been excavated but no graves of the first inhabitants of sites No. 3 and No. 4, people of the Linear Pottery culture, have been found so far. Many Lengyel burials are accompanied by rich grave goods, including copper ornaments.

Archaeology and Ethnography, accompanied by the other (Bogucki), then a graduate student at Harvard University, reconnoitered sites No. 3 and No. 4 in the summer of 1976. We found that substantial areas of both sites were still unexcavated. Receiving financial grants for further work from the Włocławek district and the town of Brześć Kujawski, we have now finished seven seasons of excavation, mainly at Site No. 4.

As at most Neolithic sites in temperate Europe, the archaeological remains here lie at a relatively shallow depth below the surface. The topsoil is a rich medium-weight Kujavian "black earth" that rests on a clay and gravel substrate. The upper 30 centimeters are regularly disturbed by plowing each year, and so the method of excavation is to strip away the plow zone, thereby exposing any features dug into the sterile clay and gravel underneath. Unlike the layered accumulation of deposits typical of a deeply stratified site, what comes into view is a palimpsest of pits, wall trenches, postholes and graves, which frequently overlapped. Such overlaps make it possible to determine the relative ages of successive settlements. The absolute ages can be determined by carbon-14 measurements; a total of 15 have now been made by laboratories in Poland, the Netherlands and the U.S.

Two main periods of Neolithic occupation are evident at the sites. They are separated by an interval of two to three centuries when settlement was on a much reduced scale. The initial period began in about 5300 B.C. (the true calendar date according to calibrated carbon-14 chronology) and continued to about 4800 B.C. The occupants belonged to a group assigned by European archaeologists to the Linear Pottery culture because of the distinctive incised-line decorations of their wares.

DEER-ANTLER SPOON, unearthed from one of the many trash pits at Site No. 4, is the first such artifact to be found among central European Neolithic remains. The Lengyel people also made pickaxes out of the antlers of red deer they collected after the animals had shed them.

MUSSEL-SHELL BEADS, strung in strands, were among the grave goods found with this Lengyel woman's skeleton. One such burial included more than 5,000 one-centimeter shell beads.

The remains of the culture are found all across Europe from the Ukraine to France, both on the loess uplands and on parts of the north European plain. Many of the upland sites show traces of sturdy longhouses, sometimes only a single "farmstead" but more commonly several dwellings grouped into a village. No Linear Pottery longhouses have been found on the north European plain, however, and the two sites we excavated are no exception. Among the large but shallow trash pits that indicated the Linear Pottery presence were only a few scattered postholes, probably marking the location of lean-tos or similar temporary shelters. Two separate phases of Linear Pottery occupation could be perceived. The earlier was at the tip of a lakeshore peninsula at Site No. 3 and the later was about 200 meters away at Site No. 4. No Linear Pottery burials were found at either site.

Centuries later emigrants assigned by European archaeologists to the Lengyel culture arrived to occupy both sites. This early Neolithic manifestation, which is named after the original site in Hungary, represents an essential continuation of Linear Pottery traditions in east to central Europe but is characterized by new pottery forms and a decline in the amount of decoration on the pots. Many Lengyel sites also have longhouses that are trapezoidal in plan, being significantly narrower at one end than at the other. Longhouses of this distinctive form have been found both in the loess uplands and on the north European plain; they are the first permanent shelters to appear at the two Brześć Kujawski sites.

Four Lengyel phases can be identified at the sites. The earliest phase, evident mainly at Site No. 4, appeared between 4500 and 4400 B.C. and continued until about 4300 B.C. The three later phases, which extended from about 4300 until about 3900, are evident at both sites. In the 1930's Jażdżewski named these later local forms of the Lengyel culture the Brześć Kujawski Group, a name that is still in use.

The most striking of all the features dug into the subsoil of the two sites are the traces of the Lengyel longhouses. They appear as long, dark discolorations in the clay and are the remains of trenches where the upright posts of the longhouse walls were set in place. Between the start of work in the 1930's and the present more than 50 such "house plans" have been uncovered, some of them more than 30 meters in length. All are oriented with their long axis running from northwest (the narrow end)

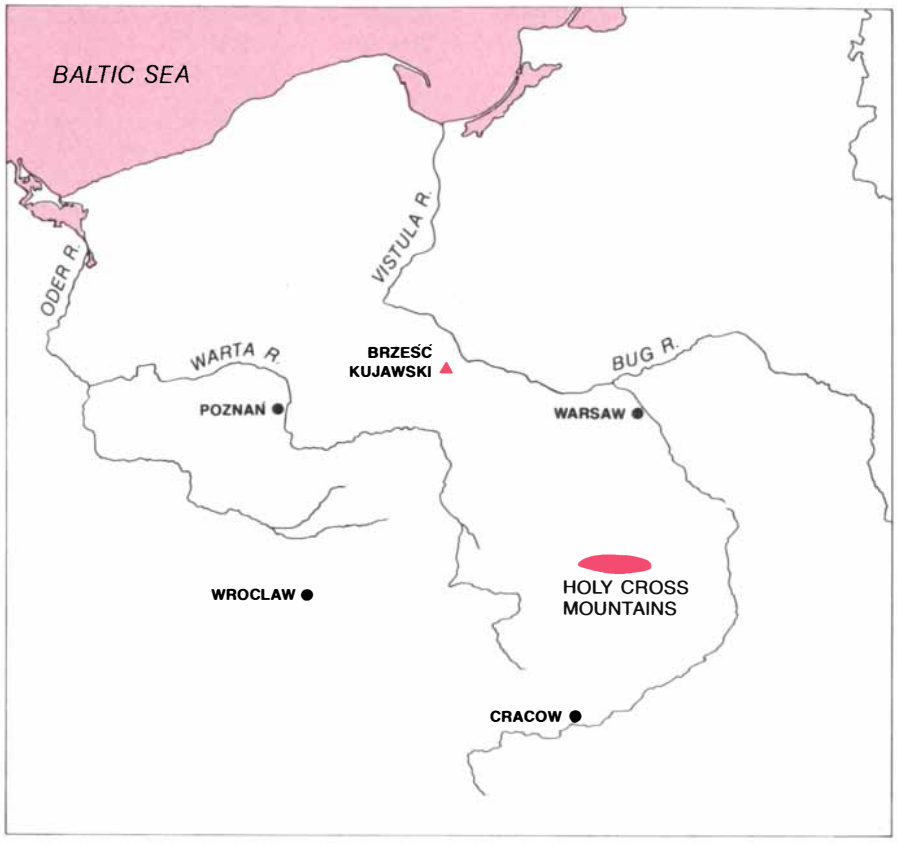
to southeast (the wide end). On the average the Lengyel longhouses were some 20 meters long; the northwest end was about three meters wide and the southeast end about five meters.

The reason for the Lengyel people's building trapezoidal dwellings remains uncertain, but a probable explanation is that the narrow end faced into the prevailing winds. In 1976 a replica of a symmetrical Neolithic longhouse was erected in France as a television prop. The end facing the prevailing winds has already suffered severely from weathering but the other three walls are still sound. Several instances of Lengyel house rebuilding are evident at the two sites; the fact that the same locations were often reused suggests the occupation was continuous through all four phases, probably with as many as 10 houses occupied at any one time.

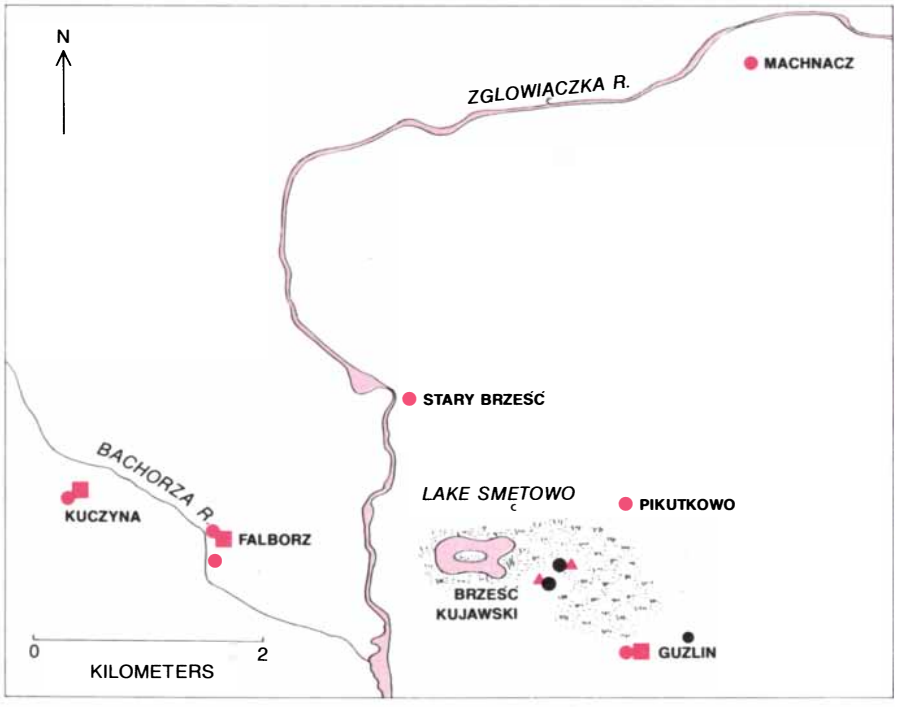
The commonest and most informative subsurface features at the two sites are pits of various sizes and shapes. As we have noted, the pits associated with the Linear Pottery people's trash are generally shallow and large. At the time of occupation they may well have been nothing more than natural depressions in the ground, such as one left when a falling tree is uprooted. They contain dense accumulations of debris, consisting of animal bones and discarded stone, flint and pottery artifacts. In contrast, many of the Lengyel pits are deep, irregular holes dug in parts of the site where clay lies close to the surface. This suggests that the Lengyel people originally dug them to get clay for "plastering" their timber dwellings and for making pottery.

Other Lengyel pits are generally deep and circular and are found near the shore of the former lake. Silty deposits at the bottom of the pits suggest that at times they held standing water, probably for the maintenance of live mussels, turtles and fish. In any event most of the clay-yielding pits and the maintenance pits eventually served for trash disposal. Unlike the Linear Pottery pits, the Lengyel pits show considerable variation in their trash content. Animal bones and discarded artifacts are more numerous in the pits nearest the longhouses.

In some areas where the subsoil was disturbed in Neolithic times the discoloration is less than it is in the pits filled with trash; apparently the area that had been dug up had been refilled without any admixture of organic debris. On investigation such areas usually proved to be Lengyel graves. More than 70 Lengyel burials have now been excavated, the majority of them by Jażdżewski in the 1930's. The bodies were usually found in this kind of individual grave pit. Generally the skeletons are in a contracted position with the knees drawn up; males were interred lying on their



BRZEŚĆ KUJAWSKI SITES, indicated by a colored triangle, are 150 kilometers west-northwest of Warsaw and about 200 kilometers northwest of the Holy Cross Mountains, an area where chocolate flint, named for its distinctive color, is found. This unique flint was prized by the Linear Pottery people because of its excellent flaking properties. Their successors at Brześć Kujawski were largely content with glacially deposited local flint of poorer quality.



SUCCESSIVE OCCUPATIONS at Brześć Kujawski stood on a peninsula jutting out into what was then a much larger Lake Smętowo. The Linear Pottery occupations at sites No. 3 and No. 4 were near the tip of the peninsula and near its base (*black dots*); the Lengyel occupations, at the same two sites, appear as colored triangles. Other Linear Pottery sites (*colored dots*) have been found to the south, west and north. Three nonresidential Lengyel sites (*colored squares*) have also been found. One of them, judging by the many axes found there, was a lumber camp.

right side and females lying on their left. With both sexes the horizontal orientation is the same: the skull rests near the south to the southeast edge of the pit. The females were often adorned with beads and other ornaments of shell, bone and copper; antler pickaxes are frequently found with the males. So far no Linear Pottery burials are known.

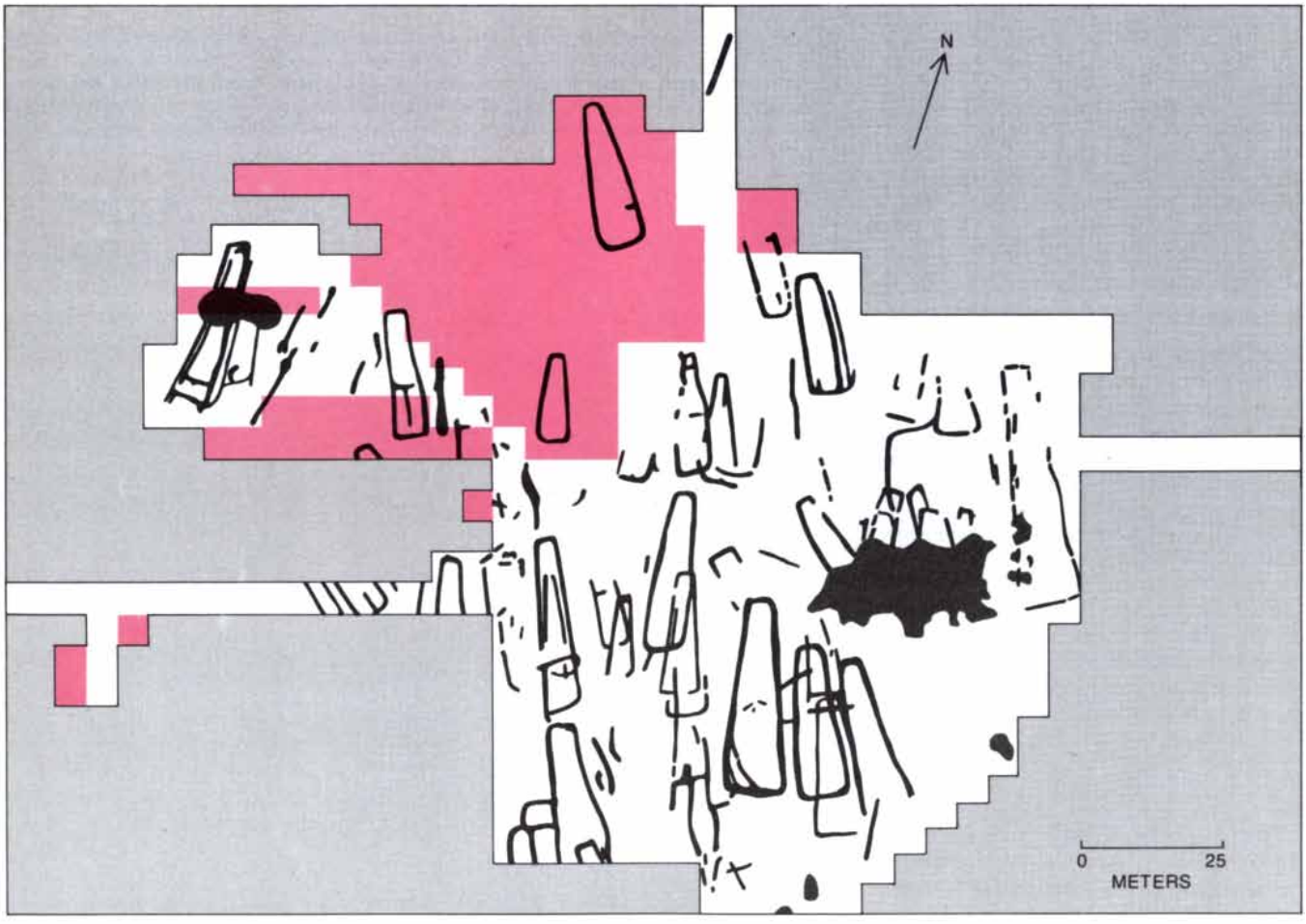
The assemblages of artifacts left by both the Lengyel and the Linear Pottery peoples include characteristically Neolithic axes and adzes made out of "pecked" and polished stone. Indeed, an ax of this type (known as the shoe-last celt) is characteristic of the Linear Pottery culture. At the same time these early farmers still made various small tools by flaking flint. The flintwork of the two cultures, however, was quite different. The Linear Pottery people favored a Polish specialty: chocolate flint, so called because of its brown color and found only in the Holy Cross Mountains some 200 kilometers to the southeast of the sites. Polish chocolate flint was valued by the makers of stone tools even in Paleolithic times. It has excellent flaking qualities, and the Linear Pottery people struck long, thin blades from chocolate-flint cores.

The Lengyel people showed no such strong preference. They made most of their flake tools from the locally plentiful flint "erratics" that the retreating ice sheet had left liberally scattered across the north European plain. Flint erratics, many of which have been subjected to pressure and other stresses in the course of being transported by the ice sheet, tend to have relatively poor flaking qualities, and the Lengyel flint flakes show it. Only when the Lengyel people needed a sharp precision tool did they take the trouble to procure and flake chocolate flint.

The Lengyel people went a step beyond the Linear Pottery people in making pecked and polished stone axes by drilling them so that a handle could be inserted; the stone plugs that were removed in the procedure are found in the trash pits. The Lengyel people also collected the shed antlers of red deer both to make pickaxes and to use as the raw material for other artifacts. Most notable among them is a handsome antler spoon, unique in central Europe, that we uncovered only last year.

Animal bones and teeth were also fashioned into beads and pendants. The ribs of large mammals (probably cattle) were bent into armlets, apparently while still "green," and then decoratively incised. Huge quantities of beads were made out of the pearly shell of the freshwater mussel (*Unio*). Strands wrapped around the waist of a female in one burial consisted of more than 5,000 *Unio* beads, each one about a centimeter in diameter. The graves of Lengyel females also contain copper beads and amulets; strips and bars of copper discarded in the trash pits indicate that these ornaments were made on the spot out of imported copper "blanks."

The pottery after which the Linear Pottery culture is named differs from the Lengyel pottery not only in decoration but also in form. At Brześć Kujawski the commonest shape is the same as the one most frequently encountered at other Linear Pottery sites in central Europe: a deep bowl forming three-quarters of a sphere. Another Linear Pottery shape that is common at the two Polish sites and elsewhere on the north European plain but relatively rare in the uplands is a sieve. We found no



MORE THAN 50 TRACES OF LONGHOUSE WALLS, many of them superposed, were excavated by Konrad Jażdżewski of the State Archaeological Museum in Warsaw at Site No. 4 between 1933 and 1939. The house outlines visible in the white area of this plan show the work of the 1930's. The dark gray areas indicate modern disturbance before Jażdżewski began work. Colored areas were excavated by the authors between 1976 and 1982. To avoid clutter burials and trash pits are omitted from the plan (*see illustration on opposite page*).

intact sieves, but the number of sieve fragments suggests that these artifacts served to separate curds from whey in making cheese. Robert Cowie of the University of Sheffield is currently conducting studies of Linear Pottery potsherds to see if their mineral composition offers clues to the sources of the clay used in their manufacture.

The Lengyel wares have shapes ranging from shallow bowls to deep vessels rather like Greek amphoras and includes such specialized items as pottery spoons. Their mineral content has not been subjected to detailed analysis, but the large amount of mica in the wares suggests they were made out of materials available locally. The same is suggested by the fact that clay was removed from pits at the site.

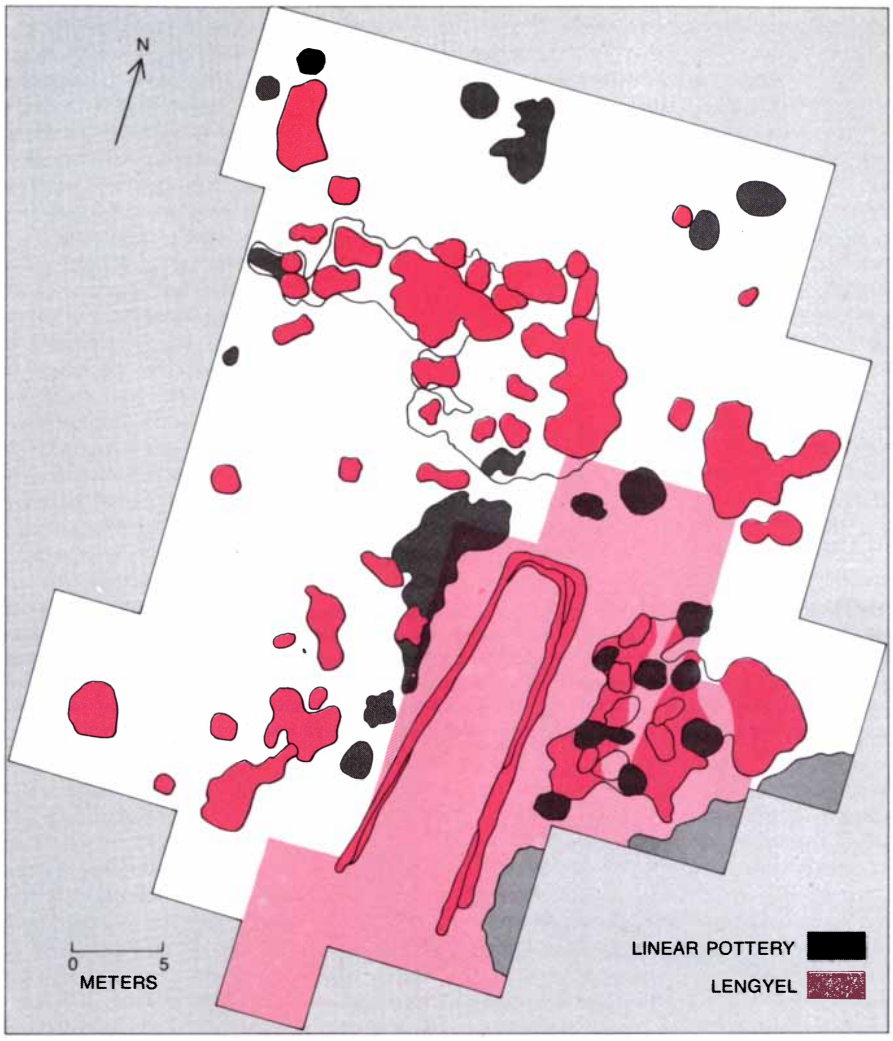
In our work since 1976 we have recovered a great many animal bones in a state of good to excellent preservation. For example, we have separated out more than 6,000 fishbones, mostly those of perch and bream. Here again there is a contrast between the animal remains characteristic of the earlier occupants of the site and those characteristic of the later occupants. As is the case with other sites of the culture on the north European plain, the primary domestic animals of the Linear Pottery culture were cattle. Since most of the cattle bones are at the small end of the overall size range, the herds appear to have consisted mainly of cows. Some sheep and goats were also tended by the Linear Pottery people, but whereas these farmers kept many pigs in their upland settlements, we have unearthed traces of only three pigs over the entire 500 years of the Linear Pottery occupation of Brześć Kujawski. Also notable for their small numbers are the remains of birds, fish, turtles and mussels and the bones of game animals: red deer, roe deer and wild pigs. Indeed, of the large number of fishbones found at the two sites, fewer than 100 come from the Linear Pottery occupation.

The animal bones associated with the Lengyel occupation tally differently. Although overall the remains of Lengyel cattle are somewhat more numerous than those of Linear Pottery cattle, these animals do not figure as prominently in the livestock totals. Sheep and goats are almost as numerous, and the pigs equal the cattle in numbers. Simultaneously there came an increase in the harvest of wild game: red deer and roe deer, waterfowl, turtles, fish and mussels. Not all the hunting was for meat. For example, beavers were evidently killed for their pelts, and so too, perhaps, were otters, weasels and hares.

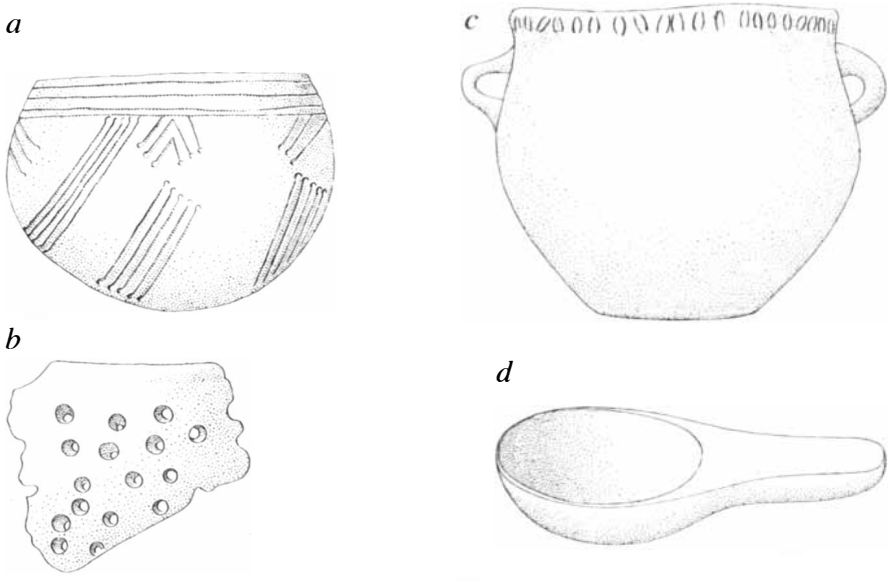
What about the tending of crops at these early Neolithic settlements? We have paid particular attention to the recovery of plant materials by means of wet-sieving and flotation techniques. We have succeeded in finding only three kernels of carbonized grain in the Linear Pottery trash pits, which suggests that these people engaged in very little grain cultivation. The Lengyel trash pits, in contrast, have yielded copious amounts of carbonized grain. One pit we excavated last year yielded more than 300 specimens. Preliminary analysis by Caroline Quillian Stubbs, who was then working at the University of Tübingen, indicates that most of the Lengyel grain is the early form of wheat known to botanists as emmer (*Triticum dicoccum*).

It is not clear whether the Lengyel people cleared forest to enlarge their farming activities. Such a conclusion would call for the analysis of pollen grains at various levels in the soil. No such pollen profiles are yet available from our two sites, although work to this end should soon be finished. One possible indication of forest-clearing activities, however, is the presence of the bones of eagles and marsh hawks among the animal remains. Both birds require open areas as part of their habitat.

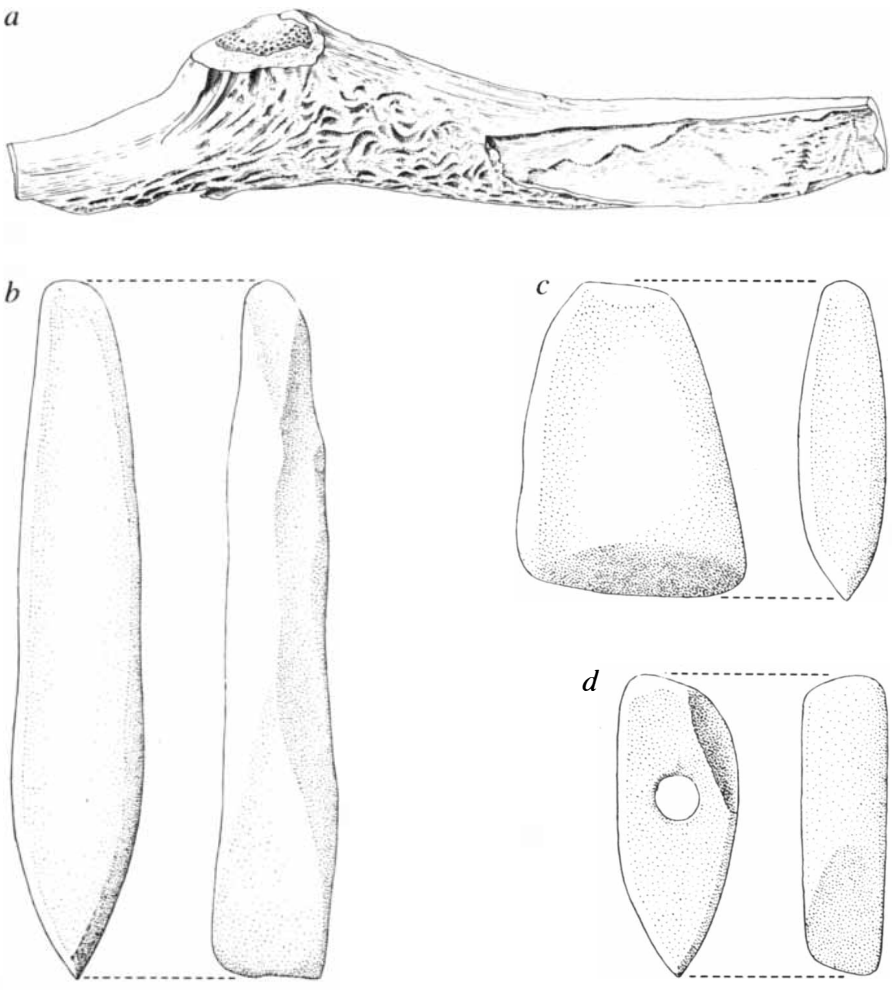
To determine what resources the early Neolithic populations exploited at various times of the year, we depended on a number of different clues, including the teeth of pigs and deer, and the degree to which the teeth still in the jawbones of the animals had erupted. We also noted other indications of seasonality such as the presence among the animal bones of the remains of certain waterfowl species (indicative of winter and spring hunting), of pond-turtle remains (the animals are inactive from late fall to early spring) and of shed deer antlers (they are cast annually in February and March). We could find no indication of winter activities in the Linear Pottery trash. At the same time the presence of turtle



WORK AT SITE NO. 3, nearer the lakeshore, done by Jażdżewski lies within the colored area of this plan. It included the exposure of two longhouse outlines almost perfectly superposed and a number of similarly overlapping trash pits that contained artifacts and animal remains of both the Linear Pottery and the Lengyel occupants of the site. The trapezoidal shape of the Lengyel longhouses is evident; the narrower end may have faced into the prevailing wind. Although the longhouses of the Linear Pottery people are found elsewhere in Europe, none are known on the north European plain. Postholes associated with Linear Pottery artifacts here suggest that these earliest Neolithic migrants constructed shelters of only a temporary kind.



DEEP POTTERY BOWL shaped like a three-quarter sphere (*a*) displays the linear style of decoration that gives the Linear Pottery culture its name. Below it (*b*) is part of a sieve, a common Linear Pottery artifact at the Polish sites, although intact sieves have not been found. The sieves probably served to separate curds from whey in making cheese. The simply decorated pot with ears (*c*) is a typical Lengyel form. Below it (*d*) is another common clay object of Lengyel manufacture: a pottery spoon. Neither the sieve sherd nor the spoon is shown to scale.



AXES were made out of pecked and polished stone or red-deer antlers (*a*). The stone ax at the left (*b*), known as a shoe-last celt, is a characteristic tool of the Linear Pottery people. The shorter, broader ax (*c*) is a characteristic Lengyel form. The Lengyel people also drilled holes for handles in some of their axes (*d*). No intact drilled axes have been found at sites No. 3 and No. 4, but the stone plugs removed in making the holes have been found in trash pits.

bones in it indicates that the Linear Pottery group was active at the sites in the summer months. In contrast the contents of Lengyel trash deposits demonstrate that these later occupants of the sites lived there the year round.

The examination of "growth rings" in the teeth of mammals proved to be particularly informative. These layers of cementum are deposited as opaque bands in summer and as translucent bands in winter. By sectioning a tooth and determining which kind of layer was last deposited one can broadly determine when in the year the animal died. In this way we found that the Lengyel people usually slaughtered their pigs in midwinter and hunted red deer and roe deer in late winter and spring.

In addition to our work at sites No. 3 and No. 4 we reconnoitered the nearby countryside in search of other early Neolithic sites. We found evidence of six other Linear Pottery occupations, all showing the same characteristics as the main sites near Brześć Kujawski: they lacked evidence of permanent dwellings and their rubbish pits were shallow. Three additional Lengyel sites have also been discovered, all within an hour's walk of the two main sites. They also lack evidence of any permanent dwellings and the few pits they contain generally yielded arrays of artifacts more limited in variety than those at the main sites. They give the impression of being areas where some specialized activity took place, perhaps crop tending or herding. One of them, at Kuczyna, appears to have been a lumbering camp: its trash pits yielded an inordinate number of stone and antler axheads.

In all, both the nearness of the Lengyel camps to the main settlement area and their lack of permanent structures suggest that the Lengyel farmers occupied a well-defined "territory," whereas the more extended scatter of Linear Pottery camps gives the opposite impression. This, together with the functional differentiation of the Lengyel satellite camps, indicates that the Lengyel farmers exploited their surroundings in a more organized fashion than their Linear Pottery predecessors.

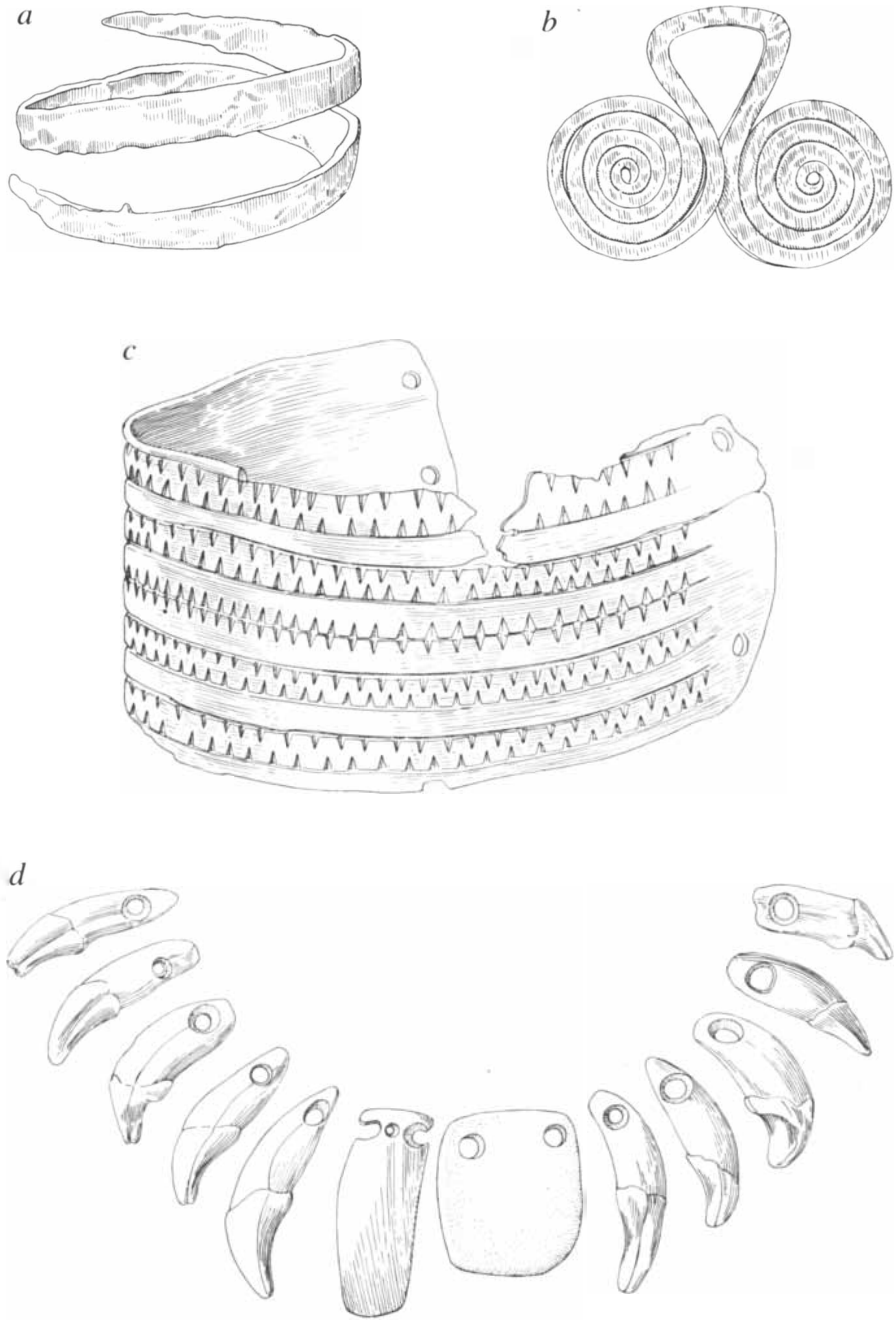
What are the general conclusions to be drawn from the work at Brześć Kujawski? In the past both the subsistence economy and the material culture of the first Neolithic communities in central Europe have often been implicitly characterized as "package deals." For example, wherever Linear Pottery is found it is presumed that an entire "package" of longhouses, pecked and polished "shoe last" axheads, grain, cattle, sheep, goats and pigs will also be present. At the two Polish sites, however, such is not the case, and neither is it at other Linear Pottery sites on the north European plain. The upland longhouses

are absent, the evidence of grain cultivation is sparse and pig bones are a rarity. Moreover, the Linear Pottery occupations of sites No. 3 and No. 4 show no indications of winter residence. The opposite is true of the Lengyel occupations of the same sites and also of Linear Pottery sites in the upland zone to the south.

We interpret this information as calling for a reconsideration of the way of life in the earliest food-producing communities of the north European plain. In view of the omissions from the "package" and the high proportion of cattle bones among the Linear Pottery animal remains we suggest that this first Neolithic excursion north of the uplands consisted not of permanent farming settlements but of seasonal cattle herding (and cheese making) in the lowland forests. The ecologically diverse vegetation of the lowlands would have provided rich summer forage for cattle in spite of the timber cover, probably far richer than the grazing available in the narrow valley bottoms of the uplands.

The conditions favorable for seasonal cattle herding may have been further enhanced in this forest area by an activity of the indigenous Mesolithic (pre-Neolithic) inhabitants of the area: the deliberate clearing of standing timber by fire. Evidence that such was a Mesolithic practice is provided by the abnormally high proportion of hazel pollen in the pollen profiles representing the period dated at about 5800 B.C., some 500 years before the first Linear Pottery people entered the lowlands. Hazel is a common second growth on cleared land.

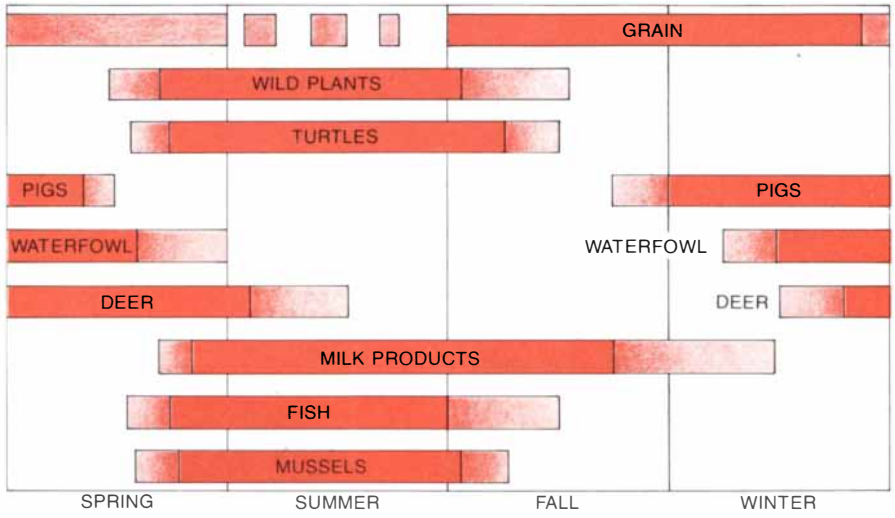
Added evidence of the importance of dairy products to these earliest Neolithic immigrants is the presence of clay sieves both at Brześć Kujawski and at other Linear Pottery sites on the north European plain; these artifacts are comparatively rare at upland Linear Pottery sites. One may presume that one reason for it is that the upland settlers had not only grain but also numerous pigs, sheep and goats, whereas the lowland diet was limited to wild plant foods and dairy products. Another reason may be that the Linear Pottery people of Neolithic central Europe had not yet developed the tolerance to lactose (milk sugar) characteristic of modern European peoples; therefore they needed to process cows' milk into cheese (and perhaps yogurt) in order to consume dairy products without indigestion. Given the entire array of evidence, it seems probable that Linear Pottery herders came north with their cattle in the warm season but returned to permanent settlements in the uplands for the winter.



TYPICAL ORNAMENTS from Lengyel burials are a copper bracelet (*a*) and a copper "spectacle" pendant (*b*). Incised bone armlets (*c*) were made out of animal (probably cattle) ribs. The necklace (*d*) combines polished fossil-coral pendants with dogs' or wolves' teeth drilled for stringing. The copper artifacts, surprising in an early Neolithic context, were probably made on the spot out of copper carried here from mining areas south of the Carpathians.

The Lengyel farmers who succeeded the Linear Pottery people on the lowlands left behind evidence of the kind of diversification of resources that might be expected of a newly established year-round agricultural economy. Although they grew grain, it is doubtful that the emmer harvest was large enough to feed the community until the next harvest and at the same time provide seed for the spring planting. They must certainly have collected such wild produce as hazelnuts and goosefoot (*Chenopodium*). Goosefoot is a source of both greens and seeds that was widely exploited elsewhere in Neolithic Europe. It grows to a height of 1.5 meters in this part of Poland. The Lengyel people may also have supplemented their grain crop with such garden produce as peas and lentils; both are found at other Neolithic sites in central Europe, although no evidence of either has yet turned up at Brześć Kujawski.

Of even greater importance in the Lengyel diet were the domestic animals the settlers herded and the wild game they hunted. As our tooth studies affirm, the Lengyel people slaughtered their pigs in winter after a summer of fattening, and they hunted red deer and roe deer for meat in late winter and spring. Turtles, fish and mussels would also have contributed to their diet in spring and summer, supplementing the wild

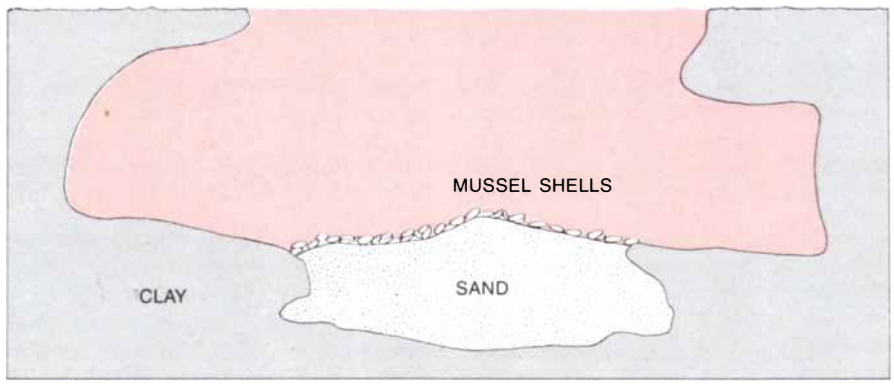


YEARLY FOOD CYCLE for the Lengyel people, beginning at the end of winter (*left*), saw a dependence on one domestic animal (the pig) and three wild animals (migratory waterfowl, red deer and roe deer) to bridge the gap until wild plant foods, freshwater mussels, turtles and fishes, together with milk from cattle, sheep and goats, became available in late spring and on into fall. With the wheat harvest in the fall the Lengyel people acquired a major resource that saw them well into the winter, when the summer-fattened pigs again became an important source of food, supplemented by waterfowl and deer and by cheese, a storable dairy product.

plant foods from the surrounding forest and the milk provided by cattle, sheep and goats. Such a combination of wild and domestic foodstuffs would have been particularly welcome in late summer, when the reaping and storing of the emmer crop would have called for a great deal of work in a short time.

The organizing and scheduling of this kind of subsistence system was evidently what made necessary a change in Lengyel times from the dispersed settlement pattern of the Linear Pottery people. We have mentioned the Lengyel satellite camps that contributed to the maintenance of the permanent residential area; there were probably also a number of other locales—hunting stations and herding outposts—that have left no trace in the archaeological record. The surrounding woods, fields and marshes must have been known intimately by the Lengyel farmers, every square meter contributing something to the well-being of the central settlement.

The long continuity of the Lengyel occupation testifies to the success with which these Neolithic farmers exploited the forest ecosystem around them. Any ecosystem, however, is resilient only up to a point. It seems likely that gradual environmental deterioration after hundreds of years of human occupation was what forced the abandonment of the Brześć Kujawski sites by about 3900 B.C. By then, however, food production as a way of life had become permanently established on the north European plain. The Neolithic Revolution was spreading along the Baltic coast and into neighboring northern Germany and Denmark in the hands of still later Neolithic peoples such as the people of the Funnel Beaker culture. The Linear Pottery and Lengyel pioneers were no more, but agriculture, with its innumerable consequences, had come to stay in temperate Europe.



PIT AT SITE NO. 3, close to the former lakeshore, is shown in simplified cross section. The presence of intrusive sand and a thin layer of mussel shells suggests that the pit was a "storage well," with standing lake water filling its bottom, used to keep mussels, turtles and fish alive.

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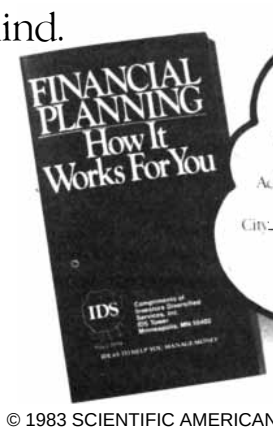

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