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ON CONTEMPORARY ARCHAEOLOGY

Contemporary archaeology embraces a relatively short space of time in the existence of this science beginning in the fifties of the 20th century. The new methods, procedures and changes, however, are so extensive that we can characterize them only briefly in the present paper whose main aim and purpose is to serve as an introduction to the study of literature dealing with these problems.

The methodological and theoretical character of archaeology (its detailed periodization, typology, stratigraphy, find entities, cultural groups) constituted at the break of the 19th and 20th centuries remained almost unchanged for a long period (e.g. Clarke 1968, Moberg 1969, 15, Neústupný 1969, 38, 1971). Only in the second half of the 20th century appear new tendencies influencing the entire structure of archaeology. These changes were explicitly felt in the achievements of the nineteen sixties, when various authors began to speak of "new archaeology" (Binford 1968, Watson 1972), of analytical archaeology (Clarke 1968), "model archaeology" (Clarke 1972), "archaeography" (Ankel, Gundlach 1969, Moberg 1969), and of "ecologically oriented archaeology" (Butzer 1964, 1972, Moberg 1971, 554). Modern archaeology uses natural sciences more and more so that we can speak of an invasion of the natural and technical sciences to the sphere of archaeology (Kolchin 1965). An important position is occupied also by "experimental archaeology" (Semyonov 1957, 1968, Ascher 1961, Coles 1973), and by the "post-medieval and industrial archaeology". The whole process is sometimes called revolution in archaeology (Martin 1971). What is behind all these changes and why did they occur exactly in mid-twentieth century?

First let us try to answer the first part of the question. On enumerating all the characteristic features of this break in archaeology it would be unfair not to mention that most of these changes appeared unsystematically, implicitly during the previous process of development of the archaeology. Explicitly worded programmes appeared only in the second half of the 20th century.

THE CONCEPT OF ARTIFACT

The concept of the artifact, of this basic and traditional source of information, is extending. In the earlier periods only artifacts meeting certain shape and technological standard were collected. Tools made of minerals difficult to process and "less perfect" were in deep disregard. Today equal attention is paid to artifacts and monuments, but also to debris (e.g. to industrial refuse), to vestiges of human activity in the surrounding terrain (e.g. traces of ploughing). These vestiges and the waste material are of great importance for studying the relations between man and environment. This is one of the reasons for decline in the importance of the research of artifacts and monuments in the traditional sense (Moberg 1971, 554).

Equal importance is paid to the artifactural and manufactural properties of the artifacts. The knowledge of raw materials and of their origin can

contribute greatly to the characterization of the technology and economy of the given period. This is closely connected with the use of the achievements of the natural sciences and technological methods for the analysis of the archaeological finds.

Today natural sciences and technical disciplines are used basically in four archaeological branches: In studying the natural environment with regards to the settlement, analysing the material composition of artifacts and their manufacturing and functional technology, origin of the raw materials, dating and searching for archaeological objects in the terrain. The question of archaeological prospecting has been dealt with in the special Czechoslovak literature, thus we can neglect it here (Bouzek, Buchvaldek, Bárta, Hrdlička 1974).

ECOLOGICALLY ORIENTED ARCHAEOLOGY

The domain of these sciences envolves the study of natural environment and of man (physical anthropology). Natural environment is formed by a complex of components, which are subjects of various natural-scientific disciplines. Lithological structure and relief are studied by geology, geomorphology, petrography and mineralogy. Climate is the subject-matter of climatology, water of hydrology, soil of pedology, plants and animals of biology, ecology, biogeography and zoology.

Each of these disciplines can contribute in its specific way to the research of the former natural environment and to its reconstruction. In this regard of top importance are the disciplines studying soil, vegetation and other components of the nature subjected to large changes in the process of development. These disciplines offer rich material for the archaeological terrain research. This fact, on the other hand, requires a more thorough study by the researchers taking and describing the samples.

One of the most important disciplines is vegetation geography, respectively geobotanics dealing, among other things, also with the process of vegetation development and with the reconstruction of the vegetation of a region in the past. Vegetation-geography research methods differ according to the age of the cultural region to be reconstructed. In the younger periods we can avail ourselves of the extant descriptions of the original vegetation in itineraries, valuation reports and other written sources.

Reconstruction proper is realized mainly through geobotanical methods based on bioindications, following from the knowledge that certain associations of plants or species are excellent indicators of certain properties of the region. A perfect knowledge of the needs of the given species or associations of plants, of course, is a basic precondition.

In other cases, e.g. in a prehistoric landscape before Neolithic settlement the reconstruction should be based on palaeobotanic methods. These methods are based on palynology (pollen analysis) and on macro palaeobotany (finds of vegetable remnants and seeds). Even isolated sites and vegetable finds enable us to draw certain conclusions concerning vegetation and its geographic distribution. Species boundary lines, to wit, have a relatively stable course for long periods of time, and even present-day natural conditions can be used for reconstruction. Palaeontology focused on the malakofauna can help us also a great deal in the reconstruction of the studied ecological conditions.

As auxiliary means we can use also various palaeopedological methods based on the research of loesses and fossile soils. This method is of great significance for the research of the stratigraphy of the Pleistocene and Postglacial Periods, since the division of these periods is based principally on the oscillation of the climate. In view of the close connection between climate, soil and organisms, if you know one of these factors, you can easily derive the other two. The work is again based on the indication of former climatic conditions, this time with the help of soils and loesses. Palaeoclimatology is an auxiliary discipline studying the oscillations of the climate in former periods. In this field the work of Lev Nikolayevich Gumilyov (Gumilyov 1971, 1974, 1974a), a Leningrad historian, archaeologist, ethnographer and geographer, is of extraordinary importance. He has theoretically solved and is practically applying many aspects of this discipline on studying the relations between the development of a society and between the environment and the problems of settling the East-European and Asian steppes. Two of his books translated into Czech are very popular in Czechoslovakia.

The hitherto archaeological and natural science knowledge on paleoenvironment was amassed by Karl W. Butzer in 1964 (Butzer 1964) at the Chicago University in a synthetic work called "Environment and Archaeology". The work was rewritten eight years later. Butzer made use also of the achievements of the team of Robert J. Braidwood (Braidwood 1961), studying the origins of agriculture in South West Asia. Butzer reconstructs the natural environment of the Palaeolithic Age, origins and extension of agriculture and of the urban civilization. The large amount of materials available from those extensive areas did not allow him to reserve more place for the problems of the domestication of vegetables and animals. On the contrary, these problems are followed in detail in a large project of the British Academy called "The Early History of Agriculture" started in 1966. The Director of the project Eric S. Higgs from the Cambridge University has formed a team of archaeologists, zoologists, botanists, geographers, ethologists and other researchers, whose hitherto achievements have been published in two noteworthy books (Higgs 1972, 1975). The authors have gathered a lot of evidence that agriculture commenced earlier than it is generally accepted, i.e. as early as in 6000—9000 B.C., and not only in the Near East.

Methods similar to those used in Higgs' project have been applied olso by the Department of Boris A. Kolchin at the Moscow Archaeological Institute

studying problems connected with early farming (the group includes archaeologists, botanists and agrobiologists). Problems of the origin of agriculture and its extension in a more general way have been dealt with by Sergei A. Semyonov (Semyonov 1974) from the Leningrad Archaeological Institute.

In Czechoslovakia great attention is paid to the reconstruction of palaeoenvironment from the archaeological viewpoint by a group of natural scientists (e.g. Ambros 1973, Kratochvíl 1969, Kyncl 1975, Ložek 1973, Opravil 1971, Rybníčková and Rybníček 1975).

NATURAL—SCIENCE AND TECHNOLOGICAL STUDY OF THE ARTIFACTS

Almost one hundred natural and technical sciences are used nowadays for the analysis of naturefactual (naturefact in contrast to artifact) properties of the artifacts, their technology and function. The number of scientific branches used by archaeologists is steadily increasing. What kind of questions can an archaeologist ask from a natural scientist?

The basic question, enabling to ask further questions, concerns the material composition of the artifacts. It is comparatively simple to answer this question in the case of artifacts made of stone, bone or wood, i.e. in materials whose naturefactual substance did not change during the process of manufacture. In such a case already macroscopic appresiation and microscopic analysis of the slices or polished sections (in minerals) or cuts (in organic materials) can analyse the exact material composition of the artifact. So it was quite simple to find out that flaked stone materials were made mainly of silicides, while the basic material of the Neolithic ground artifacts is schist. Sometimes, however, we must embark also on other tests: e.g. on spectral, chemical, X-ray, photometric and fluorescent analyses. They are usually indispensable in evaluating pottery, copper, bronze, gold, silver and other metals and of glass which had obtained new properties from their ancient manufacturers. The problem of material composition of the artifacts made of copper and bronze have been worked out thanks to Richard Pittioni and to the team of Edward Sangmeister. In studying pottery we use microscopic, spectral and X-ray analyses, which tell us a great deal about the composition and preparation of the ceramic material and on the degree of its firing (it follows from the morphological and structural changes of the minerals — the character of these changes depends on the firing temperature) and also on the use of certain technology (e.g. the use of the potter's wheel or of a rotating pad can be traced by parallelly dispersed micaceous materials). In this way was analysed e.g. the Late Hallstatt Culture and Medieval pottery in Čáslav, Bohemia, and it was found out that its basic raw materials were weathered gneiss, mica schist and exceptionally also amphibolites, forming a substantial part of the opening material, while the plastic component was formed mainly by clay. This is a fine example of examining ancient production technology with the help of procedures used in the natural sciences.

A further question, often asked by the archaeologists, concerns the origin of the raw materials. For establishing the origin of the raw material the results of the tests of these materials are compared with the results of tests realized on materials of similar composition. The probable sources of the given material are those complying with all or most of the tests. Sometimes, especially in the case of rock formations the origin of the material can be established relatively exactly. We learned e.g. that in the Middle and escepially in the Upper Palaeolithic Ages the manufacturers often used raw materials brought from locations situated tens, sometimes hundreds of kilometres away. In other materials, e.g. in copper and tin we are glad to identify at least the wider region of the origin of the material.

DATING METHODS

The impact of the natural sciences is most conspicuous in the sphere of dating, namely in absolute dating. We are thus not totally bound by the system of periods originating in the times of Thomsen and Montelius especially by their technological and typological approach. There has been a well perceptible progress e.g. in the above-mentioned shift of the beginning of the agriculture and in the possibility of its autochtonous development in several foci.

The most important dating method is the carbon-14 dating technique, a contribution by the nuclear physicists, namely by Willard F. Libby (e.g. Libby 1955, 1970) from the University of Los Angeles (Institute of Geophysics and Planetary Physics and Department of Chemistry and Space Center, University of California, Los Angeles), a Nobel Prize winner for chemistry for the discovery and application of the carbon-14 dating technique in archaeology, geology, geophysics and other sciences. The method is based on the fact that cosmic radiation creates radioactive C_{14} in the atmosphere of the earth, which is then absorbed by vegetable and animal organisms. After dying of the organism the radioactive isotope is decaying at a fixed rate, so that after establishing its rest (which is a very exacting task indeed) the age of the find can be computed. There are many C-14 laboratories all over the world, continuously thickening the network of prehistoric data. Naturally the C-14 technique is not completely perfect. Its results can be influenced by numerous negative factors. It was even necessary to revise dramatically the half-life of the radioactive carbon isotope and to recalibrate the data. A more reliable recalibration was enabled by the so-called dendrochronology. This method is based on determining the age, trees by counting their annual rings. Very suitable for this purpose is e.g. the bristle-cone pine in the Californian White Mountains, sometimes reaching the age of 4000 years. The

older periods can be dated through other methods based on radiometric system (e.g. on potassium-argon, protactinium-thorium, rubidium-strontium, uranium-helium, uranium-ionium). For dating the oldest periods of the human society we use methods based on the measuring of changes of superficial rock or mineral layers. These changes increase with the increasing time (patination of silicides, hydratation of obsidians and weathering of basalts).

One of the factors negatively influencing the reliability of the radiometric system is the variability of the magnetic pole of the earth, the basis of the archaeomagnetic method. This method is used for dating fired-clay artifacts. During the process of firing the ferromagnetic particles contained by the clay concentrate in the direction of the actual magnetic pole. The given artifact the can be dated on the basis of the oscillation of the intensity of earth magnetism.

There is a host of other methods too, but they are more suitable for relative dating, i.e. for establishing the relative age of two or more artifacts or naturefacts. This method is applied mostly with the most frequent archaeological source, with pottery. Clays contain radioactive particles radiating light during firing — this phenomenon is followed by the thermoluminiscent method. At the moment of completing the firing it reaches zero value, then it is increasing again. When heated-up in a laboratory radiation is renewed and it is increasing with the age of the artifact (Aitken 1975, Mejdahl 1973, Urban 1969). Other structural components of the ceramic products change their properties with the increasing time and their character can be identified with the help of the so-called petrochronological method (Krug 1972). Relative chronology can be established also with the help of the fluor method based on measuring the level of the fluor, uranium and nitrogen content in bones. After burial the quantity of uranium and fluor is increasing in bone, while that of the nitrogen is ropping. The data on the amount of the above substances in bones are therefore very suitable for comparing the age of the bones.

There are also other methods of absolute or relative dating, such as the so-called glottochronology, a method based on linguistic analyses (Čejka, Lamprecht 1963). Other dating methods are based on the analysis of style and frequency of artifacts. The efficiency of these methods, however, is due to various factors comparatively limited. All these dating methods are described in detail in a most up-to-date monograph called "Dating Methods in Archaeology" by Joseph W. Michels (Michels 1973) from the Pennsylvania State University (Department of Anthropology, The Pennsylvania State University, Pennsylvania).

In the introduction we have mentioned that many elements of the present-day archaeology were used unsystematically also earlier. It holds good also for the application of natural sciences during the analysis of naturefactual properties of the artifacts and their dating. The high theoretical and practical standard of modern archaeology is ensured thanks to the existence of special laboratories, periodicals, conferences and monographs.

One of the most prominent periodicals of the branch is the Oxford "Archaeometry" edited by M.J. Aitken and E.T. Hall. The articles published in this periodical are written by chemists, physicists, archaeologists and historians and they deal with dating methods, prospecting and with the composition of artiffacts. The Informationsblätter zu Nachbarwissenschaften der Ur- und Frühgeschichte, published in the Federal Republic of Germany, have a similar orientation.

One of the most renowned laboratories of this kind is the Oxford University Research Laboratory for Archaeology and the History of Art — thanks also to the above-mentioned Archaeometry and to the works of the Director of the laboratory Martin J. Aitken (Aitken 1975). There are many similar laboratories, some of them independent, others forming part of various archaeological institutes (e.g. the abovementioned Kolchin's Department at the Archaeological Institute of the Soviet Academy of Sciences in Moscow). Much attention is paid also to studying the most efficient ways of cooperation between archaeologists and natural scientists.

In the Czechoslovak archaeology the use of the natural and technical science methods has spread thanks to the extensive and complex researches realized in certain localities (e.g. Bylany, Kyjovice, Mikulčice, Nitra, Pohansko near Břeclav and Staré Město). The procedures applied by Jaroslav Böhm, Josef Poulík, František Kalousek and Vilém Hrubý were in many cases exemplary and trend-setting. On this cooperation is based also the work of Jindřich Štelcl (Štelcl 1972, Štelcl, Malina 1975) at the Brno Faculty of Natural Sciences, coupling archaeology and petropraphy into an interdisciplinary science called petroarchaeology. To have enough specialists for this new branch some students of geology are trained also in archaeology, and vice versa. The overlapping of the above branches enables us often to formulate completely new problems, contributing to the development of both branches (e.g. the relation between the structural characters of rock formations and between the functions of the artifacts).

A whole series of almanacs deal with the application of natural scientific methods in archaeology — some of them containing the proceedings of conferences and symposia (e.g. Berger 1970, Brill 1971, Brothwell, Higgs 1963, Caldwell 1966, Kolchin 1965, Laming 1952, Pyddoke 1963).

EXPERIMENTAL ARCHAEOLOGY

Experimental archaeology has constituted almost an independent branch with specific methods and theory, thanks mostly to the monograph by J. Coles (Coles 1973) and papers of S. A. Semyonov (Semyonov 1957, 1968) and R. Ascher (Ascher 1961) and also thanks to the activities of important research centres (Hansen 1974,

1975, Reynolds 1974, 1975), enabling us to deepen our knowledge on prehistoric technological and economic facts.

Coles' book is a survey of the results of experimental archaeology, amassed during more than 150 years. Already some of the members of the founder generation of archaeologists (e.g. Nilsson, Lubbock, Evans) were checking technology experimentally, namely in stone technology products. On the basis of these experiments they were able to describe the clearance of land, ploughing, sowing, harvesting, preservation of crops, preparation of foods, construction of dwellings, fortifications and monumental buildings, as well as their destruction, transport and erection of huge stones, long voyages in small boats, working of stones, wood, bones skins, metal working, manufacture of pottery and the arts of painting and music.

Experimental archaeology performed by individuals and isolated groups has reached remarkable achievements. Recently several new projects have been realized, concentrating research and experimental work in order to speed up progress. Several such centres have been founded e.g. in Denmark, Great Britain, Nigeria, Poland and in the USSR. Perhaps the Danes have the deepest tradition and largest experience in the sphere of systematic and complex archaeology. In 1964 they founded a Historic Archaeological Research Centre (Historisk-Arkaeologisk Forsøgscenter) in Lejre on the Zealand, 10 km from Roskilde. They built here an Iron Age settlement (500 B.C. — 400 A.D.), a Medieval village, an African Tonga village, and they have reconstructed and studied also various social and economic situations in these, and also in other periods. The centre has scientific goals and ambitions, but it follows also informational and educational tasks. The achievements of the centre are really remarkable in both fields (Hansen 1974, 1975).

Reconstructions are realized on scientific basis in order to understand the way of life and the milieu of the ancient periods. The scientists of the Lejre Centre, headed by Director H. O. Hansen, hold that the past forms a living part of us. Many activities in the daily life show that in certain situations we still act as our forefathers did. A perfect knowledge of the past will perhaps help us to reveal some of the secrets of the future. How is life in a society that cannot use all its resources — or what was the working day like without the pressure caused by the machines? It is a very valuable social task to explain some interesting aspects of the human existence in the past and to acquaint with them as many people as possible.

In the course of a five-to-six months season, which begins in Lejre on May 1st, the locality is viewed by an average of 50—60 thousand people from Denmark and from abroad, among them some 20—25 thousand students of various types of schools staying here for a five-day course in a camp. They live and work here under the guidance of experienced and trained instructors on the reconstruction of prehistoric and medieval houses. They take part in many production processes (weaving, pottery, metallurgy) learning a lot about the life of the ancient societies. The school camp has a fixed programme for the whole year with the exception of December and January. The camp provides also for 3-hour school activity dealing with life in an Iron Age Danish and African village, reconstructed according to materials acquired in Zambia and in other parts of Africa. The universal programme takes place between April 1 and October 1. For the winter period there is a special programme. The instructors, two for each class, show how to keep a primitive household, how to till the fields and how to do farmwork in general. Then the participants of the excursion visit the rest of the centre.

The centre has enormous capacity, nevertheless, it can provide facilities only for a small fragment of the Danish school children and students. It organizes also courses for the adults, acquanting them with various prehistoric and medieval techniques of acquiring ores, metal melting and forging, weaving, knitting, construction of dwellings, production of pottery etc. The instructors help organize courses also outside the centre. In the recent five years the courses organized by the centre were attended by more than one thousand teachers, further disseminating their acquired knowledge among the youth.

In Little Butser in Hampshire in England a new experimental farm of 22 ha was set up on a sandy terrain with subjacent chalk-soil. The farm is directed by Peter J. Reynolds (Reynolds 1974, 1975). It is a reconstructed 3rd B.C. Iron Age settlement. Several huts and cereal pits have also been constructed. The pits are filled with two kinds of prehistoric wheat (Triticum dicoccum, Triticum spelta) The wheat cultivated by prehistoric methods contains almost twice as much protein as the modern cereals do. Its yields are also quite fair, overpassing the average yield in Great Britain in 1900. The results of this experiment will not be measured after one or two years, but after ten or twenty years, enabling the experimentators to draw the necessary conclusions from the exhaustion of the soil, influence of the harvesting methods, problems connected with the storing of the grain, development of the herds, technology of the pottery, weaving and other crafts in connection with a series of special studies concerning the environment of the given epoch.

Similar grandiose educational projects are realized in the USSR and in Poland. In Poland in Krzemionki Opatowskie, in the world famous Stone Age striped hornstone mine all phases of mining have been reconstructed: the digging of hornstone blocks in the prehistoric mine, their transport to the surface, preparation of semi-finished products and the manufacture of tools (the manufacture of a semi-finished oblong Neolithic axe did not take more than 10 minutes). All the experiments were filmed. These films can inform thousands of viewers about this meticulously protected reservation (Balcer 1969). In Biskupin near Poznan a famous fortified Iron Age settlement have been restored partially. In Góry Świetokrzyskie where numerous

well conserved bateries od Roman-time iron furnaces were discovered. The so-lled "Dymarki" feast takes place every year here, in Nova Slupia. It is a public demonstration of the whole production process, including the acquisition of the necessary iron ore from local sources, realized with the couleur de l'époque (Bielenin 1969, 1974).

Experimental archaeology realized on scientific basis has become an inseparable part of modern archaeology. Its importance is strengthened by the possibilities of its extensive social application, which is sometimes neglected.

POSTMEDIEVAL AND INDUSTRIAL ARCHAEOLOGY

Since 1945 three new archaeological branches have arisen — the medieval, postmedieval and industrial archaeology, though medieval archaeology has quite deep roots and is cultivated all over the world. The home of postmedieval or industrial archaeology is Great Britain, the cradle of the industrial revolution. The latter two branches are cultivated also in the USA and in some other countries. In most countries these archaeological branches are, however, in their very beginning, but they can rapidly develop, as medieval archaeology did. As we get nearer to the present epoch the amount of written documentary materials is considerably increasing, nevertheless archaeology preserves its irreplaceable position even in these epochs. Up to the second half of the 19th century, in some cases even up to more recent times characterized by an "explosion" of written documents archaeology is irreplaceable.

The Society for Post-Medieval Archaeology and the periodical "Post-Medieval Archaeology" form an excellent basis for the postmedieval archaeology in Great Britain. Postmedievalists deal with the period up to the beginning of the industrialization, where the sphere of interest of the industrial, or as P. Riden suggests (Riden 1973, 216) recent or modern archaeology begins.

The beginnings of organized industrial archaeology are connected probably with the Conference of the Council for British Archaeology and with the subsequent establishment of the National Record of Industrial Monuments. In 1964 folowed the periodical "Industrial Archaeology" and a series of periodicals of local importance were also started. Since then many studies and books appeared on industrial archaeology. Besides theoretically and methodologically oriented works they form basically two series (e.g. Bracegirdle 1973, Buchanan 1970, Hudson 1970, Raistrick 1972, Riden 1973). The first series deals with individual industries and the second is focused on individual regions. In these works the archaeologists study the early forms of industrial activities, with special regard to their physical remnants. They comprise the study of manufactories, early factories and machine power sources, canals, locks, sluices, dams and railways, dwelling in houses of uniform type, development of industrial towns, and many other characteristic features of the 18th and 19th centuries. The final purpose of this research is to contribute to the understanding of the development process of the industrial economy and of the society.

The discussions and arguments among British archaeologists concentrate mainly on the selection of objectives suitable for archaeological research. Research should concentrate on objectives about which we have no written information, or where the existing written sources are biased. In the view of P. Riden (Riden 1973) industrial archaeology should deal besides technological problems also with the living conditions of the working class in the 19th century. The reconstruction of towns continues rapidly, in the nearest future most natural resources will be destroyed.

The Czechoslovak industrial (modern, recent) archaeology is rapidly developing thanks to the activities of the Brno Technical Museum.

THE APPLICATION OF MATHEMATICS AND COMPUTERS IN ARCHAEOLOGY

Mathematics is one of the sciences that gave mighty impulses to archaeology, enabling the development of new theoretical current in the archaeology of the second half of the 20th century. The application of mathematics in archaeology can look back at least at an 80 years' tradition, but a really efficient use of this science has been enabled by the present age of computers. The first experiments in this field were realized in the USA. Roosevelt's New Deal contained a great deal of public works, among them the Tennessee Valley Authority. The construction of the Tennessee hydroregulation system was accompanied by large-scale excavations and it was necessary to organize archaeological research of an unprecedented scale. New standardization methods were looked for and it was necessary to process quantitatively the large numbers of finds streaming to the museums. The problem was solved by the use of computers (Moberg 1969, 31).

After World War II thanks to the numerous international meetings of the archaeologists the use of computers was rapidly extending. At first they appeared in conferences of general orientation, later their use acquired more special character. The development of the use of computers was summarized in the work of Moberg (Moberg 1971, 551):

1950, New York: Conference on archaeological methods. Publications: Griffin, J. B. (ed.): Essays on Archaeological Methods. — Ann Arbor 1951, with the articles: The Use of Mathematical Formulations in Archaeological Analysis and The Use of IBM Machines in Analyzing Anthropological Data.

1959, the Wartenstein Castle: Symposium on the application of quantitative methods in archaeology. Publications: Heizer, R. F., Cook, S. F. (ed.): The Application of Quantitative Methods in Archaeology, Viking Fund Publications 28. — Chicago 1960, with the article: Spaulding,

A. C.: Statistical Description and Comparison of Artifact Assemblages, 60—83.

1963, Moscow: All-Union conference of science in archaeology, Section for Mathematics and Cybernetics. Publication: Kolchin, B. A. (ed.): Arkheologiya i yestyestvenniye nauki. — Moscow 1965.

1966, Rome, International symposium on mathematical and computer methods in the social sciences. Publication: Gardin, J. C., Jaulin, B. (ed.): Calcul et formalisation dans les sciences de l'Homme. — Paris 1968.

1969, London, Symposium on the impact of the natural sciences on archaeology. Publication: Allibone, T. E., Wheeler, M., Edwards, I. E. S., Hall, E. T., Werner, A. E. A. (ed.): A Symposium on the Impact of the Natural Sciences on Archaeology, Philosophical Transactions of the Royal Society of London, A-269, No. 1193, with the article: Kendall, D. G.: A Mathematical Approach to Seriation, 125—134.

1969, Marseille: International symposium on the use of computers in archaeology. Publication: Gardin, J. C. (ed.) Archéologie et calculateurs. Problèmes sémiologiques et mathématiques. — Paris 1970.

1970, Mamaia: British-Rumanian conference on mathematics in archaeology and history. Publication: Hodson, F. R., Kendall, D. G., Tâutu, P. (ed.): Mathematics in the Archaeological and Historical Sciences. — Edinburgh 1971.

1970, Moscow: Publication: Kolchin, B. A., Sher, Y. A. (ed.): Statistiko-kombinatorniye metodi v arkheologiyi. — Moscow 1970.

1971, Marseille: International symposium on mathematical methods applied in archaeology. Publication: Borillo, M. (ed.): Les méthodes mathématiques de l'archéologie. — Marseille 1972.

1972, Marseille: Symposium on data-banks in archaeology. Publication: C.N.R.S. (ed.): Les banques de données archéologiques. — Paris 1974.

1973, Marburg/Lahn: Seminar on the statistical methods used in archaeology. Publication: Informationsblätter zu Nachbarwissenschaften der Ur- und Frühgeschichte, 5, 1974 (periodical).

The impressive amount of the hitherto acquired data — the number of unearthed pots is put at 150—200 million, their steadily increasing number and the increasing demands on their description and classification force archaeologists to use new techniques combined with the use of computers. The cultural anthropologist C. Lévi-Strauss writes: "It is startling to see — and it does credit to man — that the methods of handicrafts are more effective than the computers. It will not take long, however. The day when I will be defeated by the machine is nearing!".

From the viewpoint of arranging the information we can divide the use of computers to several groups:

a) Information techniques enabling us to get oriented in the respective literature.

b) Information techniques enabling us to classify and to retrive certain data on the artifacts and on their properties.

c) Techniques enabling us to study the problems of interdependence between artifacts and their properties.

The science dealing with the first circle is called "informatics" (e.g. Cigánik 1969). Its task and purpose is — in our case — to furnish all the informations relevant for our needs, alongside with the minimum number of non-relevant information. Its concrete application in archaeology was realized by M.Y. Braychevski (Braychevski 1963).

The second circle can be characterized in a similar way. The computer should sort-out only data on artifacts we are interested in. It is a question of specification and mutual relationship of the number of artifacts and of the scope and depth of our interest. If we have a large number of artifacts, then usually only a few aspects are followed — and on the contrary — if we follow the artifacts more thoroughly, we can do it only with a limited number. The two basic types of data-banks (as they are called) are organized in keeping with these two principal viewpoints. The first type is a museum-type computer catalogue, recording all the material collected by the museum, regardless of the time or place of their origin -- it contains only basic data. In this way works the Museum Computer Network in the USA and the data-bank of the Arkansas Archaeological Survey. A detailed survey of these systems is supplied by R.G. Chenhall (Chenhall 1975), a major authority on the issue.

Emphasis on detailed information brings us to specialized fields, usually arranged according to the type of the artifacts.

Let us quote two examples: The British Museum has a data-bank oriented on animal remains from various archaeological sites, and the French Ministry of Culture has an inventory of works of art in the form of a data-bank.

Further specification and concentration will bring us to the third group. Here, we face very concrete problems. The group of the finds is relatively small and limited to a number decided beforehand. Thus according to pre-set programmes we can form groups and types of artifacts, we can study the interdependence of their relations and realize further statistical research. Each specific problem requires a different description as a rule, but when we decide to embark on a complex research of a definite group (e.g. a burial ground), we must choose a certain form of universal description.

In this case a specific methodology is used, enabling instantaneous and fluent flow of the information to the data-bank in the course of the archaeological research. This way the research strategy can be readily changed in keeping with its gradual results.

One of the essential questions of the use of data-banks is how to find out and how to follow certain properties. On establishing a data-bank we start, as a rule, with records realized in a certain order, according to a certain code recorded on

punched cards. The information is fed to the computer memory by means of these punched cards. At present exist also methods enabling direct graphic entry. The shapes of the object are drawn on a special plate and they are recorded and processed by the computer. There exist also plans to record the artifacts directly, with the help of a TV-camera connected with the computer.

The French, thanks to the pioneer-work of Jean Claude Gardin, are well-ahead in this field. Gardin's works in this sphere was focused on the projecting of codes for the description of various categories of artifacts and their attributes: shapes of pots, of metal tools and weapons, abstract ornaments, the iconography of oriental cylindric seals. Gardin synthetized the results of his work in 1958 (Gardin 1958, 1967). In the same year he was commissioned by the National Centre for Scientific Research (Centre National de la Recherche Scientifique or C.N.R.S.) in Paris to organize the Centre of Documentary Analysis for Archaeology (Centre d'Analyse Documentaire pour l'Archéologie), which was later transferred to Marseille. Its present Director is Mario Borillo (Borillo 1972, 1975). Later J.C. Gardin continued analysing ancient texts and through the use of computer methods he processed archaeological data. On his initiative a second research group was founded in 1960 within the framework of the National Centre for Scientific Research. This group is studying various problems connected with the modernization of bibliographical work. The group is called Section for Documentary Automatisation (Section d'Automatique Decumentaire). Later the centre has been renamed "Laboratory of Documentary Automatisation and Linguistics (Laboratoire d'Automatique Documentaire et Linguistique), whose present Director is Maurice Gross. Gardin's recent work (Gardin 1971a) on the topic is a report on the applicability of the World Scientific Information System UNISIST. He was commissioned to write this work by the World Council of Scientific Associations and by the UNESCO. He continued his work also on the formal problems of archaeological description and on the use of these descriptions in archaeological data-banks (Gardin 1971, C.N.R.S. 1974). At present J.C. Gardin is Director of the Archaeological Research Institute No. 10 (Unité de Recherche Archéologique No. 10, C.N.R.S.) in Paris.

Extraordinary attention is paid to this field also in the Soviet Union, with the excellent team of Boris Alexandrovich Kolchin (Kolchin 1965, Kolchin, Sher, 1970) in the Archaeological Institute of the Soviet Academy of Sciences in Moscow. The work of the team is oriented on formal aspects of the description of artifacts, namely on pottery and pearls, according to their system of characters and burial complexes.

In the USA there is a periodical dealing with the problems of the use of computers in archaeology. It is called "Newsletter of Computer Archaeology" and was started in 1964. The periodical brings news from the whole world. In its editorial board R.G. Chenhall was replaced by Sylvia W. Gaines (Gaines 1971) from the Department of Anthropology, Arizona State University, Tempe). Robert G. Chenhall, working at present in Rochester (The Margaret Woodbury Strong Museum) is one of the main representatives of this trend in the USA. His vast activities range from the use of computers in archaeology and anthropology in museums to the foundation of data-banks for archaeological and museological purposes (Chenhall 1975).

The periodical "Archäographie" is published in the Federal Republic of Germany by Cornelius Ankel, Director of the Duisburg Museum (Niederrheinisches Museum der Stadt Duisburg) and by Rolf Gundlach (Institut für Nichtnumerik, Darmstadt). In the first issue of the Archäographie in 1969 the two editors define the notion of archäography as an auxiliary archaeological discipline of orienting value, concerned with the description of artifacts from the viewpoint of their general applicability, with subsequent data-processing on a computer. They count with the use of the acquired data in a data-bank (Ankel, Gundlach 1969). Statistical problems and the use of computers are dealt with by Peter Ihm (Ihm 1974, 1974a) Institut für med. -biol. Statistik und Dokumentation, Marburg/Lahn, and by Klaus Goldmann (Goldmann 1968, 1974), Museum für Vor- und Frühgeschichte, West Berlin.

The British archaeologists, namely Frank Roy Hodson (Hodson 1968, 1969, 1970, 1974), Professor of Archaeology at the Department of Prehistoric Archaeology, University of London, are assisted in processing archaeological materials by renowned mathematicians and statisticans, such as James E. Doran (Doran 1970, 1971, 1973, Doran, Hodson 1975), Hodson, Sneath, Doran 1966 from the Computing Centre of the University of Essex, Colchester, David, G. Kendall (Hodson, Kendall, Tâutu 1971, Kendall 1969, 1970, 1974), Professor of the Department of Pure Mathematics and Mathematical Sciences, Statistical Laboratory at the University of Cambridge, and also by the specialists in taxonomy, widely used in the archaeology, Peter H.A. Sneath from the University of Leicester (Medical Research Council, Microbial Systematics Unit, University of Leicester) and Robert R. Sokal from the State University of New York at Stony Brook (Sneath, Sokal 1973, 443—446). Their cooperation during the research of a La Téne Culture burial site in Münsingen, Switzerland, was quite exemplary (e.g. Hodson, Sneath, Doran 1966, Kendall 1970). The problems of global description of the shape and the use of computers in archaeology are studied by John D. Wilcock (Allsworth-Jones, Wilcock 1974, Wilcock, Laflin 1974) from the Department of Computing, North Staffordshire Polytechnic, Stafford. The Rumanian Professor Petre Tâutu has also contributed to the development of statistical methods in archaeology (Hodson, Kendall, Tâutu 1971).

Several archaeographical works appeared also in Poland (e.g. Dymaczewski 1971, 1971a, Mazurowski 1973) and in other countries (e.g.

Todorova-Simeonova 1971, Todorova, Stavrev 1971); sporadically appeared such works also in Czechoslovakia (Bouzek, Buchvaldek, 1971, Neústupný 1973, 1973a, Pavlů 1974, Podborský, Kazdová, Weber, Koštuřík 1975, Smetánka 1971) — so far we lack the initiative of the Czechoslovak archaeologists, matematicians and statisticians in this field.

On concluding this part I would like to draw the attention to certain periodicals reserving more space to these problems. Besides the above-mentioned periodicals the most important are: American Anthropologist, American Antiquity, Antiquity, Archeometry, Archeologia Polski, Computers and the Humanities, Informationsblätter zu Nachbarwissenschaften der Ur- und Frühgeschichte (see copy 5 — 1974 completely dedicated to statistical methods in archaeology), Revue archéologique, Science and Archaeology, Sovietskaya arkheologiya and World Archaeology.

THE THEORY OF ARCHAEOLOGY

Mathematization, use of computers and the constantly improving methods of description of the archaeological finds and data are only means bringing us nearer to explanation — which, of course, depends on the standard of the archaeological theory. The problems connected with archaeological theory and methodology are of basic character, nevertheless they are most controversial and are widely disputed. At present, when the general basis of Czechoslovak archaeology is historic materialism, usually the hypothetic-deductive methods are emphasized. These procedures were first applied in physics, biology and in the social sciences, including archaeology (most successfully in psychology and sociology). The general principles of archaeological scientific explanation were developed mainly by Carl. G. Hempel (Hempel 1965, Hempel, Oppenheim 1948). Their application in archaeology was demanded by Walter W. Taylor as early as in 1948 (Taylor 1948), but their full application was possible only in the sixties, when the required computers were available.

The notion "new archaeology" was explained by Richard A. Watson (Watson 1972, 212) in one sentence in the following way: "The new archaeology consists of an acceptance of the covering-law model of scientific explanation, with an emphasis on the hypothetico-deducive method for the testing of conclusions derived from archaeological data."

The new concept was generally accepted in the nineteen sixties and nowadays we can distinguish two basic trends. The first is represented by the so-called American "new archaeology" of Lewis R. Binford, and by Kwang-chih Chang, in spite of the considerable differences between the two. It is based on American traditions (American archaeology is anthropology, or it will be nothing), reevaluating the notions hitherto used by archaeology from the viewpoint of anthropology. By the way, Binford's work is based on the anthropological approach of L. White, who was openly called a marxist in the "Current Antropology". Some archaeologists of Binford's circle openly avow materialism. The Soviet review of the "New Perspectives in Archaeology" (Binford, Binford 1968) in the Sovietskaya arkheologiya (Kleyn 1973) states that the results achieved appear utterly new and perspective. B. A. Kolchin compares them with the sociologically oriented Soviet archaeology.

The other trend is represented by the British "analytical archaeology" of David. L. Clarke and is based on the use of new methods, first of all system methods and the archaeological notions are adapted to these methods. "Representing an enormously detailed refinement of the notion culture, specially adapted for quantitative processing" (Harris 1971, 39).

This division is naturally very schematic and can serve only primary orientation. Their common basis is a declination from the descriptive, ideographic approach, in order to emphasize the general, nomothetic features, which is a shift very characteristic of the modern geography. It served, the way, not only as an example, it showed also the way for solving certain concrete archaeological problems: "... it suggests a number of ways in which archaeologists can approach and analyse distributions in space of archaeological materials (of artifacts, settlements or cultural groups). It is not an exaggeration to say that we have been working on problems which have already been solved". Besides this statement A.C. Renfrew (Renfrew 1969) says that Haggett's book (Haggett 1965) "Locational Analysis in Human Geography" could be renamed to "Locational Analysis in Prehistoric Archaeology". This is one of the approaches documenting the general shift in scientific methods in various science branches which must be taken into account by archaeologists. The process of development which the globally and descriptively oriented "archaeo-history" could cath only in its outlines, is analysed through the registration of new trends. Trends which are observed in cultural evolution require explanation; they are certainly not explained by postulating emergent human traits which are said to account for the trends.

As regards the analysis of archaeological phenomena as a system there is a well perceptible shift from culture to smaller units, as e.g. Harris' (Harris 1971) "catchment area", which is a certain limited area around an inhabited location.

Lewis R. Binford is at present Professor at the Department of Anthropology, University of New Mexico, Albuquerque. He realized ethnohistorical research of various Indian groups in the central Atlantic-coast states, of the inhabitants of the Ryukyu Islands, of Alaskan Eskimos and of Navajo Indians, one of the most populous Indian tribes in the USA. He conducted also archaeological research in the central Atlantic-coast states, in the area of the Great Lakes, in the Central Mississippi Basin, in Alaska, in France, and in some historical French-English settlements all over the USA. He combines aptly the experience acquired in the terrain with

the creation of new theory and methodology in archaeology. In the book "Archaeology as Anthropology" published in 1962 L.R. Binford holds that archaeologists should concentrate on formulating and checking hypotheses concerning the cultural behaviour of man. These views appear in the "New Perspectives in Archaeology" jointly edited by L.R. Binford and his wife Sally R. Binford, and in "An Archaeological Perspective", a monograph published in 1972.

In the view of L.R. Binford conventional archaeology concieves cultures as lists of their characters, with each property having its special meaning. Each property of the culture separates ideas, beliefs, preferences, mental patterns and standards, which are then identified with the artifacts. Problems are solved by describing and comparing assemblages of certain properties, since it is believed that their variations and changes are explicable in terms of the variability and changes of cultural standards, i.e. in the terms of diffusion and influence of the ideas. It means to look for the sources of ideas and standards. The emphasis is on studying materials distinguishing individual cultures, preferring stylistic variability to functional and adaptational variabilities. Traditional archaeologists are much more concerned with comparing components and phases than with describing variability inside components and phases.

The explanation of similarities between archaeological complexes must be based on the structural properties of a cultural system, in contradiction to historical explanation limited to the description of the mechanism of the cultural processes. It is necessary to pass from the explanation of archaeological observations in terms of processes and events of the past to the explanation of these processes and events. Similarities and differences in archaeological data must be explained within the framework of their function inside the cultural system through form varieties, associations and distributions of the artifacts. We must look for an explanation for the observed phenomena, i.e. the observations based on archaeological data are connected with the laws of cultural or "behavioral" functioning with regards to past conditions or events. The explanation takes place by formulating hypotheses and by their testing.

It is therefore imperative to isolate and to establish a certain cultural system and to follow its processes. We can consider as a cultural system a set of constant or cyclically recurring connections between social, technological and ideological extrasomatic adaptive means valid in a certain human society is studied through archaeological data. Binford (R. Binford 1965) shows that the properties of pottery products show whether they were actually used and also what was their purpose (cooking, ritual pottery, etc.) and the differences caused by various manufacturers and the social standing of the proprietor are also evident. The old archaeological concept followed only the properties having certain value for the identification of a certain culture. Nowadays a regionally differentiated approach is required, i.e. a detailed and systematic study of the region, where the given cultural system is situated.

In cultural systems concieved this way people, things and locations form components of the socio-structural and ecological sub-systems. They cannot be explained by a simple reduction of the ideas, behaviour, patterns as supposed by the concepts of culture limiting the assemblage of ideas. It is therefore necessary to study the variability of artifacts so as to isolate causally important factors, which will help us to discover certain structural and functional properties of the system. Such facts can be then studied in various systems and their changes, and on this basis we can express new laws.

In the sixties and seventies a series of new works appeared in the USA, which are based on the above-mentioned methodological preconditions. It is first of all a textbook edited by Frank Hole and Robert F. Heizer in 1966 called "An Introduction to Prehistoric Archaeology". In 1967 appeared a book with the interesting title "Invitation to Archaeology" by James Deetz from the Department of Anthropology, University of California, Santa Barbara. In the same year appeared also "Rethinking Archaeology" by Kwang-chih Chang, Professor of the Department of Anthropology at the Yale University in New Haven, based on Chinese archaeological material and using ethnographical analogies. Both authors furnish a series of excellent examples documenting the possibility of reconstructing the prehistoric way of life through the use of material sources. Many other American authors (e.g. Kent V. Flannery, James N. Hill, William A. Longacre, Robert Whallon Jr.) contributed to the almanac edited by Betty J. Meggers (Meggers 1968). The problem was summed up in the following books edited in the USA: the "Explanation of Archaeology. An explicitly Scientific Approach" by Patty Jo Watson, Steven A. LeBlanc and Charles L. Redman, and the "Systematics in Prehistory" by Robert C. Dunnel, Professor at the Department of Anthropology, University of Washington, and the "Introduction to Prehistory. A Systematic Approach" by Irving Rouse Professor at the Department of Anthropology, Yale University, New Haven. An important representative of the new wave is James N. Hill (Hill 1972, Hill, Evans 1972) from the Department of Anthropology, University of California, Los Angeles. His interest concentrates mainly on the explanation of changes in the social organization on the basis of archaeological data and analogies. The interesting thing is that he openly avowes materialism. He contributed also to Clarke's "Models in Archaeology". In the review of this book he was called by J.C. Gardin (Gardin 1974, 341) "the most geometrical Binfordian spirit". He edited also the almanac "Explanation of Prehistoric Change" (Hill — in preparation). The most important studies from the field of "new archaeology" in the USA were reviewed in the volume of Mark P. Leone (Leone 1972), and in the historic context they were dealt by G. Willey & J. Sabloff

in the book "A History of American Archaeology".

Professor Bruce G. Trigger (Trigger 1968) from the Department of Anthropology, McGill University, Montreal checked the competing hypotheses on materials from the pre-dynastic Egypt.

Professor John Grahame Douglas Clark (e.g. Clark 1957, 1970) has created a remarkable basis for the development of archaeology at the Cambridge University with some of his works and with his extraordinary sense for all modern trends. He inspired David L. Clarke to write his Analytical Archaeology, influencing greatly the development of archaeological thinking. Few books had such an echo in the world of archaeology (e.g. Rouse 1970. Tabaczyński, Pleszczyńska 1974).

The concept of the analytical archaeology reflects Clarke's thorough education in the natural sciences, chemistry, physics and mathematics. In his words: "Archaeology is an undisciplined empirical discipline. A discipline lacking a scheme of systematic and ordered study based upon declared and clearly defined models and rules of procedure. It further lacks a body of central theory capable of synthesizing the general regularities within its data in such a way that the unique residuals distinguishing each particular case might be quickly isolated and easily assessed. Archaeologists do not agree upon central theory, although, regardless of place, period and culture, they employ similar tacit models and procedures based upon similar and distinctive entities — the attributes, artefacts, types, assemblages, cultures and culture groups. Lacking an explicit theory defining these entities and their relationships and transformations in a viable form archaeology has remained an intuitive skill — "an inexplicit manipulative dextrity learned by pote". (Clarke 1968, XIII). Clarke's categorization of archaeological notions and the subsequent analysis and model processing are based on this critique. He does not neglect anything positive the development of mathematics or other social sciences has brought about. We meet therefore with suitable applications of numerical taxonomy, theory of games and information, location analyses, etc.

The possibilities of the "new" and "analytical" archaeologies have been explained in the volume "Models in Archaeology" edited by D.L. Clarke (Clarke 1972). It contains twenty-six articles by twenty-nine authors, mostly from Great Britain and from the USA, comprising an extensive field from the theoretical bases of archaeological explanation (Clarke, Hill), up to their application, e.g. on palaeolithic materials (Binford). These meritorius activities, enabling useful dialogue between new ideas in archaeology, are continued also by D.L. Clarke, the editor of a series of publications prepared in cooperation with the Methuen Publishing House in London. The series will become a new platform for discussing modern trends in archaeology.

D.L. Clarke concieves the socio-cultural system as a system of individuals connected through extremly complex mutual relations. Culture in Clarke's view are informations inside the system, i.e. culture is a communication system of the acquired attitudes complementing the individual's instinctive behaviour. It is composed of acquired ways of behaviour and their material manifestations, transferred by the society and by the individuals mutually. The system of culture integrates the social, psychological, linguistic, economic and material sub-systems. It alone, respectively through the sub-systems is reacting upon the environment.

Archaeology deals with the remnants of material culture (archaeological culture), studied in connection with the entire socio-cultural system. Artifacts supply us with information on perceptions, notions, activities of the originators, enabling us to express ourselves also in other sub-systems of the entire socio-cultural system.

On describing Clarke's system let us start with the archaeological entities defined by him. The basic notion is the attribute as a logically non-reducible property, acting as an independently changeable factor inside a certain system of artifacts. Artifacts are objects modified by human activities — the results of these activities are the attributes of the artifact. Type is a group of artifacts given by an identical and repeated series of attribute relations, which are always elements of a certain polythetic set. Assemblage is a combined set of current types. Archaeological culture is a polythetic set of specific types of artifacts, repeated in an identical way in the sets with the framework of a certain geographical area. It is possible to use a series of territorial cultural circles, such as sub-culture, cultural group and technical complex. These archaeological entities continuously change and the series of these continuous changes is called process. The basic processes are ontogenesis, migration and integration. The model for entities, their systems and process is a general dynamic system model, for all its levels.

The basic starting point is the theory of systems enabling the linking with other specific methods. According to Clarke each archaeological entity is a system passing through various situations at every moment of its existence. Each of these situations depends both on the previous states of the system (history of the system) and on the influence of the environment. The system reacts on each change through its regulation mechanism, so that it assumes one of the possible states of equilibrium. This overall system is composed of many sub-systems (social, economic, religious systems, etc.), each of them can be studied as a separate system and their mutual interaction forms the general system. If we do not know — or know only partially — some of the categories of a given system, we can try to reconstruct it within the notional framework. The fact that many situations can be simulated e.g. with the help of a computer, without sticking knowingly to this concept (Doran 1972), is no argument against it.

Similar tendencies are followed also by A.C. Renfrew (Renfrew 1973), Professor at the Department of Archaeology, University of Southampton, who organized a seminar at the Sheffield University — the event was attended by 84 renowned

researchers from 12 countries, including Czechoslovakia and the USSR. The seminar dealt with the explanation of cultural changes and models in prehistory. The papers read at the event were later published in abridged from in the "Explanation of Culture Change: Models in Prehistory", divided into seven sections: 1. Explanation of cultural changes, 2. Data processing and variability measuring. 3. Explanation of the variability of artifacts in Paleolithic Age, 4. Changes in settlement density, ways of alimentation and the use of soil, 5. Research of social changes, 6. Movements, trade, contacts and their impact, 7. Theory of systems, their regularity and multivariational analysis.

In Renfrew's volume appears also a lecture by Leo. S. Kleyn, Associate Professor of Archaeology at the University of A.A. Zhdanov in Leningrad, one of the most renowned Soviet experts in this field (Kleyn 1968, 1970, 1971, 1972, 1973, 1973a, Kleyn, Minyayev, Piotrovski, Kheyfets 1970). The problem is intensively studied also by Yuri Zakharukh, Deputy Director of the Archaeological Institute of the Academy of the Soviet Union in Moscow (Zakharukh 1969, 1971, 1973). The work of a team of Soviet archaeologists dealing with various problems of theory and methodology in archaeology was published in 1970 (Zasurtsev, Kargaer, Kruglikova, Praslov, Rybakov 1970). A similar work will appear in the course of 1976 in the periodical "Kratkie soobshchenyiya".

Polish researchers have also greatly contributed to the theory and methodology of archaeology, in the first place Professor Janusz K. Kozłowski (Bernhard, Kozłowski 1975, Kozłowski 1975), Instytut Archeologii, Uniwersytet Jagielloński, Kraków, Associate Profesor Tabaczyński (Tabaczyński 1964, Tabaczyński, Pleszczyńska 1974) (Zakład Epoki Metali, Instytut Historii Kultury Metarialnej PAN, Warszawa), and others (e.g. Trudzik 1965, Żak 1968).

The process of inovation in archaeology is well reflected by the excellent works of Carl-Axel Moberg (Moberg 1969, 1971, 1974, 1975), Professor of Archaeology at the Göteborg University (Institutionen för arkeologi särskilt nordeuropeisk, Göteborgs universitet, Göteborg.). His textbook "Introduktion till arkeologi" is a very important contribution to this science. Of great importance are also the studies of Berta Stjernquist (Stjernquist 1971, 1972).

Modern methods are deeply rooted also in the Turkish archaeology, as demonstrated by the "Analitik arkeoloji", edited by A.M. Dinçol and S. Kantman.

In Czechoslovakia these problems were tackled by Jan Bouzek, and Miroslav Buchvaldek (Bouzek, Buchvaldek 1971) and by the studies of Bohuslav Chropovský (Chropovský 1973, 1973a), Jiří Neústupný (Neústupný 1967, 1969, 1971), Josef Poulík (Poulík 1973) and Slavomil Vencl (Vencl 1971).

Perhaps we have been able to characterize the complex changes taking place at the present-day archaeology, causing a slow change of its entire structure. Most of these changes have stood the proof and have become organic components of modern archaeological theory and practice, others, however, were only fashionable aberrations, and others still wait for the confirmation of their usefulness and viability.

It is very natural that all new procedures and methods cannot be introduced at once. It would only increase differences and the discrepancy between various ways of processing the archaeological finds. It would not be correct to refuse all the hitherto achievements or to reprobate everything new. We must proceed slowly in the dialogue between the positive achievements of the past and between the modern currents of the present epoch.

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