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Four Topics in Archaeological Chronology*

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The introduction of archaeological chronology is one of the foundations of contemporary archaeology. The evolutionary theories of early contemporary archaeology and the study of cultural history adopt the relative chronology established by stratigraphy and seriation as the chronological basis for constructing the most fundamental framework of human prehistory. Methods of absolute dating that have been introduced since the 1950s, of which radiocarbon dating is representative, have changed our understanding of prehistoric research in many ways, and are therefore considered a milestone in archaeological chronology.^[1] Since then, relative dating, ab-

solute dating and cross-dating, the last of which is the combined use of the two preceding types of dating, have been a part of archaeological chronology. Thus far, apart from such minute improvements as the calibration of radiocarbon dates with dendrochronology and the introduction of AMS dating, little progress has been made in these two types of dating compared to the rapid development of many other methods of research in archaeology. If another revolution in archaeology is to be hoped for, it is imperative to advance methods of archaeological dating that cater to the growing needs of archaeology, since even under the current system of archaeological chronology, there are topics that need to be further addressed. By way of illustration, this article elaborates on four of these topics.

RELATIVE CHRONOLOGY AND ABSOLUTE CHRONOLOGY

There are two ways to express chronology in history and archaeology. One is relative dating, which refers to the relative association of events in time; it

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serves only to reveal the chronological order, not the duration of time. The other is absolute dating; it is the numerical age obtained by calculating the rate of change of objects; it is also called quantitative dating. In most cases, quantitative dating is measured in the commonly used solar year. Most Chinese and foreign archaeological textbooks categorize the various methods of chronology used in archaeology into these two types of dating.^[2] The widely referenced *Archaeology: Theories, Methods and Practice* classifies stratigraphy, typological sequences and climate and chronology as relative dating methods, and calendars and historical chronologies, annual cycles (tree-rings and varves), radiocarbon dating and calibrated relative methods as absolute dating. However, since the application of each dating method in archaeology varies and has different limitations, the time scales differing accordingly, it is difficult to group these methods precisely into two categories.

Judging by the chronological precision and the time scale provided by each of the dating techniques, historical chronology is the only method that is accurate as to the date and time, while dendrochronology and dating by varves are the only techniques that provide an exact time and a yearly time scale. Other techniques that have been classified as absolute dating, such as radiocarbon dating and methods of calibration, provide only a time bracket. Among them, radiocarbon dating provides the smallest time bracket, with an error margin of approximately ± 30 years. Using radiocarbon dating alone, however, cannot provide a sufficiently precise date; to pinpoint the intervals within a solar year, the radiocarbon date has to be calibrated with dates from techniques that provide a precise chronology, such as the dating of tree rings or coral. But even with such calibration, there can still be systematic errors. Thus, even though modern scientific techniques can offer precision to the degree of an annual time scale, they still cannot provide accurate chronological measurements of smaller time scales.

Seriation, which is commonly classified as a method of relative dating, can provide not only relative chronological sequences but also varied time intervals, with the smallest being 20 years.^[3] This level of accuracy is comparable to what is offered by radiocarbon dating. When calibrated with historical chronology, this method can even pinpoint the exact calendar year, providing an absolute date.^[4] In fact, objects also experience a certain rate of change, but this rate is uneven since it varies according to diverse social, economic and cultural influences, making a specific object's rate of change difficult to determine. From the perspective of object change, humans, who are comparatively short-lived, are more attuned to the seasonal cycles of the solar year and are less aware of long-term changes in objects. However, researchers who have long studied the chronology of objects (cultural chronology) are cognizant of the time scale of object change and can often discern gaps in the chronological sequence of objects.^[5] In this regard, seriation is a method that embodies the meaning of absolute dating, at least when compared to such modern scientific techniques of dating as radiocarbon dating. It differs only in terms of chronological precision, and not in terms of the difference between relative and absolute chronology.

Perhaps the most meaningful relative chronology can be obtained only through Quaternary chronostratigraphy and archaeological stratigraphy, but that only applies when one is dealing with research into early history or with simple geological sequences. In the study of Quaternary geological deposits, it has long been noted that dating by varves is accurate to the solar year; similar patterns of annual periodicity also occur in deep sea sediments, ice cores, lake sediments, and loess in certain areas and for certain periods of time. The deposits archaeological stratigraphy considers can also offer a time scale, especially when changes in deposits are examined in broad spatial contexts. This is because archaeological stratigraphy studies deposits that have a physical form

and contain cultural contents. The deposits cannot merely be explained by the laws of superposition and crosscutting relationships. From the perspective of research in settlement archaeology, all anthropogenic deposits are archaeological features that have form and cultural content, making them objects of interest in typological studies. Thus, archaeological deposits alone can be used to establish chronological order and intervals of time. Climatic phases established by the dating of plants and animals are based on morphological changes in living organisms, and at times can be used to construct time intervals. Evolutionary changes in the DNA of living organisms, for one, are of particular significance to large-scale cross-distance dating. The rate of cell division in humans has been used to calculate age, which is consistent with the concept of absolute chronology.

The aim of discussing relative chronology and absolute chronology from this perspective is not to divulge the relativism embedded in archaeological chronology but to illustrate the temporality of each of the methods of archaeological chronology, and to show how better precision is gradually mitigating the polarity between absolute chronology and relative chronology. There are countless events in the archaeological record, and many among them are of little concern to us or of little relevance to our current research, but among those that we pay attention to, there is the problem of uneven durations. Based on the effectiveness of the use of archaeological chronology, the temporality of long-term events, from climatic cycles to cultural change, is the easiest to define, and most types of chronology are able to fulfill research requirements. But certain short-lived and instantaneous events, especially those in prehistory, cannot be dated. The ability to obtain the smallest time scale and the most precise date is something perpetually pursued in archaeology.

Some textbooks not only distinguish relative chronology from absolute chronology but also further categorize chronology into archaeological

periodization, geological and geochemical dating, floral and faunal dating, radiometric chronology, archaeomagnetic dating, historical chronology, and experimental methods. Their classification, however, only discriminates between materials used for dating and does not highlight the characteristics of these dating methods.

Furthermore, from the perspective of materials used for dating, most methods provide the date of the artifact or geofact; only a few provide dates for the formation or the burial of the deposit, both of which can be dated by relative and absolute methods. As well, among the many methods used for dating archaeological objects, some provide the time of their deaths (or interments), whereas others provide the lifespan. Take radiocarbon dating and seriation, for example: the former provides the time of death of short-lived organisms as well as the lifespan of long-lived organisms (which are mainly trees), whereas the latter can only provide the period of development of objects' physical forms – that is, the lifespan of a particular type of object. Even though the most commonly used method of radiocarbon dating is, at any rate, more accurate than any systems of seriation, every date it assigns only applies to a particular sample, and cannot be used to date other samples by correlation. New carbon samples must be separately dated. Seriation is, however, different. Once the time period of a particular type of object is known, the date of objects of the same type can be deduced. This applies also to new discoveries of similar objects. Seriation also provides a chronological sequence for a type or a group of objects. Thus, even though one dating method cannot be substituted for another because each method is unique and there are varied requirements for dating in archaeology, the most broadly used method is still seriation.

Among the many dating methods, the ones based on the rates of change of natural deposits are founded on the laws of physics, chemistry, geology and biology, and since they are often measured by



a single variable, they are easily controlled. There are still limitations on the relative degree of precision, but at least we are already aware, or can expect to identify the cause, of the deficiency. The method of seriation based on changes in cultural remains is more complex because it is a process of comparison among many variables; whether changes can be dated and whether there is a pattern of change have remained contentious issues. The principles of dating need to be further investigated.

CULTURAL CHRONOLOGY AND SEQUENCE DATING

The earliest relative chronology used in archaeology is periodization, which is represented by the three-age system devised by Danish archaeologist Christian Jürgensen Thomsen, who divided the pre-history of Europe into the Stone Age, the Bronze Age and the Iron Age. Later scholars, including John Lubbock, subdivided the periods into the Paleolithic, the Mesolithic, the Neolithic, the Chalcolithic, the Bronze Age and the Iron Age.^[6] This was then further divided into the early, middle and late periods of the Paleolithic, and the early, middle and late periods of the Neolithic. These systems of periodization formed the basis of evolutionary archaeology. After the emergence of cultural history research, time periods came to be further divided into cultures, cultures of different time periods, and geographical origins, giving rise to cultural periods and eras. The resulting chronology composed of eras, periods, cultures and cultural divisions has become the commonly used system of relative chronology in archaeology, which is referred to as cultural chronology.

As mentioned above, there are varied requirements for dating in archaeological research, and cultural chronology fulfills one of the basic needs. Relative chronology in archaeology, which uses periods and cultures as frameworks, is based on the classification of changes of objects (and at times, structural remains) through time. The characteristics of these

objects produced by humans typically have global or at least continental (such as Old World, New World) patterns of change, and so can be divided into periods and ages. Some objects, however, are only found in smaller regions and so experience only localized patterns of change, and these objects can only be divided into cultures and cultural periods. This is the basic principle of cultural chronology, which is, in fact, a preliminary reflection of the multidimensional, multivariable characteristics of dating objects. Further research may allow even finer divisions within the cultural periods, which in Chinese archaeology are termed subcultures or sub-periods, by introducing more changing variables of the objects (which are most often pottery).

Archaeology: Theories, Methods and Practice, summarizing the principles of relative chronology as applied in typology, posits that dating by way of typological sequences has two implications. First, products of a given period and place have a recognizable style, and individual objects can be classified by their style and arranged within a typological sequence. Second, the change in style is gradual and, thus, similar objects have similar dates. Furthermore, the rate of change is different for different objects.^[7] In fact, the fundamental premise of typology is that objects are perpetually in a state of flux, which allows them to be arranged chronologically. There is already a lot of discussion in Chinese typological studies on why objects change and why objects of a similar style are produced in similar time periods.^[8] The aforementioned principles are currently recognized as the basis for cultural chronology within academia.

What is more, there are two contested or yet-to-be defined principles. First is the assumption that objects evolve from simple to complex, and this principle was widely applied in early studies of typology, such as in the six-age theory of ancient cultures in Gansu Province proposed by Andersson, and in his belief that pottery of the Qijia culture was of an early age due to its simple design.^[9] In more recent

years, even though such simplistic applications of the principle as the six-age theory have been rectified, researchers have operated under the assumption that the age of an object cannot be determined simply by the complexity of its form. Nevertheless, this principle can, in fact, still be considered valid, so long as the conditions are further defined, since, over the long term, objects do evolve from simple to complex. Second is the stipulation, fundamental to the method of frequency seriation commonly used in Western archaeological traditions, that from their inception to their disappearance, objects follow a sequence from few to many, then from many to few.^[10] If this principle of frequency seriation is valid, it is relatively more objective as it is based on the measurement of quantity, which lessens the degree of subjective bias. However, this method has not been used in the field of Chinese archaeological research. Even if it is seriously considered, the application may not be universal, and may be limited to particular conditions.

If the “evolution” of objects in global or continental contexts indicates the change of eras, stylistic changes can be used to classify objects into chronological periods. The different designs of assemblages from different regions represent changes in archaeological culture; that is, an overall change in the assemblage signals a change in culture. Even without a complete change, stylistic changes in an assemblage, or in many object types within an assemblage, can permit division of the objects into cultural periods. The relationship between assemblages of the same style and of different styles forms the basis of cultural chronology on regional and global scales. In terms of time measurement, periods, ages and cultures are calculated in thousands and tens of thousands of years, and cultural periods are usually measured in hundreds of years. On this basis, the relative chronology of objects can be further divided into smaller units of time measurement.

Objects with different forms, textures and decoration have different rates of change. Different ob-

jects produce different intervals, and the ones with the fastest rate of change produce the most precise time scale. Wenming Yan refers to these objects as the standard forms or archetypes.^[11] He thinks that between durable and nondurable, prestige and ordinary, and simple and intricate shapes and motifs, the archetype would clearly be nondurable, ordinary and intricate. This is because nondurable ordinary objects are more likely to be damaged, and intricate designs are difficult to replicate, so that these objects experience a faster rate of change. In Chinese archaeological chronology, using these archetypes to divide time is called periodization. Based on examples in the reference cited above, the interval obtained using archetypes can reach a timescale of 20 years. In the case of the practice of Chinese archaeological chronology, the Yin ruins of the late Shang dynasty can be divided into four periods based on the changes in *li*-tripods, which produces a time scale measuring between 60 and 70 years.^[12]

Using seriation from typology, cultural chronology attains multiple measures of time – era, period, culture, cultural period and time period – to meet the various requirements of archaeological research. Seriation interprets changes in objects from multiple perspectives, and is applied to many aspects of archaeological research.^[13] Therefore, from the perspective of accounting for changes in objects through time, typological sequencing is also referred to as seriation or chronological sequencing. The reason the “science” of seriation is inferior to dating methods using natural remains such as radiocarbon dating is because the materials studied by seriation are not as homogeneous as those of natural remains; rather, objects are multidimensional. Take pottery, for example: its attributes include raw material, temper, production method, vessel type, shape, finishing, decoration, firing and restoration. The combination of these attributes and their correlation provide means for verification. Thus, seriation also has its own scientific significance.



Like in radiocarbon dating, where for various reasons different laboratories may provide different dates and intervals for the same sample, dates based on object evolution can vary among researchers because changes in assemblages and objects are influenced by many factors. Some changes follow a clear pattern, but other changes depend on the objects' makers and do not follow a regular pattern, which can mean that the changes in objects relevant to dating are not always distinguishable. How any period gets divided may also depend on the perspective of a given researcher, different researchers having varied ways of dividing cultures, cultural periods and cultural phases, even for the same assemblage. A nearly unanimous recognition of chronologies, like that seen with the chronology of the Yin ruins, is rare. The current state of research shows that there are countless systems of cultural division and cultural periodization in Chinese archaeology, especially of the Neolithic period, with almost no two researchers sharing the same view. Leaving aside debates over cultural components, however, many systems of division are in fact very similar, especially when addressing long-term trends, though many classifications remain highly disputed. If, on the one hand, changes in objects were regular, dating by seriation would not produce ambiguous dates. If, on the other hand, changes were irregular, not following a set pattern, this sort of dating would be meaningless, offering no consistency for the study of chronology. The current state of research clearly does not show either of these extremes to be typical. Reasons for disagreement on dating by this method stem not only from the presence of non-regular factors but also from the lack of corroborative evidence for periodization.

LAWS OF STRATIGRAPHY, ASSOCIATION AND TIME CAPSULES

Even though some researchers think chronological sequences can be constructed using objects only, without referring to the contexts of deposits,

all archaeological materials do have an excavation context, and artifacts are unearthed from excavation units. Artifacts are unearthed from stratified archaeological sites; this provides seriation with two other important variables for using artifacts as proxies for time measurement: first, the stratum where the artifact is uncovered indicates its chronological relationship with other strata; second, the co-occurrence of artifacts in the excavation unit demonstrates the contemporaneity of objects and assemblages. These two variables are used to corroborate the cultural chronology established by seriation.

The chronological relationship provided by stratigraphy refers to patterns of superposition and the lateral continuity between archaeological layers of deposit. In ideal situations, these superimposed and crosscut layers follow a chronological order,^[14] but since complete and unbroken sequences of superposition and crosscutting are not revealed in an archaeological excavation, we can only observe strata that are chronologically connected. This, however, does not mean that the interval between strata is not known. In the case of stratigraphy between fairly simple archaeological deposits, without information on the nature of the deposits, there is little indication of the length of the interval. As mentioned in the first section, however, if the area exposed is relatively large, we can still infer the interval between artifacts by studying the nature of the stratified deposits. For example, the interval between settlement artifacts that indicate a change in settlement pattern tends to be larger, whereas the interval between crosscutting burials located within the confined space of a cemetery with continuous burials is not long. The stratigraphic relationships between archaeological deposits can provide temporal indexes for seriation, thereby facilitating the understanding of the temporality of artifacts retrieved from these contexts.

Another temporal dimension that needs to be considered in the laws of stratigraphy is co-occurrence. Previously, the author has discussed how ex-

aming stratigraphic relationships of superposition, crosscutting and co-occurrence in the same stratum and even occupation surface alone does not suffice to establish the association between different assemblages.^[15] Co-occurrence is not about the position in the chronological sequence, nor is it related to the interval and temporal span: it is about the structural temporality between things, and refers to the concurrency of structural correlations between archaeological deposits. This structural relationship is in fact what settlement archaeology studies; it aims to examine the relationship between archaeological deposits through the morphology, function and distribution of archaeological deposits, so that deposits can manifest the temporality of intervals. And in the practice of seriation, the association between artifacts from different assemblages needs to be considered. Thus, an examination of the association between assemblages can help us understand the chronological relationship between artifacts.

Objects from the same deposit or excavation unit are derived from the same context. This shared context indicates that objects were deposited in the excavation unit concurrently, but it does not suggest they were produced at the same time. Because various properties of artifacts are determined during production, and because seriation relies on precisely the properties of artifacts originating during production, there is a time difference between the creation of the artifacts and their burial in the excavation unit. This time difference may be small, in cases where an object was buried right after it was made, but it may also be large, extending over as many as thousands of years, spanning multiple eras. Another complication is that the time it took to produce each artifact found in the same excavation unit may have been different, and such is most commonly the case. As well, sites with recurrent deposits are prevalent in China and in the homelands of other ancient civilizations. Under this circumstance, were we to indiscriminately assume the co-occurrence of artifacts from the same

excavation unit, then by way of lateral connection, co-occurring artifacts – the same type of artifacts discovered in different excavation units^[16] – would provide evidence for the contemporaneity of different loci, causing us to conclude that perhaps all artifacts co-occur.

The co-occurrence of artifacts in the same excavation unit is seldom discussed in Western archaeological textbooks, and it may be related to the fact that there are few complex archaeological deposits in Europe and North America. In order to prevent the above situation from happening, in implementing the method of seriation in Chinese archaeology, first, objects used for sequencing must come from typical units of excavation. Wenming Yan thinks these typical excavation units are those created by a one-time depositional event, such as burials and vaults, and secondarily, ash pits, storage pits and wells, etc. Even though these features would have been gradually filled, which would typically have taken a long time, the degree of co-occurrence in normal stratigraphical deposits is relatively poor.^[17] At sites with multi-period deposits, earlier and lower layers may be crosscut by later activities, resulting in artifacts from earlier periods being deposited in units of later periods. Therefore, theoretically, at a given site the contemporaneity of artifacts in later period matrices is often dubious, whereas that of artifacts in earlier matrices, especially in the earliest matrices, is reliable, because earlier deposits do not contain artifacts of later periods. To resolve the occurrence of artifacts of mixed provenance in later deposits, artifacts from earlier deposits can be used to distinguish artifacts in the later deposits, thereby identifying those that may have been relocated to later deposits due to disturbances. The remaining artifacts in the later deposit can then be dated to the same period. The same situation also occurs between different sites, in which case artifacts from simple deposits should be used to distinguish artifacts from complex deposits. Furthermore, co-occurrence, that is, the contempo-



raneity between artifacts in the excavation unit, has to be substantiated by recurrent cases.

In short, the so-called typical locus has two attributes: first, it is the lowest layer at the site; second, it is accumulated from a rapid, one-time depositional event. These typical loci provide the smallest temporal scale for contemporaneous objects and minimize to the fullest extent the temporal distance between the time the objects took shape and the time when the objects were buried in a single locus, thus minimizing the time difference of the burial process. Under this circumstance, from the perspective of the timescale of the artifacts in the locus, this stratum or locus can also be defined by an existing concept, which is the time capsule.^[18] A time capsule can be used to discriminate between artifacts that have been discovered in the same context for various reasons but were created and buried at different times. The recurrent verification of the stratigraphical relationship between the time capsule and the approved loci can best attest to the chronological order established by periodization to promote a common understanding of the cultural chronology.

Time capsules can also provide support for other dating methods. For example, in many cases, acquiring the date of the tested material is not the sole objective of absolute dating (especially radiocarbon dating). It aims also to understand the date of the locus in which the tested material is found and the date of other remains therein. In practice, it is common to find discrepancies and an inverted relationship between the stratigraphy and the series of radiocarbon dates from the stratified contexts. If we exclude the problem of the timespan of the radiocarbon-dated material, the main causes of the discrepancy would be that the sample has an unknown provenance and that earlier samples have been mixed into later loci. Once the dates of a series of samples are found to be inverted, even though the dates are not wrong, identifying which locus the samples belong to becomes a problem. Therefore, samples with reliable

contexts that are used for absolute dating should be retrieved from loci of time-capsule significance. Because samples used for Carbon-14 dating cannot be compared the same way the properties of objects are compared, that is, by using objects in a time capsule to identify the same type of objects in other loci, time capsules are considered less useful than objects for samples of radiocarbon dating. Following this logic, radiocarbon samples retrieved from the surface of objects would, in such cases, be especially significant. This would then be considered the chronological method of cross-dating.

CROSS-DATING AND HISTORICAL CHRONOLOGY

It is commonly held that cross-dating was devised by English Egyptologist Flinders Petrie, and that it was first applied to seriation from regions with unknown cultures by comparing them to areas with established cultural chronologies, in order to establish a system of chronology for those unknown regions.^[19] Thereafter, it was extended to calibrating uncertain chronologies with accurate systems of chronology; it was also extended to comparisons between two or more methods of chronology. In this discussion, the broadest definition is adopted. This definition describes cross-dating as the integration of two or more methods of archaeological chronology, or the using of more accurate methods to calibrate less accurate methods, or the using of one method to complement the other to increase dating precision and testable timespan. This is not limited to cross-dating between relative and absolute methods of dating, but aims for calibrations between different systems of chronology.

In the absence of breakthroughs in methods of archaeological chronology, the key to obtaining more precise archaeological dates or longer spans of chronology, be it for absolute dating or relative dating, is to cross-date with two or more methods. In absolute dating, there are already methods, such

as dendrochronology and coral dating, that can provide dates accurate to the year, and which have been successfully used to calibrate Carbon-14 dates. Not only does cross-dating enhance the precision of radiocarbon dating but it also extends the span of chronology to beyond 10,000 YBP (years before present), something not achievable through dendrochronology alone. Dendrochronology can be used to finely calibrate radiocarbon dates until 10,000 YBP; samples older than 10,000 years can be calibrated with uranium-thorium dating of corals. Since dendrochronology can provide intervals accurate to the year, radiocarbon dates calibrated by dendrochronology are doubly verified and are theoretically reliable; this is why this form of cross-dating is referred to as the “second radiocarbon revolution.”^[20] New methods of dating that have been introduced by modern science include obsidian-hydration dating, archaeomagnetic dating and amino-acid dating, all of which are scientific methods of cross-dating that use absolute dates to calibrate relative dates.

Among traditional methods of relative dating, the commonly used seriation is itself a cross-dating of seriation (typology) and stratigraphy. It not only lays out big temporal changes like what is addressed by the three-age theory, but it can also subdivide eras and archaeological cultures. Using archetypes as a standard of measure, it can further delineate cultural periods and eras. The archaeology of the Shang and Zhou dynasties is an example of the use of historical chronology for cross-dating to reconstruct cultural period (era) accurate to the year. The cultural period is measured in 60 year timespans, even in 20 year spans in Western cases, which means it is almost as precise as radiocarbon dating.

Stratigraphic cross-dating can be further utilized. Because Quaternary stratigraphy intersects with archaeological layers, the connection between regional geological layers and archaeological cultural deposits serves to bring about breakthroughs in relative chronology. Tephrochronology synchronizes

layers of volcanic ash with deep-sea sediments and varves to offer cross-regional comparisons across long distances. Synchronizing volcanic ash layers with archaeological deposits or dendrochronology can produce dates accurate to the year after cross-dating with historical chronology and tree rings.^[21] Archaeological stratigraphy originally concerned itself with the archaeological deposits of a site, without consideration for the measurement of time. Interpreting archaeological deposits from the perspective of settlement archaeology, however, the contemporaneity of deposits can be established through their association on site, and intervals between changes in the deposit can be deduced from changes in the settlement pattern. As well, large-scale changes of contemporaneous settlements can help establish the relationship between the changes in deposits at different sites.

The archaeological chronology built on cross-dating methods is the most complex. The Chinese Neolithic, for example, is the result of the triple cross-dating of at least four systems of chronology, namely, the cultural chronology from the cross-dating of seriation and stratigraphy, the absolute chronology from radiocarbon dating and dendrochronology, and the cross-dating of these two results. Among them, there is little to be said about the calibration of radiocarbon dates by dendrochronology; as for cultural chronology, as previously discussed, its smallest possible timescale, which is comparable to that of radiocarbon dating, can be obtained by integrating time capsules with archetypes. There are, however, still many problems concerning the cross-dating of radiocarbon data and cultural chronology, which is the very dating method most used in prehistoric and protohistoric archaeology. Cultural chronology is different from radiocarbon dating in that the time bracket provided by radiocarbon dating is fixed, whereas the timescale of cultural chronology varies according to the time span of change in the archetypes. Radiocarbon dates are positioned within existing chronological sequences, whereas cultural



chronology obtains its approximate temporal scope only after the entire system of chronology is established for the region. Thus, cultural chronology and radiocarbon dating play different roles in different periods of the archaeological chronology. This also involves a related issue, namely, the source of the samples and the matching of seriation.

The use of cultural chronology and radiocarbon dates in the practice of archaeological chronology has caused great controversy in the Xia-Shang-Zhou Chronology Project, and this controversy remains unresolved.^[22] Leaving aside the issue of whether the chronological divides between the Xia and Shang dynasties and between the Shang and Zhou dynasties can be identified in the archaeological record, and the issue of whether pottery chronology can be associated with significant historical events such as the Battle of Muye [where King Wu of Zhou attacked King Zhou of Shang], it is difficult to even just cross-date based on changes in the pottery types of the protohistoric period of Shang-Zhou. Take the case of the Shang-Zhou pottery archetype of the *li*-tripod: the interval of its evolution can be measured in spans of approximately 60 years. Radiocarbon dating provides a similar result that is no better than the timescale offered by pottery typology. Even if cross-referencing and comparisons can be used to establish the temporal scope for cultural chronology, it is still difficult to determine the provenance of a given sample and to pinpoint the sample within the 60-year bracket of change. This difficulty can ultimately lead to incompatibility among data sets. In the archaeology of the Chinese Neolithic, the common resolution is to adopt the earliest and the latest Carbon-14 dates within a single cultural period as the temporal limits of this period. There is also no basis to this method because, without evidence of association between these dated samples and the pottery, their co-occurrence within the deposit does not necessarily corroborate the claim that the sample is contemporaneous with changes in the pottery. Not

even so-called serial samples^[23] can resolve this kind of problem.^[24]

Therefore, in the archaeological chronology of the late Neolithic and protohistoric periods, due to the appearance of archetypes constituting a fine timescale, one that is comparable to the interval provided by radiocarbon dates, the purpose of cross-dating becomes the dating of the chronology. In the absence of better dating methods at this time, devising cross-dating methods with close reference to principles of cultural chronology is the way to guarantee results.

For example, even though it is difficult to locate the beginning and ending years of a particular pottery type (archetype), it is not entirely impossible, but it requires a good scheme and materials. The key issue is how to determine whether the form of a given pottery vessel represents its initial type. Clues may be found in certain time capsules. For instance, because funerary replicas from “real-life” originals [*mingqi*] are frequently found in burials, the production of these funerary replicas should be concurrent with the deceased’s time of death, and the date of the funerary replicas can be obtained by dating the age of the deceased. Well-planned burials of multiple periods may be found in large cemeteries, the order of which can even be discerned at times. It may be possible to resolve the problem of precise dating in cultural chronology through multiple cross-dating by means of time capsules, typological chronology, burial order and radiocarbon dating. To obtain relatively reliable absolute dates for typologies from settlement contexts, we may also have to rely on such complex methods of cross-dating.

In ideal situations, such complex cross-dating may be possible. Even in such cases, however, the degree of time precision required by the Xia-Shang-Zhou Chronology Project still cannot be attained. Such complex cross-dating, however, may increase the precision of the cross-dated chronology of the late Neolithic period. Before the appearance of complex archetypes, because the timescale of pot-

tery chronology has a long span, date determinations are more ambiguous. Given a cultural chronology that is also not perfected, the result of cross-dating can still be considered significant so long as it can be confirmed that the sample is of the same provenance as the object, even without a well-designed technical direction for cross-dating. There are examples of tracing the provenance of the samples of deposits using sediment micromorphology in the research of the absolute chronology of early pottery.^[25] In current research it is clear that the older the period, the greater the importance of cross-dating. But no matter the time period, the only way to obtain a satisfactory archaeological chronology is to continually devise ideal techniques and methods of cross-dating that comply with the principles of cultural chronology and stratigraphy in order to perfect the chronology for the site and the region.

There are many methods in archaeological chronology, each with its own merits and weaknesses, and one cannot replace another. Even though these methods may generally be classified as relative chronology or absolute chronology, no method, with the exception of historical chronology and dendrochronology, can produce results that establish a definite absolute chronology or a definite relative chronology. Methods of dating generally classified as absolute chronology are mostly derived from the

temporal changes of a single variable, which makes it easy to account for variance and errors, whereas methods classified as relative chronology that date the changes in the cultural remains are multivariate dating methods. The principles of the latter have not been fully understood, thus conclusions can be heavily subjective. Among the many methods of dating, the commonly used cultural chronology can provide various time scales – epoch, culture and cultural period (era) – through cross-dating the chronologies of sequence dating and stratigraphy. Using archetypes in time capsules allows the time scale to be fine-tuned to a level comparable to the results of radiocarbon dating. The definite path to advancing the science of this dating method is the comprehension and repeated verification of cultural chronology through the relationship between time capsules and stratigraphy. Archaeological chronology mostly adopts more than two methods of cross-dating in its practice in order to compensate for deficiencies in each method. The historical chronology for archaeology even uses at least four or five methods of cross-dating. A precise historical chronology relies even more on a dating program based on a close correspondence of cultural chronology and radiocarbon dating. Before new methods of dating are discovered, devising stringent cross-dating methods may be one way to continually improve accuracy in archaeological chronology.

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