MANUAL ON THE TECHNIQUE OF ARCHÆOLOGICAL EXCAVATIONS

INTERNATIONAL MUSEUMS OFFICE

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EDITORIAL COMMITTEE

INTRODUCTION

In presenting this manual on the technique of excavations, in which the principal methods that have proved their value in archæological research in the field are explained, we fully realise that such a manual would fall short of its purpose if no mention were made of what might be called the excavator's mission. *Professional excavators know very well that when they undertake excavation operations—which differ from biological or chemical research, for example, where experiments can be repeated, for biological and chemical materials are constantly renewed and always available—they are opening up tangible evidence, which, once it has been brought to light, layer by layer, will forever be lost for subsequent research in the conditions in which it was found at the time of the initial investigation. This observation is, in itself, sufficient to emphasise the very heavy responsibility devolving on the scholar who undertakes the task of extricating and examining this evidence. The authors of this work have, however, several times drawn attention to this responsibility in their description of a given method of unearthing or preserving archæological documents; neither has this factor been overlooked in the analysis of, and commentaries on, the various legislative texts published in another volume and to which it would be superfluous to refer again.*

In this manual, however, the human and psychological aspect of the excavator's mission could not be dealt with other than by incidental remarks.

In the majority of cases, archæological expeditions, like geographical and, more particularly, ethnographical exploration expeditions, are obliged to come into contact with the inhabitants of the region in which they pursue their investigations. There is no need to dwell on the fact that the excavator will find it to his advantage to win and secure the confidence of the native populations, if he has not already been prompted to do so naturally from purely human motives. Previous knowledge of the customs and habits of the natives is therefore indispensable for the successful carrying through of operations and the excavator should make a point of initiating himself to these characteristics by consulting the records of explorers and ethnographers who have already worked in the region to be studied. It would be vain and presumptious to lay down a sort of code of savoir-vivre, *and yet experience goes to prove that many errors and disappointments have been avoided when the*

excavator was careful to do nothing that would clash with native usage, when he has made an effort to maintain friendly relations not only with the official authorities, but also with the persons for whom the local inhabitants have the greatest esteem—the schoolmaster, priest, mayor, doctor, etc., according to the region considered.

This good understanding will not only facilitate the material organisation of the operations and the recruiting of labour, and help to give the heads of the expedition the authority they require—results which are already appreciable—but, very often, the archæologist will, in his dealings with the natives, also be able to glean extremely valuable information on the past history of the locality, on its traditions and customs, traces of which may be found in the objects brought to light in the course of his excacations and thus contribute to their interpretation.

And this is not all. An excavator is sometimes called upon to pursue his investigations in a region which is sacred to the native population and where excavation work might be regarded as a sacrilege. If he has taken the trouble to make the natives understand the aim and meaning of his work—very often a difficult task—he will be able to persuade them that his investigations are not sacrilegious but really constitute the respectful study of their history and of their own past. In this connection—for this is one of the most delicate problems with which the excavator will be faced—it is all a matter of tact, perspicacity and, above all, patience. But it is also on this point that the mission of the excavator reconciles the demands of science with his responsibilities as an educator. Moreover, he may perhaps draw some useful conclusions from the experience of those explorers who were not content to collect data, but who endeavoured to bring to the regions which they explored in the name of science the benefits which they in their turn might derive from such a contact with the civilised world.

The significance of these relations between the excavator and the population indeed outweighs the interest attaching to the satisfactory development of the work undertaken by an expedition: they may be a determining factor in the subsequent preservation of the archæological documents discovered. We here touch upon a new aspect of the excavator's mission, and by no means the least important, namely his educational mission in the enhancement of the vestiges of bygone civilisations. Besides the material precautions which he must take to ensure the preservation of such objects as cannot be removed from the site, he will have to satisfy himself that these objects will later be protected against wilful damage and respected by the local inhabitants. In paving the way for this moral safeguard, the excavator must use every possible means to bring home to the natives the value represented by these

tokens of their past, which are entitled to the same reverent respect as their own beliefs and traditions.

This is a delicate and complex task, one that is sometimes difficult to reconcile with the scientific aims of the expedition, which involve to a certain extent the destruction or removal of these historic records. There is, however, one point on which the education of the public and the practice of archæology coincide: the reconditioning of archæological groups and the conservancy of excavation sites. Any measures which tend to give an explored site an intelligible appearance, a rationally organised aspect, help to make it a valuable document for science and a place where the public will be able to study the history of the culture of those who inhabited it in the past.

Lastly, the respect for the material evidence of former civilisations, such as the excavator will have succeeded in instilling into the mind of his native assistants whose confidence he has won, will help to facilitate the supervision of the objects discovered. No supervision, however constant and stringent it may be, can prevent the theft of objects if there is no mutual confidence between the excavator and the local inhabitants. And, in spite of the abuses that may be committed, it is easy to understand why a number of archæological expeditions have been obliged to consider the system of rewards in order that the workmen may be directly interested in the material respect for finds. As will be noted later, for example in the chapter on the organisation of field services, these rewards should, however, be kept within reasonable limits in order that the workmen may not be encouraged to display excessive and often dangerous zeal, too exclusively directed towards the recovery of objects, to the detriment of other data which can be extricated only by persevering and scrupulously careful efforts.

Employment and rational remuneration, however, are not the only material benefits that the native population can receive at the hands of the excavator. Very often, the requirements to be met in the matter of equipping excavation sites,— means of access, water supply, etc.,— may represent appreciable and lasting advantages to the natives. When drawing up his plans and estimates, the excavator will therefore be well-advised to examine the possibility of reconciling these requirements with an improvement of the economic conditions of the region.

Such are the main points to which it seemed desirable to draw attention with regard to the relations between the excavator and the native population.

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The organisation of an excavation site for the purposes of research and the education of the public is dealt with in a special chapter of the manual. In this general

introductory survey, however, it may not perhaps be inappropriate to establish a closer relationship than was possible in the methodical part of this volume, first of all between the systematic laying out of explored areas and the actual technique of excavations. The restoring of an excavation site to its original state with the idea of facilitating future investigations and also of guiding the public as to the meaning and intentions of the work already accomplished constitutes an international obligation to which all conscientious excavators will readily subscribe. But this "finishing touch" given to a site will fail to satisfy the requirements of subsequent investigations if during the whole of the operations the head of the expedition has not already borne constantly in mind the ultimate destination and future use of the area he has explored. The reconditioning of the site will also be largely facilitated if the excavator makes all necessary provision for this in the procedure which he adopts for his excavation work.

Reference to the application of such a principle brings us to another aspect of the excavator's mission and of his responsibilities that lie far beyond the specific confines of a site and the question of setting it in order for future exploration. At the same time, we approach the capital problem of the professional training of excavators.

The international adoption of a method of excavation will not only facilitate future research in the explored area but will also make it possible to draw far more fruitful comparisons with other areas studied under the same conditions, for the advancement of archæological science. The essential aim which should predominate in all field research is, indeed, to extract certain data which can be used not only for determining the history of the bed subjected to analysis and for assembling corroborative documents, but also and chiefly for adding a stone to that far vaster edifice represented by archæological science and the history of world civilisation. The services which the director of an excavation expedition, who is naturally inclined to allow himself to be guided by his own speciality, renders to the progress of archæological science are commensurate with the extent to which he can sacrifice his personal ideas for the higher interests of research. If he conforms strictly to a method the essential elements of which are internationally applied, all the specific data which he deduces will, in addition to their intrinsic value, assume the weight of factors of comparison for the consideration of information collected on other sites and by the same methods. International discipline is no doubt more difficult to enforce in the sphere of archæological research than in many other sciences, owing to the variety of the objects dealt with, the special conditions of habitat, soil, vegetation, geographical features of the region, etc. The experts who attended the International Conference at Cairo were, however, of the opinion that the difficulties were amply

compensated by the advantages that would be derived from the comparative study of documents and sites. The authors of the manual, therefore, without claiming to establish an infallible doctrine, have wished to place at the disposal of the professional excavator a guide and a series of principles the adoption of which would facilitate that wide collaboration so desirable between researchers. It was, moreover, this same aim which actuated them in the study of the various legislations and in the formulation of the recommendations deduced from them—safeguarding of the interests of science, a certain uniformity in the duties assigned to excavators and to the country on whose territory excavations are carried out—in order to facilitate international collaboration and to promote exchanges, not only with regard to experts and personnel but also with regard to documentary material.

This balance which must necessarily be established between the study of a given site and the contribution made to the progress of research in general should also govern the contributions made by the different sciences—ethnography, philology, natural history, physics, chemistry and technology—all of which are, in varying degrees, called upon to second archæological science in field research. The share and nature of these contributions, which are defined in the various chapters of the manual, consequently demand that the director of any excavation operations should have a sufficiently eclectic training, if only to assist him in choosing his collaborators wisely. If it is desirable that he should be a specialist in one or other branch of archæological science, it is no less important that he should be capable of coping with every kind of problem whose solution will require his scientific, technical and administrative competence.

There is another point which merits special mention, namely, the museographical aspect of excavation work. It is a well-known fact that most of the finds are ultimately incorporated in systematic collections—public collections or study collections. In many cases, however, it has been necessary to warn excavators against the tendency—which is fortunately disappearing—of working primarily with a view to constituting or completing museum collections. It is obvious that such a restrictive point of view will in all probability falsify the spirit of research, which should be brought to bear on all the elements that come to light in the course of excavation work and not only on material finds. However, while this too exclusive tendency was disappearing, the conception of an archæological collection and the principles governing its museographical presentation evolved to such a degree that, today, an excavator who, in his investigations and the assembling of data and documents, allows himself to be guided by modern methods of presentation would not thereby be neglecting the interests of research properly so called. He will even obtain

valuable information from present-day curators who endeavour to reproduce the environment of their exhibits or to display groups of objects in the state in which they are extricated from the ground, and who, in the sphere of archæology and ethnography, have abandoned the purely analytical method in order to bring into play all the resources of the synthetic method for illustrating a given civilisation. An excavator therefore has a most important mission to fulfil in regard to museums, for, besides the material documents which he furnishes for their collections, he can in the course of his examination and classification of these documents find a quantity of transient data, which, with the help of explanatory notes, diagrams and photographs, will effectively illustrate the exhibits of a museographical collection. This collaboration between excavators and curators is therefore in conformity with the scientific principles on which field operations and the constitution of excavation records are based.

The foregoing remarks apply also to the principles laid down for the conservation of finds. It is precisely because archæological research reveals such a large quantity of transient data that, by every possible means and precautions, efforts must be made to fix and preserve all the material documentation, both that which can be removed and that which has to be left in situ. *The chapters dealing with the preservation of finds explain the various methods calculated to safeguard archæological material. Needless to say, these "remedies" and "therapeutical" treatment will not always be sufficient to counteract the devastating consequences of bringing objects which have lain buried for thousands of years into contact with the air. We know of many cases where a painting or a mummy has crumbled to dust under such conditions. These are, however, extreme cases and it is for the physicist and the archæologist to examine how far this destruction can be prevented or, at least, to devise a process which would to a certain extent preserve these relics from disintegration. But if, in these extreme cases, contact with the air is likely to cause or accelerate the process of decay to such an extent, it may be presumed that any object which has remained buried for centuries and which is restored to its normal surroundings will more or less acutely and more or less visibly undergo some structural change. The expression "normal surroundings" should be taken to mean a certain degree of atmospheric moisture and a certain quota of sunshine (1).*

Speaking generally, exceptional care should be taken in cases of particularly dry or particularly humid environment, where objects may have retained the whole of

(1) Certain experimental data relating to this question were given in a study published in Vol. 23-24 of the review *Mouseion*, from which conclusions may easily be drawn as to the precautions that need to be taken when exploring tombs, grottoes and caves, for example.

their external physiognomy while their molecular structure has been completely dissociated. Cases of this kind often become manifest when it is too late to prevent disintegration, either because air or daylight has already entered the burial chamber, or because the crumbling object has been touched with a tool or with the hand and thus irreparably deteriorated. These elementary precautions—protection against sudden exposure to sunshine and air currents which accelerate deterioration by oxidation, dehydration or hydration—should nevertheless be taken, for though they may not arrest decay they can, in cases of extreme gravity, at least retard its action sufficiently to permit of surveying and photographing the objects.

Museographical technique can therefore place a multiplicity of elements at the disposal of the excavator, elements which will exert an influence on the method of excavation and on the nature of the data to be collected. The modern conception of presentation in exhibition galleries and the organisation of study collections, on the one hand, and the views held today regarding archæological research in the field, on the other, are so closely bound up in their interests that sustained collaboration between museum curators and excavators has become necessary.

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In this general survey of the functions and responsibilities of the excavator, the principle of establishing close collaboration between the various branches of science is repeatedly emphasised, whether in connection with the choice of personnel, methods of organisation, excavation technique or the treatment of archæological material. It was therefore only logical that the International Conference on Excavations, held in Cairo from March 9th to 15th, 1937, and organised by the International Museums Office, should immediately have adopted this principle of collaboration for the discussion of the various administrative, scientific and technical problems arising in connection with field research. This decision, moreover, was a response to a wish which had long ago been expressed by the national departments of antiquities and excavations, archæological expeditions, research institutes and museums all of which would, in various respects, find it to their advantage to work under a more homogeneous system, better adapted to the requirements of organisation and the interests of science.

In the preparation properly so called of the Cairo Conference, which was a continuation of the big international conferences organised by the International Museums Office at Rome (conservation of paintings), Athens (conservation of artistic and historic monuments) and Madrid (planning and equipment of museums of art and

history), the Secretariat of the Office again adopted the method of work which had proved so successful at the previous meetings.

It had already assembled, for the Athens Conference, a mass of documentary material concerning the conservation of artistic and historic buildings, which, on many points, was relevant to the subject of excavations. Pursuing its investigations in the administrative and legislative field as well as in the scientific and technical field, it collected a large quantity of documents which it divided into three groups for the Cairo Conference: juridical and legislative questions; technical problems and problems of international documentation. This material was distributed to twenty rapporteurs chosen from among the most eminent archæologists in the different countries and among jurists specially qualified to deal with problems relating to antiquities and excavations. The preliminary reports prepared with the help of this material were intended to serve as a basis for the deliberations of the Cairo Conference, but they were also drafted in such a way that they could be used as the chapters of a manual, similar to the Traité de Muséographie *which was published after the Madrid Conference. Each of the rapporteurs was given an opportunity of examining the reports contributed by his colleagues and of submitting his observations and necessary additions. These texts were, finally, approved in the course of the Cairo discussions, where they were endorsed by the scholars attending the Conference.*

This collection of studies and memoranda was subsequently edited to form two separate volumes; one dealing with legislation, the other with the technique of field research and questions of international documentation. It is this latter volume which is now presented under the title of Manual on the Technique of Archæological Excavations.

These two works clearly complete one another, for, as was pointed out at the Cairo Conference, the administrative and juridical régime of research cannot be separated from the requirements of science and the principles that govern the conservation of the archæological heritage; and, conversely, excavation technique is subservient to the various obligations expressed in the laws and regulations relating to antiquities and excavations.

In publishing this manual, the intention of the authors was to place in the hands of archæologists, curators and national administrative departments, a practical guide in which they would find a description of the most recent field research work such as it is carried out in the different countries. This theoretical survey, however, needed to be implemented by concrete examples, and then completed by accounts of the practical application of the methods recommended in the manual. To meet

this need and also to give effect to a recommendation formulated in the Final Act *of the Cairo Conference, the International Museums Office has opened a new section in its review* Mouseion *under the title:* The Technique of Archæological Excavations. *Drafted as corollaries to this methodological treatise, which they will, so to speak, illustrate, the studies appearing in this new section will enable archæologists to keep themselves constantly informed on the various methods of prospection, sounding and exploration practised on archæological sites.* (1)

It should, however, be pointed out that these studies will be confined to strictly technical problems and will not, therefore, duplicate the reports published by archæological expeditions on the results of their research operations. But as no method can be separated from the object to which it is applied, these studies will often have to analyse specific cases in order to illustrate a given theory or a given process. The heads of archæological expeditions will, for their part, find in this new section of Mouseion *a medium for making known their views on debatable points and of communicating their experiences to their colleagues and, in general, to the archæological and museum world, so that their suggestions may be given the international publicity they deserve. These are so many matters which cannot be dealt with— at any rate from this doctrinal aspect—in the usual excavation report.*

The International Conference which sat in Cairo, however, fully realised that these reports on field research would be of the utmost value to excavators and archæologists in general and it accordingly suggested that a documentation and information service should be organised within the International Museums Office, to which the reports would be regularly communicated as soon as they were published. Thus rendered more readily accessible and assured of an international dissemination through the analyses and references to appear in the Monthly Supplement *of the review* Mouseion, *these reports will really constitute the material basis of archæological research and, at the same time, the complement and permanent commentary of the theoretical code of research contained in this manual.*

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(1) See Vol. 43-44 of *Mouseion* for the first series of articles which, though dealing with concrete examples, contain some general data relating to excavation technique. They were prepared with that object for the Cairo Conference. We would mention, in particular: *La Technique des Fouilles en Egypte; Les Fouilles du Temple d'Arthemis Orthia à Sparte; Les aspects particuliers des recherches archéologiques en Turquie; La Technique des Fouilles au Mexique; Les Fouilles archéologiques aux Indes; La Technique des Fouilles aux Pays-Bas.*

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In the foregoing outline of the mission devolving upon excavators, we have emphasised the importance of certain principles and certain internationally applied methods, in the interests of comparative science. It was only natural that problems of international documentation, which are so closely bound up with problems of technique, should be allotted a place in the same work. Besides the chapters specially devoted to this subject, numerous references are made to the various factors of this international co-operation which springs from the very notion of archæological science. There is, indeed, scarcely any science in which interpenetration and, consequently, collaboration of the different scientific disciplines and the variety of technique is more evident and necessary than in archæology. But in order that this collaboration may produce the maximum results, these disciplines must speak a common language and have a common form of notation and expression. The rules formulated in this connection in the present manual have not necessarily an intrinsic value and although recognised by the majority of scholars they could be modified on quite a number of points; they must therefore be considered from another angle if they are to be accepted almost universally, that is from the standpoint of their practical utility in the establishing of archæological data which should be intelligible in all countries and to all researchers. This is the homogeneity which the excavator should aim at in his treatment of the material that comes within the range of his investigations, for it is thanks to this homogeneity that the study of a specific case can pave the way for the comprehension of other cases and that the data based on the results of practical experience will be saved for the scientific world as a whole.

It will be seen that this documentation, to which certain norms should be assigned in a spirit of broadmindedness and impartiality, concerns not only methods of conservation and notation and the use of certain instruments of prospection or excavation, but also the technical staff and assistants chosen for this work. There exists such an intimate community of higher interests between all who, in varying degrees, devote themselves to archæological research, that no effort should be spared to facilitate the exchange of all those elements which contribute to the success of this work and to permit of its being pursued in full knowledge of the resources available today.

Perhaps, bearing in mind the origins of this manual and the quality and standing of the authors who have collaborated in its publication, it will be thought that it is addressed solely to archæological missions endowed with a large staff and all the up-to-date equipment of an expedition organised on a big scale. This impression will be rapidly dispelled on reading the various chapters that follow. If, in

fact, it was necessary, in a treatise of this nature, to give an idea of all the resources that can be made to serve field research, it was thought desirable to mention the advice, recommendations and elementary processes which can apply even in the smallest of undertakings. Above all, stress has been laid on the primary factors which contribute to the success of these investigations; it is neither a question of highly perfected equipment nor of the efficiency of tools and instruments—the importance of which cannot, of course, be disregarded—it is chiefly a matter of the spirit of initiative shown by the excavator, his experience, skill and facility of adaptation to exceptional, and very often, unforeseeable circumstances. There is, in the mission of the excavator, a share of talent and a share of genius, which no professional training can provide; the purpose of a manual such as this consists simply in defining the demands which an excavator must be able to meet, and in placing before him a number of data and methods whose value has been proved in the course of rationally conducted archæological research.

As regards administrative departments, this work will serve as a guide which will help them in organising their services, by furnishing them with the necessary particulars concerning the choice of personnel, the drawing up of their programme of work, the estimating of the cost of expeditions and the composition of the requisite staff. Lastly, curators will find in this manual on the technique of excavations various suggestions concerning the ever closer collaboration that should be established between the archæologist and the museographer, and the better co-ordination and concordance of the requirements of science and the presentation of collections. If its authors have succeeded in bringing out this community of interests which unifies the mission of the excavator and the task of the curator, they will have the satisfaction of knowing that they have not laboured in vain for the progress of science and the preservation of the tokens of the past. Furthermore, in order that it may be fully understood that this manual is a collective work each element of which reflects their joint opinion, they have by mutual consent decided to remain anonymous in so far as concerns their personal contributions.

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The International Museums Office desires to thank all those who, directly or indirectly, assisted it in the preparation of this treatise, bringing to it the fruits of their experience and the authority attaching to their name. The Office is particularly indebted to the Egyptian Government, who, in inviting the experts to meet in Cairo, combined their generous hospitality with the advantages offered by a country possessing such a remarkable wealth of archæological treasures. The

International Commission on Historic Monuments, *under whose auspices this Conference was held, contributed the views of the national departments represented by the members of this Commission.*

The International Centre for Institutes of Art and Archæology, *for its part, recognised the importance of the problems that were to be discussed at this assembly, by sending the most eminent representatives of these research institutions to the Cairo Conference. Space does not allow us to give the names of all the persons—heads of archæological services, curators and archæologists—who took an active share in the preparation of the papers and in the exchange of views which took place at the Conference.*

Lastly, the International Museums Office *deeply appreciated the interest which all circles specialising in this vast problem of archæological research took in its initiative, the success of which was due to the soundness of their counsel, their learned contributions and the unanimous spirit of good will that prevailed.*

E. FOUNDOUKIDIS.

CHAPTER I

PRELIMINARY DOCUMENTATION

The choice of a site for archæological excavation is governed by several considerations and the sites chosen may be grouped under the following heads:

1. Famous cities and centres of civilisation of the past:
   a) of which few remains survive above the surface, e. g. Antioch, Sparta, or Troy;
   b) of which the ruins are extensive and, in part at least, well preserved; Persepolis, Mycenæ, Bogazkoy, Ostia.

2. Cities of secondary importance:
   a) which have been almost completely buried, more or less forgotten, and therefore well preserved and discovered by accident. Classic examples of this type are Pompeii, Herculaneum, Dura-Europos and Ugarit;
   b) of which the ruins are so well preserved that they afford a striking picture of the life of the past, e. g. Gerasa, Timgad and Leptis.

3. Prehistoric sites or mounds marking the positions of comparatively insignificant settlements of the Neolithic and Bronze Ages. The scientific excavation of such sites, especially in the Near East, has in a large part provided the material for the reconstruction of prehistory in that region. Typical sites are Alisar, Phylakopi (Melos) and Cucuteni.

1. Cities of the first class, to whichever sub-division they belong, are naturally extremely suitable sites for excavation. The more famous the city the greater the likelihood of recovering important historical and artistic monuments and of extending our knowledge of the past. In Egypt, such a site still unexcavated is Saïs. The advantages—archæological, historical, artistic and ethnological—of excavating such sites are so obvious that there is no need to emphasise them here. Practically all important cities have been identified by the discovery of inscriptions, by the recognition of some of their known monuments, or by the preservation of their fame on the spot.

The site of Troy was a matter of dispute till Schliemann began his excavations. His work proved that the Hellenistic and Roman city of Ilion (verified by inscriptions) had been built on a site which had been occupied by the successive remains of seven important prehistoric towns. The Greeks of later classical times and Alexander himself fully believed this site to be that of the Homeric Troy. Since Schliemann's discoveries and the publication of them by Doerpfeld, the site at Hissarlik has been generally recognised by scholars as that of Troy and only recently have doubts again been raised. The evidence, however, of the archæological discoveries and a survey of the neighbouring region, coupled with that of the inscriptions, is so strong that the position of Troy at Hissarlik may be taken as practically certain. The identification of Hissarlik as Troy, made first in the light of Homer and other ancient authorities, was supported by local traditions and the inscriptions of Ilion and confirmed by archæological excavations.

Any scholar who plans to excavate such a site should first of all be acquainted as fully as possible with all that is known about that city from ancient literature and from ancient inscriptions or documents (e. g. cuneiform tablets, etc.) discovered there or in excavations elsewhere. In some cases, ancient literature (e. g. Pausanias) gives topographical details which enable the more prominent buildings in the city to be identified at least provisionally. Further, the study of the ancient literature often provides important clues as to the history of the buildings excavated. Good instances of this are the temples of Artemis at Ephesus and Sardis. The skeleton history of the city derived from ancient literature can then be expanded by the results of excavation.

There is one precaution to be taken as regards the study of the ancient authorities. A city may not be mentioned by ancient writers or in documents after a certain date, but the excavator must not assume that the city was destroyed about that time and never again inhabited. The absence of records does not necessarily imply the complete desertion of the city, or the end of its history. Thus, if the excavator assumes that everything found in the city must date from before the cessation of the records he may be led into serious error. For instance, the ancient records of Mycenæ cease in the XIth century B. C., and later writers like Pausanias imply that it was completely deserted in their time, whereas excavations have shown that there was some inhabitation even then. Pausanias, Diodoros and Strabo even imply that Mycenæ, after its capture about 470 B. C., was never again inhabited. This statement is, however, disproved by scattered references in one or two authors and by inscriptions and other

monuments found in excavations there. Thus, anyone who took a preconceived idea that everything at Mycenæ must be older than 470 B. C. would be committing a grave error. The same possibility of error also exists at other urban sites, and no one should allow himself to be deceived by the silent or negative evidence of ancient authors.

The written records of literature can often be supplemented by the local traditions which have survived among the inhabitants of the locality and which have been handed down from generation to generation. These, however, must be used with caution. Local traditions frequently apply the names of great historical characters to ruins without any reason. The Tomb of Agamemnon at Mycenæ is an instance of this and in the Near East the name of Alexander or some other hero, who had become legendary, is similarly used. Sometimes too, the suggestions of medieval or more recent travellers have given to places names drawn from ancient history which are nevertheless incorrect. Instances of this are the names Tomb of Patroclus, Tomb of Ajax, Tomb of Protesilaos applied to mounds near Troy, the Lantern of Demosthenes in Athens, and many of the medieval names of Roman monuments. Nevertheless, the comparison of local traditions with the statements in ancient literature is often extremely useful in helping to clarify the topography of the site selected.

The observations, plans and researches of medieval and modern travellers who have visited the site are extremely important. Their statements, arranged in chronological order, often explain the gradual destruction or burial of a building. In some cases, they record inscriptions now destroyed or seriously damaged. In other cases, they mention, as visible, buildings in places where there is now nothing to be seen on the surface. If to their written descriptions the travellers have added plans or sketches, these should, before scientific excavation is attempted, be most carefully compared with the present state of the site.

The accounts of travellers, however, vary considerably according to their temperaments. The best traveller's account of an ancient site is to be found in the works of a man like Leake. Some travellers are careless and romantic in their descriptions and have even been known to describe a site without ever having been to it. Even modern travellers are not exempt from this fault. One recent traveller has described as prehistoric sites mounds which he saw only from the windows of a railway train. Some earlier travellers, who visited Greece in Turkish days, found all the principal topographical features of ancient Sparta at Mistra, which was then the capital of the province.

It is therefore essential to visit the ancient site itself before attempting to reach any constructive results from the accounts of earlier travellers or explorers.

If one could venture to suggest an ideal procedure, the following programme would perhaps be the best. Before visiting the ancient city which he plans to excavate, the archæologist should:

a) read the ancient literature;

b) read the works of medieval and modern travellers and explorers;

c) study any maps or plans which relate to the city or its immediate neighbourhood.

If a bibliography of the city exists, the task will be all the easier, but few ancient cities have been endowed with bibliographies like Mr. Philip Argenti's unpublished bibliography of Chios.

The archæologist should then visit the city and study the extant ruins in the light of past records and make his own observations in the light of his own knowledge and experience. He can even attempt a preliminary survey and plan of the city and its environs. A study of this preliminary documentation should then enable him to decide the most important places for excavation. If this ideal plan is successful it avoids the necessity for borings or trial trenches, because, as Sir Flinders Petrie long ago stated, every boring causes some damage to the site. In this connection, the comparative study of the accounts of medieval and modern travellers will help to show whether the site has been disturbed by illicit excavation by unscientific persons in search of treasure.

Another most important aid for the preliminary survey of a site, especially a city of the character here imagined, is air photography. An aerial photograph gives a rapid and complete survey of the whole area and, by its peculiar properties, often reveals unsuspected details which otherwise could have been discovered only by excavation. Air photographs often show the position of buried walls, the lines of streets, the sites of shrines or similar important buildings, roads and the lay-out of fields. They thus serve as an invaluable aid in the preparation for excavation and in many cases avoid the necessity for borings. They have been known to reveal the existence of sites previously unknown and, in cases such as that of Caistor by Norwich, the plan obtained by preliminary air photography was the main guide for the excavators when they began work and enabled them to determine with good probability the sites of the walls, streets and principal buildings of that Roman settlement. A greater use of air photography for such preliminary work is much to be desired in the Near East.

It has, moreover, been used with success in these countries, as will be seen in Chapter III.

The study of the ancient writers and of the later travellers and explorers will also help in another important matter: that of the climate, which has an important bearing on the successful progress of an excavation. First, such a study will help to show whether the climatic and telluric conditions have changed since ancient times. This is important because a change from a rainy climate to a dry one or *vice versa* will help to explain the accumulation or non-accumulation of soil over buildings. Further, a study of the prevailing winds may in certain cases assist in the excavation when it is a matter of clearing drifted sand from a town and also explain the burial of some buildings and the exposure of others.

Very often, climate also affects the actual conduct of the excavation. A formerly healthy district may have become desolate through malaria, and it is vitally important for the excavator to know this. He should take steps to deal with the scourge by draining marshes and exterminating mosquitoes, for an outbreak of the disease among his staff and workmen might well put a stop to operations. The health and well-being of all his assistants should be one of the excavator's primary concerns. The prevalence of malaria in that district may then explain its depopulation and the desertion of the town. The change of the course of a river or the silting up of its mouth may have brought malaria and also have destroyed the trade of the city by the ruin of its harbour. This is well illustrated by sites in Asia Minor like Miletus, Magnesia on the Mæander, or Ephesus, and some sites in Greece like Ceniadæ.

Similarly, before he begins or even plans to excavate, the excavator ought to ascertain what the local supply of labour is likely to be. He should also be familiar, or make himself familiar, with the language of the country and of his workmen. These questions will, however, be developed in Chapter III (Material Organisation of Excavations) and in Chapter XII (Technical Training of Excavators).

2. The same methods of preliminary documentation should be followed for sites of both types in this class as for those in the first class. Little difference is to be observed, but less important towns are less likely to have been mentioned by ancient writers or in ancient documents. On the other hand, sites that are well preserved, unless they are situated in remote or dangerous countries, are more likely to have been visited or surveyed by travellers and explorers. Thus, the lack of ancient literature about them may well be compensated in many cases by a corresponding richness of medieval and more modern literature.

3. Prehistoric mounds or similar early sites of nameless settlements of the Neolithic or Bronze Ages are almost certain never to have been mentioned in ancient literature, unless some incorrect name based on legend has been misapplied to them. Such a case is the name "Tomb of Protesilaos" given to the prehistoric mound on the Gallipoli Peninsula at the entrance to the Dardanelles. Such mounds are extremely common all about the Near East and bear many different national names, *Tell*, *Hüyük*, *Magoula* and so on. With them should not be included the mounds that mark the sites of well known cities such as Tell Duweir, where Lachish stood, and those that mark the sites of early Tarsus or Carchemish. These places naturally fall under class 1.

The mounds which claim attention now are those of settlements whose names have been long lost, but which from the richness of their archæological deposits may nevertheless become the type sites for certain phases of ancient civilisation. Cucuteni, for instance, the modern Rumanian name of a mound in Moldavia, has become the accepted scientific name for a prehistoric culture. These settlements, long since abandoned and unoccupied in recent times, yield, under scientific excavation, priceless information about the gradual development of civilisation. The preliminary documentation for such a site is naturally far different from that required for the sites of classes 1 and 2. In the first place, there is no ancient literature about them. Even big settlements, like Mohendjo-Daro, had been long forgotten till their resurrection by scientific archæology. Their sites were abandoned for many centuries and, in the ceaseless ebb and flow of the human tides, all knowledge of their inhabitants, their period, their culture and indeed of their very existence, has been lost. Medieval and modern travellers also are hardly likely to have noticed them, though occasionally casual references to such mounds may be found. The first references to them in literature are most likely to be those of scientific explorers of the later XIXth century, though even they paid little attention to them. The recognition of the value of prehistoric pottery has now led to its scientific study and classification and consequently the surface exploration of mounds can often give some clue as to the date, the culture and the extent of the civilisation they represent.

Thus, if an archæologist wishes to excavate a prehistoric mound in some region, he should first study the maps and the physical features of the country, since prehistoric settlements owe their position in many cases to their surroundings. A good supply of water is one essential and thus such sites are to be found by good springs or within easy reach of a good river. In some cases, shelter from cold or the prevailing winds was sought and in others rising ground was chosen

to enable the settlement to be more easily defended. Mountainous regions and forest-clad areas were avoided and open and reasonably level country was preferred. Bearing these points in mind, an archæologist can determine from the maps the regions where such sites are most likely to be found and then, by a study of previous prehistoric exploration of the region, he should be able to decide the general character of early sites in the area he proposes to explore. If one or more sites have been recognised and excavated (even only partially) in that region, his task will be easier, for where one site is, there are likely to be more. If no sites have been located, then only surface exploration will tell him whether such exist or not.

Surface exploration, however, needs training and experience. First the sites have to be recognised and then they must be carefully examined, which means that the archæologist must walk over them personally, with his eyes and mind alive to all the possibilities. From such exploration, a mound will yield the documents which can, to the expert, give a preliminary idea of the value, character and date of the site. These documents consist of fragments of pottery, stone and bone implements, traces of walls perhaps, and possibly even tombs which have been revealed by the plough, by tree planting, or by subsidences. They should be compared with previous finds, if any, from the same area and with those from neighbouring areas, and then the archæologist can, to some extent, anticipate what any particular mound he has explored is likely to produce on excavation.

If a mound is on the bank of a river, or happens to have been dug away partly for some modern industrial or even warlike purpose, the erosion or excavation will reveal part of the mound, at least in section, and so permit a preliminary survey of the successive strata which compose it. Such a site is Vinca. If over a given area a number of mounds are located, they should be plotted on a map and a graphic illustration of this kind will give some idea of the density of the prehistoric population. Then it follows that true scientific exploration would select one site each in the north, east, west, and south of the area, with perhaps one more in the centre so as to give a conspectus of the culture of the whole and to show how it may vary in a limited region and also what external influences may have affected it from the different points of the compass. The sites chosen should be big enough to give a long succession of strata, and easy to excavate but not too small. On the other hand, a very large site may present technical difficulties. In any case, the documents found in the surface exploration will be invaluable when the site for excavation is being selected.

A prehistoric area where such mound sites are comparatively common would form an admirable field for co-operative excavation by expeditions from two or more nations. If such co-operation takes place, and it is by no means impossible, scientific results of great value may be more easily obtained. Naturally, the expeditions co-operating would divide the area or spread their excavations in such a way that the whole region could be well tested archæologically. In other words, they would arrange that their efforts should be complementary and in no sense competitive. This was attempted in Crete (1) when, on the proclamation of its autonomy, the nations desirous of conducting archæological excavations in the island and the Cretan authorities allocated by consent among themselves spheres of influence or particular sites for scientific exploration. The result of this co-operation has resulted in the great knowledge of the Minoan civilisation now at our disposal, which is entirely the work of the last thirty-six years.

By way of conclusion, it may be said that the preliminary documentation of an area or of a site on the lines sketched above should be the essential introduction to an excavation, as a piece of scientific research directed to reinforcing knowledge where it is weakest. In the past, there has perhaps been rather too great a tendency to excavate where excavation was easy or where quick results and imposing material objects were likely to reward the excavator. Excavation should be a strictly scientific enquiry for scientific results. Material considerations as well as preconceived theories should be banished from the excavator's mind. The more thorough the preliminary documentation the more sober and objective will be the excavation. No one should excavate merely to prove his own theory or disprove another's theory, or to obtain objects to fill museums. The excavator's sole aim should be to enlarge scientific, artistic and historical knowledge, and proper preliminary documentation is the first of the scientific methods of excavation which he should employ, especially in the case of prehistoric sites.

(1) This experiment is a case where scientific co-operation between a number of countries proved to be of inestimable value fom the point of view of the enrichment of knowledge and documentation, and there seems to be no reason why the method should not be extended to other spheres of archæological research.

This international collaboration in field research is, moreover, provided for in the programme of activities of the International Museums Office. It is desirable that this organisation should, with a view to such co-operation, have the full support of qualified institutions and be assured of the willingness of interested countries.

CHAPTER II

METHODS FOR SURVEYING ARCHÆOLOGICAL SITES

1. *Definition.* — The surveying of an archæological site, with a view to undertaking excavations, is here taken to signify the search for traces of ancient life which are not clearly apparent on the surface of the soil or of the water.

Once an archæological site has been discovered, its survey has, as a further object, to determine the limits of the area which it is worth while to excavate.

This chapter will, as far as possible, avoid the subject of excavations properly so called. It will be noted that in certain countries or regions, —Ireland, for example (1), —surface indications are so complete that no preliminary survey is necessary; the survey becomes an integral part of the excavations themselves. Even in this case, however, a survey by means of aerial photography may be useful, if only to establish the limits of the area to be excavated.

2. *Toponomy.* — The first archæological clue is generally provided by toponomy, — in other words, by the survival of ancient place names or the use of a term which suggests an ancient monument or an ancient settlement, even if it has disappeared. The appearance of names on a map, the statements of travellers who formerly saw the site in better condition, historical data locating a vanished city or monument with reference to a known city, or even a toponymic survey carried out on the spot may serve to determine the location of an ancient site. The result thus obtained should be verified by one of the methods described below.

Thus, although texts have perpetuated the memory of the important Palestinian city of Gezer, and although it was still known at the time of the Crusades under the name of Mount Gisart, it had never been possible to determine its actual location. Clermont-Ganneau suggested its identity with Tell el-Djezer, between Jaffa and Jerusalem. A few years later, in 1874, he discovered several rock inscriptions in Hebrew and Greek which marked the boundaries of the city and confirmed the identification (2). When Mr. Macalister undertook the

(1) Documentation of the International Museums Office.
(2) Bibliography in *Syria*, IV (1923), p. 163, notes 1 and 2.

excavation of the site, his discoveries immediately fell into their place in the historical framework. There is, however, no need to enlarge upon this subject as these points have been dealt with more specifically in Chapter I.

3. *Chance discovery.* — Frequently it is the native who discovers the site as he tills his field. The local Archæological Service, immediately notified, takes the preservative measures prescribed by law. According to circumstances, it either carries on the survey itself, or entrusts the excavation to a special archæological mission (1).

It may be laid down as a principle that where traces have been found once, they will be found again. But the chance discovery may lie a generation or two in the past. When that is the case, it is desirable to question the old inhabitants of the region, but with the greatest prudence, so as not to lead them to shape their answers solely with a view to pleasing the stranger.

4. *Appearance of the site as seen from the ground.* — The contour of the ground often permits the discovery of an ancient site without any survey, especially when a settlement thousands of years old has risen in the midst of the plain in the shape of a tell or hill formed by successive reconstructions.

In the case of Ras Shamra (Syria), for example, it soon became apparent that the necropolis excavated at Minet el-Beida was not in contact with the ancient city. The mere appearance of the ground led the archæologists to locate the city on the characteristically-shaped tell called Ras Shamra, eight hundred metres to the east of the necropolis.

When the site formerly inhabited has not been ploughed up and planted, it often appears, in the regions where brick is used for building purposes, as a lighter area in the midst of the spring vegetation. This was notably the case at Tello, in Mesopotamia, where it was possible thus to determine the boundaries of the ancient city, which formed an oval, four kilometres long by two kilometres wide (2), On many Mesopotamian sites, bricks are to be found bearing a pressed inscription and so furnish definite information.

(1) Such was the case of Ras Shamra-Ugarit.

A peasant, while tilling his field, discovered a tomb, well built, and having a corbelled vault. The Service of Antiquities of Syria sent an inspector to determine the plan of the monument and to take away the pottery. The Shaeffer mission was organised and soon made a rich harvest of objects in this Bronze Age necropolis.

In like fashion, the excavations of Mari, on the Euphrates, were undertaken as a result of the chance discovery by natives of a Sumerian statuette. The name was determined later, on the basis of texts discovered in the course of the excavations.

(2) Cros, *Nouvelles fouilles de Tello, campagne de 1903*, p. 5.

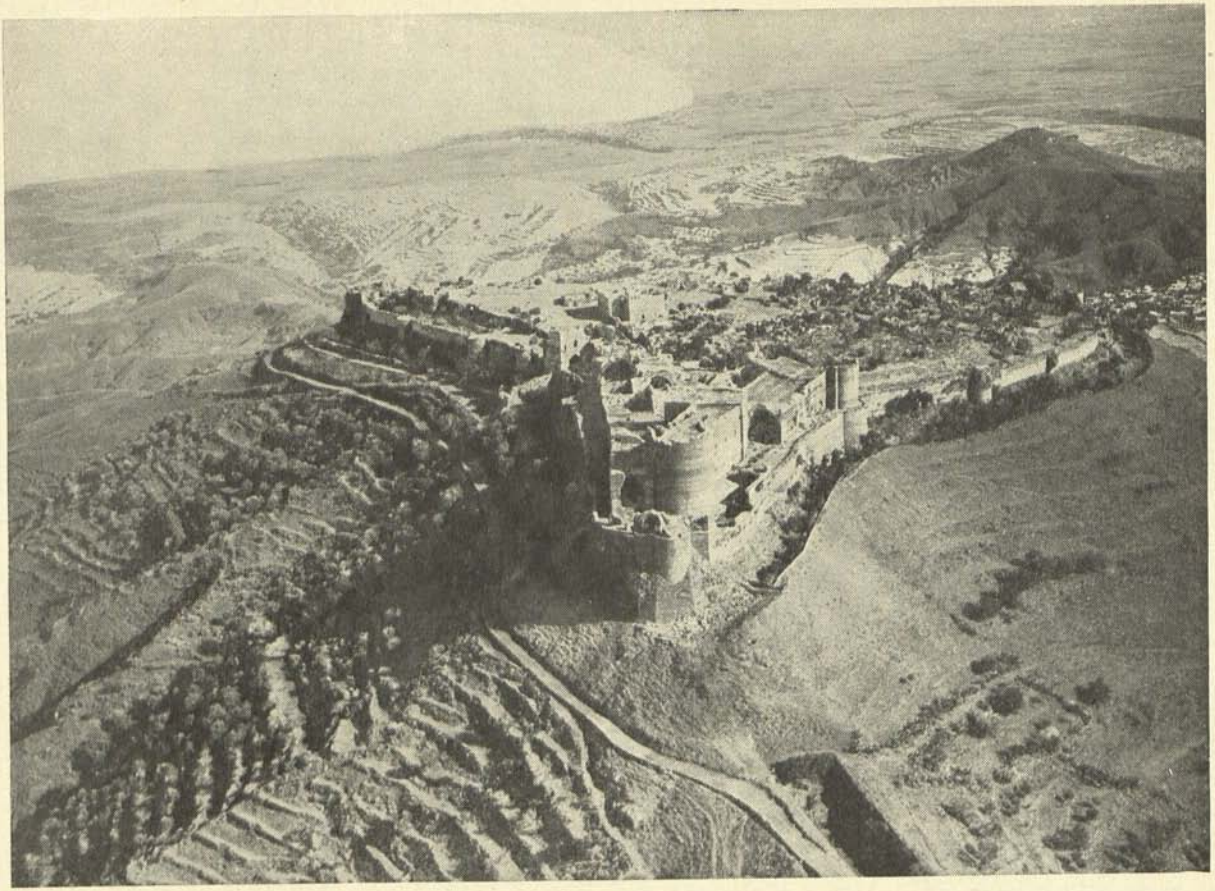

FIG. 1. — THE FORTIFIED TOWN OF MARGAB (SYRIA). OBLIQUE VIEW FROM AN AEROPLANE.

It will be necessary to come back to the question of the clues provided by the appearance of the ground in connection with aerial observation.

It should, however, be noted that differences in vegetation sometimes indicate the presence of ancient constructions. Thus, in certain forests, growths of ivy have led to the discovery of tombs. In other cases, it has been observed that snow melted more quickly above ancient structures hidden in the ground.

The native is generally a good observer of the terrain; attentive to all its aspects, he is particularly quick at discovering a tomb. Thus at Cumm el Awamid, south of Tyre, the natives recognised the place where a tomb hasd been hollowed out by certain irregularities in the rock-surface.

5. *Ceramic Survey.* — The procedures thus far considered are means rather than methods. The first which deserves that title is ceramic survey. The collection of potsherds picked up on the surface of the soil not only makes possible the discovery of an ancient site, but furnishes valuable clues to the date or dates at which that site was occupied. It likewise provides information as to the civilisation to which the site belongs.

This presupposes on the part of the explorer a thorough knowledge of ceramics, and not merely a book knowledge, but a really practical knowledge; indeed, as will be seen in the chapters devoted to excavation technique, that knowledge will be no less indispensable in the course of the excavations.

A remarkable instance of the method of ceramic survey is that which was carried out in Transjordania by the American Archæological School of Jerusalem, under the direction of Mr. Nelson Glueck, with the aid of Mr. Head, attached to the Antiquities Service of Transjordania (1). Seventy-five sites were thus discovered and dated by means of ceramic remains (2). As the making of kiln-baked pottery presupposes a sedentary life, it was possible to demonstrate that the population of Transjordania was sedentary from the XXIIIrd to the XVIIIth century B. C. The absence of pottery after that date points to a return to the nomad life until the Iron Age, when a new period of sedentary life extends from the XIIIth to the VIIIth century B. C. Then the nomad state is resumed and lasts until the IVth century B. C., when the Nabatean domination makes its

(1) *Annual of the American Schools of Oriental Research*, XIV and XV.

(2) The importance of ceramic material as a means of dating sites did not escape the attention of the Cairo Conference. The latter formulated a recommendation to the effect that ceramic records should be constituted in all large museums. See *Final Act*, Section V, § 35.

appearance. Of course, these results, based solely on surface exploration, need to be confirmed by regular excavations, or at least by borings.

6. *Exploratory borings.* — The foregoing example shows that a ceramic survey should be accompanied by borings, which are likewise indispensable as a preliminary to excavations properly so called.

The question of borings, it is true, has been a subject of discussion, and some people advise against this method of search. The method of exhaustive excavation, which consists in cutting away the ground in a succession of thin horizontal layers, does not require the use of preliminary borings. The only result of borings in this case is to ruin certain portions of the site.

a) *Depth Boring.* — However, there is much to be learned from the case of Megiddo. The American mission which was working on the site wished to apply strictly the method of removing the earth by successive horizontal layers, advocated by Mr. Fisher, who has worked it out with particular care. The insignificance of the results obtained, however, finally led the mission to try a depth boring; and the resulting discoveries, in regard to stratification, appeared so interesting that the method of borings came back into favour, notably at Jericho, where Mr. Garstang obtained unexpected results. The deep borings at Megiddo and Jericho have furnished information regarding the succession of the most ancient civilisations in Palestine. The same may be said of Tell Jedeidé in the plain of Antioch.

b) *Exploration by Trenches.* — Preliminary exploration by means of trenches should be carried out over the whole of any area where it is proposed to dump excavated earth. The trenches will either show that the ground contains no remains, and may therefore properly be used as a dumping-ground; or they will reveal the existence of an ancient settlement and lead to the carrying out of systematic excavations before the site is covered with earth dug up elsewhere.

If a necropolis or any other structure (city or other) is being explored at a small distance below the surface, trenches will likewise be dug, in the hope of finding clues leading to a starting-point for the beginning of a systematic excavation.

The use of narrow trenches is to be avoided. Trenches three metres wide are preferable. To make the work easier, M. Claude F. A. Schaeffer uses what he calls the checkerboard trench, three metres wide, but with only alternate

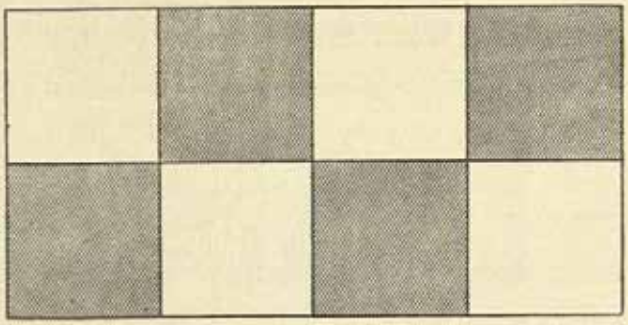

DIAGRAM OF CHECKERBOARD TRENCH.

squares dug out (Fig. above: the shaded squares only are dug out). This plan offers the advantages of exploring by means of a trench three metres wide, while only digging, in reality, a width of one metre and a half.

c) *Tunnels.* — Even more than the narrow trench, the use of tunnels should be strictly avoided; for they serve only to introduce confusion into a site, without any scientific gain. The method is unfortunately used by clandestine diggers, whose sole object is to obtain antiquities for sale.

d) *Exploration by means of a Probe.* — A convenient and rapid method is to probe in loose soils (sand, etc.) by means of a bayonet plunged into the ground and withdrawn with a twisting motion. When the probe thus penetrates a tomb, a deposit of ashes or bones, particles of a nature different from that of the soil lodge in the grooves of the bayonet and reveal the existence of an interesting deposit.

e) *Exploration by Sound.* — To discover the tombs of the Marne in France, use was made of a sort of slender miner's drill, which was vigorously thrust into the ground like a javelin. It is possible to tell from the sound produced by the vibration of the probe whether the rock which it has struck is solid or hollow.

At Enkomi (Cyprus), where many large and well-built Mycenean tombs have been opened, another method was employed. The layer of humus, generally quite thick, was first removed. A square hole was then dug in the hard soil, and the four walls of the resulting pit were struck with a miner's drill. By this method a tomb as far away as two metres can be discovered. When he was excavating at Enkomi, M. Claude Schaeffer had three men constantly employed on this exploration by sound.

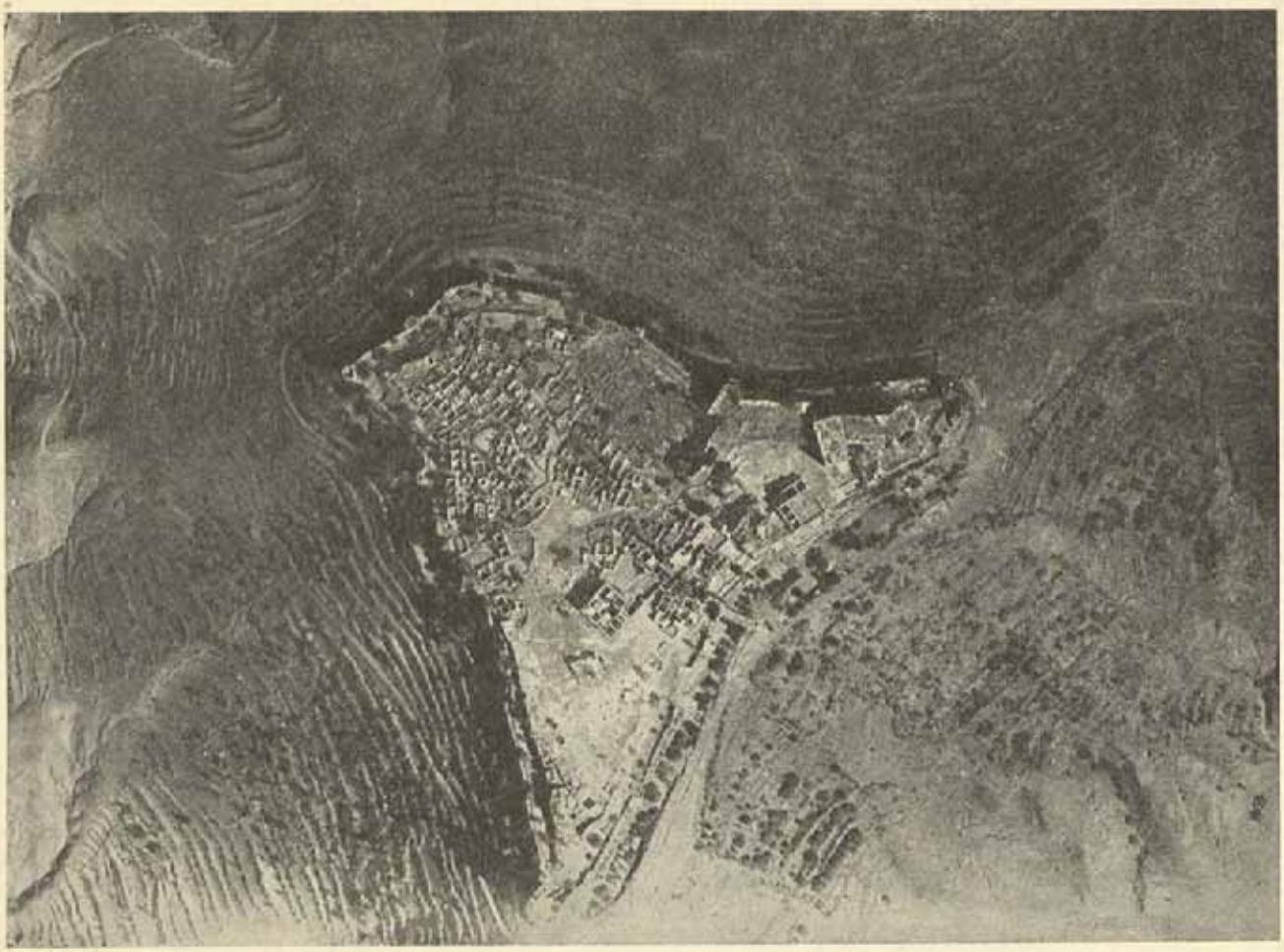

FIG. 2. — THE FORTIFIED TOWN OF MARGAB (SYRIA). VERTICAL VIEW, SHOWING PLAN.

7. *Survey by aerial observation.* — The method consists in taking aerial photographs and interpreting them, as was done during the World War. It has been discovered that, because of the length of the shadows cast when the sun is low on the horizon; because of the difference in the actinic reactions on the sensitive plate of the different types of soil, —and because of the continuity, for the observer above, of the lines thus formed, a photograph taken from an airplane reveals archæological details which an observer on the ground misses.

Even during the war, aerial photographs were used for archæological purposes by M. Leon Rey in Macedonia, as early as 1915; by M. Theodor Wiegand in Palestine, and by Lieutenant-Colonel G. A. Beazeley in Irak (1919).

After the war, the method was used more systematically. In England, Mr. G. O. S. Crawford, from 1923 on, mapped out, over fields and prairies, the ancient Celtic and Saxon remains. The Director of the Archæological Service of the State of Jaipur in India states that, in 1923-1924, an area 50 miles long in the old bed of the Ravi River (Punjab) was explored by airplane.

Father Poidebard undertook a survey of the same type in the desert regions of Syria, and was able to plot, by airplane, the whole system of ancient roads and fortifications of the Syrian desert. Attention may here be drawn to the technical improvements which he worked out in the use of horizontal lighting and especially in the novel utilisation of photography with the camera facing the light. The explorer's description of his method, prepared especially for the Cairo Conference, is given below.

a) *Horizontal Lighting.* — The Syrian Desert is a steppe region, with a clay and alluvial soil, in which sand occurs only exceptionally at certain very limited points. The plants and grass of the steppe prevent the formation of dunes. The earth brought by the wind in the course of thousands of years forms a deposit which very rarely exceeds thirty or forty centimetres in thickness. The ruins covered by this deposit should then ordinarily betray their presence by slight surface undulations. These undulations, often invisible from the ground under the violent vertical lighting of the middle of the day, appear clearly to the aerial observer who makes use of the oblique or horizontal lighting of the early morning or late afternoon.

The horizontal lighting of the morning or the evening brings out and exaggerthes the slightest irregularities of the ground. It is the well-known phenomenon of the road which appears perfectly level and smooth during the day, under the aigh-angle lighting of the sun, but which appears covered with bumps at night,

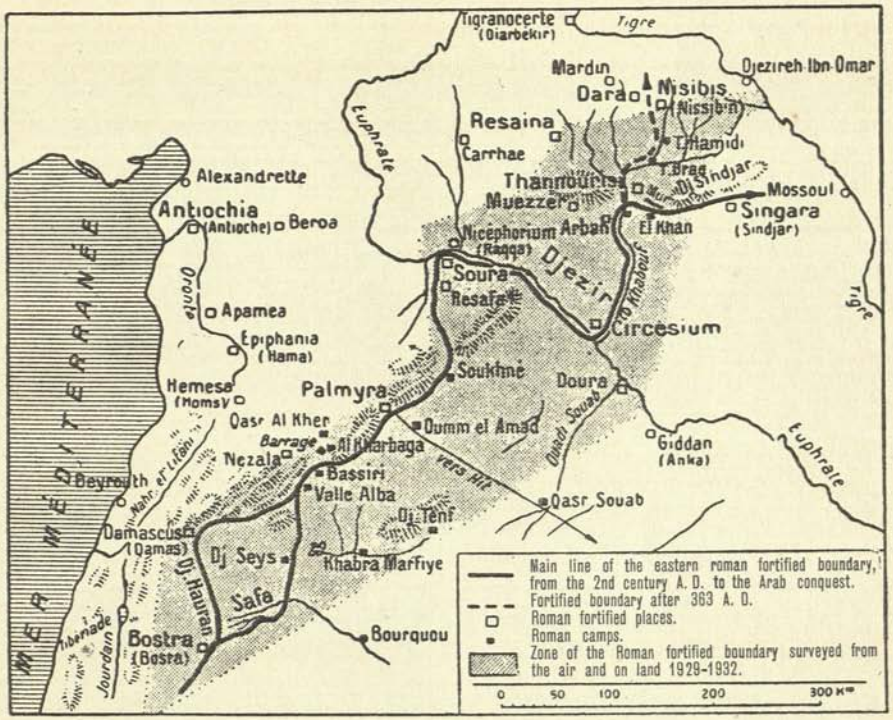

FIG. 3. — AERIAL EXPLORATION (1925-1932) OF THE ROMAN FORTIFIED BOUNDARY.

under the beam of light, almost parallel to the surface, thrown from the headlights of an automobile.

The colours of the vegetation further accentuate the effect of horizontal lighting.

At the first autumn rains, the steppe suddenly turns green, but in shades which differ according to the permeability and the undulations of the soil. The colour remains lighter where a ruin is hidden underground, because the permeability is less, or because plant life is hindered by the dissolving of the lime in the old walls. The colour is darker in the depressions due to an old paved road or trench. A depression of a few centimetres is enough to increase the dampness of the soil. At the first hot days of spring, under the violent action of the sun, which withers the vegetation in a few weeks, the colours of the steppe present the same phenomenon.

In the aerial photography of subterranean ruins absolutely invisible to the naked eye, it seems certain that the variable actinic intensity of the ground in the sites under consideration plays a part. Plates coated with an ordinary emulsion, or better still, plates with a special emulsion, reveal details that the eye does not perceive at all, even from an airplane. Tests should be made with special emulsions sensitive to different sorts of substances. In the course of excavations, it has been observed that there is a marked difference in consistency between earth that was disturbed 2,000 years ago and virgin soil.

The method of horizontal lighting, aided by the variations in colour of the steppe, was perfected and then employed from 1929 to 1932. The ruins of the frontier zone of the Roman Empire in the Syrian Desert, about a third of which were buried beneath the surface, were rapidly discovered and photographed over a distance of 750 kilometres in a straight line and a breadth of 100 to 200 kilometres.

The principle was established and verified that an ancient ruin, buried at a depth of about one metre beneath the steppe, could be observed from an airplane and photographed.

The problem remained unsolved as regards aerial reconnaissance in the middle of the day during the hot season, with dazzling, high-angle lighting and the vegetation completely withered. Under these conditions the use of counter-light was resorted to.

b) *Counter-light.* — In the Syrian Desert, during the middle of the day, in the hot season (from May to September, theoretically between 10 a.m. and 3 p.m., but practically from 8 a.m. or even 7 a.m. on) there are special difficulties in the way of taking panoramic views, and, indeed, of observing the ground from an airplane. It is almost impossible, without screening the lens, to obtain oblique views with sharp detail and neither over-exposed nor fogged negatives.

The dazzling atmosphere which the photographer observes between him and the ground is due to two causes:

1. *Extremely glaring light* due to reverberation from the ground, whether it be the grey-white steppe, entirely dry and without vegetation, as in the *Hamad*, or the uniform surface of basalt or of lava, acting like a veritable mirror, as in the *Harra*. The *Néfoud*, or desert of sand, occurs only at rare points in the Syrian Desert.

2. *A thin haze of sand* in suspension in the air. This haze is due to the sandstorms of the preceding days. It appears, in the dazzling rays of the sun, like

FIG. 4. — FORTIFIED BOUNDARY NORTH OF THE EUPHRATES : SETTLEMENT AT TELL SAWAN, INVISIBLE AT GROUND LEVEL, EXCEPT FROM TELL MÉDOAN. — AERIAL PHOTOGRAPH, WITH OBLIQUE LIGHTING, TAKEN IN THE LATE AFTERNOON AT AN ALTITUDE OF 1,100 METRES, FACING WEST.

a brilliant atmosphere; the details of the soil, seen through it, are blurred, and the colours are softened, turning to mauve, or to light rose-colour, while the shadows are definitely azure blue.

In the neighbourhood of the oases and of the cultivated regions at the edge of the desert, the effect of this sand haze is often modified by a haze of water-vapour, which is hard to distinguish from an incipient sand haze, and which helps to thicken the atmosphere. This creates an additional difficulty in the way of panoramic photography, because the screen of water-vapour does not act on the photographic plate in the same way as the sand haze.

These difficulties disappear or are greatly reduced toward the end of the day in the hot season, and they are almost non-existent for vertical photography at low altitudes.

The air eddies close to the ground are likewise important. The temperature of the ground, in the middle hours of the day, often reaches 45° or 50° C. in the shade in the hot season.

From the point of view of photographic survey in the desert, this constituted a blind spot which it was necessary to eliminate. A solution was sought by taking photographs in the direction opposed to the normal one.

1932 experiments: Already in 1919, the method of counter-light observation had given good results, with the airplane flying facing the sun, and the camera directed obliquely downward below the lower surface of the machine.

In July, *1932*, at 9 a.m., flying eastward at a height of 100 metres in the desert to the north of the Euphrates, a successful observation was made over a distance of 60 kilometres of an ancient road which had remained invisible to all the observers of previous missions, whether in airplanes or on the ground.

During the summer of *1932*, the study of the counterlight method was resumed, and an attempt made to apply it to panoramic photography. The tests were made with orthochromatic anti-halo plates, with no yellow screen over the lens. The sites were chosen beforehand in the steppe regions of the Hamad and the Harra, in spots remarkable for the particularly violent intensity of their reverberation. The sand haze was constantly present throughout the experiments.

The principles applied were as follows:

a) use of counter-light, the angle with the direction of the sun being not more than 15° to 30°;

b) low altitude (maximum, 200 metres);

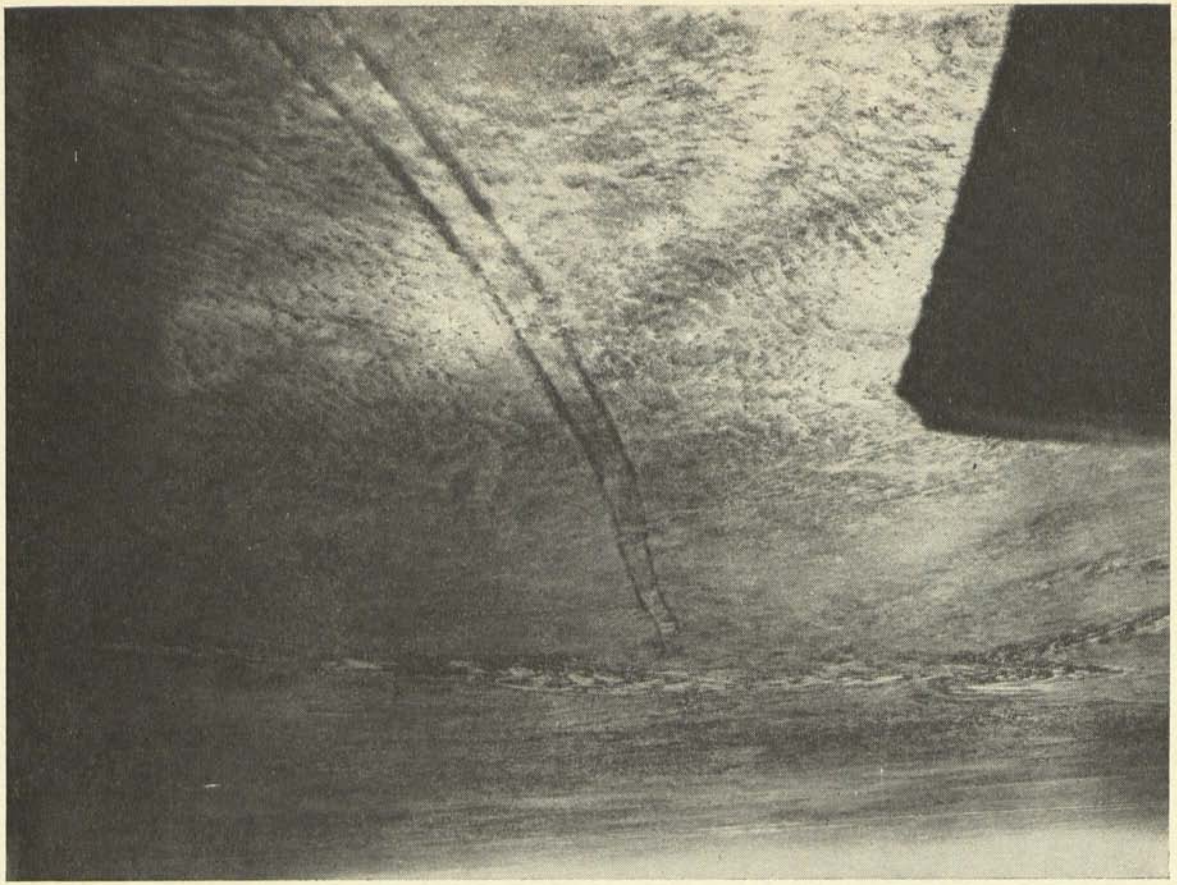

FIG. 5. — ANCIENT CARAVAN ROUTE BETWEEN PALMYRA AND HIT, INVISIBLE AT GROUND LEVEL. — AERIAL PHOTOGRAPH, OBLIQUE LIGHTING, TAKEN AT 100 KMS. S. E. OF PALMYRA AT 7.45 A. M. ON MARCH 3RD, 1930.

c) photography at a wide angle with the horizontal (45°).

The result was that, while all the check-photos taken back to the sun were notably hazy, most of the plates exposed facing the sun still bore traces of a slight over-exposure, but there was no hint of haziness, and all the plates produced good positive prints on contrast paper. A good many of them looked like plates exposed with normal lighting and a dim sun.

The conclusion seems, then, to be established that in the summer, even with a slight sand-haze, it is possible to carry out excellent photographic surveys by working at a very low altitude (60 to 200 metres) and by taking very steeply inclined views against the light. These results can be obtained with orthochromatic plates and without a yellow screen.

This method of survey in desert regions has been applied in Algeria (1),

It has seemed necessary to devote a good deal of space to these technical details of survey by airplane, for this method offers a novel and considerable help to archæological research, but only if it is properly applied.

In this connection, it must be observed that scientific publications too frequently reproduce views taken from airplanes, which are certainly interesting as curiosities, but which are on too small a scale to be studied. It would be desirable to give, along with the general view, detailed views, and, as far as possible, vertical views.

The method of survey by aerial photography may be carried a step farther by means of photogrammetry, which will be taken up in the next section.

8. *Photogrammetry.* — As a step beyond the aerial survey, attention may be called to the use of photogrammetry, employing what is known as the Roussilhe process, which makes it possible to transform an aerial photograph into a plan established according to scale.

This method allows the photographer, when taking vertical views during a flight: *a*) to disregard the altimeter readings, which are always difficult to determine; *b*) to disregard the question whether or not the airplane is flying strictly horizontally (2).

A four-point base is determined, before or after the photograph is taken, consisting of natural features of the terrain which are visible on the plate. This base is next reproduced on the screen in the laboratory to the desired scale. The

(1) The results of this survey are given in the *Revue du Ministère de l'Air*, Nov. 15, 1936. The whole *limes*, from southern Tunis to Morocco, will soon have been surveyed.

(2) The present statement also is based on a note communicated to the International Museums Office by Father Poidebard.

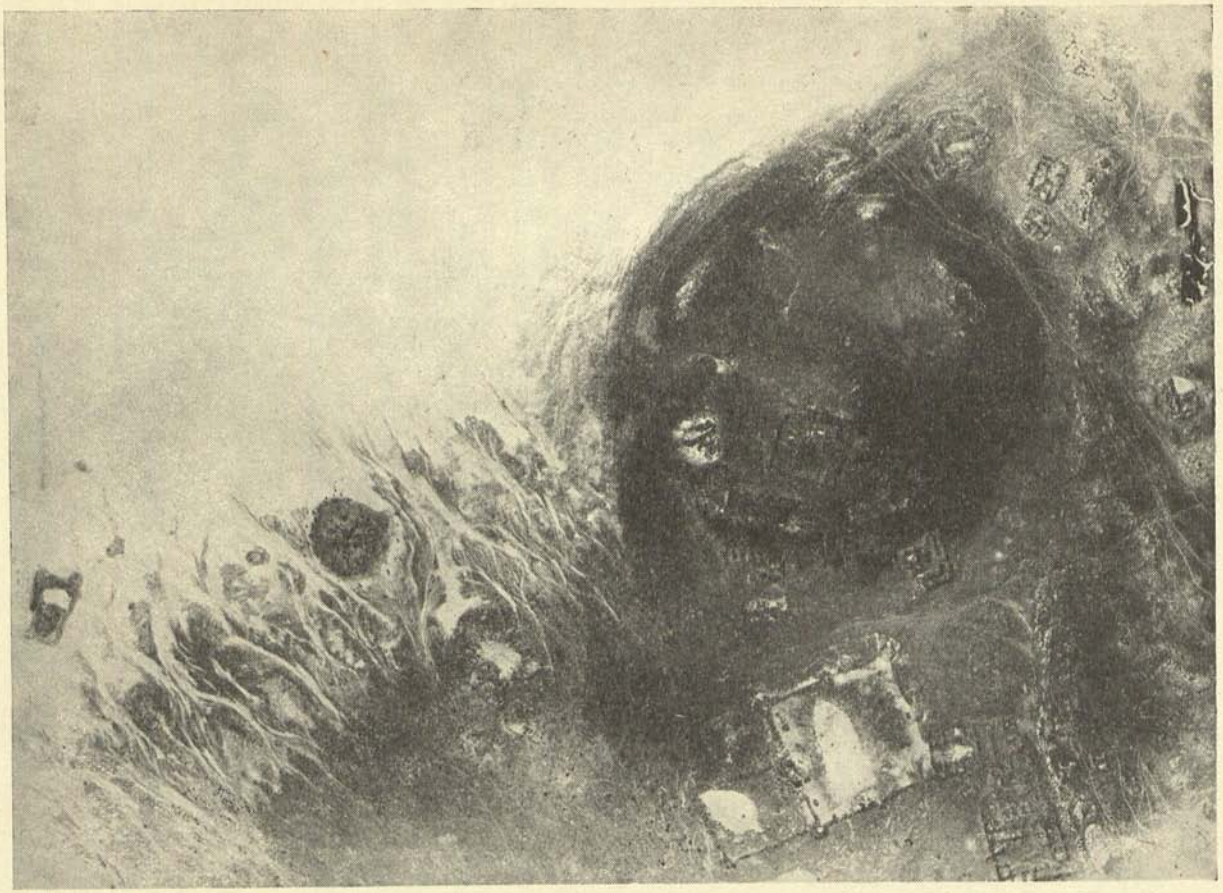

FIG. 6. — CASTELLUM AT GEBEL SEYS. — AERIAL PHOTOGRAPH TAKEN AT AN ALTITUDE OF 1,400 M. AT 9 A. M. ON JULY 18TH, 1927. — DOCUMENT USED FOR DRAWING THE PLAN.

plate is then projected on the screen, and moved until the photographic image and the graphic image of the base (1) coincide on the screen. This process corrects the photograph's deviation from the horizontal and at the same time adjusts it to the required scale.

This is an extremely practical method of expressing the results of a survey in the form of plans.

In the case of surveys carried out in regions too remote to make it possible to return to them on the ground, sites invisible from the ground have been measured by photographing from the air the convoy plane at rest on the ground within the field of the photograph. Thus, in 1930, the width of the road from Palmyro to Hît was measured, although its lateral borders became invisible at a low altitude. The airplane, whose dimensions are known, thus becomes either a linear base, if it is photographed at an angle, or a four-point base which can be used to reduce the photograph to scale, if it is photographed vertically.

In practice, with the aid of measurements taken on the ground in the course of ground surveys following aerial studies, specialists in this method of photogrammetry are able to produce plans of exactly the desired degree of accuracy.

The services rendered to archæology by these rapid and accurate methods of map-making are obvious. In the course of a single flight of a few hours, the plan of several ancient sites can be established—a task which would keep a party of surveyors busy for months. The excavator provided with a properly prepared aerial plan has constantly before his eyes a means of directing his search in the midst of the complicated or barely perceptible surface undulations which reveal the traces of an ancient city or settlement.

9. *Survey of a lacustrine or submarine site.* — The search for ancient remains under water can be carried on with the aid of divers, without, or, better still, with diving-suits; but the information obtained by these methods is not sufficient for an exhaustive study. Three methods, which it is often useful to combine, permit of systematic investigation.

a) *Aerial photographs.* — This method is similar to the taking of land views from an airplane. However, the difficulties are greater in this case.

Viewed from above, the surface of sea-water offers obstacles to visual observation and to photography which make the problem delicate and arduous. Submarine visibility is conditioned by the lighting and the degree of humidity

(1) It is, of course, the four points of reference that are made to coincide.

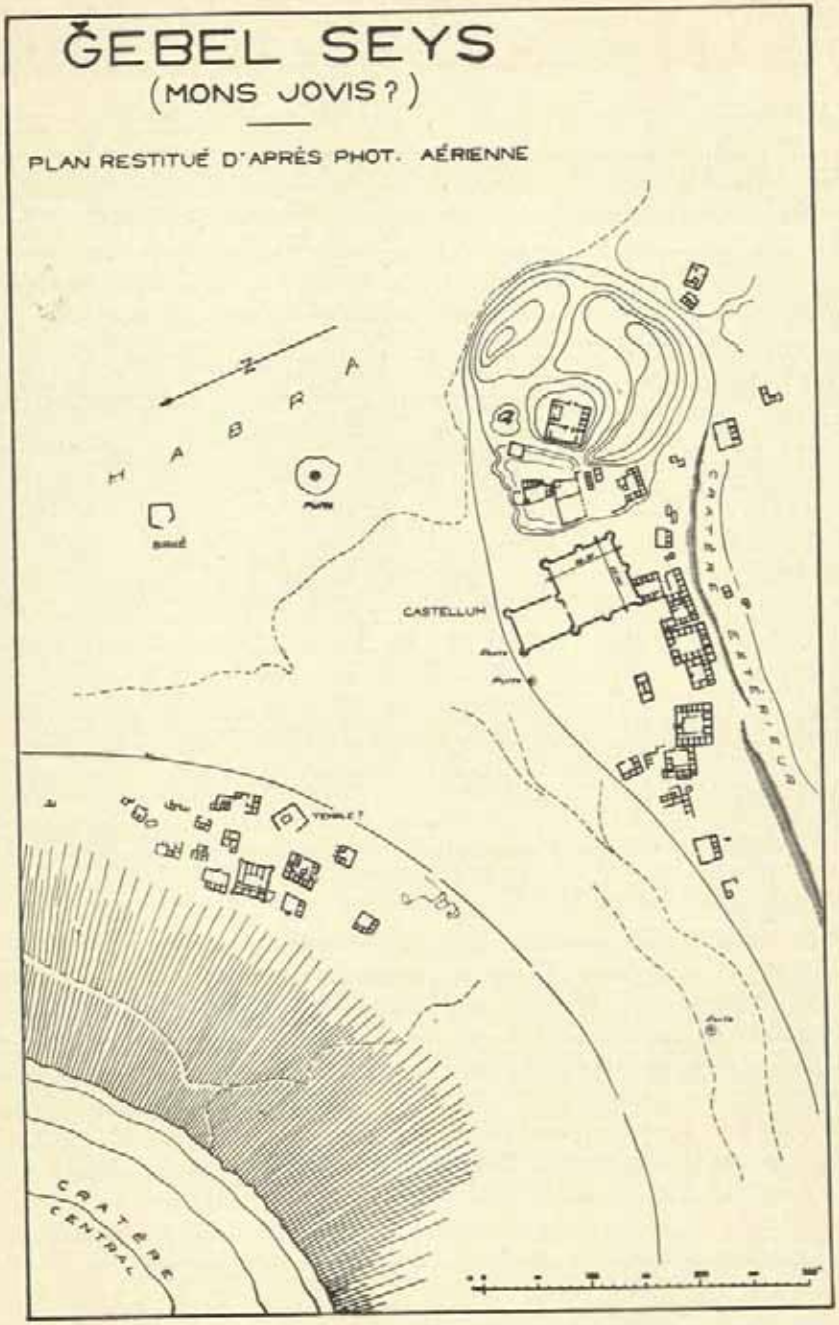

FIG. 7. — CASTELLUM AT GEBEL SEYS. PLAN BASED ON THE AERIAL PHOTOGRAPH.

of the atmosphere, by the colour of the bottom, and especially by the degree of surface calm and by the degree of transparency of the water.

Aerial views taken either at an angle or vertically at different altitudes makes possible an effective examination of the sea bottom to be studied. Enlarged and located by means of a marine chart, these views prepare the way for further investigation by the diver. It was a survey of this sort that led Father Poidebard to undertake his study of the port and roadstead of Tyre.

b) *The "Caulker's Bucket-glass"*. — On the coast of Syria, the sponge-fishers make use of an optical instrument which is both simple and excellent. They take a petrol tin, a *téneké*, and remove the top and bottom, leaving only the four vertical sides. When the lower part of this instrument is plunged vertically into the water, a perfectly still water surface is obtained within it, so that the eye is able to discern objects to a depth of 13 to 15 metres.

It is possible to photograph the sea-bed by means of this instrument, known as the "caulker's bucket-glass". A similar apparatus is manufactured for sale, and can be fitted with either an ordinary or a stereoscopic camera. Photographs can be obtained at a depth of 8 to 13 metres. It is necessary, however, to take only vertical views. Any deviation from the vertical would result in a marked distortion of the objects examined. Even the interpretation of vertical photographs is not without difficulty and calls for considerable experience.

The caulker's bucket-glass is also useful in guiding and supervising the movements of the diver below water.

c) *Photographs taken on the Sea Bed.* — For these studies, a submersible camera has been perfected, which enables the diver to take horizontal views under water.

As the photographs must be enlarged for purposes of study, it has been found that the most practical type of camera was a water-tight box containing 35-millimeter cinema film, and provided with a high-grade lens.

One rather serious difficulty to be overcome in the photographing of underwater remains by the diver is the necessity of first freeing the objects to be photographed from the submarine vegetation or the sea-shells which have covered them, not to mention the sand in which they may be embedded. The most practical means of dealing with this problem is to use the miner's drill.

In a very thorough exploration, a preliminary survey may be made by taking various views of the site from an airplane. The next step, after locating on a marine chart the areas to be examined, is to take vertical views by means of the

bucket-glass. Finally, having determined precisely what points are to be studied, the diver may be sent down, guided and supervised by means of the bucket-glass, to clear with the miner's drill the portions to be photographed; after which, the diver takes horizontal photographs with the submersible camera.

The diver may measure blocks and sections of wall. His measurements can be followed through the bucket-glass if he is provided with a rigid metal measuring-rod painted white with black graduations. The chief diver—generally a spongefisher capable of diving to a depth of 12 metres and remaining under water a minute and a half—signals his findings to the observer in the boat, by means, for example, of a communication cord.

The bearings of the interesting points noted by the diver are immediately taken by the person in charge of operations, by means of the sextant or the hydrographic protractor. A numbered buoy is moored at the spot so that it can be rapidly located again. The point is marked on the marine chart.

It is by these methods that it was possible to solve the problem of the Egyptian harbour at Tyre, thus closing a controversy that had been going on for more than a century.

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The examples cited in this chapter have been taken chiefly from investigations carried on in the countries of the Near East. We are not unaware that similar experiments of the greatest importance have been made in other regions. One notable example is the aerial survey made by the Egyptian Air Force, which proposes to concentrate its efforts on the desert area.

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Lastly, mention should be made of a novel and interesting method applied in Sweden, where phosphates were analysed in connection with the survey of dwellings belonging to the Neolithic Age. It is possible, with the results of these analyses, to determine the centre and boundaries of ancient sites.

CHAPTER III

MATERIAL ORGANISATION OF EXCAVATIONS

The practices involved in the organisation of personnel and the division of duties for an archæological project or mission differ in detail for the various countries and institutions engaged in that type of research. There is considerable similarity, however, in the broader aspects of the methods employed.

In almost all countries where excavations are made, the director of the mission is chosen from a group of trained men, professional archæologists, and preference is given to one who is thoroughly familiar with the archæology of the region where the work is to be done. If he is not actually acquainted with the field he should at least be thoroughly versed in the literature concerning it. The director may be from one of the scientific institutions, museums, universities, or governmental departments or, in very special cases, a person without official position, but one who is qualified by preparation and experience to assume such responsibilities.

It is the duty of the director to see that all necessary permits or licences are, or have been, secured; that all contracts are properly executed; that agreements are made with the owners of the land if the site or station is on private property; and to make all plans for the conduct of the excavation. This includes the providing of essential equipment such as tools, instruments of precision, cameras, preservatives for artifacts, containers for specimens, boxes in which to store and ship them, journals or diary books, various forms of filing cards for keeping the records, albums for photographs (both the negatives and the prints), in fact, all supplies that will be required during the progress of the work. The director must also solve the problem of a camp and headquarters for the staff, frequently that of a camp for the workmen as well. The director determines the size of the staff necessary for the proper conduct of the work and the number of labourers to be employed. These factors are governed by the scale of the project and the funds available for the work. Very often, the excavations are of such a nature that the director needs only one assistant, or may himself

constitute the entire staff and carry on the investigations with a group of from ten to fifteen workmen. On the other hand, there are excavations where the director must have a corps of assistants and a large number of labourers. This is particularly true for missions in Egypt, Palestine, Mesopotamia, and other Old World fields.

When the director undertakes to recruit the personnel for his field assistants, he applies to the colleges and universities where there are departments for the training of students in the theory and practice of archæological procedure, to staff members and apprentices in museums, and to men who have served in minor capacities with previous expeditions. It is sometimes necessary to take men with little or no training and give them preliminary instruction, then supervise them closely in the field until they have gained sufficient experience to carry on their duties by themselves. This is not so satisfactory as having men prepared to do the work when they take to the field, and to guard against such contingencies novices or apprentices are frequently added to the staff of an expedition in the capacity of assistants to the trained assistants and are thus prepared to fill more responsible positions when the need arises. The advantage of having assistants properly trained in advance for the duties they are to perform is readily apparent. The director is thus freed from numerous small, although important, details and is able to devote his entire attention to the tasks requiring his personal supervision. It is even possible for him to delegate some of the preliminary preparatory work, such as the purchase of supplies and assembling of equipment, to one of these assistants.

When recruiting his staff of assistants, the director usually chooses them with a view to the performance of definite duties. The customary practice is to have one or more men qualified to direct the actual excavation; one or more versed in the care and preservation of objects; epigraphers when there are inscriptions or glyphs to be deciphered; anthropologists (physical anthropologists or anthropometrists in the restricted sense of the term used in some countries); a geologist, a surveyor, a photographer, draughtsmen, a recorder or scribe, and experienced foremen to have immediate control and supervision over the workmen.

In many cases, various duties may be combined and assigned to a single assistant; this is especially true for small missions. The director generally performs some of the special tasks in addition to his other functions. On many missions it is necessary to have an inspector or agent representing the Government of the country where the excavations are being made. He is assigned to

the party by his own Government and sees that the work is carried out in accordance with the permits and contracts, but has no say concerning the technical conduct of excavations. He also serves as an intermediary between the mission and the local authorities and people.

At the scene of the excavations, the director, if it is the beginning of a project, chooses the location for the camp and headquarters. This may be in a village where houses are available, but if it is necessary to erect quarters for the mission he supervises the construction with due attention to the matters of comfort, convenience, and sanitation. Many expeditions use tents, but under certain conditions and when the work is to last over a period of years more permanent quarters are erected. (This question is dealt with more fully in Chapter VII.) When the mission is properly housed, the plan of procedure is drawn up, or, if it is a continuation of work already under way, it is explained to and discussed with the staff. They are informed of their duties; the labourers are hired and assigned to various gangs and categories of work, and the excavation is started.

Arrangements are often made for supplementary assistance by men who may not be attached to the mission or who do not actually visit the scene of the excavations. They pursue their studies in a laboratory or museum. Included in this group are zoologists, who identify the bird and animal bones from an excavation; palæobotanists to study samples of earth from the site and explain the significance of such fossil plants, seeds, or pollens as may be present; invertebrate zoologists and palæontologists to examine fossil shells, etc.; chemists to determine ingredients used in pigments and in the manufacture of certain kinds of objects, even the extent to which bones are decalcified or fossilised and the degree of antiquity indicated by their condition; technologists to help determine how things were made, perhaps to locate the sources of many of the materials used in manufacture; geographers to explain the natural environment and climatic conditions under which the people lived; petrographers to identify and name the kind of stone of which implements and other objects were made; and, lastly, astronomers who help by determining celestial and mundane forces which affected the destinies of mankind.

Where large groups of labourers are employed, most directors draw up a set of rules and regulations to cover the duties of the foremen and the workmen and insist upon very strict observance of them. In the case of a division of labour into several grades it is frequently customary to pay varying rates of wages and, as men become proficient and exhibit a zeal for their work, to promote them to higher grades and better pay. Unusually industrious labourers

are sometimes rewarded at the end of the week with a small bonus. This practice stimulates other labourers to greater efforts in order that they too may receive the extra wages and possible promotion. It is also customary to pay certain fixed rewards for the discovery of some classes of artifacts and for complete or undamaged specimens. This emphasises the need for careful work and will give the men further incentive to be on guard against unnecessary breakage (1). The type of objects for which such rewards are paid depends entirely upon the work being done and the nature of the objects found. Sometimes it becomes necessary to reduce the amount of the reward because of the large number of objects found and the consequent drain on the mission's finances. These are all factors that the director must determine from time to time and cannot be governed by hard and fast rules.

The differences in the actual details of personnel organisation will be best illustrated by the following summary descriptions of missions which have conducted excavations and of those at present engaged in such work.

In the United States of America, most institutions follow the same plan. Each museum, research institution, or society has a regular staff of men who are specialists in various fields. The director chosen for a particular project is the staff man who is an expert on the area where excavations are to be made. He chooses his staff from students who frequent his museum or the organising institution.

The National Geographic Society's Pueblo Bonito Expedition, excavating in the Chaco Canyon, New Mexico, had the following organisation: Director, Mr. Neil M. Judd, Curator of Archæology for the U. S. National Museum, Smithsonian Institution, who supervised the work as a whole, handled all specimens, exclusive of ceramics, kept the general journal or diary, the field catalogue or register of objects, and a set of notes on all phases of the work. He had a secretary to aid him in the performance of his numerous duties. There were two assistants who devoted their whole time to supervision of the excavations and such restoration and preservation of masonry as was necessary. Two assistants were in charge of the ceramic problem, including the making of stratigraphic tests in refuse mounds and other parts of the site to determine the sequence of types as well as the study of the pottery itself. One assistant was in charge of all equipment, tools, automobiles, camp materials and the commis-

(1) This practice is not approved by all excavators. Various objections will be found in Chapter VIII. See also the remarks on this point in the Introduction.

sary with the attendant purchase of supplies, and also attended to the general administration of the camp. There was a surveyor-draughtsman; an architect to study the types of construction, prepare diagrams of the various features and draw reconstructions of the buildings; and, lastly, a photographer. Other specialists served from time to time in working out the problem of changing climatic and topographical conditions and their effect on the former inhabitants, in determining what their food supplies had been, and in applying dendrochronology as a means for dating the site. Each member of the organisation kept a series of notes on his part of the work to augment those made by the director. When possible, and whenever the qualifications of the men warranted it, the staff duties were rotated in order that the assistants might gain more experience and have a broader understanding of the project. The workmen, Navajo and Zuñi Indians obtained from their reservations in New Mexico, were divided into several groups: there were masons, each with an assistant, to patch and repair walls; the main diggers; pick and shovel clean-up men to remove the débris from around the buildings and to clear away the dumps; wheel-barrow men; teamsters with scrapers; and the men who filled and tipped the light railway cars.

For its project at Chichen Itzà, Yucatan, Mexico, the Carnegie Institution of Washington was represented by Dr. S. G. Morley, who served as the director. His staff consisted of a chief assistant, an assistant in charge of each unit of excavation, a supervisor for the restoration of buildings, an epigrapher (Dr. Morley did most of this work himself, however), an architect, a surveyor, artists to copy in colour the frescoes and murals and make studies of the various cultural elements therein depicted, a photographer, an engineer in charge of all equipment, a housekeeper to administer the staff headquartors and, as a trained nurse was always obtained for this position, she also had charge of the infirmary. The labourers, divided into groups, were local natives, Maya Indians, secured at first through the heads of nearby villages, later by direct bargaining between a staff member chosen for the purpose and the natives themselves. There were also a head mason and a gang of masons, each with an assistant, besides the diggers, the wheel-barrow men, men to haul away the débris in carts or trucks, and a group of men to clear away the trees and brush covering the portions of the site to be investigated and to keep excavated areas from growth.

As an example of the small type of expedition, the Smithsonian Institution excavation at the Lindenmeier Site in northern Colorado may be noted. The entire party consisted of twelve men: the director from the regular staff, a

surveyor and draughtsman also from the regular staff, a geologist, eight students from departments of archæology in various universities, and a cook. Supplementary assistance was given in the Institution laboratories by zoologists, palæontologists, palæobotanists, and invertebrate palæontologists. The site is one where some of the oldest materials yet found in America have been obtained and extremely meticulous work was required. The eight students were all qualified to serve as assistants on larger expeditions, yet did the actual excavating. They kept independent notes concerning all phases of the work and thus amplified and furnished a check against the notes of the director. The latter kept the general diary, specific notes, made drawings of the stratification of deposits, took all photographs, kept the field register, and administered the operation of the camp. Progress under such conditions is not rapid, but the results are extremely satisfactory.

The Tell en-Nasbeh expedition in Palestine, under Dr. William Frederic Badè, director of the Palestine Institute of Archæology of the University of California, was organised along lines somewhat similar to those discussed above. During the 1932 season, the personnel and duties were as follows: The director, who was the epigrapher of the expedition and had general supervision of the entire project; the directress, who acted as curator of beads and jewelry and managed the staff headquarters; the chief recorder, who supervised the cleaning of specimens and determined the order in which the objects selected for record passed into the draughting room; two draughtsmen to make drawings of objects for the record; the scribe, who wrote the description of the objects; the photographer; the surveyor; the field recorder, who numbered the structures, tagged the baskets of artifacts, kept tally of the workmen and made cross-sections of structures as needed; and the consulting architect. There was a secondary corps of assistants, composed of from five to seven skilled Egyptian foremen, and an experienced Egyptian restorer. The excavation crew was divided into gangs, under the direction of Egyptian foremen, consisting of pickmen, basket-fillers, and carriers. A few were employed as watchers on the dumps to scan the débris from the baskets as it slid down the slopes and thus make sure nothing had been missed. In general, several gangs were used, but at times all were combined under the supervision of one foreman.

During his excavations at Samaria, Dr. George A. Reisner, of the Harvard University Expedition, had the assistance of an architect and a recorder; Egyptian overseers, photographers, and household servants. The labourers were drawn from nearby villages. The crew was divided into nine regular gangs,

each gang being under the supervision of three Egyptians. An occasional tenth gang, under the direction of one Egyptian, was employed for all of the heavy stone work, such as breaking down walls, the carrying of stones, and the building of retaining walls. The regular gangs varied in size and comprised from three to five pickmen with one or two Egyptians; five to eight hoemen with one or two Egyptians; twelve to twenty-five basket-carriers, usually with four Egyptians, including the head overseers, directing the carriers and keeping the lines moving.

During two centuries of uninterrupted labour at Pompeii and Herculaneum, Italy has had an opportunity to develop and perfect elaborate systems for excavation. The organisation of personnel at Pompeii has been developed to the following:

1. Chief of the work.

2. Assistant.

A. Squad of workmen assigned to the excavation; chief of the squad; pickers; basket carriers; labourers operating light railways. A time-keeper attends daily for the first signallings to the assistant or to the office of direction.

B. Cleaning squad for removing vegetation from the streets and the interior of the houses.

C. Squad of masons and their helpers. They do the work of ordinary maintenance, of consolidation and of restoration under the direct supervision of the chief of the work.

D. Squad of plasterers assigned to the care of the walls and of the plaster.

E. Squad of keepers of the paintings and mosaics.

F. Blacksmiths and masons.

G. Storehouse-keeper for the deposit and removal of dockyard materials.

H. Technicians for the restorations and for completing the plastic model of Pompeii.

I. Draughtsmen and photographers.

J. An assistant to edit the *Journal of Excavation* and *Journal of the Works.*

K. Those in charge of the transcription of the archæological material in the little inventory book, and for its assignment for deposit, and for consignment

in part to the edifices whence it came, in part to the Pompeian Antiquarian Museum or to the storehouses for deposit.

In Ireland, excavation work is carried on by the National Museum, by the Office of Public Works in collaboration with the Museum as a part of a country-wide scheme for the relief of unemployment, and by parties engaged in so-called "rescue" excavation. For direct supervision of the Public Works excavations, the State has relied upon the assistance of official, private, native or visiting archæologists, and, besides contributing toward their expenses, it has in some cases supplied them with the services of promising students who have been paid either at foremen's rates or have been given honorariums. The supervisors have undertaken the work of recruiting the ordinary labour locally from the Labour Exchanges and the workmen are paid by the State. Some of the students, after obtaining sufficient experience, have been put in charge of separate excavations. By this means it has been possible to build up a promising native "school" of archæology. The "rescue" excavations, pertaining to the saving of antiquities disclosed in the course of agricultural or industrial work, are carried out by the staff of the National Museum of Ireland or are entrusted to competent archæologists resident in the locality of the find.

In India, officers who are delegated to undertake independent excavation are given special training before they begin their work. Until a few years ago, archæological apprentices were recruited to receive training in excavation and allied subjects so that they would be prepared to direct such work, but the practice had to be suspended owing to lack of funds.

In Poland, as in other countries, the extent of the researches determines the number of the personnel of an archæological mission. There may be one or several persons. The direction of the work is assigned to professional archæologists, such as professors of archæology in the different universities, their assistants, to directors of archæological museums and archæological sections of museums of more general character, to assistants in museums, and in exceptional cases to persons possessing the necessary qualifications but not attached to any institution. Sometimes, advanced students of archæology are appointed to direct minor researches. For the actual conduct of excavations in Poland, students who have just commenced their studies in archæology or volunteers working in the different museums are employed.

In Mexico, the exploration of a site is entrusted to an archæologist of the Department of Monuments or to the archæologist whom the institution or indi-

vidual holding the permit or concession for exploration may designate. In the latter event, however, the archæologist has to be approved by the Department of Monuments. The number of technical aids employed on an excavation depends upon the size of the project and the number of workmen to be employed. At Monte Alban, the organisation consisted of the archæologist in charge, four archæological assistants, one anthropologist, and one draughtsman. The crew consisted of 120 men. A majority of the men who have worked in the zones at Teotihuacan, Chichen Itzà and Monte Alban have spent at least five years in the same zone and have specialised in certain branches of archæological research. Some are assigned to the working out of staircases, others trace foundation walls or work in the upper structures of tombs, others excavate in the wells and caves for stratigraphic evidence, etc. The archæologists who have worked as technical aids have been trained in the field, as a rule, although some of them have studied in a university or museum. As in other countries, the director of an archæological project calls upon other technicians to make special studies and do definite tasks. In this group are anthropologists, architects, topographers, photographers, draughtsmen, etc. Also, where the total study of a region has been undertaken, as at Teotihuacan and Chichen Itzà, the archæologists have cooperated with the historians, ethnologists, philologists, medical men, biologists, geologists, etc., in order to establish a complete cultural picture of the area.

The practice in Sweden is to place a member of the Museum staff or an expert archæologist in charge of the work to be done. Where it is a question of an ordinary excavation on a small scale, only one specialist is detailed for the work, but he is often assisted by archæological students. For more extensive excavations, the director has a staff consisting of a preparator, a specialist in anthropology or zoology, and several students in archæology. Students of archæology preparing for their University degree are required to take part in scientific excavations. These are carried on either under the auspices of the professors or under trained men from the museums.

CHAPTER IV

TECHNICAL METHODS OF EXCAVATION

In this chapter, in which a description of the different methods and technique of excavations will be given, there can be no question of examining all the conditions of practical application which are primarily determined by the location of the site and the purpose of the excavation. Reference should therefore be made to the series of studies recently started in the review *Mouseion* and dealing with specific cases. Needless to say, these examples will not by any means exhaust the variety of cases that will arise in the course of the excavator's activities, but in one or other of their aspects they will certainly be of a nature to determine the choice of a technique which, of course, can be adapted to the peculiarities of the case. The sole aim of this chapter, therefore, will be to review the main features of certain universally adopted rules, the value of which has been confirmed by the experience of excavators in every country and whose efficacy has been proved in practice, especially as regards the documentary requirements of research.

In order to emphasise the general character of the problems that will here be discussed, the various points have been classed under equally broad headings.

Stratigraphic excavation. — The system of stratigraphic excavation is universally adopted by excavators whenever they have to deal with an archæological site in which there is a relatively shallow deposit of soil and few superimposed strata representing historic or prehistoric periods; or whenever their investigations must be carried down from the ground level of a building brought to light to deeper layers of the sub-soil, either: *a*) in order to examine the foundations of this building and the strata of the corresponding period, or *b*) to discover traces of earlier buildings and archæological beds.

This system is adopted at the very outset of any serious exploration work, for the preliminary examination of the site and its archæological character involve the digging of trenches and shafts in vertical stratigraphic sections,

with a view to ascertaining the nature of the terrain and the depth of the archæological layers.

Stratigraphic excavation ends at the layer where there is no longer any trace whatsoever of past work, or, to be more precise, (for barren layers can alternate with archæological layers), it comes to an end when the zone of virgin soil that has never been touched by the hand of man is reached.

The method universally adopted is as follows: As soon as it has become possible, by means of a more or less extensive vertical section, according to the special features of the site and the aim of the excavations, to determine the nature and number of the layers, work proceeds by horizontal sections that closely follow the plane of each bed.

Passing from the sphere of geology and palæontology to that of archæology, stratigraphic excavation can well claim to have imparted fresh life to research of this kind and multiplied its possibilities; for, taking as a starting-point a given building or a given period, it makes it possible to exhaust the archæological study of the site, from the most recent historic events that have there taken place back to the evidence of the most remote proto-historic and prehistoric ages.

Applied first of all by archæologists, naturalists and geologists for the study of prehistoric civilisations—where the association of geology and archæology is closer and more direct—the method and technique of stratigraphic excavation have gradually been extended to the exploration of cities, shrines and burial grounds; it has, above all, become the generally applied rule for the study of cities which, from the standpoint of history, were the most important in the times of antiquity. In this respect, highly significant and instructive instances can be cited: the stratigraphic excavations at Troy, undertaken by Doerpfeld; the stratigraphic excavations undertaken for the first time by Boni in the Comitia area of the Forum at Rome, the importance of which is well known in the study of early Roman history.

It may therefore be said that a considerable part of the scientific interest attaching to archæology in acquiring knowledge of the oldest civilisations and the still obscure problems of the past is the result of the practice and method of stratigraphic excavation. Stratigraphic exploration can furnish the solution for problems which would not always be solved by surface exploration.

Although the method is unique and general, however, its aims and possibilities of application are varied.

The stratigraphic method and the excavation of monuments. — Stratigraphic excavation has proved itself particularly valuable and fruitful in the excavation of cities (dwellings and monuments), especially in cases where the buildings have been preserved at a certain level, e.g. Ostia, Pompeii and Herculaneum. Even when the upper parts of a building, the upper storeys of a dwelling, loggias and projecting balconies are discovered in a state of ruin, on the point of collapsing or in a state of extreme instability, it is possible, thanks to the method of exploration in horizontal layers, to identify, reconstruct and restore to their original positions, the elements of support, ornament and architecture which, with the old system of borings by vertical sections, would have been irretrievably lost and mixed with the soil dug away. In such cases, stratigraphic excavation is the condition *sine qua non* for the execution and justification of a restoration; in other words, excavation proceeds *pari passu* with the work of preservation and re-assembling. Wherever restoration work is necessarily slower, excavation is suspended in order that skilled workmen may have an opportunity of terminating the delicate work of reconstruction and reinforcement. In short, the renewed vigour that characterised the excavation operations undertaken at Pompeii, Herculaneum and Ostia was due to the application of the method of stratigraphic exploration, conceived as a means of arriving at the fullest possible utilisation of all the structural and decorative elements that had remained buried under the ground.

This system of stratigraphic exploration as applied to superstructures may be designated by the term "surface or sub-aerial examination" as distinguished from stratigraphic excavation below ground.

The technique of "sub-aerial" stratigraphic excavation is also a technique of restoration. It necessitates extensive work in the matter of the shoring, retaining and consolidation of the weak parts of a building in order that the delicate work of re-assembling the superstructure may be undertaken; to avoid the danger of destruction and collapse more serious than that due to age or to seismic and volcanic upheavals, woodwork, door-openings, angles of walls and piers must be solidly shored up. For example, at Pompeii, and still more so at Herculaneum, the substructure had to be underpinned in order to support, repair and strengthen seriously deteriorated and sunken walls which made it impossible to continue the excavations without danger to the workmen and, still less, to raise or load other parts of the structures.

Difficulties of this kind have been encountered more particularly at Herculaneum, where the shafts sunk during earlier Bourbon excavations and the con-

tinual vertical and lateral thrusts of the soil give rise, at every step, to physical and mechanical problems even before those of an archæological order. Consequently, stratigraphic excavation is carried on concurrently with vertical digging and the indispensable work of reinforcement and restoration, giving rise to a multiplicity of situations, solutions and contrivances which it is impossible to classify and determine in advance. Such operations require: *a*) enlightened, rapid and methodical technical supervision, sufficiently flexible to adapt itself to an infinite variety of cases; *b*) qualified and well disciplined workmen ; *c*) ample resources and facilities on the site. It is because these requirements have been met that, during the eleven years spent on the excavations at Pompeii and Herculaneum, not a single serious accident has occurred among the field gangs.

Stratigraphic excavation below ground. — It may be taken for granted that stratigraphic excavation commences at the moment when the work of clearing the ground in which a building, or the paving of a highway lies buried, comes to an end. In fact, immediately a paving-stone is raised or an area of beaten and compressed earth is disturbed, stratigraphic excavation begins, whether the scene of operations is the site of a city, a temple, a public or a private building. It is at this stage that the most delicate part of the work has to be undertaken, the work that most engages the responsibility of the excavator and which might be called the advanced surgery of excavations. And, as in the case of a surgical operation, it is the stage that calls for the maximum of material aid, combined with the personal, physical and moral devotion of the excavator. Underground explorers are not born, they are made (1). An excavator must join in the work of his men and handle the pick, spade and scraper, in the dampness of the trial shafts, wells and trenches. Preliminary data concerning the stratigraphy of the site should be sought from the local peasant or from the clandestine despoiler of burial grounds. To acquire a technique, it is necessary to have training, a personal aptitude for research and understanding, to be able to work patiently for hours on end crouching over a few square feet of ground. For it must be borne in mind that stratigraphic excavation is not only the mechanical application of a method, simple and straightforward in itself, but also expresses intelligence, intuition and penetration of facts, very often of infinitesimal vestiges of facts. A person who undertakes this work other than in a wholehearted spirit of zeal and self-denial will be unfit to face the problems of stratigraphic excavation;

(1) See Chapter XII on the technical training of excavators.

he must confine himself to the already vast and complex field of "surface" exploration, where the object of examination and study offers itself more or less intact to our observations and the observations of others. Stratigraphic excavation, on the contrary, inevitably involves the destruction of the area examined and consequently places on the shoulders of the excavator the gravest responsibility of his mission.

With regard to the study of the older parts of a given monument or given area, it is necessary that the excavator should possess an extensive knowledge of materials and building construction. Past experience proves that the most complete, the most accurate and the clearest results have been obtained when the excavator combined the qualities and experience of the archæologist and the engineer, of the scholar and the technician, or when he was able to secure the collaboration of an architect specialised in the study and knowledge of ancient buildings.

The simplest way to examine the buried portions of ancient ruins (foundations and earlier buildings) is to undertake a stratigraphic exploration in short lateral sections along the flank of the building. If other ruins exist, the sections are extended horizontally above the remains, penetrating farther into the untouched area until virgin soil is reached. For these *sondages*, it is a good plan to utilise existing shafts and excavations, care being taken to clean and clear the surfaces until the stratification is disclosed as it must have stood when these shafts or excavations were first formed.

The passage from vertical sections to the removal of horizontal layers furnishes an opportunity to quote the recommendations formulated by Boni in 1901 — the date of the first discoveries in the Comitia area:

"The exploration of a given stratum should be as exhaustive as possible, the soil dug away and any fragments which might cause confusion removed from the site. The cutting away of the layer below should not be started until the whole of what remains of the upper layer has been carefully scraped, brushed, and damped with a sponge. The lumps of earth in each layer should be removed and characteristic material carefully selected and washed in a tub of water; minor objects should then be wrapped in strong paper and packed in a small box, with detailed notes as to the position and level at which they were found. These boxes are the stratigraphic records of the exploration".

By following this programme, Boni succeeded in identifying and distinguishing as many as twenty-three layers below the Comitia area, including the metalling and the layers that had been successively formed throughout the ages.

When there is no possibility of removing portions of buildings and of digging, by stratigraphic excavation, horizontal sections, the superstructure must be shored up and consolidated and vertical sections cut in small stages with scrupulous care, the work being rigidly controlled by diagrams. This procedure will have to be adopted more particularly when a date has to be assigned to a structure of great historical and archæological importance. Boni, for example, was obliged to shore up the *Lapis niger* in this way before being able to cut any vertical sections below.

In addition to the special cases of buildings and monumental groups, stratigraphic excavation has for some time past been more extensively adopted for the unearthing of cities as being the only means of studying and understanding the urban development of a great civic centre. The problem is still somewhat obscure but its interest is growing day by day. It is, for instance, thanks to this method, applied to the sub-soil, that we now know that there was a republican Ostia next to the imperial city of that name; similarly, at Pompeii, stratigraphic excavations made it possible to recuperate material and votary columns, dating from the VIth and Vth centuries B. C., belonging to the Greek temple and the Temple of Apollo; to glean information as to the original plan of the Forum; to discover a long strip of the old city wall, with portions of its bastions and gates. Even if complete agreement is not reached as to the interpretation and significance of finds, the documentation relating to the excavations will always be available; further finds and fresh data will come later to dispel controversies, shedding light on some more or less complex questions and on more or less misleading theories.

It is obvious, however, that in the case of cities such as Ostia and Pompeii, of monumental sites like the Acropolis at Athens, the Roman Forum and the Palatine Hill, stratigraphic exploration must not be undertaken to the permanent detriment of the visibility of, and access to, the better preserved monuments of later times; these must not be isolated by excavating and cutting up the surrounding ground by a network of trenches, pits and shafts. An accurate survey of the sub-soil and surface, considered with the actual requirements to be met in the matter of preservation and circulation, will give the explorer a good indication of the spots he should select for his *sondages*, those that should be filled in afterwards and those that should be left permanently open, not only with a view to placing documentation at the disposal of the scholar, but also to enable the

public to view and analyse from its very origin, a monument, an architectural group of buildings or a city (1).

In research of this kind, and especially when it is undertaken by young excavators, it is impossible to over-emphasise the necessity of collecting the most thorough and accurate graphic documentation possible, or to over-estimate the patience required for such work. Work of this description can scarcely be done with the aid of more than one or two workmen, chosen from among the most skilful and the most experienced in site surveying. When a doubtful case arises, and this may happen at every moment—assigning of an object to one particular layer rather than to another; disturbance of layers and introduction of some foreign object which upsets its aspect and character—the conscientious excavator should not rely solely on his own judgment; if possible, he should consult his colleagues, even those of less authority, for, in many instances, the concentration needed in observation work and the more or less preconceived ideas that each contributes to research and to the progress towards a given scientific goal, are the main causes of extraordinary miscarriages or distortion of judgment.

When dealing with sites of special historic and archæological interest, particularly when it is not easy to fall back on the judgment of others, the feeling of responsibility incurred advises us to leave unexplored certain parts of a stratified site, and to leave a trial excavation open and accessible, so as to permit of checking and verification, both for the excavator himself and for others that may follow. For it occasionally happens that when excavation operations are resumed, or when the time comes to draft scientific reports, the excavator is obliged to re-examine diagrams and sections on the spot, to carry out further trial diggings for the purpose of checking the result obtained in the course of partial initial investigation.

Stratigraphic exploration of pre-historic sites. — The stratigraphic method calls for the strictest and most scrupulous application when it is a question of exploring open pre-historic sites or caves, in dry ground or, when practicable, in marshy and lacustrine areas. The mere fact that, in these instances, excavation operations have to be carried through to the complete exhaustion of the anthropozoïc archæological bed without it ever being henceforward possible to check

(1) See Chapter X for a general exposition of the organisation of excavation sites in the interest of research and education of the public.

over and revise the data, and also the fact that the greatest uncertainty, the most serious gaps and the most conflicting opinions exist regarding the evolution and trend of the different phases of civilisation in certain regions, demand that the palæoethnologist should have had a thorough training, possess a keen understanding of his responsibilities, be able to exercise the closest surveillance of the work and, if he can do so, free himself from his personal preconceived theories when confronted with the object of his research. He should therefore set a true value on his own sense of judgment and study when exploring a fossil bed or geological stratum, and should not hesitate to call in the assistance or, as is frequently necessary, the direct scientific collaboration of geologists and palæontologists whenever desirable.

The method of stratigraphic excavation has been adopted by many excellent practitioners and has given invaluable results in the vast sphere of the pre-historic European civilisation, from the lacustrine fortifications and dwellings of Ireland (1) to the neolithic beds of the Minoan palaces of Crete; from the excavations of tumuli, which the Swedish School of Archæology is undertaking, collecting the most detailed information on geological formation and the changes in climate that have taken place since the post-ice age, to the piles on which the lacustrine villages of Switzerland and Italy were built. An illustration of what can be disclosed by carefully executed stratigraphic exploration is furnished by the impression that the curators of Leyden Museum succeeded in taking of the shape of a prehistoric tumulus, thanks to the different colouring of the soil due to the timber framing of the original structure (2).

Exploration of lacustrine sites. — The stratigraphic exploration of lake settlements—built on piles in peat-bogs or along the banks of lakes and ponds—is more difficult to carry out and, in some cases, impossible.

The objects dropped from the dwellings and which sank to the bottom of the lakes have not necessarily remained in their original bed and it frequently happens that the movement of the water and mud causes heavier objects to become embedded. The means of investigation offered by hydraulic or industrial works (drainage or exploitation of a peat-bog) are not always of a nature to facilitate the systematic exploration of the area. Nevertheless, the scholar must endea-

(1) In this connection, the Irish Free State Department of Antiquities communicated some highly instructive examples to the International Museums Office and these will form the subject of a study in a forthcoming number of the review *Mouseion.*

(2) See the study entitled *La Technique des Fouilles aux Pays-Bas*, in *Mouseion*, Vol. 43-44.

vour to derive the maximum advantage from his work by following and by systematising the drainage operations.

Methodical work can, however, be undertaken at periods when the water is at low level or, still better, when, for reclaiming purposes, the whole or part of a lake site has to be drained or the water diverted by channels. In this connection, it will be found very instructive to refer to the report of the Harvard Archæological Expedition on its exploration of lacustrine settlements in Ireland (Crannogs); this work was carried out at low water with the help of hand or engine-driven pumps, wells and drainage cuttings. Similarly, at the lake settlement of Offeano Veronese (Italy) (1919) it was possible to conduct methodical exploration to a depth of 3 m. 30 by using powerful drainage plant known as "hydrovorous" pumps. Lastly, it should be pointed out that when it is impossible to explore the whole of a prehistoric settlement, its area and shape can be determined by means of wells and borings.

Submarine exploration of remains of the classic period. — The salving of important works of art of the past, lying on the sea bed, along the normal trade routes of antiquity or in the neighbourhood of sea-ports, has in recent years given special topicality to the problem of submarine exploration. Chance discoveries by fishermen have restored to us several masterpieces of the rarest sculpture and bronze-work: the Marathon Ephebus, the Mahdia bronzes and the marble Venus of Rhodes.

At Mahdia, the information supplied by sponge-fishers, and, later, the systematic exploration of the sea bottom, led to veritable marine salvage operations undertaken by the Regency of Tunis. Between 1907 and 1913, with suitable equipment, it was possible to salve some of the cargo of a ship that was carrying works of art and had been wrecked in these waters. The ship had sailed from Greece, possibly Athens, after the siege of Sylla and was making for Italy. The objects brought to the surface in this way are now displayed in five new rooms of the del Bardo Museum at Tunis. The cargo was located at a depth of 39 metres and the salvage operations presented certain difficulties because work had to be conducted in the open sea amidst under-currents.

But the locating and salving of works of art in the open sea—work that is governed by the technical and legislative regulations pertaining to marine salvage—give rise to many other difficulties and problems when we pass from the ocean to coastal areas, ports, lakes and rivers. Certain parts of the Italian coast, characterised by the geological phenomenon of *bradyseismism* and very important

from the historical and monumental point of view (the volcanic coast of Pozzuoli, Baja and Miseno, for example), make the problem of submarine exploration and the investigation of submerged buildings one of topical necessity and urgency. The excavation and laying-out of the Roman baths at Baja according to a systematically prepared plan of action will offer the first opportunity of approaching this problem in all its complexity and, by proceeding in stages spread over a number of years, of finding a solution.

The recovery, in 1924, during dredging operations at Baja, of a large quantity of architectural fragments and fine pieces of sculpture belonging to the imperial thermæ, at present from 5 to 6 metres below water, proved the abundance of works of art that can be retrieved in exploration of this kind, and also the more extensive knowledge that can be gained regarding important monumental ensembles of thermal architecture.

Naturally, the difficulties met with in this respect are considerable and it must be recognised that they exceed the usual bounds of excavation technique. The archæologist cannot and should not rely solely on his own abilities; he should avail himself of every means that can be furnished by the technique of present day hydraulic and maritime science. In such cases, excavation and exploration schemes should be submitted to the civil engineering department so that they can be studied in relation with special public requirements; it is frequently advisable and even necessary to entrust the execution of the works to engineers and technicians, assisted of course by archæologists in all matters concerning excavation and the unearthing of ancient structures and the direct and continuous observation of all the facts that may be revealed while the works are in progress.

Among typical instances of this collaboration between technical and scientific bodies during the last few years may be mentioned:

A. The clearing and restoration of the Temple of Serapis at Pozzuoli—an instructive illustration of a building submerged by bradyseismism—where the installation of pumps will make it possible to draw off the water periodically.

B. The discovery of the galleons at Lake Nemi, where, by means of an elaborate system of hydraulic pumps, the water level was lowered until two Roman ships, sunk at fifty metres from the shore, appeared. The work was entrusted to the Riva Electrical Company of Milan, assisted daily by archæologists, while the restoration and consolidation of the wooden framework of the galleons were

carried out on the basis of experiments undertaken by the Therma Museum (1).

It should, however, be pointed out that it is not always possible to employ such radical and costly methods: the draining of lakes and ponds, the definite closing of coastal inlets or the diverting of a waterway. In many instances, one has to be content with the patient exploration of the sea-bed, and when this can lead to no practical results owing to the muddiness of the bed which reduces visibility almost to nil, it is necessary to resort to mechanical methods, carefully supervised and applied.

For the exploration of the port of Baja, for example, good use was made of a mechanical dredger; this is the apparatus used for cleaning canals, small stretches of water and lake beds. On the other hand, for investigations of this kind, the use of the ordinary grab-dredger should be prohibited as it breaks into the bed with great violence, smashing, crushing and extracting everything it meets on its path.

But apart from occasional salvage work and the major reclaiming and drainage undertakings, it must be admitted that archæologists do not yet devote all the desired attention to the problem of archæological research along sea-coasts, in ports and under water.

Reclaiming and drainage operations, work in seaports and the building of sea-walls are too often conducted without the direct, effective and necessary supervision of the archæological expert; in many cases, too, this expert has not received the indispensable technical training enabling him to determine and recognise the nature of the maritime structure of the past. In this connection, mention may be made of the investigations carried out by Luigi Jacono, the engineer and archæologist, in the swimming-baths of the Roman coast towns of Campania, of Lazio and the Island of Ponza. Thanks to the combination of the technical and archæological knowledge used for the conduct of this work, it was possible to determine the action of the tide in the ducts of some of these baths, whereas for many years these partly submerged ruins had been regarded as the upper portions of structures that had sunk below the level of the water as the result of subsidence.

Excavation of cities.

General Principles. — Two centuries of uninterrupted excavation work at Pompeii, and archæological explorations spread over a hundred years or so, in

(1) See *Mouseion*, Vol. 43-44.

every country of Mediterranean civilisation, have brought to light cities, shrines, architectural groups, lines of defence and military camps. When we come to consider this work as a whole and follow its evolution, however, it is soon realised that the aim of research and the attitude of the modern mind towards the past have undergone a radical change. To-day, nobody any longer regards the excavation of an ancient city as the despoliation and dismemberment of an organic entity. Interest, formerly confined exclusively to works of art, is now attached to architectural monuments, to buildings and the whole of the urban ensemble of an ancient town. The words used by Gaston Boissier in summing up the new methods initiated by Giuseppe Fiorelli in 1863 at Pompeii, can still serve to define the programme and the essential aims of excavation operations undertaken in a city or in any settlement of the past such as they were carried out by the leading excavators of the XIXth century.

"He declared and repeated in his reports that the centre of interest in the Pompeiian excavations was Pompeii itself; that the discovery of works of art was a matter of secondary importance; that efforts were directed, above all, to reviving a Roman city that would depict for us the life of bygone ages; that it was necessary to see the city in its entirety and in its minutest details in order that the lesson it taught might be complete; that knowledge was sought not only of the houses of the wealthy but also of the dwellings of the poor, with their common household utensils and crude wall decoration. With that end in view, everything became important and nothing could legitimately be overlooked".

The new objective pursued in excavation work naturaly led to a radical change in method. Instead of stripping the dwellings of their decorative features and furnishings, and penetrating into the buildings from the street, thereby bringing about the collapse of the superstructures and the destruction of the façades yielding to the thrust of the surrounding earth, Fiorelli was the first to apply the stratigraphic method in his excavations at Pompeii. His procedure consisted in clearing the dwellings in gradual stages, starting from the top and working downwards, so as to ensure the conservation *in situ* of the different elements of the masonry. It was this notable innovation in method that made possible the rapid work of protection and restoration of the new sections of the Via dell' Abbondanza, of the Villa Mysterium at Pompeii and in recent excavations at Herculaneum.

With the exception of extensive excavations undertaken in the cities of Greece and Asia Minor, however, there are comparatively few cities of great historic interest for which the plan of integral excavation could be applied, as was the

case at Pergamum, Priene, Miletus and Ephesus, without having to respect modern dwellings that have been erected on those of the past. Nevertheless, the possibilities of investigation are still considerable and it may be claimed that the task of the explorer and excavator of cities is rendered more important and more complex by the new conception of the town-planning of bygone ages, the approach of the obscure problem of origins, of the controversial question of the plan of Italic, Greek and Roman houses, and of the contribution made by the different currents of Mediterranean civilisation to the formation of the original nucleus of a city. In the vast field of research, we have after all in our possession sporadic and isolated data but we have not yet got a comprehensive survey, an organic view of the genesis of this culture, for the gaps to be filled are still important. To mention only a few relating to the problem of Italic civilisation, it will suffice to recall that nobody has yet succeeded in carrying out a systematic investigation of a dwelling-house in an Etruscan city. Apart from the polygonal ramparts, a few temples and burial grounds, very little is known about the system of habitation in the cities of the provinces of Latium and Samnium in Central Italy.

An exhaustive and objective analysis of our knowledge in respect of the historic problems of antiquity would, however, be a starting-point for future research and a basis of orientation towards definite goals, even if the results arrived at seemed to be less striking (1).

It seems difficult, not to say impossible, therefore, to lay down any hard and fast rules for the excavation of a big urban centre. Above all, it depends upon the situation and configuration, on the nature of the surrounding ground, on the space available to receive the earth which is dug up and, essentially, upon the object and limitations of the exploration. The only fundamental rule, therefore, will be, that having ascertained and fixed the perimeter of the town, by examining the ground and by making soundings, to divide the area into geometrical sectors, making what are presumably the main roads, the boundaries of these sectors; whenever this is possible, the excavations should be begun in the very centre of the site, whether civil or religious (acropolis, agora or forum), gradually and methodically working outwards towards the peripheral sectors. This

(1) International scientific institutions, the schools of archæology in the different countries and the patrons that finance excavation expeditions should, when undertaking work for the excavation of buildings, also set themselves the task of solving certain problems of vital historic and scientific interest.

was the plan laid down for the future gradual exploration of Pæstum, which is one of the cities in Italy to which it is possible to apply the systematic exploration and research of a settlement. For this reason, a beginning has been made by exposing the gates, the walls, all the towers on the circumference, then the most important arteries and lastly the great forum; these essential points of the general topography having been fixed, it is possible to proceed with the excavation of the different sections.

The essential principle of all exploration, and the fundamental rule for all excavators, is to examine everything of historic interest which is found in the zone of search from the surface of the ground to the deepest archæological layers. Neither the search for and recovery of particular objects, nor the quest for and excavation of monuments of a specific epoch, nor even the excavation of important buildings of the classical era, should be carried out to the detriment of elements, or archæological strata, of more modest appearance or of a more recent age. In fact, experience teaches us that the life of a building or city rarely stops suddenly; more commonly it flows on and becomes transformed through various epochs of civilisation. Further, the more precise judgment which we are in a position to form to-day of historic monuments of the post-classical epoch; the problems relating to architectural styles of the Palæochristian and Byzantine age; the rarity and value of objects and burial grounds of the barbarian era, and finally the problem, which is so important and still obscure, of the passage from ancient civilisation to the medieval and modern era, imposes a less restricted criterium on the archæologist, and one less exclusive in the execution of his programme of work. Thus, excavations in a Greek Temple should, under no circumstances, lead to the destruction of the remains of a Palæochristian basilica, and according to the very wise resolution of the Egyptian Department of Antiquities, the search for papyrus in the region of a *kôm*, or in the ruins of a Greco-Roman site in Egypt, must under no circumstances be the occasion of spoiling a whole archæological area.

The excavator, to-day, should make it a rule to respect every trace of civilisations which he may find, with the utmost scrupulosity, especially when unavoidable circumstances compel him to touch the upper layers, either partially or wholly, in order to reach objects or buildings of greater historic or artistic interest. In such cases, which should always be considered as exceptional, especially when it is a question of veritable buildings superposed on older structures, complete graphic and photographic documentation should be considered as indispensable. But it is unwise to fall back on the only æsthetic criterium

and to follow the rule, generally admitted in the past, which was to restore monuments of the classical age to their original appearance, by removing all additions and transformations of more recent origin. This method can be justified only when absolutely essential. It must be remembered, on the contrary, that frequently the clearing of an edifice, following principles which are too rigid, may take away from it not only a large part of its historic interest, but may deprive it of those very elements which would precisely render it intelligible to the world of savants and the general public. The following is an example, among many others: On the Acropolis of Cumæ (Campagna) two temples were discovered, in 1912 and 1927, the one on the lower esplanade, the other on the upper esplanade of the Acropolis. Both bore traces, on the ancient Greek foundation, of important remains of successive changes of the Augustinian, post-Augustinian, and Palæochristian eras. The excavations in the site of the temple on the lower esplanade, carried out in 1912, only left the structures of the Greek and Roman period. On the other hand, the excavations in 1927, concerned with the minor temple on the upper esplanade, respected the structures of the last conversion into a Christian basilica, in the Vth-VIth century. Now, these constitute the most exact and the most instructive document which we possess of the millenium of Cumæ, during the dark period of the barbarian invasions; moreover, it is also one of the most precious remains of Palæochristian architecture in the Campagna. Also, we see in this case, how the end in view, namely to bring to light a temple in one of the oldest Greek colonies in Italy, did not cause the traces which remained of Palæochristian, Byzantine and medieval Cumæ to be neglected and forgotten.

Another example: in the excavations in 1927, carried out about the enclosure of the Temple of Ceres, at Pæstum, the remains of a few modest buildings of the post-classical period were discovered and preserved, in so far as a systematic exploration of the ground allowed; to-day, these are the sole accurate testimony we have concerning life in Pæstum from the Vth to the Xth century. This method is, in fact, the principle of stratification applied to the preservation of outer structures, but only in so far as they have real historic value, and do not prevent monuments of great architectural value from being properly excavated and appreciated.

On excavating buildings. — Normally the work of excavating monumental edifices should be in the care of an archæologist and an architect. When this is impossible, it is of paramount importance that the archæologist, assisted by a good draughtsman should make scrupulous plans of everything belonging to

the construction, as well as the position they occupy in the stratum. He should also make a very complete photographic record and should never proceed with the displacement or the removal of structural and architectural elements without numbering carefully each piece which has to be moved. It is wise, when faced with important and complex ruins, to record immediately on suitable cards all data relating to the form and size of the different architectural elements dug up in the course of work, so that they may be classified and grouped according to type, material and period, as and when they are found.

The excavations should be conducted with still greater care when the building to be cleared has already suffered deterioration or spoliation, which may have upset its original stratification, more or less upheaving the ground, as well as disturbing architectural and decorative features. In this case, the excavator should distinguish those features which are still in their primitive position from those which have been removed and which cannot, either directly or logically, belong to the architectural item near which they are found. If this is done during the excavation work, errors of interpretation and attribution will be avoided.

The search for ancient buildings under modern constructions. — The exploration of ancient buildings situated underneath modern constructions is often necessary in all the historical towns in the Greco-Roman world. In Italy, for example, one has frequently to identify and study the outline, plan and principal buildings of an ancient city within the compass and under the very monuments of a medieval or modern city.

The problem is both technical and financial: it presents a number of problems and cases: from the simplest, where it is only a question of making a schematic and partial abstract based on the few remnants visible of the ancient edifice, to the complete and radical termination of the total uncovering of the building, which may necessitate the destruction of modern superstructures. Between these extremes are intermediate possibilities — partial attempts and excavations, intended to discover the nature of a building, its historical and artistic value, and to recover works of art which lie hidden therein. A typical example is the excavation and recovery of the *Ara Pacis*, in the foundations of the Fiano Palace. The archæologist, in such cases, should not hesitate to appeal to the engineer, as problems of a mechanical nature arise all the time, as well as those of equilibrium.

It may also be that excavations, and the clearing of ancient monuments buried

in the foundations of modern dwellings, and their consequent historical, monumental and æsthetic valuation will necessitate considering plans to replan the town. As examples of this one can cite the work on many gateways, walls, and monuments of the Roman era, in Rome and other historic towns of Italy.

Removal of excavated earth. — One of the capital points in the programme of work for any properly conducted excavation, is that of the removal of excavated earth. If the problem is not carefully studied and a means chosen at the beginning of operations, the success of the enterprise and the development of future work may be seriously jeopardised. If the dumping ground has been badly chosen, the normal budget of the expedition may be seriously burdened, as further dumping and transport will be necessary. In very big archæological undertakings, such as excavations of towns, temples, and monumental necropolises, the removal of excavated earth is the largest item of expense, as it is usually a question of large and cumbersome matter. The excavations at Pompeii provide a typical example of this. For a long time, the excavated earth from the various sections was dumped immediately outside the walls: the oldest necropolises of the city and the buildings in the suburbs were thus buried under a mass of earth, and Pompeii lost the appearance of a city which had been exposed to view, while the walls and towers were invisible. The clearing of this mass has recently been begun, but there are some millions of cubic metres of earth, and the end of such an enormous task seems hardly achievable.

True, it is not always easy to solve the problem of the removal of excavated earth in a rational way; the nature of the surrounding country, the agricultural requirements, roads and railways, æsthetic reasons, municipal regulations are all factors which often make the solution difficult and onerous. But it is essential to face the problem, grave as it may be, especially when the excavation work is intended to spread and thus encroach upon neighbouring territory.

The removal of excavated earth raises a serious problem when the large area of a necropolis is being explored, for the alternate opening and filling in of alternate trenches may leave intermediate zones unexplored, and thus give rise to clandestine searches and discoveries.

However, we are here touching on problems which are more fully discussed in Chapters IV and VIII.

Temples and Sanctuaries. — Although it may be said that the period of great archæological discoveries in the field of excavating the most important Greek

sanctuaries is closed, there is, nevertheless, much yet to be done in the way of research and methodical exploration of the temples and sanctuaries in the vast area of ancient civilisation encompassing the Mediterranean. For example, the excavations of the Temple of Apollo, at Cyrene, are only recent, and those at the sanctuary of Hera Argiva, one of the most famous temples of Ancient Greece, at the mouth of the Silaros, near Pæstum, are now going on. Moreover, it has been deemed necessary to resume the methodical exploration of many areas consecrated by temples and towns, because the excavations of the last ten years, at Agrigentum and Selinus (1), have shown what a wealth of documentary riches may be contained in the sub-stratum of a large city, concerning the religious life of antiquity. Pompeii affords us a most instructive example. A minute search carried out in the area of the Greek temple, and even in the material itself, which had been used in the reconstruction of the steps of the temple, led to the recent discovery of precious remains of architectural decoration and foundation deposit, of the VIth and VIIth centuries. Another exploration of the same kind, carried out near the Temple of Apollo, led to the discovery of architectural terra-cotta and Greek ceramics which proved the existence of this art at Pompeii in the VIth to Vth centuries B. C.

The same is true of research work and exploration carried out in places consecrated to minor divinities, where considerable documentary riches are still concealed, touching the myths, beliefs and popular cults of Greek and Italic religion.

But, generally speaking, whether the sanctuary be large or small, excavation always has two essential ends in view: *a*) the clearing of the temple, buildings and minor edifices in the sacred precincts; *b*) the recovery of material at foundation level. In an undertaking which has been properly prepared and arranged, the exploration of this material should follow that of the temple.

It is especially in this type of research that the excavator should follow a strict method, remembering that the religious life of a place of worship, even more than its architectural structure, will be reconstructed by the furniture and the paraphernalia of the cult, as well as by the votive objects which are more or less slowly deposited on the ground, forming what may be called the holy archives of the temple.

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(1) See the study in the volume published by the International Museums Office: *La Conservation des Monuments d'art et d'histoire: Travaux de relèvement du Temple d'Héraclès à Agrigente et du Temple C. à Selimente* (1933).

Among numerous examples of analogous research, methodically carried out, should be cited the excavations at the Temple of Artemis Orthia, conducted by Dawkins, in Sparta, during 1906-1909 (1).

The area was divided into sections, not exceeding four metres square; each section was bordered by vertical cuts right through to the greatest depth of the stratum. The search was then carried out in successive horizontal planes, no one of which exceeded 15-20 cms. in depth. The material retrieved was placed in small boxes marked with the number of the section and divided into several compartments according to the size and fragility of the find. As the deposits had not always accumulated on flat ground, but on very uneven ground, the horizontal layer had to be judged, in many cases, rather from the stratigraphic nature of the ground than from dead-level, and the curves of the layer which followed the curves and undulations of the ground followed slowly and carefully. This principle is *de rigueur* in all stratigraphic excavation, when carried out on broken ground, for example, the bottom of a prehistoric cavern, or the unloading of foundation deposit which has accumulated in a natural hollow in the ground.

Excavation of Necropolises and Tombs. — This type of excavation is the most frequent in the countries of Mediterranean culture, from the period of prehistory to that of Rome and the barbarian. Every experienced explorer has had occasion to work on a group of tombs or a necropolis. One knows that in many regions it is the necropolises, even more than the remains of habitations, cities and monuments, which reveal the particular character and the development of a special culture, and which occasionally bring light to some specific historical event.

But it is in this domain also that the archæological strata have suffered, and can suffer, the greatest damage, not only at the hands of clandestine pillagers, and through accidental discoveries which escape control, but also through the inexperience of excavators and the application of faulty methods.

Here ordinary necropolises will be considered more especially, those for burial and cremation, in tombs, coffins and graves —not the monuments of Egyptian, Mycenian, Greek, Etruscan and Roman funeral architecture; in fact, for this category at least, it is the preservation of the monument *in situ* which constitutes the safeguarding of the documentation of the discovery.

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(1) See the article on these excavations in *Mouseion*, Vol. 43-44.

On the other hand, in ordinary necropolises, the archives of the discovery are in the hands of the excavator, and their integrity is dependent upon his knowledge and method. A tomb containing coffins, once opened and emptied of its contents and refilled with earth, continues existence only under the guise of a diagram in a note-book and a group of classified objects in a museum case. It has too often happened that the artistic interest shown in the funeral furnishings of a rich necropolis has caused the examination of the forms, of the ritual of burial, and the ensemble of observations which the discovery of a necropolis including different periods of civilisation might suggest, to be overlooked or relegated to a secondary place. Too often these excavations have been carried out with the main purpose of recovering more or less rich furnishings. Thus one ends by having, on the one hand, a rich harvest of material, and on the other, a topographical and archæological documentation which is very poor in regard to rites, forms, and the development of the historical cities of antiquity.

The modern excavator who undertakes or carries on the work at some important necropolis already partially, and not methodically, explored, should above all determine to fill in the lacunæ of the past. For this reason, besides a minute description, and a classified list of the furnishings found in each tomb, he should try to follow the injunctions here summarily enumerated:

1. Excavations in a necropolis should be carried out in successive zones, in order that tombs may be exposed in groups and not in an isolated way; and at the same time, in order to be able to keep a photographic record giving a picture of the whole, and not merely a map.

2. He should, in so far as possible, attempt to recognise the grouping of tombs and understand the reason (family, religious, ritualistic or chronological) of the grouping.

3. He should carry out the necessary stratigraphic experiments to see whether there are superposed deposits.

4. At the same time as he identifies and records the funeral furnishing, he should do the same for the different types of deposit, so that he may be able to reconstruct them in a museum, with the aid of the objects found.

5. On the site of the more important necropolises, which form part of monumental archæological centres, it is wise to preserve, and leave on the spot, a group of tombs which will serve as examples and a record of the character and period of the necropolis. The excavations at the Christian cemetery of Tarragona

are an example of this. This case is especially instructive and can furnish useful suggestions when the opportunity and the possibility arise. The new Tarragona Museum has been constructed on the site of the cemetery, in such a way that a part of the necropolis itself is preserved and enclosed in the basement, while, in the upper stories, the objects in glass, mosaic and terra cotta, which were found there, are on view.

Excavation in necropolises, and especially in archaic ones, requires, above all, the most complete knowledge of the composition and nature of the ground, of the water system, which may have modified the morphology of a certain zone, and lastly, of the character of the local vegetation. Moreover, it is known that, in spite of the most careful and wise excavation and though soundings and trenches were made, many necropolises in famous cities of Greece and Italy have given no interesting result, until the moment when the excavator, by chance or through sheer tenacity, revealed the first group of tombs. And in this respect, one has to admit that clandestine excavators have often forestalled the archæologist, since they have been able to pillage the furnishings of many necropolises, throughout a number of years, and even some of the richest ones of antiquity, in Egypt, Greece, and Italy. If this is so, it is that these excavators are drawn from the simple peasants of the district, who have a knowledge of their home-land and who have learned their job using the two tools of the archæologist — the shovel and pick.

The excavator who undertakes research and excavation in a necropolis situated on unknown and unexplored territory—and here we touch upon the question dealt with in Chapter III— is often unable to dispense with the assistance of these local excavators. Disciplined and watched, they can be very useful auxiliaries, thanks to the perfect knowledge which they possess of the earth and subsoil. Old Greek and Italian navvies are especially gifted in distinguishing, in the compact mass of clay soil, the outline formed by the remains of an ancient tomb, or the section of a mortuary chamber hollowed out of the mass of earth. One should therefore employ such local labour — duly disciplined and guided— for it is often the most modest yet useful collaboration in scientific research.

The general considerations, set forth above, concerning the technique of excavation of urban districts, as well as of all architectural works of antiquity, force two essential principles on the attention of the excavator, as well as on the competent authorities for the preservation of historical monuments, town planning and land sanitation:

TECHNICAL METHODS OF EXCAVATION

1. Every enterprise of this kind requires the close collaboration of the archæologist and the architect. This principle is, moreover, in conformity with the resolution voted by the Conference in Athens, on the technique of preserving historical and artistic monuments.

2. In all cases where civil work — urban reorganisation schemes, planning of railways and ports, land reclaiming — is undertaken in areas where ancient remains or archæological strata are to be found, it is essential that, in organising the work, the competent authorities should take advice from qualified archæologists and be assisted in the work itself by a specialist in excavation.

CHAPTER V

THE TECHNIQUE OF PREHISTORIC EXCAVATION

Although the general principles governing excavation technique, such as they have been set forth in the preceding chapter, may be applied to all types of excavation work, prehistoric deposits give rise to problems of a sufficiently permanent and special character to justify the inclusion of a complementary study on the subject. Consequently, while developing the principles laid down above and in the light of concrete examples, we shall now examine the characteristics of these deposits and the technique of their treatment.

Methodical excavations, whose purpose is to solve prehistoric problems, must be carefully distinguished from the superficial work whose only object is to enrich collections, and which, from the point of view of scientific value, do not differ in the least from mere searches for treasures. For the most part, amateurs and collectors are only interested in finding objects, and in the number of those objects, especially in those which are destined, because of their beauty, to adorn show-cases. If one looks for strata with this in mind, one runs the risk of omitting to make stratigraphic observations, of not noting the conditions under which the object was found, and, in fact, of depriving the object itself of all value as a historic document. One can also put in this category the work of museums for which excavations are carried on by amateurs or by staff who are not specialists, with the sole object of continually increasing the number of specimens catalogued in the various public collections.

Yet, prehistoric research has already found the right road, and as the end which it seeks is of a clearly historic character, excavations, in their turn, contribute to the solution of the great problems of prehistoric interest. Admitting, in the domain of this line of research, that excavations have become a decisive factor, it goes without saying that a special knowledge and a sure and accurate application of the various methods is required of the investigator. The aim and purpose of excavation is no longer just the collection of material, but a work which has its own value, analogous to the research work of the historian in the

archives, with this difference, however, that in the first case it is the object found which is the historic document, duly identified both as to its stratigraphic position and the circumstances of its discovery.

In this change of objective, the archæology of the sites of human colonies, to which so much attention has been paid since the beginning of this century, has undoubtedly played a preponderant part. The new tendency, which is directed towards determining the different civilisations and to settling the boundaries of cultural areas, therefore demands methodical excavation. It is known that prehistoric cultures, both in their formation and fixation, attached and adapted themselves to certain geographical features. It is within the framework of these geographical features that these centres of culture must be sought. The topography of sites and of cemeteries enables us to trace the limits of each culture and to distinguish the cultural areas. At the same time, similar material, found in analogous conditions, gives us a faithful picture of the culture as a whole. It is necessary, however, in determining a culture, to note, not only archæological discoveries, but also other cultural phenomena. One can hardly overlook the conception of the settlement, the choice of site, the nature of the housing and all the information obtained by the examination of the defensive structure, ramparts and small earthworks. Further, we must consider the method of burial and the rites which were observed. All this requires methodical excavation, carried out according to a preconceived plan.

Another essential domain of prehistorical research consists in the study of those factors which bear on the formation, expansion, migration and extinction of different cultures. The problem is to find out whether one is dealing with a primitive autochtonous culture, of which the variations only mark, at intervals, the stages of internal development, or whether one is dealing with the immigration of a new people, who, having impregnated the primitive culture with the elements characteristic of their own contribution, have succeeded in speeding up their evolution. It is necessary to mention also the problems of race, ethnical character, and nationality in the various human groups—problems, the solution of which will enable us in the end to outline a comprehensive picture of the prehistoric. But these historic details and these decisive turning-points in civilisation can be recognised only by studying the phenomena which are presented side by side, at the same level, and the authenticity of which can be emphasised only by means of methodical excavations. The truth of this is the more evident in that chronological order is decisively attested by proofs furnished by excavation. To obtain reliable information in regard to relative chrono-

logy, it suffices to observe the stratigraphy of sites of human occupation, where evolution is represented by several layers super-imposed. In this respect, closed strata, burial grounds and hidden treasures also furnish valuable testimony. These last, however, having been intentionally hidden, can be found only by chance, which in relation to methodical research, considerably diminishes their value. Finally, for the absolute chronology of a specific culture, it is the stratigraphic position of imported remains, of foreign origin, which enables one to establish it.

Such are the problems around which centre the excavations of to-day, the method of which varies according to the aim of the research and the nature of the object. We shall now review these different methods, without, however, dwelling on the conditions obtaining in the Ægean and Mediterranean areas, where the sites, which are often composed of stone monuments, require an appropriate technique. With the exception of megalithic burial grounds, monuments of this kind are rarely found on the continent and they are entirely missing from other prehistoric regions. As it is impossible to give the methods of all the schools, we must content ourselves with certain characteristic examples.

When one intends to study the culture and cultural areas, and to establish chronological facts, the exploration of centres of life would seem to be the most important work, From the purely technical point of view, it is precisely this type of excavation which is the greatest test of the specialist in the prehistoric. Although the various primitive cultures of prehistoric Europe are already, morphologically, fairly well described, the problems of their origin, their duration, their absolute and relative chronology still require much scientific research which must be methodically organised. When it is a question of only one stratum of civilisation, the most simple methods suffice. The methods of excavation must be adapted, on the one hand, to the ground, and, on the other hand, to the urgency for replacing earth removed in the course of excavations. In any case, one should avoid too small trenches, for these prevent one from having a good general view. The best method is to dig successive trenches and to enlarge them till it is possible to work in them in comfort; to remove earth and fill in the trenches as soon as possible and measure the site by a simple method of coordinates. The ideal trench is 10 metres long and 5 metres wide, which permits of the examination of a fairly large surface. Obviously, if it were not necessary to fill in the trench it would be possible to work on a bigger area, but, by doing so, clearing the earth would slow up the work. Having ascertained, from the testimony of the strata, the colour of the earth, or even-

tually from the foundations of huts, hearths or the holes made by wooden stakes, that only one layer of civilisation exists, an attempt is made to fix the level of the settlement which has been discovered. One tries to reach, by excavation, the line of the foundations of the huts or hearths; then, after mesurements and photographs are taken and that layer removed, one digs to virgin soil, upon which the settlement was built. In most cases, one finds there a layer of rich humus, the black colour and thickness of which is easily distinguished from the structure of recent and less compact layers which have been superimposed. As these latter are often mixed with ashes, they are usually of a lighter colour, verging towards grey.

The surface of primitive soil should be carefully cleared in order to be able to identify hut foundations, ditches which were destined to receive refuse or food, as well as traces of stake-holes.

It should be noticed in this connection, that the sterility of the layer, that is to say the absence of finds, does not always mean that one has reached the lowest limit of the zone of culture. For example, on the hill of Herpâly (Hungary) —a characteristic specimen of sedimentary agglomeration— the first exploration was entrusted to a provincial museum, which, having brought to light a layer of the later bronze age, at a depth of 1 metre, considered they could stop, in view of the apparent uselessness of further work. During the excavation operations undertaken on the same spot by the National Hungarian Museum, it appeared that the supposed virgin soil, situated in a zone exposed to floods, far from being a natural layer of earth, was but sediment, some metre and a half deep. Underneath lay an extended layer (2.50 m.) from the copper age, or older neolithic. At Felsödobsza, beneath a later stratum of the bronze age, was found one metre of pure loess, but under this was found a zone of culture corresponding to the later bronze age. In view of these facts, it is always advisable to dig a deeper experimental trench, at least on one section of the field of exploration; this enables one to decide whether virgin soil has really been reached. In the case of sites composed of a single layer, one can, however, disregard the thinner layers under the humus, as these may well be waste carried in by wind, water, or by agricultural labour. Obviously, these layers cannot have any bearing on the establishing of the relative chronology. For excavations on sites of this nature, those carried out near Cologne-Lindenthal are useful as guidance. In the substratum, very clear contours of neolithic huts were found, as well as stakes supporting barns. At some spots on the same site, superposed cultures were brought to light which emanated from different periods. Defensive ram-

parts were also found. In excavating in a trench of this kind, one must proceed in the same way as one would to remove a mass of recent earth covering the huts. In the case of several superposed cultures, the period when the moat was dug can be established by the comparative examination of the cultures, or by the study of the objects found in the bottom of the moat. To-day this method is generally in use.

Hungarian explorers also use analogous methods, as is shown, to give examples, by the excavations of the neolithic settlements of Tiszakeszi and Bodrogkeresztur, as well as those at the settlement (earlier bronze age) which was discovered at another spot at Tiszakeszi. Further, near Balaton, rich magdalenian strata have been found. As these were buried in thick layers of loess, without any of the characteristic colouring, the finds were alone able to serve as indications to establish the thickness of the layers of culture. In such cases, excavation must reach the level of the hearth and of the objects.

Excavation requires more complicated technical procedure when one is working on a settlement composed of several layers. It is especially in Hungary, in the region of the Danube and the Tisza that one meets with innumerable hillocks of the *tell* type, which must not be confused either with *Kökkenmödinger*, nor with terramares. These hillocks, formed of residue, and which often rise to considerable height, are not formed of culinary waste, and although they are found close to a sheet of water, the traces of civilisation which are found with them are not lake dwellings, but raised habitations of wood. The growth and the thickness of the layers is due either to natural deposits of the earth, or to the raising of the level of rebuilt houses. As is seen from the different layers, these houses were often destroyed by flood. The ruins, and the consequent influx, due to the floods, contributed to raise the level of the houses. So the outline of settlements of the *tell* type are seen in very different guises; and for that reason it is necessary always to follow the level of each dwelling during exavation. Before all else, it is essential to disclose the outline, in order to be able to discern the various cultures, and to be sure whether it is a question of a mere rising in the level of the dwelling, of superposed strata, due to different epochs.

To facilitate measurement and to control the progress of work regularly, according to the evidence of vertical cuts, it is useful to dig medium sized ditches (10 m.× 5 m.). As the different levels are removed, one can separate the ruins from the débris of the roughcast, as, for the time being, the objective is the foundation-level of the houses. In the case of a house destroyed by fire, the soil retains traces which are very clearly distinguished from those of ruins and from

superimposed earth. One finds the hearth, remnants of the walls and roof-timbers, as well as the stake holes. The structure, the position of the foundations of the houses, as well as the homogeneity of objects found there, allows us to conclude that we are not in the presence of several cultures, chronologically distinct, but that the level of the house was raised, or, several houses reconstructed one above the other, on the same spot. Thus, for example, at a settlement of the bronze age, near Hatvan, at 80 cms. depth were found three layers superimposed—the total thickness being but 50 to 60 cm.—in each layer a base of hard clay was found, damaged by fire, which showed that these houses were destroyed by fire. As these three layers were fairly thin, even the holes for stakes for the upper structure were discovered, here and there, in the primitive humus. In order to form an idea of the contours of the various buildings, one must compare the marks of the stakes in the humus with the lines and dimensions of the foundations, which are clearly outlined in the contours. In spite of the three successive layers, this was a case of a homogeneous colony, without any chronological break, as borne out also by the finds, which show a no less marked harmony. Another analogous settlement (with several layers, but all of the same culture) may be mentioned: that of Füzesabony, in Hungary (bronze age), where the total thickness of the layers occasionally reaches 3 metres. At certain spots as many as four layers appear, though the finds are all of the fourth period of the bronze age. The considerable thickness of the layers is due to deposit left by floods. In so far as the construction and form of the houses are concerned, it is, on the one hand, the outline, and on the other, the bed of the trenches, which provide the most decisive proofs. In the basin of the Danube, one of the most important settlements is that of Laposhalom (near Toszeg), in which the sedimentary layers, seven metres deep, offer a perfect synthesis of the bronze age in Hungary, in its four periods. The exploration of such a station requires extreme care. Precise distinction of the different layers of the dwellings is of paramount importance, not only as regards knowledge of the cultures and the mode of existence in the colony, but also for the relative chronology, which is entirely founded upon the stratigraphic observations. At Toszeg, one occasionally meets with fourteen layers, but this does not mean that each one represents a distinct stage in evolution. It is in excavations of this nature, that one realises the necessity not only for a profound knowledge of the methods and of the technical questions that arise, but also a discerning vision, a mind accustomed to weighing up information, a rapid intuition, all of which qualities are the apanage of the true specialist in prehistory.

Previous explorers, both at Toszeg and Pécska, as well as at Perjamos, where settlements of complex stratigraphy are also found, imagined they recognised as many cultures as they found layers of different colours, and, in the end, it was extremely difficult to explain a formation, so rich in superposed layers. Some ten years ago, the same mistake was made with regard to the settlement of Vinca, in Serbia, which was prolific in finds and of especial importance for the solution of prehistoric problems. In layers, which were as much as 11 metres deep, were found several cultures of the neolithic, early bronze age and La Tène. As the quest, here again, was simply to collect finds, without paying attention to the irregular, that is to say the non-horizontal, lines of the stratigraphy, it was considered sufficient to measure the depth at which such and such a find was made. It is for this reason that only in recent years have we been able to elucidate the cultures and the stratigraphic conditions of the *tells* of Hungary and Vinca.

Having cited these few examples, we can now lay down the essential principles governing the exploration of this type of settlement. First of all, it is essential to differentiate very clearly the various layers of habitations and to decide whether these layers represent the reconstruction of habitations in the self-same settlement, whether they correspond to distinct evolutionary stages, or whether they show the traces of several epochs and of several different cultures. Then, it is necessary to class the finds, which go to complete this documentation, according to epochs and to cultures. And finally, in order to have a definite picture of the character of the settlement and the construction of the dwellings, it is necessary to carry out the measurement and recording of the foundations of the huts, the stake holes, pits and trenches. Lastly, there only remains the sketching of outlines, at different stages of the work. Having exhaustively searched the whole settlement, this method permits one to reconstruct each stage of the successive settlements. A faithful picture is thus obtained of the finds belonging to the various cultures, as well as of all the other phenomena which come to light and which help to solve the problems of chronology in a satisfactory manner.

Prehistorical research, however, does not always make it possible to draw such a clear distinction between the cultures, traces of which are found in the same area. Frequently, it happens that one finds, in a relatively shallow layer, signs of several cultures, chronologically very far apart, the characteristics of which can be clearly differentiated by a typological and morphological examination. On the plain of Goldberg (in Wurtemberg) were found, in a very thin

layer (barely 1 metre), several neolithic cultures—Hallstatt, La Tène, as well as documents of the Roman period and medieval culture. The black earth which constitutes this layer is easily distinguished from the reddish substance of the primitive tufa. The typological method, therefore, is alone applicable for the classification of finds. But in the substratum again one finds the impress of huts, houses, pits and trenches belonging to the cultures in question. In this case, the proper procedure is to remove the layer containing the finds, without delay, in order to classify according to epochs and cultures the material found there, and to devote special attention to the examination and measurement of the marks retained by the substratum. The origin of the houses, pits etc., can be determined by the objects discovered. This method was applied, for example, at Békàsmegyer, near Budapest, where several neolithic cultures were found, in a layer 1 m. to 1 m. 20 thick, jumbled together with the culture of caliciform vases, of Hallstatt, of La Tène, as well as of the Roman epoch and the beginning of the Middle Ages. The yellowish marl of the substratum showed very varied imprints, with traces of various human colonies. To obtain the right orientation from the chronological standpoint, one turns to the objects found, which may serve as guides, although their testimony is often somewhat questionable.

Research is faced with similar difficulties in the case of dwellings situated on a slope, where the crumbling of rock, or the débris washed down by rain, may efface the character of the zone of culture. Here again, it is the marks and imprints in the substratum which may guide the explorer. The thickness of the alluvial layer in grottos which served as dwellings or places of refuge depends, above all, on local conditions. More often than not it barely exceeds a few decimetres; it is therefore almost impossible to make stratigraphic observations. In diluvial layers, the thickness of which is often several metres, conditions are entirely different, for the separation of the different layers may depend not only on the finds, but also upon geological and palæontological considerations.

Lacustrine settlements or palafittes require an appropriate technique. The most rational and modern methods were used, for example, in the exploration of the settlement at Biscoupine, in Poland. The first settlement had been founded in the later iron age on a strip of land jutting out into a small lake. On the waterside, the site was protected by palissades and a fortified wattle-fence. The houses and the narrow streets were built on piles. Later, the whole settlement was under water, so that the explorers who proposed to excavate this settlement were forced to begin by constructing a dam on the edge of the strip

of land. Within the dam the water was pumped out, and the débris deposited on the tree-trunks and piles was removed, so that, to-day, one can clearly see not only the system of palissades, serving as a rampart, but also the contours of the entire lacustrine city. To give an idea of the equipment and organisation of this undertaking, it is enough to remember that in Poland one has the use of an auxiliary service, whose personnel attends to the preservation of objects and finds on the spot, to the work of measurement, recording, drawing plans, etc. and in order to control the accuracy of measurements, a captive-balloon is used for taking photographs at a wider angle. Through its efforts, Polish science has not only succeeded in setting an example of the first order in this kind of work, but also in giving us a precise and complete picture of the settlements, houses, etc., in the later iron-age.

As a further example of model excavation one can mention the research of Dutch archæologists at Ezinge. There too it was necessary to bring to light and preserve *in situ*, the remains of piles, which naturally made it possible to reconstruct the dwellings.

Prehistoric dwellings are often surrounded by a fortified enclosure, moats or ramparts. One meets with settlements of this kind in the plains or on slopes, but they are much more frequent on mountains and on plateaux. These ramparts may be either simply earth embankments, or fortifications built on wooden or stone foundations. Many earthen enclosures are to be found in the Illyrian settlements in Hungary, which date back to the later iron age. As an example, one may cite the fortifications of the little fort of Lengyel. The foundations of the fortifications of Pakozd and Jakabhegy are made of uncut stones. Similar ramparts are found, among other places, at Carniole, while in Germany the little fort of Glauberg offers a characteristic example.

It is not necessary to expose the full length of defensive walls in order to study their structure. It is sufficient to dig trenches at certain points, deep enough to reach the foundations, that is to say, to the natural bed. If it is a question of a system of fortifications which have served to protect settlements of several cultures, one must always remember the possibility of repairs or restorations. All these changes can be identified by the structure of the rampart and moats as well as by the contour of the trenches, not to mention the objects which may be found in the different layers. These latter enable us to fix also the period of fortification. Under no circumstances must the complete excavation of the doorways and other openings be neglected.

The Berlin Museum carried out some very instructive research work when it excavated a fortified enclosure at Lossow, dating from the earlier bronze age. The ramparts were strengthened by a wooden framework, and, more particularly, by a system of coffers, constructed with beams. These coffers were filled with earth and stones, and the rampart itself was covered with an earth facing. The object of the German excavations was to separate the recent layer of earth from the original embankment, and to reconstruct the ramparts, on the basis of the remains of joisting and the distribution of the less compact masses of earth, of darker colour, which filled the space formerly occupied by the beams.

In order to know the character of different cultures and to elucidate the attendant chronological problems, one cannot neglect the exploration of tombs and burial places. From the technical point of view, the excavation of ordinary flat graves and urn-cemeteries would appear to be the simplest. In Hungary, for example, one finds vast necropolises, containing several hundred tombs, for the most part of the bronze age. Experience indisputably shows that graves are not aligned, one after another, but that they are arranged in groups of varying sizes. This was proved in the cemeteries recently excavated, among others, at Magyaszo and Hernadkak.

To facilitate the work, it is best not to expose large surfaces; it is wiser to dig trenches about a metre and a half wide, which, obviously, can be enlarged according to necessity. These enlargements are necessary if the substratum contains tombs that are easily discernible by their dark colouring. Graves should be left as they are, to allow of photographs and measurements being taken, and the examination of the position of the skeleton and any objects found there. This method permits, if necessary, the exposure *in situ*. The plan of the tombs is made by a simple system of co-ordinates: for this purpose one plots, in the necropolis, one or more lines, choosing artificial or actual starting points.

A like method is used in the case of urn-cemeteries, but, since the urns are usually found near the surface of the ground, it is necessary to expose areas exceeding the practicable mean of 10 m. × 5 m. After removing the upper layers, the position of the first find is marked. Excavation is then continued down to the substratum. Only then should the urn be opened. Measurement presents no difficulty, as the trenches are quadrangular in form.

The excavation of tumuli presents more complex problems. Those of central Europe and Hungary are more easy to excavate. Inside the mass of earth, which usually contains but one tomb, is found a stone construction, or a square wooden chamber. These tumuli should be excavated section by section, beginning

with the sides of the slope, until the tomb itself is reached. As the tomb proper is thus approached step by step, there will be no risk of damage. A profile, obtained by means of a transversal cut, permits the study of the technique of the interior construction of the tumulus.

This is the appropriate place to mention also the tumuli of the cultures of the West and North. In Holland, especially in the provinces of Groningen and Drente, are found tumuli, the construction of which, in its complexity (1) approaches that of Stonehenge and Woodhenge, in the South of England. In these cases, the tomb is surrounded by a circular enclosure, formed by several rows of piles and ramparts. The Dutch explorers assume that these piles remained visible, which seems very probable, after the construction of the embankment. At a certain distance from the supposed site of the tomb, the ground was dug down to the substratum, in order to obtain a profile that would serve as a point of departure. Next, spherical segments were cut, thus revealing a series of profiles which made it possible to reconstruct the whole interior of the tumulus. All that remained to be done was to open the tomb and measure the trenches and the imprints of piles or beams placed in the ditches.

In the Yugoslavian Carniole, tumuli are often found containing as many as seventy or eighty tombs, laid out in quite irregular formation. Tombs containing skeletons, as well as urn burial-grounds are also found here. It is usual to proceed in rectilinear sections which follow, on the horizontal plane, the position of the layers. Contours help to determine not only the structure of the tumulus, but also the chronology of the different layers.

In England, Long Barrow was destined to receive an accumulation of tombs. The investigations made by the English expeditions have led to remarkable results, thanks to the technique employed. Operations progressed step by step, by vertical sections along the longitudinal axis of the mound. The impressions found in the substratum, as well as the comparison of various contours, complete the general outline of the structure of tumuli of this kind.

In conclusion, it is necessary to say a few words about funeral coffers in stone and burial megaliths. The first have no special feature and the technique of their examination is similar to that of skeleton tombs. As for burial megaliths (dolmens, covered ways, etc.) modern explorers have established the fact that these monuments were nearly always placed under a tumulus. To-day, most of these monuments stand out of the ground, so that only an excavation for control

(1) *Op. cit.*, La technique des fouilles aux Pays-Bas, *Mouseion*, Vol. 43-44.

purposes is envisaged. Nevertheless, it is precisely thanks to these excavations that it has been possible to determine, in many cases, not only the epoch of burial and the rites, but also the structure of these funeral monuments. As an example, we may cite the researches undertaken in Holland which furnished the proof that enormous masses of earth were moved in order to cover the stone cells.

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After this exposé, and the accompanying characteristic examples, of the technical procedure at present followed for pre-historic research in the exploration of dwellings, defensive enclosures and necropolises, a few complementary remarks are necessary.

In order to have a complete picture of a given culture, it is essential to explore human settlements and the necropolises in their entirety. In this way, finds are more surely placed in the milieu to which they belong; the nature of the colony, the form and use of the dwellings, the characteristic aspects of the social life, occupations and usages become known — in a word, the level of the civilisation is discovered. Dwellings and tombs of the same period go to show, among other things, the number of inhabitants who occupied a settlement, a result which, in its last analysis, allows one to judge of the density of the population.

Generally speaking, it is a grave error to attempt to establish universally applicable methods for the technique of prehistoric excavation. The operative ways and means should always be adapted, as has been said, to local problems, to the territorial conditions, and to the end one has in view. The perfection of modern apparatus, the number of workers and of specialists who take part in excavations, are also decisive factors. In so far as the organisation of the work is concerned, the best solution will naturally be that which releases the head of the expedition from all detailed work, so that he may devote himself entirely to planning, to his observations, in a word, to the scientific direction of the excavations. In this respect, it is obviously impossible to lay down rules and, therefore, all counsels can be given in one, which is of primary importance: all excavations of this kind should be conducted by specialists with extensive personal experience, for if this condition is not fulfilled, only isolated finds will result, which will provide no answer to the very questions brought up by the finds themselves.

By way of conclusion, it may be said that the methods and technical procedure in prehistoric research must necessarily be adaptable to the place to be explored and to the problems to be solved. It is not the gathering together of finds which is the essential, but rather the knowledge of the character, the chronology and the prehistoric rôle of different cultures. These ends can be attained by the excavation of dwellings, fortifications and burial grounds. The technique practised should always allow of the finds, which must be considered as so many historic founts, to be brought to light and preserved. At the same time, the methods used should furnish precise information on the stratigraphy and the chronology of the layer of civilisation enclosing the objects found, or the tombs. Finds, ruins, remains of buildings, and even the colour of the earth help to reconstruct the nature and position of the settlement, the burial rites, etc. In fact, all these observations require an historical interpretation, properly verified, which will serve to complete our knowledge of these epochs in the life of mankind which have no written history.

CHAPTER VI

DOCUMENTATION DURING OPERATIONS

All archæologists with experience of work in the field recognise that it is impossible to lay down general principles applicable to all kinds of excavations. The methods used should be determined by local conditions, and as these present great varieties according to locality, purpose, size of the finds, etc., the method has to be modified in every case. A dwelling of the stone age cannot be excavated in the same way as a large architectural monument; a tomb must not be dealt with in the same way as a vast area of ruins. It is only after long experience that one can take decisions as to the methods to be adopted.

On the other hand, everybody will agree that certain minimum conditions may be established from the scientific point of view, which can apply to all excavations. In this connection, it is interesting to recall the advice of O. Montelius, namely, that it is better not to carry out an excavation at all than to work in such a way that scientific facts are irreparably lost. An excavated earth tomb, for example, is for ever lost for supplementary investigations. The excavator should therefore concentrate his attention on the elements which are going to be removed or changed during the course of the excavation, such as the various kinds of earth, the stratification of the ground, the exact position of the finds, etc. Briefly, all changes observed in the course of the work must in some way, be recorded by means of maps, photographs, etc., supplemented by careful notes. The excavator must always be sure that, by means of his drawings and photographs, or otherwise, he will be able to reconstruct every detail of the portions removed or changed, even if much of his work may, in some cases, never be used and never serve as material for the final publication of a report. If these conditions are fulfilled, there will be comparatively few difficulties for the excavator when drafting his reports and preparing the publications, even if this work has to be done far from the scene of operations.

The following rules have proved to be extremely valuable in connection with excavation work:

1. A contour map (the field plan) of the whole of the area which is to be excavated should be available, on which fixed points are staked out and maintained throughout the whole excavation.

2. The site should be photographed from several points. The positions of the camera may be marked for later comparative photographs from exactly the same spots.

3. Suitable places for dumping the excavated soil should be investigated by means of trial diggings, and when selecting these dumps allowance should be made for the probable extension of the excavations.

4. The whole site should be divided into squares of suitable size (with sides of about 2 m.). The squares, arranged checkerboard fashion, should be numbered along the edges, and each row of squares marked along the edge of the trench by large iron spikes driven into the ground. (Workmen usually ignore wooden stakes).

5. Before the digging starts, the excavator must satisfy himself that sufficient material is available for the conservation and packing of finds.

6. The excavation should be begun not where the most interesting finds are expected to be made but with regard to the facility with which the soil removed can be carried away.

7. The *natural stratification* should, if possible, be followed. This is preferable to an arbitrary system of layers. The natural stratification is much more easily observed if the work is carried out in a horizontal, and not in a vertical, direction. In this way, the observations will be made on vertical sections cut in the soil. Sometimes, the layers can be more clearly distinguished if the section is left to dry for a couple of days. By means of *angular* sections, the slope of the various layers can be determined. If these observations are made in each square, the stratification of the whole site can easily be reconstituted when the work is finished.

8. No finds should be removed before their exact position has been marked on a plan and their relation to a certain layer noted. A closed deposit of finds should always be cleared completely before any of the objects are removed. As the finds are being removed, the camera should be used frequently.

9. In order to avoid any confusion of the finds, they should be numbered and entered in the object register while they are still *in situ*, and in each case care should be taken to see that all necessary notes are made concerning them.

DOCUMENTATION DURING OPERATIONS

In order that the results of these investigations may have the greatest possible scientific precision, excavators of various countries have made use of many methods, instruments and tools, which have proved to be suitable for various conditions appertaining to excavations. In the following paragraphs their significance for field work will be discussed.

I. Maps, Plans, Figured Drawings.

A. *The field plan* should show the location of the excavation in relation to the surrounding country. It can therefore be drawn to a fairly small scale. If great accuracy is needed, the map is made with the help of a theodolite and provided with contours. Surveying with a theodolite is, however, a lengthy operation and requires more than a few days if the plan extends over a large area. If less accuracy is required and the work must be finished in a short time, a contour sketch can be made by means of a diopter or a Wrede's mirror.

B. *The general architectural plan.* — When a large area with architectural remains is excavated, the general plan is of primary importance. On this plan, not only the general outlines of the excavated monuments should be set out, but also their details; dimensions and levels should be noted in figures and the position of any finds and other movable objects clearly indicated. It is therefore advisable to plot this plan to a comparatively large scale (1/20-1/50). Unless conditions are exceptionally unfavourable, the plan can be drawn on a fixed board, with the help of a diopter and a tape measure. But if conditions are too complicated and various layers of architecture have to be drawn on the same plan, or a set of plans, there is another system which has proved to be very practical for recording the measurements of the excavation site as a whole. The entire site is divided into squares of suitable size (1-5 m. sides). These squares serve, during the whole excavation, as the basis for every kind of measurement, as well as for the work of excavation. This system was introduced in the Nordic countries as long ago as 1872, in minor excavations, but has since been used in Greece and Cyprus on a larger scale, and has always proved to impart orderliness and logical inference to the work. The squares are marked out checkerboard fashion by means of iron pins along the edges of the trench and numbered. In most cases, string or wire can be used for marking out the squares in the middle of the area to be explored. If the distances are too great, the intersecting lines can be marked out with the aid of a diopter. The plan should be

drawn on several sheets of millimetre graph paper on which the squares are indicated. In this way, the map is made independent of the shrinkage which can never be avoided in field work. The system is convenient also in that the work of drawing and surveying can be carried out in several parts simultaneously, independently of the excavation work, provided that the whole network of squares is marked out on the ground and on the map before the excavation is started. Furthermore, when the first layer of architecture has been cleared and one has to proceed to the next below, the same system of squares is still used, enabling work to be carried out at several levels simultaneously. This method, applied to the whole of the work and conceived on the basis of the squares of the plan, which is justified by the special, ever changing conditions of all excavation operations, can naturally be combined with other systems of mensuration for purposes of control. The utility of the squares when collecting potsherds and other finds is discussed in the next paragraph.

C. *Find plans and detail plans.* — The squares constitute the natural outlines for the detail plans, which should be drawn to a larger scale (1/5-1/20). Smaller and more intricate instruments can be used for this work. The surveyor's rod can be held firmly in a horizontal position by means of iron pins of a certain pattern which have been found practical, for example in many Swedish excavations. A small surveying instrument such as a Tesdorff level will also prove extremely useful and is to be recommended for measurements in minor rock-tombs as it is provided with a convenient tripod and very short distances can be measured by it. For the detail plans, the same system of levels is used as for the main plan. The accurate drawing of the detail plans is often extremely important, even more important than for surface surveys. In Sweden (Vendel, Vallsgärde, etc.) for example, tombs were excavated, in which burials in boats were found. The wood had decayed completely in the soil, but the exact shapes of the boats could be faithfully reconstructed by a careful study of the iron nails and rivets used in assembling the various members. As a rule, the lowest part of an object is the most significant. By comparing the lower levels at which various objects lie, it is sometimes possible to prove the existence of an earthen floor, which otherwise would escape the excavator's attention, especially in rock-tombs where the moisture of the soil and the bad light make observations difficult.

D. *Sections.* — It may be admitted that the reproduction of sections in archæological publications has hitherto been very much neglected; and it would

seem that many excavations are still carried out without proper drawings showing sections of the stratification. Very often, when these sections are available, they relate to the periods, to the date of the layers, but give no indication of the real shape of the layers which can be distinguished in the soil. The lack of drawings showing the natural layers revealed in the course of excavations has frequently caused confusion, not only as regards stratification, but also as regards finds. In reality, sections are usually as important as plans and safe conclusions can be drawn only from plans and sections together. The purpose of the sections is to show, by exact measurements, the actual features of the various layers. (Often, the excavator has no opportunity to see a whole section at the same moment as it is composed of small portions and certain parts have had to be removed.) Their actual appearance to the eye can be shown by means of photographs. The sections, too, should be made in accordance with the system of squares described in Chapter II, either between all the squares or as close to each other as may be required by the nature of the site. It is very convenient to use millimetre graph paper and to draw the sections to the same scale as the general plan. All the sections should be prepared in advance on this paper and gradually completed simultaneously with the excavation and the drawing of the plan. The most important levels are taken with an instrument and the same datum is used as for the plan. Within the skeleton of vertical squares thus drawn on the paper, the details are added and all measurements carefully indicated. Thanks to this system, it is possible to complete gradually the sections between all the squares (every 2 metres) with a minimum of interference in the excavation work proper.

E. *Façades.* — When measuring the faces of excavated walls, the same principles can be recommended as for the sections. The same datum should be used as for the plan, and the main levels taken with an appropriate instrument.

II. Photographs.

a) *General views.* — In recent years, aerial photographs taken from aeroplanes have rendered great service to archæological research. The excellent results obtained at several places during the war are well known to everybody (1). The method, which is discussed in detail in Chapter II, has been practised with success, in the Near East, in England, in the Nordic and many other countries,

(1) Cf. G. A. Beazeley, *Air Photography in Archæology*, The Geographical Journal. LIII, 1919.

and everywhere the aerial photographs have revealed things that were hidden to an observer on the ground. Aerial photographs taken vertically can also be used when making the field plans. As a rule, the photographs are taken early in the morning or in the afternoon, when the long shadows give a sharp relief to the ground. Special cameras, automatically operated, should be used. The idea of photographing an exploration area from an aeroplane has developed from earlier attempts made by Major Elsdale in the late 'eighties, who used balloons specially designed and constructed for this purpose.

Towers are often erected to facilitate the work of photography. In Sweden, such wooden towers, about 5 m. high, have proved to be very useful; in some instances, it has been possible to draw the whole architectural plan with the help of photographs taken from the towers. The prints have to be enlarged and fitted together to form a complete plan (cf. the method used at Korsbetningen, Gotland, and described by Dr. Thordeman) (1). If it is a question of taking only a general view of a site, photographs can be taken from similar towers or simply from the top of a long ladder.

b) *Detail photographs and cinema cameras.* — During excavation operations, various kinds of cameras can be used and will be found suitable in the majority of cases. Besides large pictures, and those which are to be used for publication, the present-day requirements of archæology oblige excavators to make a frequent use of the camera. The small films commonly used today permit of the photographing of practically every stage in the development of field work, without any appreciable increase in expense. Every archæologist who is preparing a scientific report on his work for publication, knows that there can never be too many photographs to illustrate work in the field. If all the unpublished photographs are kept in museums or in special record offices, it will always be possible to control the work and to make supplementary observations. The use of a cinema camera in archæology has proved to be of relatively little scientific value. It is obvious that immovable objects can be photographed just as well with an ordinary camera as with a cinema camera. On the other hand, cinematographic films are, of course, useful for demonstrating the methods of excavation.

c) *The use of artificial light.* — Artificial light in connection with archæological photography has been used for quite a long time. Artificial light of some kind or other is specially necessary when photographing the interior of rock

(1) See the study published in *Mouseion*, Vol. 43-44.

tombs. Here, however, the usual flash lights are not to be recommended, as the smoke which they produce often remains in the caves for days, thus making it impossible to expose a second plate. Besides, if the tombs are very small and the flash light has therefore to be placed near the camera, this is always shaken more or less by the explosion. During the Swedish excavations in Cyprus, many plates, exposed in the small prehistoric rock-tombs of that island, were spoilt in this way. The closed glass bulbs used by pressmen, though expensive, are to be preferred in such cases. If funds permit, it is always advisable to use electric light with portable batteries in the field. This kind of photography has been seldom practised in field archæology, but it seems evident that archæologists might have a great deal to learn from the experiences of film studios, where all such problems were solved long ago. In Sweden, photographers are at present working on the Runic stones and other similar monuments on which the pictures are incised in very low relief. Electric floodlight or a powerful magnesium flash, placed very much to the side, often reveals details in low relief that can never be seen in ordinary daylight. Acetylene lamps, specially designed for the purpose, have also given very satisfactory results.

III. Various tools suitable for archæological excavations.

Although the question of tools is dealt with in a special chapter of this manual, reference must here be made to the various implements the use of which has some relation to the actual technique of documentation.

A great deal of time and money will be saved if the excavator can decide what tools are to be used in the various stages of the excavation and if he can determine the moment when the workmen shall change the tools, either because they have to be more careful, or because the danger of destroying something which needs meticulous work has passed. It depends very much on the way the workmen are trained whether they can be left to decide matters for themselves.

Picks and spades. — Excavations of architectural monuments on a large scale are usually carried out with picks and spades. In the Near East, the men use the picks and the women the spades, while in the Nordic countries the same workmen do all the work. It is always preferable to let the work of excavation proceed in a horizontal direction, along a certain fixed level. In this way, the soil falls easily to the bottom of the trench and the vertical sections can be examined without difficulty.

Small picks. — In some American and Swedish excavations, a small pick is used for more detailed work. The pick was introduced into archæological work by Professor J. G. Anderson, who adopted it for his geological researches. This very useful tool measures about 30 cm. in length.

Knives. — Various kinds of knives are used very much for detailed work as well as for the excavation of dwellings and tombs. The blade should be rather flexible and the cutting edge rather dull. These knives are made in various sizes. Most of the work of clearing finds and skeletons is done with knives. Knives with a hooked or bent blade have proved to be excellent for extricating certain parts (the ribs, etc.) of skeletons. If the finds to be excavated are of very soft and fragile material, it is always advisable to use wooden-bladed knives specially mounted for the various kinds of work.

Pencils. — All detail work must be clean and it is therefore necessary to follow the work of the knife with brushes or pencils of suitable size.

Removal of Soil. — The removal of the excavated soil to the dump is always a difficult problem for the excavator. In excavations on a small scale, the soil can be carried away in baskets or tins. In the East, where the wages for labourers are comparatively low, this method is commonly adopted. In the Nordic countries, the soil is removed in wheelbarrows, generally by boys. In excavations on a larger scale, however, and when the soil has to be transported over long distances, it is preferable to lay a Decauville railway; but it is sometimes difficult to employ this system as the ground on which the rails are laid must be almost level; in any case, the gradient must not exceed 1 in 10. It is always easier to fill the trucks if they are placed as low as possible in comparison with the level on which the excavation is going on. Owing to the difficulty of passing over or around walls, etc., which have been cleared, the whole excavation programme must sometimes be mapped out with regard to the position of the tracks. If the excavation is carried out on the basis of the system with squares described above, it is advisable to approach the site in such a way that the rails follow the direction of the squares; or, *vice versa*, if the nature of the ground makes this impossible, the network of squares should follow the direction of the main tracks of the railway.

Screens. — Very often the soil has to be examined extremely carefully. In the Nordic countries, practically all the soil from the excavations is sifted, a system which has always been practised since the earliest excavations in these regions. In the extensive excavations undertaken in the Mediterranean and other countries, however, this would be impossible. But frequently certain

portions of the soil call for minute examination; for example: the soil from the burial layers in tombs. The screens used in Sweden consist of thin wire netting fixed to a wooden frame about 1 m.×0.70 m., with a handle on each side. The mesh varies from about 5-10 mm. The screens are hung on special wooden stands to facilitate the work. They should not be rocked too violently as stones and lumps of hard clay might then break antiquities of a fragile nature. The soil should be pressed through the screen by hand only and the residue closely examined. Although the utmost care may be taken in excavation, minor objects, such as beads, buttons, stone seals, scarabs, etc., are often recovered in the screens, especially if the earth comes from poorly lighted rock tombs.

IV. Removal of finds. Classification and packing material (1).

The finds should be removed as soon as the necessary measurements, drawings, photographs and notes are made. If there is a large pile or deposit of finds which have to be removed together, as is often the case when tombs or temple sites with closed groups of finds have been cleared, special arrangements must be made to avoid all possibility of confusion both as regards the objects and their original positions. It has been found more practical to label the finds while they are still *in situ*. The finds are numbered on the plan and the corresponding numbers marked on suitable wooden tallies tied to the objects as soon as they are removed from the earth. Series of objects are checked before anything whatsoever is disturbed. For the packing of the finds, specially made cardboard boxes have been used by Swedish excavators. When empty, the boxes are packed one inside the other Chinese fashion; two or four small boxes can thus be packed in one of medium size, and four medium-sized ones in a larger case. The latter are of thin deal and are useful for the packing of skulls, metal bowls, etc. Experiments were made during the Swedish excavations in Cyprus with two sets boxes and cases of approximately the following dimensions:

	I.	II.
Cardboard boxes:	2× 5×7.5 cms.	3.5×5.5× 9.5 cms.
—	4× 8×12 cms.	6.5×9.5×12 cms.
Deal cases:	5×13×26 cms.	13.5×20 ×24.5 cms.

(1) This question is also dealt with in Chapter IX, *The conservation of archæological ensembles*, but more particularly from the point of view of the material preservation of finds and the efficiency of the packing.

Besides these types of boxes for small finds, another kind was used for the packing of potsherds. They are brought to the excavation site in the form of large sheets of cardboard, slotted in such a way that the sheets can easily be folded into a box or a small container and fastened together with metal clips. This work can very easily be done on the spot. These boxes, which are fitted with a lid, are very strong and afford protection against rain for some time. The size of the box when assembled is about 10×20×32 cms. These boxes, which are also useful for packing objects, may appear to be too small for potsherds, but the size has been found suitable for the average quantity of sherds from one layer in one of the squares described above. The pottery, too, is collected in accordance with the division of the site into squares. If necessary, several boxes can, of course, be used for the sherds from one square.

As to the labelling of the boxes, several methods may be considered. Even the smallest have sufficient surface for the recording of the following particulars :

1. Name of the site excavated.
2. Date of finding.
3. Number in the object register.
4. Number of square on the plan.
5. Level.
6. Brief description of objects in the box.

The objects are wrapped in thin paper in the box, in which a label is also enclosed. All the objects are listed with short descriptions and measurements, etc., in an object register in which notes on the boxes are also entered.

The boxes with the potsherds are also numbered according to the layer in which the sherds were found. Furthermore, there must be references to the squares, levels, etc., in question, in the same way as on the boxes for the numbered finds. It is sometimes necessary to examine the sherds in the course of the excavation. They therefore have to be removed from the boxes for washing, even those already packed for removal from the site. The risk of confusion, therefore, arises afresh when the sherds are washed. A provisional washing (without hydrochloric acid) is often sufficient for a preliminary examination of the sherds, but they must be allowed to dry thoroughly before being replaced in the boxes (1). To avoid confusion, one or two wooden tallies are enclosed

(1) For details of this treatment, see Chapter IX.

with the sherds in the boxes. These tallies are specially made, about 6 cm. square and with smooth surfaces on which it is possible to write clearly. The tallies always follow the sherds if these are taken out of and away from the boxes, e.g., when they are spread out for drying after washing.

V. Removal of finds under special conditions.

It is sometimes necessary to make special arrangements for the removal of finds. As will be seen in Chapter IX, many finds must not be withdrawn from the ground until they have undergone some kind of treatment for their conservation or strengthening. Broken vases can be removed piecemeal and packed so that the fractures do not rub against each other. Metal objects, however, should be kept as complete as possible, as, owing to oxidation, etc., the various pieces are often deformed and cannot therefore be fitted into their proper places without difficulty. Such metal objects should therefore be given a coating of paraffin; they should first be cleaned as much as possible and a copula of paraffin reinforced with pieces of linen melted over them. The whole object is removed from the earth on a thin wooden board or something similar pushed underneath. Finally, the remaining side is closed with paraffin. It is advisable to leave a tally with the necessary numbers and notes in the paraffin. By this method, a fragile object can be removed to the station, where the paraffin is melted away prior to undertaking the conservation work.

VI. Removal of skeleton remains.

Though very expensive when adopted for large objects, the same method with paraffin is sometimes used for the removal of specially interesting skeletons. The use of gypsum instead of paraffin is cheaper, but it must be borne in mind that there are always great difficulties in breaking through the gypsum shell in order to get at the skeleton embedded therein. If gypsum is used, the skeleton or bones must be covered with several sheets of wet paper before the gypsum is poured on. The skeleton remains from the Swedish excavations at Asine, in Greece (1), were transported packed partly in paper and boxes, partly, especially the skulls, in gypsum. Professor Fürst recommends the gypsum method

(1) Cf. C. M. Fürst, *Zur Anthropologie der prähistorischen Griechen in Argolis*, Lund 1930.

for skulls but not for the rest of the skeleton. In the Swedish excavations in Cyprus (1), the skulls were packed in wooden cases just big enough to hold them (see above).

VII. Notes, catalogues, etc. on the site.

In the preceding chapters, a method for labelling finds on the site has been described. As soon as the finds have been cleaned and treated for their conservation, however, the tallies should be replaced by labels attached to the objects.

The notes made in the course of the field work can be divided into three main groups, referring to:

1. The architecture and shapes of excavated immovable antiquities.
2. The stratification and description of the various layers removed.
3. The conditions under which the finds were made.

Besides these notes, which can easily be made in the course of the excavation work, it is always necessary to prepare on the spot the reports on the analysis of the architecture, as well as the synthesis of all the notes for final publication.

During the excavation, detailed records must be kept, particularly the obligatory object register, which should contain, in addition to the notes on the labels, a short description of all the finds. If the work has to be spread over several years, these particulars can be transferred to a card index, which may be arranged according to the most appropriate principles.

A corresponding card index should also be kept for the potsherds. The sherds in each box should be counted, classified according to the various types of vases, and entered on a card, which mentions also the layer, square, depth, etc. for determining the origin of the sherds.

In comparison with these data, the daily progress reports will always be found less valuable for the final scientific publication. If possible, however, the earth from different parts of the excavation site should be dumped in different places and a record of this made in the diary in case minor finds, which may have escaped notice during the work, are found later on in the dump.

VIII. Casts and moulds.

In the course of his archæological research, the excavator is often obliged to make copies of inscriptions, reliefs and other sculptures which cannot be re-

(1) Cf. C. M. Fürst, *Zur Kenntnis der Anthropologie der prähistorischen Bevolkerung der Insel Cypern*, Lund 1933.

moved. Various methods can be used in accordance with the attendant conditions. Inscriptions and very shallow incisions or reliefs can be copied on paper in the following way: The surface of the object is first cleaned and washed with water. Several sheets of wet blotting-paper are laid over the surface and beaten with a brush until every depression is filled. This is the old method which is still to be recommended if the surface to be reproduced is not horizontal. These casts can be used only for the purpose of study. If positive copies are needed, a gypsum mould should be made. Instead of wet blotting-paper, thin sheets of tinfoil are applied in the same way to protect the surface. The gypsum is poured on and reinforced with strips of linen. The work should be done in short stages until the complete mould is obtained, which can be used for positive casts. If the objects are very small (fragments of inscriptions or details, etc.) the mould can be made simply of plastelina, and the same method adopted as for making casts of coins for photographic reproductions.

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It will be seen from the preceding pages that no general principles for documentation and surveys can be laid down suitable for all kinds of excavations, and that it must be left to the excavator to decide which method he should use. Consequently, a discussion of the methods can lead to positive results only if the conditions are known in each case.

On the other hand, a systematic study might show the importance of all meticulous methods used in archæology, and confirm the opinion that certain minimum demands may be generally established regarding the method of preservation of scientific facts in the course of the excavation. As has already been suggested, these demands may be summed up as follows: All material disturbed or removed in the course of excavation should in some way be capable of reconstruction in every detail with the aid of maps, drawings, sections, photographs, notes, etc. The whole of this work must be carried out so that not only the excavator himself can complete the relevant scientific work and publication, but also, if necessary, any archæologist trained in field work. At least as regards all kinds of drawings, measurements, etc. and also, the removal and labelling of finds, certain methods might be found to suit most cases. This would greatly facilitate the work. Furthermore, it is desirable that a general system should be elaborated, adopted by all countries, for the demarcation of the chronological

periods, stratification, etc. on plans and sections as well as common terminology for objects, the classification of vases, etc., in catalogues.

As all theoretical speculation concerning modes of archæological observation and the various methods to be used must always depend on local conditions in each case, the Cairo Conference agreed that it would be desirable to collect and publish, within the framework of the Documentation Service provided for in its recommendations (1), examples of excavations of various kinds and methodically interesting, which could serve as a guide for the future. These descriptions will be supplemented with notes on the way in which the methods in question have led to the results obtained and the conclusions drawn from the work.

(1) See *Final Act of the Cairo Conference*, Section V.

CHAPTER VII

EXCAVATION EQUIPMENT

The nature and extent of the equipment necessary for archæological field work varies greatly according to the type of work proposed and the means at the disposal of the expedition. In general, the equipment falls under five headings:

I. General equipment.
II. Special equipment necessary for excavations of different types.
III. Equipment necessary for recording facts observed (1).
IV. Camp equipment (2).

Before describing this equipment and in order to define its rôle, it should be pointed out that no perfection of the equipment can replace the experience and the trained observation of the staff of an expedition. Archæological field work is a process of destruction, — the tearing apart of the deposits laid down by the hand of man and the weather over periods of time which may have lasted a few years or, in some cases, thousands of years. Provided the staff has the necessary training and the faculty of "reading" the facts exposed, the extent of the equipment may vary considerably without prejudice to the recovery of historical material and its logical interpretation. Nevertheless, there is a minimum of equipment required by an efficient expedition staff.

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(1) See also Chapter VI.
(2) See also Chapter III.

THE TECHNIQUE OF EXCAVATIONS

I. Indispensable general equipment.

As has already been stated in Chapter I, a general survey begins with the identification of all known ancient sites and marking them on a map. This survey should be expanded and completed by exploring in order to discover and mark on the map all sites of which any remains are preserved. The complete survey consists in the excavation and recording of all sites known or discovered by exploration. At any time, when a sufficient number of sites have been so recorded, the material collected may be used to reconstruct the history of the country under survey and to define the character of the inhabitants. In our time, such a survey is practically confined to the boundaries of a single political State. Most of them are based on maps prepared by the National Survey Department of the countries concerned and this is a national duty. The completion of the survey by exploration is also a national duty, but has usually been carried out by learned societies or public institutions which have undertaken excavations each in their respective areas.

The equipment required varies considerably according to the nature of the country under examination: open country, such as the deserts of Egypt, Arabia, Arizona; areas overgrown with jungle, such as Central America, parts of India and Burma. The aerial survey by photography, utilised for photometric map-making and mosaic photographs (1), is useful in all these areas but must be controlled as far as possible by surveyors working on the ground. The aerial survey is most useful in the location of sites in inaccessible or crop-covered areas, or in exploring those where natural agents—rivers, vegetation, sand, etc.—have deposited a more or less uniform layer which conceals the remains of ancient sites from the view of an observer on the ground.

Equipment for Aerial Surveys. — The essential equipment for an aerial survey is at least one aeroplane equipped with a photometric camera and the necessary sighting instruments, and provided with a crew trained in the work of land surveying. Behind this must stand a staff of trained map-makers and mosaic men, with modern office equipment. Surveys of this type have been carried out by governments. Mention may be made of the photometric map of the *sudd*-region in the Anglo-Egyptian Sudan, which was surveyed for the Sudan Government by Imperial Airways. Another example is the mosaic map of the

(1) See also Chapter II.

great necropolis of Giza, prepared by the Egyptian Air Force. Other photographic maps have been prepared by the British Air Force and placed at the disposal of archæologists.

Although the equipment necessary for an aerial survey to produce a photometric map or a mosaic map is beyond the means of a single expedition, it is possible that an expedition may obtain, for a short time, the use of an aeroplane properly equipped. In such cases, the equipment can be used to great advantage in scouting or reconnoitring an area suspected of containing sites requiring excavation.

Equipment necessary in an archæological survey on foot. — It has long been the practice of governments to organise a surveying office to prepare maps of their country for administrative or military purposes. The organisation and equipment necessary for such geodetic or cadastral surveys are beyond the means of an ordinary scientific expedition and such surveys come under the obligations of the governments concerned. Such maps, prepared and published by individual governments, serve as the basis of the archæological survey of the country or district in question, whether that survey is undertaken by the government itself or by a private expedition. Several countries have had archæological maps prepared by private enterprises; the map of Palestine published by the Palestine Exploration Society may be cited as an example. All privately made maps are liable to error and should, if possible, be replaced by official maps made by government survey offices.

For a general archæological survey, a map of the district of the country under examination is therefore a primary necessity. A map made in a government office by surveyors without archæological knowledge or assistance will show only well preserved and known sites. As regards the information to be entered on these maps, representing the preliminary data required for the preparation of the final survey, this question is dealt with in Chapters I and II.

One example of a general survey is that made in 1906 by the Egyptian Government, in Nubia, preparatory to flooding the banks of the Nile for fifty miles south of the Assuan reservoir. The preliminary survey was made in a steam launch (which an excavator will in some cases have to provide for) from which both banks of the river were clearly visible through a pair of binoculars. A description of the equipment required for the recording and excavation work that followed this preliminary survey is given later. Similar preliminary surveys can be, and have been, carried out by boat, camel, motor-car or any other

mode of conveyance suitable to the country under examination, provided a sufficiently accurate map is available. The most essential equipment consists of a hand camera, a note book, a pair of binoculars and a compass.

II. Equipment necessary for excavations of different types.

Sites may be roughly divided into types: (a) the simple site, representing only one comparatively short period of time, and (b) the more or less complex site, which represents a period of occupation of hundreds or thousands of years, or more than one occupation of the site in widely separated periods. Whether simple or complex, every site is *sui generis* and presents an individual problem to the excavator. Sites generally represent either a town (including cities, small settlements or single habitations) or cemeteries, both of which may be of every possible size. The deposits of débris vary considerably according to the geological formation of the subsoil, the material used in the structures, the topography and the climate. Each archæological expedition must, of course, adapt its equipment to the character of the deposits in the country or district in which it is working. Not only that, but the tools employed must be adapted to the physique and the habits of the workmen available. For example, ordinary labourers in European countries are trained in the use of the spade, pick-axe and shovel. Workmen in Egypt, on the other hand, trained in the use of the short iron hoe, can only be taught with difficulty to use the spade or shovel but easily acquire the use of the pick-axe.

The equipment must also be adapted to the character of the débris to be removed. The essence of the problem is presented by the simple site. In general, such a site consists of: 1) the substratum; 2) the floor of the building or camp with its structures (masonry, crude brick, wattling, etc.); 3) the débris of occupation deposited by the persons using the place; 4) the débris of decay (the deposit formed by the decay of the structures and ending above with an uneven surface of decay formed by weathering); 5) the surface débris accumulated over the surface of decay or produced by the cultivation of the upper deposits for crops or tree plantations. It is necessary to remove these deposits 2-5 in inverse order without breaking into the underlying deposit. The complex site presents a series of simple sites, in some cases superimposed one over the other, and in others with the structures and deposits of the later occupation partly intruded in the earlier (1).

(1) See Chapters IV and V for the precautions to be taken in removing each layer separately.

The method of attacking the various kinds of débris must be varied according to each problem presented. Nevertheless, a simple and cheap equipment is sufficient to enable an expedition to deal with all the types of sites and all kinds of débris. The chief difference in the equipment arises out of the difference between surface débris, which can be cleared away rapidly, and essential deposits which must be handled with great care. Deep deposits of sand, earth and similar surface deposits which contain no objects can be removed with great rapidity. But every deposit which may contain objects must be cleared away slowly and meticulously. Let us take up first the tools necessary for dealing with the usual types of débris.

Ordinary tools used in removing the common kinds of deposits.

The short hoe. —The ordinary tool used in excavation in the Near East is the short hoe with an iron blade (different local forms) and a short wooden handle. The hoe may be used in removing:

(*a*) Shallow or deep deposits of surface débris (sand or agriculture);

(*b*) Débris of decay, decayed mud brick, fallen stones and structural filling, down to the next surface of decay or to the next underlying floor;

(*c*) In excavating and filling of intrusions down to original deposits;

(*d*) In emptying graves and burial shafts down to the burial level;

(*e*) In breaking floors after their recording and in order to reveal the underlying deposit of the geological stratum.

The basket used in removing the débris. — Whether the débris is to be deposited in a suitable dump near by or carried to a distance by a railway or similar equipment, the most convenient means to be used in the removal is the common palm-leaf basket used all over the Near East. It has been found necessary, in employing boys and women, to adapt the size of the basket to the prolonged task of carrying a loaded basket the whole day (8 hours divided into three periods). The bottom of the basket should be reinforced with palm-fibre, otherwise the cost of renewal becomes excessive.

The pick, with double-pointed iron head and wooden handle. — The pick with a double-pointed head and a wooden handle is one of the most dangerous of tools, but it can be used to advantage in dealing with deposits which contain no objects.

Very often, surface débris is found hard-packed by rain or consolidated by moisture. The same condition occurs also in deposits of débris of decay and in burial pits or shafts. When such a hard deposit is proved by its position or by preliminary examination with a knife to be free of antiquities, it can be rapidly broken up with the pick and the broken débris dealt with by the gangs of hoemen and basket-carriers. Such hard deposits lying on the floor of a building or a burial chamber should never be attacked with the pick.

The pick used ordinarily in the Near East has an iron head with the wooden handle inserted in the middle. The two cutting points curve downwards with one end pointed and the other with a narrow edge (1-2 inches).

The shovel. — The shovel can only be used with safety and advantage in removing deep deposits of sand. It is an unusual implement for the field labourers of the Near East and it is necessary to train a small gang of men for its use. A good method for dealing with deposits of sand is to lay a railway on the lowest possible level and to cut into the drift. The shovel men stand on the side of the track and throw the sand directly into the trucks. When the sand is hard-packed, a gang of pickmen break down the wall of sand before the shovel men. In the deep narrow deposits at Giza, a single line sufficed to clear the deposit of sand. In the dunes at Nuri, the wider deposits had to be approached by supplementary switch lines branching from the main track.

Special tools supplementing the use of hoe and pick. — The use of the hoe, the pick and the shovel in removing the greater part of the débris in a site brings the excavator sooner or later to deposits, usually small, which contain the important historical material; deposits which must be examined with meticulous care. The deposits of special character are, among others:

(*a*) The débris on the floor of a house, a temple, or a chapel, covering the objects left on the floor by the last occupant;

(*b*) The lower part of the filling of an open pit grave in which is preserved the body and the burial furniture; in fact the whole filling of such graves (1);

(*c*) The burial chamber of a large shaft tomb and, in fact, all burial chambers whether intact or plundered;

(*d*) Deposits resulting from plundering either of houses or burial chambers which may be met with in the débris above or outside such structures.

(1) See Archæological Survey of Nubia, Report 1907-1908, Vol. I, pl. 3-8.

All the objects and the material facts contained in these deposits must be exposed by careful handwork before they can be recorded by scale drawings and photographs. This examination requires special tools: tweezers, needles and thread, a broad-bladed knife, brushes of various sizes and qualities, hand bellows, a tablespoon, and various supplementary materials, such as paraffin wax, celluloïd solution, plaster of Paris, etc.

The broad-bladed knife. — The broad-bladed knife should have a thin iron blade about 24-30 cms. long and about 5 cms. broad, pointed at the tip and firmly fixed in a wooden handle giving a firm grip. This knife is used as a substitute for the hoe in small deposits, for dissecting such deposits by picking away small bits by lifting coherent layers of hard débris, by slicing wet débris and in other ways which can be acquired only by practice.

The knife is the most handy tool in dissecting deposits of silt (from rain water) left on the floor of a burial chamber which contains or might contain objects, bones, or linen. It is also used in clearing a living floor on which layers of mud and silt have been deposited by occupation or weathering. A third use is in removing plaster, either mud or gypsum, from door sealings or blockings.

The broom. — A long-handled hair broom, about 50 cms. in width, is useful in sweeping floors of all sorts, not only the mud floors and stone pavements encountered but also the surfaces of decay, the floors of rock-cut chambers, the tops of walls, and all vertical surfaces which are not decorated or inscribed.

The house-painter's brush. — The house-painter's brush can be obtained in various sizes and it is useful to have several sizes available. The large brush can be used for the same purposes as the broom, but more particularly for clearing away sand and dust between objects or between the bones of a skeleton. As in the case of the knife, special workmen noted for their skill should be assigned to jobs requiring the use of the brush.

Small camel-hair brushes. — Small camel-hair brushes are used in removing dust from small objects, for example, strings of beads and amulets the threads of which have decayed, and beads found in the sand, dust or loose débris. When the sand or dust is thick and crumbly, it is best to expose a short length of a necklace and immediately string it with needle and thread. This work should be carried out by the excavator himself. When a bead garment is discovered, it

will usually be possible to expose only a portion at a time, which must be consolidated and removed to a tray until the whole is assembled. It is impractical to string such garments until after the reconstruction on the tray on account of the complicated threading.

These brushes and small tweezers were the chief implements used in clearing the Hetep-heres Tomb, the secret tomb of the mother of Cheops (Harvard Expedition).

Tweezers. — Tweezers are useful for lifting small single pieces without disturbing the rest of the deposit. These should be of different lengths (from 10 to 20 cms.), with a spring which keeps the points separated. The ends should be flat on the inside and slightly roughened with a file surface, rounded for lifting larger pieces and pointed for picking up small beads and amulets or inlays. The use of tweezers requires a delicacy of touch and they should be handled by the excavator himself.

The hand bellows. — The hand bellows in several forms is useful in blowing off dust, light sand and organic dust (after recording). The hand bellows with a long metal spout such as is used for blowing up fires has proved very valuable for the final clearing of skeletons in predynastic and similar graves filled with sand or light broken gravel. It can, however, be used only when the objects in the deposit are heavy or fixed in position (such as a skeleton with the ligaments preserved). In dealing with more delicate deposits, a small bellows (a rubber bulb for example) can be employed if care is used. The small bellows used for sprinkling insect-powder can also be employed.

The tablespoon. — The tablespoon is here cited as an instance of the devices which the excavator must invent to deal with special circumstances. In clearing skeletons, it has been found that, very often, pebbles and small hard bits of earth, which have to be cleared without damaging the archæological specimen, cannot be removed by means of the bellows.

Equipment used in removing débris from intrusions and shafts. — As stated above, the débris excavated is ordinarily removed by basket carriers. When the depth of the intrusion exceeds three metres, however, the removal by a line of carriers becomes slow and expensive. Either the hollow being cleared must be approached from a different direction on a lower level, or, if this is impractical the

débris must be removed by a line of men standing on steps cut in the ground or on the rungs of a ladder leaning against a wall of solid débris. When the intrusive cavity being excavated is a shaft such as a burial shaft less than two metres deep, the loaded baskets can be easily lifted on to the surrounding surface.

The ladder is the most economical method down to a depth of 5-8 metres, but grows costly in time and labour at the lower levels, and in such shafts as those at Giza, with depths as much as 30 metres, the pulley arrangement should be used, with devices usually employed by bricklayers and stone-masons.

The ladder used for evacuating earth from a shaft. — The ordinary European ladder, with round rungs, is too light and is not always suitable for native workmen. It is preferable to build ladders on the site from local wood; these may be of various lengths but of the same construction, consisting of two long side pieces (2-4 inches in diameter) with heavy slats nailed across at intervals of about 50 cms. The side pieces taper from butt to tip; the slats may be made by sawing lengths of 2.5×5 cms. white pine beams. In cases where imported wood is not available, it will be necessary to construct ladders of local tree trunks sawn by local carpenters according to the directions given to them.

Power-driven excavating machines. — A number of power-driven machines have been invented and are in use for excavating foundations of buildings, canals and railway cuttings. All these are much too expensive for an archæological expedition and would seem to be impractical for archæological excavations. Certain types of digging machines would destroy practically all the evidence which an archæologist is in duty bound to uncover and record. As a matter of fact, in archæological excavation, the dissection of the deposits of débris can be carried out only by hand.

Screens. — Screens and their use were dealt with in a special Section of Chapter VI.

Equipment for transporting débris from the excavations to a distance outside the area to be excavated (1). — The final disposal of the débris produced by excavations is a problem which has several solutions. When the site is a simple isolated site, the solution is simple; the débris produced is carried outside the

(1) The question of principle is examined in Chapter IV and taken up again in Chapter VIII.

site and dumped on ground previously examined and proved to contain no ancient remains. Care must, however, be taken to begin at the part of the area farthest from the dumping ground so that the carriers do not have to walk over excavated ground.

When the strip or checkerboard system is employed (1), the carriers will follow the procedure indicated for the simple site. By this system, a large site can be excavated in convenient strips but of sufficient size to reveal the whole series of deposits. The débris excavated in one strip is thrown into the last excavated strip, after it has been fully recorded and survey marks set up. It is to be noted that the carry must in some cases be too long for economy, but this must be endured. It is not economical to use a carry of over fifty metres and, in general, carries of less than 30 metres should be arranged.

In sites of large area, the most convenient mode of transporting the débris to a distance is the light railway.

The light railway. — The most convenient from of light railway is that with five-metre rails fastened at one metre intervals by flat iron ties to which the rails are bolted. The track is 60 cms. wide. It is convenient to keep the rails assembled in five-metre lengths and in a few shorter lengths ready for laying. In addition to the rails, provision must be made for a number of switches bolted together and ready for laying. The additional material should include several turntables and the accessory tools, such as: rail benders, cold chisels, sledge hammers, iron crowbars, wrenches, oil cans, braking bars, together with grease, cotton waste and other materials for cleaning and keeping the axle-boxes in order. The truck should be stoutly built, with four wheels, on which is suspended an iron box of triangular section with apparatus for unloading by tipping the box to either side of the track. The capacity of the box should be about 3/4 of a cubic metre.

In the laying of the railway line, certain fundamental principles must be observed:

1) The loading point of the trucks should be as close to the point of excavation as possible, to shorten the length of the carry traversed by the basket carriers. In some cases, sand can be shovelled directly into the trucks without any carry.

2) The line should approach the place of excavation on as low a level as pos-

(1) See Chapter VI.

sible but should not be laid in an excavation which cuts through significant deposits. It may, however, be laid in a cut in surface débris.

3) The line should be laid in such a way that it is possible to manipulate the trucks so that empty trucks are always ready at the loading point and that loaded trucks may be tipped as fast as they arrive at the dump.

4) The line should not be on a strict level, for if so laid it requires too large a force of men to push the trucks, and is dangerous because of the difficulty in preventing the truck-men from getting empty trucks going and riding on the platform. It has been found that a very slight slope from loading point to dump was economical and prevented accidents to the men. The loaded trucks run out by gravity, controlled by men using a brake bar on the axle or the wheel. Loaded trucks are held down even on irregular tracks by their own weight; it is the empty truck which is the more liable to leave the track. A special gang should be trained to the manipulation of the trucks and no inexperienced man allowed to engage in this work.

It is only in very exceptional instances that an overhead line can profitably replace the light railway.

The wheelbarrow. — Light wheelbarrows are of practical use when a few workmen of good physique are available. It is often necessary to lay a track of planks from loading point to dump when the surface of the path is soft or irregular. They are, however, not adapted to the physique of labourers in the Near East, and where the rate of wages is low the line of basket carriers, or basket carriers and light railway combined, enables the excavator to dispense with the wheelbarrow.

Tools used in breaking stones.

The sledge-hammer. — The sledge-hammer with a steel head (20 lbs. weight) with a long handle about 1 metre long is most convenient. The head must be fixed by wedges driven into the end of the handle. The sledge-hammer is used for breaking soft stones, limestone or even granite which has rotted. Special workmen should be trained to its use.

Chisels and wedges used in splitting limestone blocks. — Limestone blocks of hard texture can be easily split along the natural bed and the separated layers smashed with the sledge-hammer. Sometimes the block can be split by the

use of long iron bars with a chisel-shaped end. In the case of more obdurate stones, the splitting is carried out with small chisels and wedges.

Stone saws. — Blocks of stone are sometimes found with one surface decorated with reliefs or inscriptions which have to be removed to a museum. When the surplus of stone is too great, it may be sawn off with the ordinary two-handed stone-cutter's saw. The use of this saw requires the services of a trained stone-worker with one assistant.

The handling and removal of large blocks of stone.

Equipment used for handling heavy blocks of stone. — In the course of excavations, a variety of situations arise in which the excavator has to move, lift or transport to a distance large blocks of stone. The blocks of stone can be broken up with sledge-hammers and removed to the dump when they have no archæological value. Occasions also occur in which blocks of stone which are too hard to be broken up are encountered and which cannot be replaced in their original constructions.

Every large stone must be freed of the débris in which it is lying and examined. Crowbars will therefore be necessary for the operation of turning the stone to expose the side underneath. Nevertheless, when the site contains stone buildings, it is advisable to have a special equipment of levers, wooden beams, rollers and ropes for handling large stones. When, for example, it is necessary to raise a stone sarcophagus up the burial shaft leading to an underground chamber, the equipment should comprise a long rope 2 inches in diameter (of Manilla hemp), two compound pulley-blocks, a stout tripod of beams (4×4 inches) and occasionally a winch. The hemp rope is more pliable and safer than a steel hawser. A winch can, in some cases, replace a gang of men.

The beam with sliding shoe and the winch used for raising and transporting heavy stone objects. — This equipment consists of three heavy beams (12×12 ins. and 25ft. long) on which slides a heavy wooden shoe of 2 in. planks about 6 feet in length. The beam is well greased with axle-grease to facilitate the sliding of the shoe. The object is set lengthwise on the shoe and dragged forward by means of ropes pulled by a large heavy winch anchored out in front. When the shoe reaches the end of the beam, a second beam is placed in position ready to receive the shoe and its load. The gang required is about 20 men, and stones weighing from 5 to 15 tons can be moved in this way.

Lighting.

Lights used in underground chambers. — For underground work (burial chambers, rock-cut tombs, subterranean apartments in large buildings, etc.), light must be provided artificially: candles, oil-lamps, acetylene lamps, etc. Care must be taken in using oil and acetylene lamps to prevent explosion or fire.

The electric hand battery is convenient for use by the excavator in making personal examinations, but its short duration makes it expensive for use by workmen.

An electric lighting plant is expensive but is necessary and justified in certain situations. When the secret tomb of Queen Hetep-heres I was discovered at Giza, the task required such a plant: a 5 HP engine, an electric generator producing 4,000 candle-power, four 1,000 candle-power portable lamps with reflecting screens and about 8 bulb lamps of 50-100 candle-power. This equipment amply lighted the chamber being cleared and facilitated the taking of photographs.

Light can also be provided by the use of mirrors when there is sunlight. A plain glass mirror set in a wooden frame (about 60 cms. × 80 cms.) is held by a man at the top of the shaft so as to keep a steady reflection descending to the bottom of the shaft. There, another mirror turns the ray of light horizontally into the chamber. The final mirror can throw its light on a nickeled disc from which the light is distributed.

For general use in the open air, the most convenient light is given by the hurricane lantern.

Conservation of finds, preservation material and transportation.

Materials and implements used in preserving fabrics, organic matter, wood, ivory, faience, plaster, etc. — These materials and implements, with a description of their use, are dealt with in Chapter IX.

Carpenter's tools. — The minimum equipment should include a handsaw, claw-hammer and nails, screwdriver and screws. A fuller equipment includes also an auger, chisel, rasps, files, gouges, short and long planes, adze, and different forms of saws and hammers, etc.

Maintenance of lines of communication. — The means of transporting supplies and keeping up regular communications depend entirely on the situation of the

excavation camp and the relative positions of various fields of excavations. Water must be brought to the site by donkeys and camels, water-carriers, or by motor transport where suitable roads exist. In some areas, native boats and motor-launches must be used.

III. Recording material.

Equipment necessary for making maps and plans. — The work of every archæological expedition requires the production of a general map of the whole site, maps of the different fields of excavation and maps of limited areas (cemeteries, groups of buildings, etc.) and plans of separate structures. On the general map, the levels must be indicated by contour lines showing selected levels. In detailed maps of fields of excavation and limited areas, sections must be made at selected intervals to show the foundation stratum, the structures and the underground chambers. The equipment will vary according to the extent of the work undertaken and the means at the disposal of the expedition. The minimum equipment advisable consists of a theodolite, a telescopic level, a steel tape, survey-poles, a levelling staff marked in centimetres and a drawing table mounted on a tripod. The measurements to be taken are in three dimensions in most sites, two measured by the theodolite and tape, and the third by the level and levelling staff.

A more complete equipment would include a tangential tachyometer, a prismatic compass, a magnetic compass and various other instruments for measuring angles—all of which instruments are usually to be found in the outfit carried by a topographical expedition.

Drawing instruments. — The instruments required are: a set of ordinary compasses, dividers, etc., a hardwood T-square, steel straight-edge 80-100 cms. long, boxwood rulers marked in centimetres and scale rulers adapted to the scales used in the drawings (1/1, 1/20, 1/50, 1/100, 1/200, etc.), proportional compasses, slide rules, trigonometrical tables, hatching ruler, etc.

Photographic equipment. — No kind of archæological equipment used by different expeditions varies more widely than that for making photographic records. Expeditions engaged on recording temples and decorated chapels, such as the expedition sent out by the Oriental Institute of the University of Chicago, require the fullest possible equipment. On the other hand, an expedition work-

ing in a small cemetery of pit-graves or a small simple encampment site may make a sufficient record with a minimum equipment including a single small camera.

The camera is used to record the general appearance of the field of operations before, during and after the excavation. In addition to the general views, photographs should be taken recording every unit of excavation (building, burial shaft, underground chamber), every deposit, the types of débris and every face observed. Finally, every object entered in the object register should be photographed from as many points of view as necessary to record its form and construction. In this way, a complete mechanical record is made parallel to the diary, object register, plans and sections, and will substantiate the observations recorded therein.

Cameras used in the open air should be solidly built and mounted on stout tripods to guard against vibrations caused by wind and fitted with a graduated ball and socket to facilitate the taking of general views. Preference should be given to a large plate camera designed to take negatives of the size 18×24 cms. A small stand camera is required for taking photographs in confined spaces (such as the doorblocking in a shaft less than a metre square, objects deposited in small burial chambers). A suitable size for the plates is 9×12 cms. To reduce the volume of sensitised material, small cameras taking strips of cinema films can also be used. Autochrome films are also very useful for recording the colour aspect of sites. The tripod should be of the tilting top pattern with a ball and socket joint.

It is, of course, impractical for an archæological expedition undertaking serious work to dispense with a dark-room for filling plate-holders and developing negatives, when the means at its disposal permit such facilities. Special tents have been designed for this purpose, but they are all not to be recommended for use in hot countries with strong sunlight. It is therefore preferable to build a dark-room of brick, with a mud roof covered with overlapping boards also heavily plastered with mud.

The accessories will include all that is habitually necessary for the development of negatives (plates and films), drying and printing, etc.

IV. Camp equipment.

Camp outfit. — Archæological expeditions use three types of camps: 1) the temporary camp necessary for a short piece of field work; 2) the camp installed

for the excavation of a large site and occupied for two or more years, and 3) the permanent base camp from which the expedition operates.

The installation will consist of sleeping quarters, dining-tent, kitchen, with all requisite furniture and utensils, an office and a store for the records, a dark-room and a studio. The tents may be either square (4 m. × 4 m. with double roof) or bell-shaped, according to the use to which they are put. Each tent should be supplied with a spare set of ropes and wooden pegs. On any large site which is to be completely and scientifically excavated, some provision of a more permanent character must be made: hutments constructed of crude brick or rubble laid and surfaced with mud plaster; they can be roofed with local logs and reeds.

In a river country, a house-boat may be profitably used to provide the living quarters, the office accommodation and the storage of records. The furniture and accessories should include all that is normally required for a camp of this kind. For food, a wire-screen hanging box protects the food from flies and insects. An ice-box is also very useful, not to say indispensable.

Health service and medical supplies. — The importance of providing for a health service, which is indispensable to any excavation expedition working in regions where medical attention would be practically obtainable, must not be overlooked. The equipment required should include an outfit for the dressing of wounds, of the type served out to the army; simple appliances for dealing with fractured limbs; and a medicine chest, the contents of which should (if no medical staff is attached to the expedition) be chosen by a doctor familiar with the chief diseases prevalent in the region being explored.

As will be mentioned again in Chapter XII, the importance of organising a medical service cannot be over-estimated, not only from the point of view of the proper conduct of the excavation operations, but also to facilitate relations with the natives. The excavator should therefore seek the counsel of doctors who have practised in the region or in similar areas, regarding not only the various methods of treating the diseases which may be contracted, but also the habits of the natives and their attitude towards medical help. All experienced excavators know that a special effort must be made to win the confidence of the natives if they are to become useful auxiliaries, especially in relatively little civilised regions. A medical station, well installed and able to render first-aid in cases of sickness or accident, should therefore form part of the equipment of even the smallest of excavation expeditions.

In this connection, the excavator should also bear in mind the preventive measures to be observed, on the one hand, in the recruiting of native workmen—which should always be carried out under the supervision of a doctor—and, on the other, in all matters relating to food hygiene and cleanliness.

Water Supply. — The supply of water is one of the essential factors in an archæological camp. When taken from rivers, care must be taken to draw the water from the moving current upstream of any possible source of infection. Drinking water should always be boiled and bottled for cooling. The sanitary equipment should include filters, disinfectants and, lastly, vaccines to counteract, or eliminate, as far as possible, all dangers of contamination.

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In this chapter, which deals with necessary tools, we have attempted to draw up an inventory, as detailed as possible, of the instruments, tools and other accessories needed in the various operations of a methodical excavation. This inventory may therefore be regarded as a sort of analytical schedule of the various instruments mentioned in the chapters dealing with the various aspects of the technique of archæological research.

Among these accessories, there are, of course, some which are in general use and to which, therefore, only a bare allusion is necessary in so far as they are put to some particular use, in archæological research.

We have attempted, however, to give as detailed a description as possible of tools which are peculiar to the excavator, and in view of the fact that this is a technical study, it was necessary to give examples of how the tools should be used in addition to a description of them. In fact, it is not always either possible or desirable to separate the description of an instrument from that of its use, and only abundance of material has occasionally necessitated such a course. For example, in regard to the work of preservation, it was better to refer simply to Chapter IX, in which the methods and principles of the preserving of excavated objects, methods and principles which alone can determine the choice of tools and materials necessary to this work, are dealt with, rather than to duplicate the descriptions.

In regard to surveying instruments and cameras, the shortest descriptions also suffice, since they can be classified with any other list of ordinary geome-

trical instruments or photographic equipment. In any case, this equipment and its use have been dealt with in Chapter VI.

The same observations may be made in regard to various installations and arrangements for transport, shelter, and consolidation which excavation work may require. In this respect, the chapter indicates only the principal materials with which the excavator must provide himself, while the specific use of these materials is dealt with in Chapter III (Material organisation of excavations) and Chapter XII, in which are indicated the various professions of which the excavator should have some knowledge in order to be capable of directing the work. Finally, in regard to the installation of the camp, it was necessary to limit oneself to general lines, which vary according to the duration of the work, for this part of the equipment does not differ widely from that of any expedition which intends to remain outside the path of civilisation for some length of time, and must necessarily take into account the peculiarities of the district: climate, hygiene, safety, supplies, access, etc.

This chapter has therefore been treated as a memoir, to which the excavator can have recourse when he wants to draw up a plan of campaign and when collecting his supplies, before starting operations.

Thus, if it has been necessary to describe equipment, suitable to a large expedition, it goes without saying, that when dealing with more modest researches the equipment will be in proportion to the importance of the work and the resources available.

Lastly, in many specific cases, the choice of packing and the manner in which it is used must necessarily be left to the experience and *savoir-faire* of the explorer. Excavations, being complex and delicate enterprises, should not be undertaken except by experienced men and by archæologists wise not only in archæological science and the peculiarities of the strata to be explored, but also in the various aspects of the technical problems necessarily encountered in work of this nature.

CHAPTER VIII

SUPERVISION AND MAINTENANCE OF EXCAVATION FIELDS AND ARCHÆOLOGICAL SITES

The authority issuing the excavation permit, as well as the beneficiary of the permit, accept a heavy responsibility. The former confers on the latter a treasure for the benefit of human culture, of intellectual value for the history of the civilisation and art of the country in question, as well as for science in general. And, in certain cases, a treasure of material value. It is also to the interest of the country concerned, and to the interest of the world at large, that this treasure should not be destroyed or lost, either by reason of the excavations themselves, or in the course of the work. It is therefore necessary to examine, under the following headings, the questions which arise from this fact:

I. Measures to be taken in regard to the excavations, to ensure the application of strict scientific principles and approved technical methods, consonant with the maximum safeguarding and preservation of objects and monuments, during the work.

II. Measures to preserve—during and after working—the integrity of monuments; that is to say, for all architectural monuments which are on the site, and which are to remain there.

III. Measures to remove movable objects from the ground, so that they may suffer the minimum of damage; that they are placed in a place of safety, in the most complete state possible and that they reach the museum to which they are finally destined, under the very best conditions.

IV. It is necessary to examine, under a separate heading, what responsibility rests with the authority to whom it is proposed to give power to issue excavation permits.

V. In this last paragraph will be set out, in brief, the legislative rulings which govern the questions raised in the paragraphs above, in the different countries.

THE TECHNIQUE OF EXCAVATIONS

I

Excavation has frequently been compared with reading a document which vanishes as it is read, and which therefore can be read only once. It has also been compared with a chemical experiment which cannot be repeated. This is true: for the earth gives up its secret only once, and all depends upon the intelligence and experience of the excavator, who either enables, or prevents it from telling its story, while he carries on his excavations. For even leaving landmarks in place cannot compensate for want of observation. In this respect, the very smallest factor, in the course of excavation, may have the most widespread bearing. It is very rare indeed that all that has to be done is to remove encumbrance—sand for example. Also, modern excavation aims at more than the mere recovery of valuable museum pieces. It looks for the history of a place from its infancy; for the story of a human colony until its disappearance, for the fixing of every change, every superposing of houses, of which there are signs; and thence, after correlation with the individual finds, it expects to obtain a precise picture of the development of a section of human history, and of the evolution of civilisation. Such a programme has only been rendered possible by the constant perfection of the technique of excavation and observation. It is not the object of this chapter to study this technique, which has been dealt with under various aspects in Chapters IV and V. One would go to work very differently to unearth a Greek temple in marble, to remove the successive layers of an Asiatic tell, or to bring to light some Nordic wood structure of which nothing remained but traces of discoloration in the soil. Suffice it to say here that this work calls for the very highest type of technical experience and the gift of observation in the excavator. Such qualities and knowledge as are only gained by long years of practice, and are the prerogative of those who are predisposed to this work by their natural gifts. As the question is fully dealt with in Chapters III and XII, we will dwell only on those points which have bearing on the subject of this exposition.

The director of the excavation must not only be an eminent scholar, he must also possess gifts as an organiser and have technical knowledge, or at least be interested in technical problems. For, in the course of an excavation, which at every turn gives rise to new problems and calls for new measures, it will often be his technical knowledge and his ability to take prompt decisions, upon which will depend the saving of a valuable piece of research material, by means of some wise technique or by some method adapted to the circumstances. Con-

sequently, the more his expedition is working under exceptional conditions, so much the more must he equip it accordingly with all the necessary technical machinery: machines, tools, and means of conserving his finds. Likewise in the choice of his staff, he must see that he has the co-operation of assistants who also, in their respective spheres, have scientific and technical qualifications, and he must have at hand someone who has the necessary knowledge and experience for the temporary safeguarding of objects excavated. He will fix the number of his assistants, according to the nature and extent of the work envisaged, in order that he may distribute the work reasonably, and guarantee a proper examination of the finds.

With regard to the workmen, he will do well to choose, as far as possible, men who have had experience in excavation work. For an inexperienced gang will cause him endless worries in spite of the vigilance of his staff. It is also wise not to economise on wages, but to obtain a reliable gang, even at the cost of paying more. It is better to begin with too few workmen than with too large a gang. He can always augment his workers if found necessary; it is wise not to begin on too vast a scale and thus find he has more work than can be handled by his staff. In the same way, the director of the excavations must consider the choice of his overseers, though he should give the preference to those whose profession is useful in excavating work: such as stone-cutters and masons who are used to handling large blocks of stone. It goes without saying that he should engage men in whom he has complete confidence.

Payment of the workmen should be done by the director himself, and not left to the overseer, especially in the Orient; for, apart from the possibility of irregularities, by paying out the money himself he establishes his position as head of the expedition in the eyes of the natives. It is advisable to pay the workmen in proportion to their capabilities, which can only be determined after the first week's work. A system of payment, favoured by many excavators and based on the quantity of earth dug out, is apt to lead to hurried digging and consequently to the loss of finds. But this method may be used when it is only a question of clearing large quantities of sand or other material, in which it is certain no objects of interest lie hidden. It is also advisable to discountenance the *Baksheesh* system, by which the workmen get a bonus, over and above their pay, for each find they make, the bonus being calculated according to the market value of the find (1). This system encourages the men surreptitiously to intro-

(1) Cf. the views expressed on this practice in Chapter III.

duce objects which were not found on the spot, and even spurious objects. This however does not mean that, under exceptional circumstances, one should not give a bonus to a workman who has shown himself outstandingly careful and diligent, whether it be in the discovery of some isolated object, the location of some particular site, or the unearthing of structural remains which were particularly difficult to handle.

With regard to the actual operations, it is essential to note here that every member of the excavation party should be present at all times: this in necessary for the proper care in handling the finds. This principle used not to be recognised as paramount. It is only by insisting upon this regular attendance that irreparable damage to the specimens can be avoided, as the workmen do not always realise the value of a find, or, at least, not in time to avoid damage, and they may not have the necessary knowledge of how to preserve a find, if such measures are needed at once.

It is hardly necessary to insist upon the need of recording minutely the progress of work in the excavation diary, together with full particulars regarding the circumstances in which the objects were found, sketches of finds and their position, plans and contours, etc. These measures assist in safeguarding the finds, and in many instances are the only means of their preservation. Equally necessary are notes on all ephemeral signs, such as traces of colour, grafitti, etc. Photographs of the objects *in situ* are also of great use. Sometimes the form of an object no longer there may be preserved by taking an impression of the mould left in the earth.

In addition to the diary, it is essential to keep a register of all finds, in which each object is recorded, after it has been carefully numbered. The number should be put on the object, or the packing, in the safest manner possible. Objects should be entered in the register in numerical order, together with a short description, and, if possible, a photograph or drawing should be appended in order to facilitate identification. It is advisable to record these numbers in the excavation diary as well, opposite the objects to which they refer.

As has already been said above, in regard to the personnel, these few remarks on the recording of finds appear in the present chapter only in so far as they are connected with the preservation of objects brought to light, since, from the point of view of principle and method, this question has already been dealt with in detail in Chapter VI.

II

In all excavations, nothing whatever that the ground contains should be destroyed, either in the course of excavation, or by the use of deliberate brute force. Blasting should always be forbidden, unless, under exceptional circumstances, it is necessary to clear away rough rocks which may, for example, encumber a site as the result of a landslip. Likewise, the use of a hammer on pieces of stone should be allowed only in specific cases, and then only when dealing with shapeless matter.

Intentional destruction can be permitted only when it is necessary to remove pieces of wall of a much later period and, in certain cases, masonry in which one may expect to find documents of value of an earlier period (1), or when it is quite impossible to continue the excavations without removing the obstruction. But it must always be borne in mind that such destruction must not be allowed until one is satisfied beyond doubt as to the significance of the object to be destroyed, and that it is only of minor importance. This being settled, the object to be destroyed should be accurately surveyed, and, if possible, photographed before action is taken.

The work of excavating necessarily destroys the stability in which architectural remains are found when embedded in the earth, and so their preservation is endangered. This stability must therefore be restored, by strengthening walls which have cracked, by straightening parts which lean, by replacing foundations in order to preserve the superstructure in its original position. It is possible, by adapting a carefully thought out plan of excavation to each particular case, to preserve even elements which would be irreparably destroyed in the very operation of excavation. Stones which are falling away from an arch should be cemented in position to prevent the collapse of the structure; loosened portions of masonry should be secured with metal clamps. Walls can be protected with unbaked brick to prevent crumbling. Often the excavator must himself protect the remains of mural decorations by fixing portions which are flaking off and by making the edges impervious to humidity. In damp climates, he must be prepared to erect a protective roof over the structure. In any case, and while continuing his excavations, he should protect all mural decorations, by means of straw mats, against splashing and scratching.

(1) These operations cannot be governed by general rules or considered without taking into account the reservations made on this point, for example in Chapter IV, in connection with the excavation of cities.

A difficult problem arises when it is necessary to preserve the different colours on large expanses of architecture, the transport of which to a museum cannot generally be undertaken. If it is a difficult matter to preserve the colours on pieces destined for a museum, and a problem not yet satisfactorily solved, even these methods cannot be satisfactorily applied and are often useless when the remains are to be left in the open air. Even when one attempts to fix the thin layer of colour by means of cellulose or some form of soluble glass, it is still impossible to prevent the colours from fading quickly in the rays of a very hot sun. There is only one way to preserve these remains, namely to recover them with earth, after studying them carefully and copying the colours. Mosaic floors should be covered with sand, after consolidating the edges. In northern climates, walls which have been exposed in the course of operations, will suffer serious deterioration during the winter period of cessation of work, due to water infiltration and frost, unless the upper courses are covered with a reasonably resistant coating of cement. If this is found impossible, the only thing to do is to recover the walls with the excavated earth and thus protect them.

We must also include in this section the "conservancy" of the excavation site. This question, which formerly was often neglected, and which goes beyond the measures strictly necessary to preserve the site, is nevertheless particularly important and a special chapter is devoted to it (Chapter X). Today, every excavator considers it as a point of honour to leave the site of his explorations in the most perfect order possible, in order to assist later study of that which he has discovered, and for the benefit of visitors, even though uninitiated. In general, it is possible to do this without too great expense being incurred. The excavator will, for exemple, restore stone steps to their original position, or adjust any other architectural fragment which has been disturbed in the course of his work; he will set up again on their base the drums of a fallen column and put scattered architectural pieces back in the building or setting to which they belong. He will even do more; he will attempt to reconstruct the original grouping of architectural ensembles. He will remove the material excavated which may obstruct the view of the ruins, as well as any vegetation which may spoil the aspect or hinder access; he will, in short, make every attempt to give to the ruins the same aspect which they had in their pristine state (1). He will

(1) This chapter deals essentially with the measures taken to ensure the preservation of a site. It is obvious, however, that this question cannot be studied without taking into consideration the æsthetic bearing of these conservatory measures; this aspect of the problem is examined in greater detail in Chapters IX and X.

also take steps to protect certain fragments by means of a roof, and collect the specially valuable pieces in some shelter where they can be kept under lock and key.

Here, evidently, the question arises as to how far the excavator is responsible for preserving the pieces and how far the country giving the permit is responsible. In so far as the obligations of the former are concerned, however, it would seem that the above exposé has described and defined them in all completeness. If some countries are inclined to go beyond this very broad programme, in the terms which they lay down for the excavator, they should remember that today, when most of these men undertake the work from purely idealistic motives and with financial aid which often represents a considerable sacrifice on the part of their own country, they put at the disposal of the country in which they operate, a cultural treasure which the country itself has every interest in conserving, especially as it will derive tangible profits therefrom, if only from the touristic point of view.

We now see that if mention has been made in this section of certain technical questions concerning preservation and upkeep, dealt with in Chapters IX and X, these remarks were necessary in order to determine the respective duties of the excavator and the government department which issues the permit.

It is in the same spirit that we now broach the question of guarding the site, not only during work, but also during rest hours, and eventually when the work is finished. The purpose of this guarding is primarily to prevent undesirable visitors — natives or foreign tourists—from damaging the objects which have been brought to light. The former will be found particularly annoying in the neighbourhood of a large settlement. They hinder the workmen at their job, they induce them to commit thefts, they endanger unstable walls and deep excavations and they expose themselves to accidents. And, either through malevolence or simply in a spirit of destruction, in their desire to obtain valuable objects, or material which they can put to their own use, they do not hesitate to destroy architectural features. It is unnecessary to give examples of this. In countries where tourists abound, they will be found just as annoying; they want to see and photograph everything, to take away a souvenir—which is often thrown away a few hours later—, they break statues and pieces of architecture, scribble on walls, etc. The only way for the director of the excavations to protect himself against these troublesome visitors is to appoint guards who shall be on duty at night and also during all lengthy periods when work has ceased. In many cases it will be found advisable to maintain a guard even when the work

is completely finished, especially if one has reason to believe that the authorities will fail to do so.

The guards must also stop any attempts at stealing on the part of the workmen. Needless to say, if it is possible and if the men are reliable, a guard formed from the supervisors attached to the expedition will be still more efficacious.

For excavations taking place in a large settlement, or even near one, the surest means of protection is to construct a wall round the site to exclude all strangers. For the purpose of keeping wandering animals from doing damage, a barbed-wire fence will suffice.

III

The technical ways and means used for loosening, extracting and preserving finds will be the object of only general remarks here. The question is treated at length in Chapters VI and IX and it will suffice here to draw attention to certain aspects, in so far as they throw light upon the responsibilities of the excavator.

These various methods depend entirely upon the nature and substance of the object, as well as on the way in which it is embedded. Stone structures or pieces of sculpture are less likely to suffer deterioration in the course of excavation, than, for example, objects made of clay or even more brittle substances. However, certain kinds of stone, such as sandstone and tufa, are sometimes so softened by moisture that they must be allowed to dry before they are withdrawn. But harder types of stone, such as marble, must still be handled carefully, for any marks made by instruments would be just as unsightly later as a chipped piece of architecture. If, for any reason, an object of this kind must remain in the ground while excavation goes on, care should be taken to cover it with mats or planks.

The loosening and extraction will be more difficult in the case of objects made of fragile or perishable material, which, such as baked clay, may be completely softened through having lain long in damp earth. It should be laid down as a principle that the loosening and extraction of such objects should only be done by the scientific members of the expedition. Never can hurried handling have more deplorable consequences than in such cases and it should be understood that nothing whatsoever shall be touched until it has been properly loosened, examined and all relevant details noted. It is also necessary to note that anything which may be damaged in the course of clumsy extraction should be recorded and preserved, and that no crumbling fragment should be

allowed to be thrown away. All waste of time and each false move carries its penalty, for it is only with great difficulty—and even then not always—that one can reconstitute scattered elements or recover lost forms. In this respect, as was said at the beginning of this section, the methods to be used must be determined by the nature of the object. In so far as it is possible, objects of baked clay should be left to dry before they are extracted. Fragments of frescoes which are detached from their setting should be strengthened from the back, by pouring in plaster of Paris, as they can easily crumble away completely when they are detached from their support. Objects made of wood, bone, ivory, textile fabrics, ropes, bark, even metal which has become thin, soft or brittle, should be impregnated with paraffin before being removed, in order to prevent their destruction or decomposition. As for objects in clay (tablets), they should be removed with the surrounding earth.

It is advisable to have at hand, for the stowing of small finds, provisional receptacles *ad hoc*, such as baskets, boxes, paper bags, on which can be inscribed the numbers corresponding to the entries in the diary. Objects should be taken immediately to a store-room, which should as far as possible be damp-proof, fireproof and burglar-proof. Near the store should be a workroom, with every possible facility for the work of cleaning and preservation. Cleaning the finds—which is of importance to the excavator as it enables him to identify the form of objects—should be done with the greatest possible care. Sometimes too energetic cleaning will efface inscriptions and grafitti on clay fragments. Traces of food, for example, which may remain attached to these pieces of pottery have their interest for the specialist in prehistoric matters. Also it must not be forgotten that cleaning with water obliterates the beautiful changing colours of glass objects.

Generally speaking, an excavating expedition has a chemical laboratory at its disposal; it is therefore advisable to leave to the museum and its staff the cleaning and repairing of the more delicate objects. However, certain provisional measures may be necessary, in order that chemical action may not spoil the finds. Wiegand, for example, suggests that bronze and iron should be washed in clear water to remove any acids or salts, then dried and lacquered to preserve them. If necessary, pottery can be washed in water to arrest the corrosive action of salts. Organic substances, such as bone, wood, ivory, and horn, which have become chalky owing to the absence of organic matter, should be impregnated with dammar resin, or paraffin, an operation which should be done without delay (Ratgen). The only way to preserve the form of clay objects

is to bake them at once (Woolley). Retention of form is especially difficult in the case of damp wood, which in the process of drying shrinks and splits. Wood demands prompt and particular attention: immersion, immediately after extraction, in a weak formaldehyde solution, or packing in damp earth or moss. Eventually, recourse may be had to impregnation with paraffin or glycerin (Ratgen). (See also Chapter IX, I c.).

Objects in stone or bronze should never be cleaned with inorganic acids, such as sulphuric or nitric acid. When taking casts, only those methods which which will not alter the appearance, nor damage the structure, of the objects should be employed.

As a rule, the work of reconstruction and completion of broken objects should be left to the restorer at the museum. This applies especially to vases, which are more difficult to pack and despatch, once they have been restored. In some cases, the excavator will, however, be well advised to determine *in situ* the original form of these objects.

The responsibility of the excavator in regard to finds does not end until he has handed them over to the agent of the authority which issued his excavation permit. Frequently, this transfer is only effected in the place, or on the spot, where the objects are to be finally kept. For this reason the excavator should include in his duties the packing of objects and their removal to this place. Heavy objects, large pieces of stone, should be packed in strong cases. It is permissible, however, to transport these pieces on a lorry without more protection than a mattress of sufficient elasticity under them. One must remember that, if occasion arises, the archæologist must turn road-builder, or road-man and, in particuliar, he should check the carrying capacity of any bridges which his lorries have to cross.

Fragile objects should be packed with the greatest care. They should be wrapped in some soft material (cotton) in such a way that jolts on the road will not damage them. It is advisable to send a list with each case, giving the contents and the number in the excavation register. The cases should be marked, preferably by means of branding irons.

IV

We have so far dealt only with the responsibility attaching to the holder of the excavation permit. The share of responsibility which the authority which issues the permit must assume, can be briefly outlined as follows:

1. Weighing the abilities of the applicant, both as a scientist and as to his technical ability in excavating. It is evident that this entails a heavy responsibility. For, even though the permit be suspended or withdrawn, following serious infringement of rules, the damage which may have been done in the meantime cannot be repaired.

2. Controlling the plan of work suggested by the applicant, as well as the material means necessary for its realisation and the method to be applied; in this respect, the authorities may, if necessary, give specific orders which go beyond the generally accepted line of conduct.

3. The supervision of the excavation operations, which supervision is entrusted to a representative of the authority which granted the permit. His duties will be:

(*a*) To supervise the excavations in so far as the scientific methods applied to the work are concerned;

(*b*) To supervise the excavations from the point of view of the preservation of the objects dug up; to prevent the intentional destruction of anything, before exact descriptions have been prepared; to prevent the spoiling of finds, by carelessness, in the course of the work; to see that good methods of preservation are employed, that the excavation diary and the object register are properly kept; that all objects found are preserved and guarded, according to the necessities of the case, and that precautions against theft are taken.

If, in theory, these duties are simple to determine, in practice they are often a source of dispute between the excavator and the agent. The ideal agent should have the same qualifications and the same experience as is expected of the excavator, if he is to supervise the latter effectively. It often happens that he is not of the same opinion as the excavator as to the choice of method, and that misunderstandings arise. More often than not, difficulty will arise because the agent is not qualified to carry out his task. Such an agent may seriously hinder the progress of the work, by interfering with the organisation of the site, unless he contents himself, in his capacity as supervisor, with preventing any of the objects dug up from being stolen.

These few remarks are sufficient to show that the choice of a really qualified agent may be of decisive importance for the easy running and success of the excavations.

4. The appointment of guards for watching the excavation ground.

5. The reception of the objects found in the course of the excavations, with a view to their ultimate preservation and safe-keeping, and the upkeep and permanent guarding of the site and of all that is dug up.

V

The more recent the laws in the various countries, the more detailed they are in regard to their provisions concerning the points which have been discussed in this chapter.

Nearly all the legislative provisions of recent date, require that the applicant should possess scientific and *archæological* qualifications, which must be attested by recommendations from learned bodies, or which may be left to the judgment of the authority delivering the permit; the latter may also refer, in turn, to learned bodies. Iran, Switzerland (Neuchâtel), Syria and Lebanon, for example, deliver permits only if the application is made by a learned body.

The Egyptian authorities demand that a licensee who has not already distinguished himself by his work in the field shall secure the assistance of a recognised scholar having the necessary experience to supervise the excavation operations. In Greece, no persons are allowed to undertake excavations unless they have previously carried out such work or have spent some time on an excavation site.

As regards the composition of the staff, Iraq is the only country to formulate detailed regulations, and fixes a minimum of four members. It stipulates that an expedition must be provided with all the necessary material for the preservation of objects according to approved scientific methods.

In most cases, responsibility is, in a way, concentrated on one person alone, in that the authorisation is made out in the name of one person and is not transferable. The suspension or withdrawal of a licence, due to defective or insufficient work, is provided for by legislation in Egypt, India, French Indo-China, Italy, Turkey and the United States of America, unless the stipulation be tacitly understood. India and Italy expressly indicate, as a reason for withdrawing a licence, the deterioration of antiquities in the course of working. Furthermore, India requires the deposit of a sum of money in guarantee, which can be drawn upon, either for compensation for objects lost or destroyed during the period of the permit, or as a fine for infringing the rules laid down for the conduct of work.

Permanent supervision of the excavation site by a person nominated by the

authority which delivers the permit is expressly stipulated in India, Bulgaria, Spain, Greece, Iraq, Yugoslavia, Mexico (optional), Prussia, Rumania, Switzerland (Geneva), Syria and Lebanon (optional), and Turkey. In Egypt, the excavator can be accompanied by an agent, if he wishes; the authorities always reserve the right to send one of their officials to inspect the site of the excavations at any time, both in regard to the material security of the excavations, and the organisation and scientific execution of the work. Peru even requires supervision by a committee of experts. In Italy, Ireland and the United States, excavations may, according to circumstances, be supervised by official bodies. In French Indo-China, it is the duty of the Administration to control and supervise excavations.

In Egypt, India, Greece, Iraq, Mexico, Palestine, Syria and Lebanon, the excavator is obliged to take precautions to protect objects brought to light, both against damage due to the climate, and to men, as well as against theft. Palestine, in particular, stipulates that the holder of a permit must take all reasonable steps to preserve the antiquities which he unearths; Syria and Lebanon lay down the principle that the excavator must take all appropriate measures to safeguard remains of buildings which have archæological or artistic value and which have been endangered by the excavations.

In Greece, throughout the excavation operations, and until the final report is published, the excavator is required to pay the cost of preserving any ruins brought to light, the shoring up of walls, etc.

In Cyprus, Egypt and India the destruction of architectural remains is expressly subject to permission from the official body.

Italy grants half the cost of the indispensable work of preservation; the other half is met by the excavator.

In Palestine, it is forbidden to use chemical or electrolytic processes, in the course of excavation, to clean antiquities. The use of paraffin is expressly authorised.

In Egypt, it is forbidden to take casts of monuments by any wet process, and in general, to undertake any work which may damage them.

The excavator is obliged to engage guards, at his own expense, in Egypt (even during suspension of work), in India, Iran and Iraq.

The keeping of an excavation register is obligatory in Egypt, India, Greece, Ireland, Italy, Palestine, Syria and Lebanon, Turkey, and the United States.

The safe-placing of finds in an enclosed spot, near to the excavations, and the responsibility of the excavator during the whole period of the permit, with

regard to the objects deposited there, are provided for in Egypt, Syria, Lebanon and India.

In Turkey, the supervising agent collects, every day, the antiquities found and registered, and deposits them in a special place. Greece divides the responsibility for excavated objects between the excavator and the agent.

Iraq stipulates that finds shall be packed and transported to Bagdad. Syria and Lebanon specify that the expense of packing and transport shall be met by the excavator.

It appears, so far, that no rules are laid down for the conservancy of excavation sites. Only Egypt, India, Sweden, Switzerland (Neuchâtel) and the United States insist that the site be restored to its primitive condition.

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The science of archæology is the only one of the theoretical sciences, which, in common with the technical sciences, is privileged to interest the legislator, at least in so far as its material documentation is concerned. Legislation aims at permanence, the static; whereas science is mobile, seeks new ideas, new methods. Legislation can therefore constitute a serious obstacle to the development of science, even if it only concerns itself with the acquisition of equipment. It would seem that, as far as administrative regulations and responsibility are concerned the most recent legislation in this matter, with its wide scope and detailed provisions, already touches the very limit of what can be imposed on the excavator by the authorities who issue permits. It would be well to lay down in principle, in this respect, that foreigners should not be more severely treated than natives, or native institutions undertaking excavations. By pushing requirements too far, one implicitly demands of the excavator material wealth which only institutions having a very large capital can be expected to possess. It must be pointed out, however, that an expedition with very large resources and the most up-to-date equipment at its disposal does not always give better results, from the scientific point of view, than an expedition conducted by a really qualified excavator working with more limited resources. It is by no means certain that the best interests of science are served if administrative requirements and material costs are so burdensome that excavation work becomes the monopoly of the few institutions possessing substantial capital. But this will undoubtedly happen if the obligations imposed on the excavator are too heavy, and if there is a tendency to look upon him as a hunter who

must be made to pay dearly for his permit to indulge in his favourite sport (1). In those rare countries where the excavator is allowed to keep a part of the finds, it is only natural that, by way of compensation, conditions should be more exacting. But in countries where the finds remain the property of the nation, and where the excavator works from purely disinterested motives, looking for no other reward than the satisfaction of having served science, it is to be hoped that such countries will remember the cultural and material gain which the finds, given to them by the excavator and which remain their property, represent for their own heritage.

Naturally, one must take into account the heavy expenses incurred by countries which are exceptionally rich in archæological material: the construction of local museums, increase in staff, expense of preservation and exhibition, etc.

But, without overlooking these considerations, which are dealt with in detail in the volume devoted to the administrative and legislative system of archæological research, it would seem advisable not to burden the excavator, for too long a period, with the responsibility for repairing and preserving objects which are brought to light, and to place these objects under the care and protection of the State with the least possible delay.

(1) Other repercussions due to this spirit are dealt with in the paper submitted by Professor A. D. Kéramopoulos to the Athens Conference, and published in *La Conservation des Monuments d'art et d'histoire*, pp. 392 (International Museums Office, Paris, 1933).

CHAPTER IX

THE CONSERVATION OF ARCHÆOLOGICAL GROUPS AND OF THE OBJECTS DISCOVERED

The conservation of excavated material is a branch of practical archæology too often neglected *in field work*, on the ground that it requires peculiar technical qualifications and the facilities of a chemical laboratory. This conception is due, perhaps, in part, to the growth of the laboratory idea in the larger museums within recent years, and to the expert assistance which excavators may receive in general preservation work, in the revealing of ornament and preparation of materials for exhibition. The idea that an archæologist can afford to relegate his own responsibility in these matters completely, however, is very dangerous, because, if he is to meet his moral obligations, he must be prepared in three different emergencies to face the practical issues himself, and the success which attends his efforts will be measured by the importance he attaches to the work and by the equipment with which he has provided himself.

These three issuesare :

1) The treatment of excavated objects left *in situ ;*

2) The preliminary or first-aid treatment of objects to be transported;

3) The treatment of material left behind in a local museum with no special restoration facilities.

It is proposed, under these three headings, to approach the study of conservation from the point of view of the field wishes and to describe, within the limits of the present chapter, only such methods as can be readily applied where the facilities of a well-equipped laboratory are not available. For more specialised processes, reference may be made to the Bibliography at the end of the chapter.

For the field worker, however, conservative methods are usually restricted to first-aid methods of preventing chemical and physical disintegration and to methods of protecting against mechanical damage which invariably accompanies thoughtless packing or careless transportation of objects from the site of ex-

cavation to the museum, and it is therefore with these matters that the present chapter will be principally concerned.

Causes of Decay. — In the first place, it should be stated that methods cannot be worked out and applied satisfactorily unless the causes of decay are known.

When objects are dug out of the ground, they suffer a change of environment which may put a particular strain upon them, —a change which is both physical and chemical in character.

The prime agency of decay is sharp variation of temperature and humidity; usually, though not always, a rise of temperature and a lowering of humidity. When objects are left exposed to the weather they may be damaged by frost, sunshine or rain.

Organic structures, for example, may shrink and warp, resulting, in extreme cases (e. g. in wooden objects from bogs or lake-dwellings) in irreparable decay which the timely application of preventive measures could have avoided.

The colour of frescoes, painted marbles, etc., is destroyed by sunshine and rain; the paint is washed away and any residual pigment bleached, so that scarcely a trace may remain.

A potential source of decay which is common to all objects left *in situ*, is that caused by organic growths; lichens and algæ, for instance, may soon cause grave damage to decorated surfaces, whilst the higher vegetation, creeping plants (such as ivy) and trees are especially dangerous. They convey an illusory sense of protection whilst, in fact, they may be undermining foundations or causing a lasting disfigurement.

When soluble salts are present, as is commonly the case in objects obtained from the ground or from the the sea, the issue becomes more complicated. The archæologist is concerned with two kinds of salts: those soluble in water and those which are insoluble, and both types are freely distributed near the surface of the soil. This is significant, and a little consideration shows the reason. Evaporation takes place most readily at a porous surface; loss of moisture concentrates salt solutions until a point of crystallisation is reached and white efflorescences begin to appear *at the surface*. This is a commonplace in Egypt and in dry climates generally; we often come across such efflorescences on alluvial soil, and they are found, for precisely the same reason, on the surface of stele, porous earthenware, etc.

When antiquities are permeated by soluble salts (e. g. carbonates and chloride of sodium), the first effect of excavation is to cause the salts to move towards

the surface of the objects. Disintegration begins, marked by a loss of surface detail and perhaps by the flaking of painted decoration or glaze, because of the ever present tendency of the salts to accumulate and crystallise where there is greatest evaporation. The final condition may be the complete loss of surface and even of significant shape by continued powdering and exfoliation.

Insoluble salts, of which gypsum is typical, may also disfigure an object: they do not generally weaken it, however, and the decay which they cause subsequent to excavation may be negligible. Gypsum is commonly recognisable in two forms: it may be either a hard opaque nodular greyish mass, or it may be in glassy selenitic crystals. The latter may be recognised by applying a hot knife to the crystal surface, when a white opaque spot appears as a result of local dehydration.

Where metals are concerned, the action of salts is more complicated. Salts of all kinds, and particularly chlorides (recognised by their forming an insoluble precipitate with silver nitrate in nitric acid solution), hasten the corrosion of all metals of antiquity, save gold, and, in conjunction with oxygen, cause electrochemical decay, with attendant swelling, powdering of the surface and loss of shape or ornament. Each metal has its own particular kind of degradation products, easily recognisable and familiar to everyone.

When the quantity of chloride is small and evenly distributed, a protective skin of minerals may form over the metal and slow down decomposition processes almost to the limit. Such a protective layer has often an aesthetic appeal of its own and receives the name of patina. Good patinas are rare in Egyptian antiquities because chlorides are almost always present in irregular distribution. The surface of Egyptian metals is generally an incrustation, often malignant in the sense that active decay may break out in spots where there is any excess of chloride, and the immediate cause of such an outbreak may be simply exposure to damp; where an otherwise uncorroded metal begins to decay, it may have suffered surface contamination with salty material, perhaps from another object with which it is in contact. The only cure is the removal of all chlorides and, incidentally, of all other water-soluble salts which may be present.

Such, in brief, are the principal agencies of decay with which the archæologist has to contend. To what extent can he reduce their effect upon antiquities?

I. Treatment of excavated objects left in situ

Objects which are left *in situ* are often massive or elaborate: remains of ships, totem poles, mosaics, engravings or paintings on stele or rock, etc. Preliminary

cleaning of the surface of objects is accomplished by mechanical means and with suitable tools, such as brushes and wooden scrapers or chisels. The lesser organic growths (fungi and algæ) may be softened by dilute ammonia. Friable plaster may be strengthened with celluloid in acetone or other impregnating fluid. Stones and other objects of mineral structure can be subjected to some process of washing, adapted to the requirements of the particular specimens, prior to impregnation with hardening fluid.

Where, for any reason, objects cannot be washed, the first concern should be to avoid exposing them to extremes likely to cause rapid reduction in humidity, as this causes salts to crystallise and organic materials to warp. In practical excavation, the exigencies of sketching, photography and adequate documentation must be met; but, as soon as convenient, the material should be protected from a too rapid transition or acclimatisation to conditions above ground. It should not be unduly exposed to heat and should not be left in the sun. This applies also to the excavation of material from frozen soil. The ice should be melted very slowly, otherwise objects will be enfeebled.

Wooden objects from lake dwellings illustrate an extreme case, but even these can often be completely dried out without warping by the simple method of packing the waterlogged wood tightly in wet moss and setting it aside for some months to dry gradually at its own pace. This is not a popular field method because it takes time. It is a very useful museum method, however, instanced here in order to illustrate the fact that, even in such extreme cases, it may be possible to save specimens from resolving themselves into shapeless masses of twisted fibres, by bringing them to the museum wet and controlling the rate of acclimatisation by a leisurely drying thereafter. A large scale operation of a similar kind will presently be described.

Soluble salts should, if possible, be washed from siliceous objects by a stream of fresh water. Any painted decoration which shows a tendency to flake must first be fixed with a few coats of 2 % celluloid in acetone. The washing of a surface which has been so protected can then be carried out without fear of dissolving the paint.

Petrie has described an ingenious way of removing salts from objects discovered in Egypt, which takes advantage of the fact already emphasised that there is a tendency for the salt to accumulate near the surface of greatest evaporation. He advocates burying the objects a few inches below clean sand and watering the sand at night. The heat of the sun during the day draws moisture and salts out of the objects to the surface of the ground. With a few daily changes of

sand, most of the crystalline matter can be eliminated. It is obvious that such a method can only be applied where spring water free from salt is available.

Scott has suggested applying moist paper-pulp to stele, the salts in this case being drawn from the stone into the pulp as it dries. A modification of this method has been found very practical for all kinds of cleaning work, because the pulp can be charged with a reagent designed for some particular purpose and its effect is thus localised and the decomposition products resulting from its action duly eliminated on drying.

Strengthening or even temporary reconstructional work (e. g. for purposes of photography) has often to go hand in hand with the cleaning of objects left *in situ*. Particularly is this the case with siliceous materials and such like.

A wide range of inorganic cements is available, the nature and quality of the stone being the determining factor in the choice of cement which is to bind it. Where the surface of the stone is too thin or pulverulent to offer a satisfactory jointing face, reinforcement by some form of strut or dowel will be required, and for this purpose Delta metal offers advantages. For work which is not exposed to weathering, plaster of Paris may then be used for filling in, protected, if desired, by subsequent waxing. But where the object is exposed, plaster of Paris is useless and a concrete aggregate with a basis of Portland cement will be required.

It is sometimes desirable to have a cement which is waterproof and at the same time somewhat elastic, allowing of a certain expansion and contraction with changes of temperature. This kind of ground is the best for mosaic which is exposed to the weather and may be prepared by mixing red or yellow oxide of lead with clean sand and incorporating a double-boiled linseed oil until a stiff paste forms, the tesseræ being laid in this paste before it sets.

When choosing a cement, for large or for small work, it is important to consider the strength of the cement as compared with the object to be repaired and also to assess the amount of shrinkage which may accompany setting. It may sometimes be an advantage for example to adjust a cement aggregate so that, in the event of damage or accident, the cement joint will be the line of least resistance and break first. It may be a great disadvantage if the cement should have a large amount of shrinkage on setting. An extreme case, which applies to smaller antiquities is the use (most ill-advisedly) of thick celluloid in mending frail ivories. Viscous solutions of celluloid contract so markedly on hardening that they may easily cause distortion or even tearing of the surface to which they are applied if this is disproportionately weak.

Cements are used in the treatment of excavated objects left *in situ* in three ways:

1) As filling material where the weight is carried by dowels;

2) As bonding material where strength and permanence are desired. Hardening materials ("Stone preservatives") might also be classified here;

3) As material to give temporary support in order to facilitate treatment of another kind.

As an illustration of practical manipulation showing the various uses of cementing materials in the treatment of an object left *in situ*, one could hardly choose a better example than that of a water-logged canoe or Viking ship. Objects of this nature have been successfully salved by more than one method; the following applies to a boat which has not gone to fragments. We assume that the shape is practically intact:

(a) *Temporary Reinforcement:* It is recommended that paper be pasted all over the interior and on this should be applied a very thick coating of plaster of Paris. This forms a very strong support for the wood and prevents any shrinkage. If it is desired to make this shell extra strong, 20% of Portland cement may be mixed with it.

(b) *Drying:* To dry the wood where a large surface is concerned, apply sheets of cotton-wool impregnated with dry calcium chloride, covered in turn by some waterproof material. The calcium chloride draws the moisture from the wood and it is absorbed by the wool. This treatment must be applied several times till the wood is thoroughly dry. The wet sheets of cotton wadding, after being removed from the wood, may be dried by heat and used over again.

(c) *Hardening:* With regard to the subsequent hardening of the wood, while a treatment with a synthetic resin such as vinyl acetate is very satisfactory for small pieces, this is rather an expensive process for large surfaces. For hardening purposes, it is more satisfactory in such cases that the wood should be treated with a solution of sodium silicate of high silica content. This has a petrifying effect. When the timber is dry, a diluted silicate solution is readily absorbed and forms a very hard substance which is not attacked by mould or rot. Several applications are required.

(d) *Removing temporary reinforcement:* After the treatment is finished and the wood is thoroughly hard, the inner shell of plaster of Paris can be readily knocked off.

This method has the merit of being cheap and at the same time very effective.

The acidity or alkalinity of a cement or hardening fluid has often to be taken into account, especially when it is to be used with stone or metals. (Test with litmus paper.) Silicate of soda solutions, for example, are strongly alkaline and may stain materials which contain iron. For this reason and because they are very prone to effloresce, they should not be used on stonework of any kind.

Some brands of Portland cement contain free sulphur and sulphur acids which would not be compatible with limestone and it is essential, therefore, to use good quality material for important work.

In stone preservation, the first thing to discover is whether the stone contains carbonate of lime as this is a constituent of many stones in addition to limestone; some sandstones, for example, contain carbonate in addition to silica, and, for this reason, they cannot be treated with any acidic substance. Hydrofluoride mixtures containing potassium silicate have often been recommended as stone preservatives for museum purposes, but it is on the whole safer to avoid using stone preservatives which have any acid or alkaline reaction because they tend to form a hard skin on the stone which eventually flakes, and the object may then be in a worse condition than before.

The question of stone preservatives has been the subject of very careful study by the competent departments or services in the different countries, amongst which may be mentioned the Building Research Station (see *Special Report No. 18*—Department of Scientific and Industrial Research). The current views on the use of surface treatment for preserving building stones are that at present no satisfactory process is available. "To sum up, the Building Research Station is at present unable to recommend the use of stone preservative solutions except to provide temporary protection in special circumstances. If after careful consideration, it is decided that a surface treatment can be used with advantage, then the material to be adopted must be chosen with due regard to the individual conditions. Preparations of undisclosed composition should be avoided. The material selected should be applied when the stonework is in a suitable condition, and it must be remembered that the protection afforded can only be temporary and that periodical renewal of the treatment will be necessary."

Objects which are not exposed to the weather, however, may often be treated with advantage, and treatment, indeed, is a necessity when the surface is in a flaking condition and when the loss of an inscribed or decorated surface is threatened.

A large group of neutral preservatives is available and these confer sufficient strength for museum purposes, weathering qualities being of secondary importance. An important quality is the capacity to render the surface waterproof to such an extent that any salts retained in the stone will not be affected by changes in atmospheric humidity. The surface of the stone after treatment with white shellac in alcohol (not bleached shellac but shellac which has been clarified by passing through carbon filters), for example, or white beeswax in turpentine is protected from changes in atmospheric humidity which are likely to occur within a museum building.

Waxes are of value for treating many kinds of objects. It is important that good penetration should be achieved and this is ensured in a variety of ways. Impregnation must be thorough, if any preservative whatever is to be effective, because adding a surface skin devoid of penetrating quality merely imparts an additional strain and affords no lasting protection. For outside work, wax is commonly applied in turpentine solution, in a series of thin coats. Sometimes spermaceti is added in preparing stronger solutions and the mixture may be driven well into wood (and sometimes even stone when necessary) by heat from an iron or blow-lamp. A little linseed oil is sometimes added to the mixture in preserving frescoes. It should be noted that wax generally darkens the colour of anything to which it is applied. It is most suitable for wood and basketry, —less so for stone. In the preservation of rotten stonework which is not exposed to weathering, good results are obtainable by using a double technique,—wax as the waterproofing agent after the application of one of the more effective inorganic hardening agents.

When a stone is standing in water, it will constantly tend to absorb the salts and these, on crystallising further up the stone, will gradually wear the surface away. In such cases, impregnation with wax is the best treatment.

Where a painted rock is suffering from weathering and flaking, mere treatment from the surface may be ineffective because decay may originate from the movement of water which is oozing through from behind. A wall can be isolated by damp-proof courses top and bottom. But the introduction of damp-proof courses, using, for example, bitumen or lead as insulating materials, is seldom possible where a painted rock is concerned. Even where the system

cannot be thus isolated, it is often possible to drain it, and for this purpose it is recommended that channels be drilled into the rock in an oblique direction upwards behind the painting and filled if necessary with porous cement to exclude insects and plant growths. Some form of grouting with cement will often be required for strengthening purposes in any case. A dripping stone may be added above to throw off the rain. It may be stated that wax affords the best surface protection for rocks which are exposed; otherwise, several coats of celluloid solution should be applied. When all else fails, some form of shelter must be constructed around the painting or it may be protected under glass, and in some cases one may even have to consider the possibility of removing a slab of stone bearing the painting and re-erecting it on a more advantageous site.

It is obvious that problems which relate to the preservation of objects which are to be left *in situ*, are largely bound up with a knowledge of the qualities and working properties of materials.

There can be no set rules for their solution, as methods and manipulation have to be determined by individual circumstances. The archæologist would be well advised to work in co-operation with local engineers and builders, where possible, as they have experience of the characteristics of the local stones, materials and climate; and if choice is made of a commercial preservative, manufacturers are always willing to advise as to whether its use in a particular instance is likely to do the firm credit, and how best to carry out the impregnation, whether by painting, spraying or the application of heat.

Before concluding this section, reference should be made to the problem of removing large plant growths and ensuring that they will not break out again after the end of the season.

Creeping vegetation, such as ivy, is cut off close to the root and very gradually drawn off making any necessary repairs to stonework, etc. with a suitable cement as the work proceeds. Plant roots are cleared away in the same cautious manner and any residual rootlets killed by an injection of sulphuric acid, due care being taken that it is not allowed to damage limestone or marble.

Trees which threaten a monument may sometimes be cut down so that they fall clear,—in cases where such summary treatment might be dangerous, the bark is ringed near the root and the tree left to die. It is then easier to cut down.

The root presents a problem depending on its size. Sulphuric acid treatment will facilitate its extraction but one must generally consolidate the foundations and allow a season to elapse before one can be justified in assuming that the

organic growths have been killed and that the work of consolidation has been accomplished satisfactorily.

In tropical regions, the annual growths of vegetation may present difficulties which are well-nigh insuperable to the archæologist with limited resources. Something may be done either by methods of sterilisation, using for example either arsenical or chlorate weed-killers, or by isolation of the site; but even then repeated inspection and attention may be required to prevent the excavation becoming buried in forest growths during the off-seasons.

The Forest Products Research Laboratory (1) emphasises the difficulty of dealing with vigorous herbaceous growth in moist tropical climates and makes the following suggestions:

" 1. *For woody growths:* The development of coppice shoots and similar regrowth can probably be hindered if not altogether stopped by the use of arsenic (sodium arsenite) either applied to a frill girdle in the case of stems over 3 inches in diameter, or painted on to the roughly cut ends of stems of smaller diameter. The method has been used extensively in Malaya and is described in the *Malayan Forester* and the *Indian Forester* (2).

" A caution must be given as to the danger to live-stock from the use of this substance, as it has been found that the saline taste attracts cattle and goats to lick the treated wounds or ground on which it has been spilt, with disastrous results to themselves. In deep jungle away from villages the risk is small.

" 2. *For herbaceous growth*: Sodium chlorate solutions of about 5%-7% are temporarily effective, but it is questionable whether the effect would persist throughout a growing season in regions of high rainfall on account of the high solubility of the salt. It might, however, be worth trying as a withering agent if it were found possible to spray the vegetation a fortnight or three weeks before the actual work of investigation started.

" For withering, a 2%-3% solution applied to the foliage is often very effective and may lead to the death of the plants...

" In the above strengths, the solution is virtually non-poisonous to animals but

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(1) Department of Scientific and Industrial Research, —private communication to the International Museums Office.

(2) *Malayan Forester* — October 1934, p. 173, January 1935, p. 52, October 1935, p. 209. *Indian Forester* — January 1918, p. 23, October 1919, p. 547.

is slowly corrosive to clothes. The only care to be taken is to see that the salt does not come into mixture with carbonaceous matter as it is then inflammable or even explosive."

II. Preliminary or first-aid treatment of objects to be transported.

III. Treatment of material left behind in local museums.

The first-aid treatment of portable objects in the field and of objects which are to be left under unskilled custody in a local museum may conveniently be dealt with together. The agencies of decay are, of course, the same as those affecting objects left *in situ* and enumerated in the introduction to this chapter, and all precautions and methods of treatment already referred to apply, *mutatis mutandis*.

For field-work in the conservation of small antiquities, the following repair materials or reagents are of most general use: fresh water, plaster of Paris, wax, celluloid in acetone, celluloid cement, shellac in alcohol, glue, caustic soda flakes and citric acid powder. Equipment consists of vessels for soaking objects, a good strong knife and a selection of scrapers and brushes for mechanical cleaning and for lacquering, empty petrol tins, match-boxes and cardboard cigarette packers, cotton waste, indian ink, pens and a copious supply of string, tape, labels, cellophane, tissue paper and squared-paper for notes and sketches. A hand blow-lamp for manipulating wax may at times be invaluable.

After excavation, with the necessary documentation, the procedure will be as follows: inspection in order to determine what first-aid or field treatment is necessary (if any), then the actual treatment followed by drying and strengthening processes, further documentation of any new facts revealed and classification for packing. When material is going straight to a laboratory, a memorandum of field cleaning is desirable.

Details of the routine are determined by the site of the excavation and types of material brought to light, by the object of the excavation and the time and funds available and by the question as to whether exhibits are being consigned to a museum equipped for routine restoration work or whether they are unlikely to receive further attention by the home museum unless showing signs of obvious disintegration. All these factors, as well as the more immediate problem of local facilities, have a bearing on the routine adopted.

In the small compass of this chapter, the subject can only be satisfactorily discussed in general terms, leaving ample room for the initiative of the excavator. It is just as important that he should not attempt the impossible in restoration as it is that he should not fail to act when treatment is essential, and in this he must be guided by his experience.

The time factor has a very important bearing on the amount and quality of the work he undertakes. Strengthening processes may require his continuous attention for many hours; pottery may require to be soaked for some days, bronzes may require a fortnight or longer for cleaning and an additional period for washing. Obviously, he must set himself some arbitrary limit,—but not at the expense of the antiquities. In other words, he must not commence cleaning more objects than he can satisfactorily get into a suitable condition for packing and transport in the time available, and this applies particularly to metals. Time must be allowed for final washing and drying before packing, and if this be omitted or curtailed, treatment may prove in the long run to have been not only useless but harmful, because inadequate washing of corroded metal frequently hastens decay.

Having weighed matters and decided upon the scope of his cleaning operations, choice will have fallen upon two types of excavated material, (*a*) material requiring special treatment for purposes of its correct interpretation and description, —e.g. corroded coins or inscribed tablets; (*b*) material demanding attention in the interests of permanence,—e.g. pottery from which a glaze is peeling. Where time is restricted, archæological impatience may here be in actual conflict with the more technical desiderata of preservation. It is impossible to legislate for such contingencies. The responsibility lies with the excavator himself and he must be free to form his own decision as to the attention he gives to the various calls upon his time.

How is he to recognise the call of urgency in matters of consolidation and cleaning? He must have practical experience as well as imagination and knowledge gained by studying technical as well as archæological publications. He should be familiar with one or other of the many excellent handbooks which have been published on the preservation of antiquities. The best practical work is done in the field or in the laboratory by those with a trained hand who, by practising, have become expert in delicate manipulation.

For the purpose of the present exposition, it is only possible to make selections from the multitude of conservation problems of regular occurrence in excavation work, and as the most formidable and recurrent are probably those connected

with the corrosion of metals, particularly of iron and bronze, these may be given priority.

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Attention has been drawn to the fact that corrosion is a characteristic of metals and that it may sometimes, under favourable conditions, become arrested by resolving itself into a stable protective skin or patina. More commonly it proceeds in an accelerated career to the limit, i.e. until no metal remains as such, and one class of excavated objects is in this category.

When the limit of corrosion is reached, an object will be swollen and probably deeply fissured. It will be of less density than before; in other words it will seem to be light in weight for its bulk.

Material of this kind which approximates to the limit of corrosion needs no chemical treatment. Field operations may be restricted to mechanical cleaning to remove dirt, lacquering to fix a powdery surface, and, if necessary, the application of a supporting splint in order to prevent damage in transit, for it must be remembered that objects of this nature are generally brittle. As they almost always contain salts, they should be isolated in packing, but any washing which may be desirable can well be deferred until reaching their final destination.

Partial decay is more common and more important. Isolated lumps of corroded matter are found on iron and on bronze marking the areas which are most infected by salts, and when decay is very active the lumps on iron become damp and rusty red in colour; on bronze they do not become damp but appear light green and powdery. A thorough washing in water is required in both cases, usually in conjunction with a little mechanical cleaning; in this way the soluble quota of the salt is removed and the objects may be dried ready for packing. Usually field treatment may stop here. When water is not available for washing antiquities, it is sometimes an advantage—where active decay is present—to seal the surface temporarily by a waxed paper; the use of wax, indeed, may be a necessity in the process of actual excavation; but those who have the responsibility of conserving antiquities are aware that the excessive use of wax in field work often complicates treatment because it is difficult to remove from porous materials, and its presence renders the removal of salts much more difficult. Shellac in alcohol may be used instead of wax, or a celluloid solution, but plaster of Paris should be avoided in dealing with metals because the moisture is retained to a certain extent and the corrosion would only be aggravated.

Where a little more attention can be given to the objects, it is a great advantage to add some caustic soda to the water used in washing iron and this soda need not be completely eliminated by exhaustive washing before drying; but care is necessary that no non-metallic inlays or organic materials (wood, bone, etc). are immersed, when soda is present, or they will be softened and discoloured.

In dealing with lightly corroded bronze and silver objects, a little citric acid powder dissolved in the water provides a ready means of releasing earthy deposits and incrustations, and when such objects are soaked for a time, details of shape and ornament are revealed with remarkable success. Where time is not so important and objects are to be left in a local museum, citric acid treatment can be confidently recommended with all metals save electrum, upon which it has a blanching effect, because of its dissolving any copper from the surface, which becomes more silvery. If iron or lead objects are so treated, they require to be thoroughly washed afterwards; with bronzes and silver this is still desirable but not so vital to their future existence.

A short description of the citric acid process will now be given because it is one of the few methods which are of wide application, and, while being practically free from possible complications, satisfies the archæologist in revealing details in a reasonable time, and the chemist in removing those salts which are insoluble in water: the oxy-chlorides, which are the persistent seeds of decay.

Suppose a hoard of corroded bronze coins is discovered. Some are partially decipherable, some heavily incrusted and most cemented together in lumps by an earthy or calcareous aggregate. Light green spots appear after a few days, marking the beginning of intensive decay due to the action of oxygen and moisture in the presence of salt.

The lumps are roughly dry-cleaned, if necessary, by brushing, and then soaked in water for an hour or two or simply held under a stream of water to facilitate the removal of mud. This is not essential to the process but is an economy as regards the amount of citric acid used. The strength of the acid should not exceed 50 grams per litre of water; 30 gms. per litre will do. This solution will quickly become green when the lumps are immersed, and the coins soon begin to appear as individuals and may be rubbed between the fingers and brushed with a small stencil brush or tooth-brush.

If complete cleaning is required, and this is nearly always desirable, the liquors are decanted about every two days (beyond which they become contaminated with chloride) and the coins are rinsed and brushed and immersed in fresh acid. With a few changes of acid, in the course of a week or ten days, the

bulk of the surface corrosion will be dissolved away. There is no waste of time as a few hours in the acid may be sufficient to reveal the inscriptions and ornament and so cleaning does not interfere with systematic recording. There is no harm, however, in returning all coins to soak because, in any case, they have to be washed finally in plain clean water and it is easiest to treat all at once. Where a source of running water is not available, the washing must be done by soaking in successive changes of clean water and a check may be made on the progress of washing by adding a little silver nitrate solution, the formation of a white precipitate indicating that chlorides still remain to be washed out. A control test should be applied to the fresh water and the results compared.

When washing has been well done, there need be no fear of a recurrence of the green spots. The coins are dried and then, if desired lacquered or waxed.

Where many processes exist it may be objected that it is invidious to give prominence to one to the exclusion of all others. This is a just criticism; there *are* other methods equally effective. There are even better methods when one has the facilities of a chemical laboratory; but experience has shown that the best results are not necessarily obtained by the more ingenious scientific processes and that, in the preservation of corroded metal, mere speed of operation is rarely compatible with success in the long run.

Methods have been advocated, for example, which apparently give immediately successful results (e.g. pickling bronzes in hydrochloric acid) but which in the future life of the specimen are likely to cause trouble, for the simple reason that washing (especially if conducted in the field) can rarely be guaranteed to remove 100% of the soluble impurities; and any chlorides remaining from a hydrochloric acid treatment, which itself introduces chlorides, would in time lead to the recurrence of malignant incrustation and consequent decay.

Even when citric acid is used and not completely washed away after treatment, a certain green film appears on bronze, but in this case it is only a surface disfigurement (unless the metal is very porous) and, under museum conditions, the green left by citric acid is not detrimental.

It is the duty of the museum chemist to be familiar with many alternative cleaning processes. These he uses as tools, knowing their possibilities and potential weaknesses and realising the purposes for which they are best suited.

The requirements of the archæologist and excavator, on the other hand, are rather a working knowledge of a few of the simpler methods just such as are adequate in helping to reveal details of the material excavated and such as will

ensure that any fragile specimens excavated are not as a result doomed to destruction.

One final point concerns the extent to which metal objects should be cleaned in the field. Opinions differ in this respect. In the special case where authenticity is in doubt, it is important to avoid destroying any evidence whatever, and in such cases no cleaning can be done. Generally, however, a selection of ancient tools or weapons can be restored to bright metal with advantage. Ornaments and household utensils and statuettes must be dealt with on a common-sense basis according to their condition and the possibilities of improving this by a preliminary cleaning.

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In stonework, the main features of decay and methods of arresting it have already been described for large objects (architecture, rocks, etc.). These methods apply with but slight modification to minor antiquities such as small stele, Ushabti and pottery, but the presence of glaze may introduce a complication, especially when it is cracked or loosely adherent. In such cases, washing with water may be dangerous or impossible.

The best first-aid treatment for a flaking glaze is to allow thin celluloid to run from a straw or drawn-out glass tube into the porous body of the ware; a series of such applications will consolidate the surface and cement the glaze in position so that the object may travel safely in cotton-wool, and the salts can still be washed out later on, without removing the celluloid. If, for example, wax were used instead of celluloid, this would be dissolved away with benzol or turpentine before washing and a certain proportion would be driven into the body of the object. The most delicate cases of flaking glaze can be dealt with satisfactorily only in the laboratory.

The baking of either unbaked or sun-dried clay tablets is also essentially a laboratory process of strengthening the material, though it has been done successfully in the field on occasions.

Where organic structures are present as an essential constituent of clay or kindred objects and such objects are salt-laden, treatment has to be restricted to hardening by impregnation. By such treatment, mud figurines, painted cartonages, etc., can be sufficiently hardened to withstand brushing from time to time as crystals work their way to the surface. Future applications of the hardening agent will be necessary, but the loss of significant detail, due to a powdery condition of the surface, will have been overcome.

One last word in regard to method. The use of a spray is essential only when dealing with ceilings and walls, and then it must be used as an atomiser and held some distance from the object under treatment. As there is a risk of the spray forming a hard skin of preservation on the surface with inadequate penetration, the pipette method of application is preferable whenever it can be used. Brushing is the commonest mode of application and the thinnest solutions should be applied at first. When objects have been strengthened by a series of thin coats of preservative, excess of the hardening fluid may easily be removed from the surface by the application of a tuft of cotton-wool charged with a suitable solvent.

Packing and Transportation (1). — As methods of packing and transportation depend very largely on local conditions it is not possible to do more than indicate general principles and refer to such details as are suggested by the types of material commonly excavated.

Packing in some form of crate or container is nearly always essential. Everyone is familiar with objects which have suffered irreparably by insufficient protection during transport, e.g. from salt spray when travelling as deck cargo.

A wide margin of safety should be allowed in the strength of the packing case and it should be steel-taped and adequately labelled, the contents being nested in twisted rolls of paper, cotton-waste, etc., so that the goods do not rattle and cannot become loose during transit. Circumstances will determine whether it is desirable to have the added protection of a waterproof (waxed) paper lining inside the case.

It goes without saying that all the material should be dry as otherwise the action of mildew or salts will be stimulated and may be destructive if the objects have to travel far. An exception to this rule is formed in the packing of waterlogged objects referred to in the first section of this chapter.

A question often raised is whether it is or is not desirable to keep archæological groups together in packing. There can be no question that the decision must be made on common-sense lines. Heavy metal objects, fragile pottery and stele are incompatibles and should be kept apart in separate cases, otherwise there is more than the possibility that the weakest objects will suffer. The records

(1) For this section, reference may also be made to the systems discussed in Chapter VI, in connection with the different methods of documentation adopted during excavation work—methods which necessarily determined the principles observed in the packing of finds.

should be sufficient to prevent any chance of confusion however the objects are distributed in the cases.

For a different reason, dissimilar metals should be kept from touching each other. It is a peculiarity of the decay of metals that corrosion is hastened when two different metals are in contact in the presence of salt: in the commonest example, that of bronze and silver, corrosion of the bronze would be accelerated by galvanic action. For this reason, they should be wrapped in separate parcels or put in different boxes inside the main packing case.

Labelling of each individual should be done in waterproof carbon ink on a solid ground, not on a muddy accretion which might go to powder during the journey, and care is necessary in fixing tie-on labels lest they should slip off and perhaps be lost in the packing material when the packages are eventually opened.

When large fragile objects have to be transported long distances and packages are liable to be jostled or dumped unceremoniously from a waggon or by the careless swinging of a derrick on board ship, a second container may be fitted inside the main case with resilient packing material between the two to act as a buffer and minimise the effects of shock. A large pottery specimen should receive additional protection by bandaging with a suitable adhesive, and it may occasionally be advisable to carry loose ends out and attach them to the inside of the wooden case so that they act somewhat like springs and, in the event of rough handling, have the effect of preventing the object from being knocked against the side. Plenty of cotton waste or wood fibre must be swathed around the pot and wedged between it and the container.

In short-term excavations in isolated position the following simple arrangements have been found satisfactory:

Smaller objects are first packed in cotton wadding in chip or cardboard boxes; pill-boxes, match and cigarette boxes can be packed tightly into a petrol tin from which one end has been folded back with the aid of a tin-opener. Wooden cases are then made to take a convenient number of these tins, the result being a package which stands up to the roughest treatment with minimum risk to the contents.

More extensive and long-period operations require detailed planning as regards packing operations and transport.

The following memorandum, by Dr. G. A. Reisner (Harvard Exhibition, Gizeh) is of the greatest value in this respect, in view of his statement that no breakage has occurred, either of cases or packed objects, from his excavations in 13 years. It shows how the problems of packing can be successfully overcome

when the excavator has fore-knowledge of the type of material which has to be transported, and it illustrates the value of standardising, as far as possible, both the equipment and the methods adopted in packing antiquities.

At the risk of some overlapping, this communication is reproduced *in extenso*.

A. *The sizes of boxes and packing material.*

The packing of antiquities must be designed to eliminate the possibility of damage during transportation. The method of packing must be adapted to:

1) The size and weight of the object to be packed.

2) The material of the object and its state of preservation.

3) The length and character of the transport (desert transport, river steamer, ocean steamer, railway, etc.).

4) The number of objects of each class which are presented for packing.

In accordance with these conditions, our expedition uses the following sizes of wooden boxes or cases:

1) No. 10, a small plain box made of 1/4 inch boards (waraq), measuring 40×26 cm. and 21 cm. high, used for packing small objects. Three boxes of No. 10 are packed in a box of size No. 5.

2) Box No. 5, with reinforced head ends, made of 1/2 inch boards (bunduk), measuring 100×34 cm. and 53 cm. high ("sugar box" as used in the Near East). Used for packing pottery, or three boxes of No. 10. Four of these boxes No. 5 are packed in one case No. 1.

3) No. 1, large case with reinforced head ends and with two girdles of battens around the middle, made of inch boards, measuring 183×124 cm. and 73 cm. high. Each case is packed with four boxes No. 5 or with boxes of odd sizes (see No. 4, below). These cases are further reinforced by four iron bands around the two ends and the two girdles of battens.

4) Odd-sized boxes. These boxes of odd size are built to a measured size for objects too large or too important to be packed in the normal sized boxes (No. 10 or No. 5). These odd-sized boxes are packed in case No. 1 or in odd-

sized cases. These boxes are made of boards adapted to the weight of the object and reinforced suitably.

5) Odd-sized cases. These cases are constructed to measure to take one or more boxes of odd size. They are made with the same reinforcements as case No. 1, including iron bands.

The following accessory containers and materials are used :

(*a*) Cardboard pill-boxes. These can be bought in nests ranging from 2.5 to 12 cm., and may be used for packing beads, amulets and other small objects.

(*b*) Flat cardboard boxes. Ordinary flat boxes used for photographic plates may be used in packing small objects. We have had similar boxes slightly deeper made in Cairo in three sizes, 9×12, 13×18, 18×24 cm. and also a number of larger sizes. Used in packing sets of small objects in order of record.

(*c*) Pasteboard trays. We have used, on occasion, trays also constructed to order and used for the same purpose as the flat boxes.

(*d*) Washed cotton cloth (found in all villages and towns). Available in small bolts. This cloth must have the starch or sizing washed out with water before using as packing material. Used for wrapping all sizes and classes of objects; used also for lining the padding of all cardboard boxes to prevent objects coming in contact with the cotton-wool.

(*e*) Cotton-wool. We buy in the largest rolls available and cut and split the cotton to the size and thickness required. Used for padding pasteboard boxes, for padding faces of statues, etc.

(*f*) Raw cotton (preferably ginned cotton). Used for packing objects before baling, boxes of size No. 10, and occasionally mattresses used in baling objects.

(*g*) Wood-wool (" excelsior "). Used for general packing of boxes of No. 10 in boxes of No. 5 and boxes of all sorts in cases. The space to be filled with wood-wool must be carefully calculated and in this space the wood-wool must be tightly compressed (by ramming on the sides). Otherwise, if the space is too wide and the wood-wool not compressed, the boxes will move. In emergencies we have used various kinds of dried plants or straw.

The general rules in packing are as follows:

1. Every object, large or small, is prepared for packing by wrapping or laying between two layers of washed cotton cloth, or nesting in cotton-wool.

2. Every object must be so packed that it cannot move in its packing, whether pasteboard box, bale or a special measured box.

3. Except for stone objects of the largest size, every box containing packed objects is to be packed in one or two other cases. Thus, small objects in boxes of size No. 10 have two additional cushions of wood-wool, that of box No.5 and that of case No. 1. Every box of size No. 5 containing pottery and every odd-sized box has an additional cushion when packed in the large outer case.

It is the additional cushions which lessen the shocks occurring inevitably during transport and decrease the danger of breakage. The use of very large cases packed as indicated also makes it impossible for the stevedores to throw the cases about, and makes theft in transport almost impossible. These large cases can only be handled by cranes. (N.B. Thefts have occurred of antiquities packed in small single boxes in transit from the Near East to Europe, but we know of no instance of the looting of a large case as our No. 1.)

4. Large stone objects, like granite sarcophagi, which weigh from 2 to 20 tons, are prepared for transport by enclosing in a framework of hard wood beams and covered with boards with bearing surfaces protected with felt.

Every added cushion in the packing of such heavy stones only increases the possibility of movement and damage.

5. Every large outer case is to be strengthened by heavy wooden girdles (battens), with iron bands and (or) with angle-irons (screwed in place). These cases must have the head-ends reinforced by a heavy wooden frame around the edge.

The reinforcement of the outer case makes smashing of the case practically impossible. We have had no such accident in the transport of over a thousand large cases. The girdles also prevent the slipping of the case in the cables when lifted by crane.

B. The packing of different classes of objects.

1) *The packing of small objects.* — In Egypt and the Sudan, the small objects include beads, amulets, scarabs, copper and bronze implements and weapons, mud sealings, shawabtis, models of vessels of pottery and stone, feather fans, wood, ivory, bone, etc. We give the following examples of packing:

(*a*) Beads and amulets: We usually pack in lots as photographed for record. If the original order is not preserved, the beads and amulets are packed in pill-boxes between two small pieces of washed cotton cloth, with cotton-wool above

and below. If the original order is preserved or reconstructed, the pieces are packed in a flat box of the necessary size in the order of the photograph, again between pieces of washed cotton cloth with cotton-wool below and above. The box should not rattle when shaken and, after testing, should be tied with string.

(*b*) Copper and bronze implements and weapons: Packed in flat cardboard boxes of necessary size and arranged in order of photograph. Each object is wrapped in washed cotton cloth and laid on a layer of cotton-wool and covered with a second layer of same. A few important long swords found at Kerma were packed in separate boxes of thin wood, wrapped and packed with cotton-wool.

(*c*) Mud sealings: The seals found at Gizeh are comparatively few and have been packed in pill-boxes, wrapped and packed in cotton-wool. At the fort of Uronarti, we found several thousand sealings from letters, boxes, and magazine doors. After these had been classified and photographed, they were packed in specially made pasteboard trays which were divided into horizontal compartments. The floors of these compartments were covered with cotton-wool and a strip of washed cotton placed over it. On the washed cotton were laid the sealings in the order of the photograph and each row covered with a strip of cotton and packed above with cotton-wool. The packed trays were let down by strings (for removing them), five in a box of size No. 10. These boxes were covered with zinc-plate and soldered, to prevent damage by water. Three boxes of No. 10 were packed in a box of No. 5 and these were packed as usually in cases of size No. 1.

(*d*) Shawabti figures of faience and stone: Both at Gizeh and in the Sudan, we have found large numbers of shawabti figures of faience and stone. All these figures, except a few in danger of breakage, were packed directly in wooden boxes of size No. 10, but the stone figures never packed with faience figures. Each large figure was wrapped in washed cotton cloth, padded with cotton-wool, wrapped with a second cotton cloth and sewn up in a piece of coarse sacking. Small figures, particularly of faience, were packed in flat pasteboard boxes, wrapped with cotton cloth and tightly packed with cotton-wool. Very small uninscribed figures were not wrapped separately but laid as in the case of other small objects above.

(*e*) Models of vessels of pottery and stone: Stone and pottery not to be packed together; stone models are wrapped as stone shawabtis in cotton cloth, cotton and coarse sacking and packed in box No. 10 tightly packed with wood-wool

(excelsior). Pottery models of importance and large size are packed as stone models; small poorly made models are wrapped in paper and packed in wood-wool, also in boxes No. 10.

(*f*) Feather fans: At Kerma we found a number of fans of ostrich feathers of different sizes; we had no flat pasteboard boxes (which are to be recommended) and had a local carpenter make a small wooden box adapted to the size of each fan. The bottoms of the boxes were covered with a layer of cotton-wool, which in turn was covered with a piece of cotton cloth; the fan was laid on this foundation and covered with cotton cloth and the top was packed with cotton-wool, so that when the lid was nailed on no movement was possible. Boxes containing such materials should be soldered in zinc.

(*g*) Small objects of wood, ivory, bone, etc., should be packed according to size and importance in trays with the use of cotton cloth and cotton-wool as described above.

The boxes of size No. 10 in which all these small pasteboard boxes containing small objects are packed, are themselves packed with wood-wool in boxes of size No. 5. Each box of size No. 5 contains three boxes of No. 10, not separated but with 3-5 cm. of wood-wool tightly compressed between them and the sides, bottom and lid. Four of the boxes No. 5 are similarly packed in a large case of No. 1, not separated from each other but separated from the case with 5 cm. of tightly compressed wood-wool. The wood-wool on the bottom is compressed by the weight of the boxes of No. 5 left for several days. The wood-wool around the sides is rammed tight with an iron crowbar. The top layer of wood-wool is compressed when the lid is nailed or screwed on.

2) *The packing of pottery.* — In most excavations in the Near East, a large number of pottery vessels are found and usually these will fill a large number of boxes of size No. 5. These vessels will be partly whole unbroken examples, broken but complete examples, broken but incomplete examples, and potsherds. As far as possible, we repair the pottery vessels in the field with seccotine. This temporary repair is necessary for the field record and for classification. The usual proceedure is to wrap each vessel separately with paper (old newspaper or sheets of thin packing paper), fill the cavity with wood-wool and pack with wood-wool (or similar material) in boxes of size No. 5. We have packing paper of different colours and the vessels of one deposit are wrapped in one colour and those of another deposit packed with it in another colour to facilitate sorting at the time of unpacking. Of course, each object is marked in ink with its re-

gistration number. The potsherds are wrapped separately in the required coloured paper. In the case of large and fine examples which have been temporarily repaired, we sometimes separate the fragments with water and pack each fragment wrapped separately. In the case of large perfect vessels, each is packed separately in a box of size No. 5 or in a special box made to measure. These boxes of size No. 5 are packed as already described above, four in a case of size No. 1. The special boxes are packed in outer cases also made to measure. It may be noted that perfect and mended vessels can be strengthened for transport by enclosing in wet squeeze-paper (several layers) and allowed to dry thoroughly before packing.

3) *The packing of important objects of larger size.* — A number of classes of objects require to be packed in boxes of odd sizes made to measure. These fall into two categories differentiated by size and preservation. Let us first consider objects which are small enough to be baled, or packed in small boxes. These objects include statues and statuettes of wood and stone, stelæ, stones, inscribed or in relief, etc.

(*a*) The packing of statues and statuettes of stone: The object is wrapped in two to three thicknesses of washed cotton cloth; between the layers are placed pads of cotton-wool protecting the face and other important details (painted necklaces, etc.). The wrapped object is laid on a mattress made to measure consisting of coarse sacking filled with wood-wool or cotton, held in place by string ties like an ordinary mattress; the surplus ends and sides of the mattress are folded over the wrapped object and sewn with stout twine; thus a compact bale is produced. The bale is placed in a strong box made to measure and all surplus space packed tightly with wood-wool. If the object weighs over 50 kilos, the ends of the box should be strengthened by strips of wood around the edges to which the long boards are nailed. The boxes of odd size are often packed together in a case of size No. 1, but large boxes containing important pieces are placed in a specially made box. Each fragment of a statue or statuette of stone should be baled separately.

(*b*) Wooden statues and statuettes should be treated with paraffin wax and then packed in the same manner as stone statues but baled in a mattress of cotton or cotton-wool. Small figures may be packed in small boxes of thin wood which are packed in boxes of size No. 10.

(*c*) Stelæ, or stone slabs from a chapel decorated with reliefs, sunk reliefs or inscriptions:

1. Large stones of granite, limestone, or sandstone in sound condition: a tightly fitted stout wooden frame is built around the stone; the back of the frame (on which rests the back of the stone) is covered with boards. The frame must project about 2-5 cm. above the decorated surface so that wooden bars bearing on the blank edges can be nailed inside the frame flush with its top. Then the lid is nailed or screwed on and the frame packed in an outer case of requisite size and strength.

2. When similar stones have no blank edges, they should be wrapped, padded and baled as the stone statues; then each is packed in a separate box and packed in an outer case.

3. When stones are in unsound condition, a packing must be devised for each stone; we usually bale them with special attention to the padding of the decorated surface, and usually in raw cotton.

All these boxes must be marked "right side up" and packed in cases lying on their backs, and the outer cases must also be marked "right side up" for loading in railway car or steamer hold.

(*d*) The packing of stone objects of great size and weight :

We have had to pack a large number of stone coffins of granite and limestone, an enormous altar (weighing 17 tons) and one enormous stela of white limestone. Most of these objects were too large to be baled but were so sound that they could be sent in heavy wooden frames constructed around them.

1. The great altar of Atlanersa, packed at Kareima in Dongola Province (Sudan), and shipped by rail to Port Sudan, by steamer to Suez, transferred to another steamer and carried from Suez to Boston, Mass. (U.S.A.). The upper edge was blank, as were the top and bottom and the bottoms of the four sides. With heavy hard wood, a frame was constructed around the blank upper edge, drawn tight and fastened with screws. On top of this, resting on the blank top, heavy boards were nailed. Around the bottom was constructed a similar frame also covered by boards below. The altar was then set upright on the boards of the lower frame and the frames were connected by vertical boards (hard wood) nailed to the upper and lower frames. Thus the altar was cased in hard wood with no part of the case touching any decorated surface. The corners were strengthened horizontally and vertically with angle irons screwed to the frame (supplied by the workshops of the Sudan Department of Steamers at Kareima). This stone weighed 17 tons.

2. The great stone coffins from Gizeh were transported by lorry from the Pyramids to the Cairo Museum, sealed, transported by train to Alexandria and by steamer to Boston. Each coffin consisted of the two pieces, lid and box, and each piece was packed separately. These were enclosed in a framework of hard wood but with strips of thick felt between frame and stone. To this frame were nailed the sides, bottom and top of the box made of 2-inch boards with girdles of heavy battens already fastened. When complete, the box had four girdles of battens, one at each end and two spaced in the middle. The ends had also been strengthened by 2-inch framework around the outer edges. The box was then bound with heavy iron bands one around each girdle with iron angle clamps at each corner (at top and bottom).

It should be a rule that whenever possible, the individual whose duty it is to superintend the packing of objects should also be responsible for unpacking. This not only avoids the possibility of confusion but is an added safeguard where frail specimens are present, because with a knowledge of which objects are particularly fragile or cracked and of the relative positions in the cases, the risk of damage during unpacking is greatly minimised.

When all possible precautions have been observed and the transportation has been carried through without incident, there yet remains one danger which is sometimes overlooked, namely, allowing an unreasonable time to elapse before the goods are unpacked. If it is true that the presence of damp is liable to cause fermentation or the growth of moulds on material of an organic nature, it is equally certain that the converse (excessive desiccation, resulting, perhaps, from storage in a heated basement or ship's hold) encourages surface crystallisations in porous stone or earthenware and may cause the disfigurement of painted decoration or inscriptions or the splitting of glaze.

The excavator must at all times be on his guard against these possibilities, which apply alike to the problems of transport and to subsequent storage.

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CHAPTER X

LAYING OUT OF EXCAVATION SITES FROM THE STANDPOINT OF RESEARCH AND THE EDUCATION OF THE PUBLIC

The question of the organisation of an excavation site on the completion of the work of exploration is bound up with various other problems.

One of the most important questions is that of determining in what manner the objects discovered are to be arranged and deciding the positions to be allotted to them, so that the site explored may be presented intelligibly to visitors, without losing any of its scientific interest for archæologists desiring to study it in detail. Its documentary value would indeed suffer if, for example, architectural features were insufficiently cleared of their surroundings or if characteristic data in the matter of sculptural work were not rendered perfectly visible.

It is true that the archæologist can always consult the reports and plans published in connection with the investigations of an archæological expedition. Further, the laying out of an excavation site, reconstruction and restoration work, upkeep of approaches, sign-posts and plans for the guidance of visitors (all of which will be discussed in this chapter) may result in a heavy charge on a field budget. The present, and legitimate, tendency of countries in whose territory particularly numerous excavation missions carry out their work, is to regard excavation not only as a contribution to science, but also as a duty to be fulfilled towards the public at large. This balance between the scientific and the educational aim of excavation, advocated at the Athens Conference of 1931, convened under the auspices of the International Museums Office, was, on the occasion of the Cairo Conference, once more recognised to be one of the guiding principles which should be observed by the responsible authorities as well as by the institutions that undertake excavations.

I. Arrangement of antiquities on the excavation site.

The solution of the problem concerning the arrangement of antiquities on an excavation site depends on the nature of the excavation undertaken, that is whether the site contains a temple, a city building, urban dwellings, tombs, etc.;

it will also depend on the state of preservation of the objects discovered, on their significance and the period they represent; lastly, consideration must be given to the distance between the site and a fair-sized town in the locality.

Consequently, it is difficult to apply indiscriminately to all these cases hard and fast rules which would, once and for all, govern the excavation and organisation of a site containing say a temple, a bouleuterion, an agora, etc.

It is, however, possible to formulate certain general rules, similar to those adopted by the Athens Conference for the specific case of anastylosis in respect of the monuments of the Acropolis: elements to be reconstituted or reinstated; choice of materials; rôle of casts; protection of certain architectural features against weather. Although, at that time, the principle of anastylosis was applied solely to the superstructure of buildings, it can profitably be taken up again here and extended to the field of architectural groups in general. The point will, moreover, be referred to later in connection with the principles of reconstruction (1).

With regard, first of all, to visible structures, all the heavier architectural features to be used in the reconstruction of a building, whenever anastylosis is possible, would have to remain on the site if their preservation is not likely to be attended by grave risks of deterioration. In cases where anastylosis is impractical, the existing parts can be reinstated in their original positions (drums of columns set up on the existing bases, with what capitals remain; imposts; cornices on the existing architraves; lintels over doorways, porches, etc., etc.), in so far, of course, as these architectural fragments were found in their respective original positions when the excavation operations were begun.

The excavated monument will, in this way, retain at least some of its decorative aspect and the visitor will be able to form a more faithful and more complete idea of its general design.

If it is a matter of organising and reinstating fragments of urban dwellings or tombs, it will be necessary to measure the significance of these remains and to arrange them in accordance with the above observations wherever they can be followed.

Any architectural and sculptural elements which it is thought advisable to

(1) See the detailed study on this subject in *La Conservation des Monuments d'art et d'histoire*, published by the International Museums Office: *Le Relèvement des Monuments de l'Acropole*. The International Conference which met at Athens in 1931 under the auspices of the I. M. O. also had occasion to express an opinion on this question of anastylosis. (See, in the work above cited, Section B of the conclusions of the Athens Conference.)

leave on the site must be repaired without deteriorating them, properly attended to and displayed in a manner that will ensure their preservation, in so far as this can be guaranteed on the spot. They should in all cases be numbered so that they can easily be identified in the excavation register when information is being sought regarding the place and circumstances in which they were found (1).

Lastly, sign-posts and guide panels for the information of the public must be fixed at all important points of the excavation site, indicating the most interesting sections and the most convenient route to follow. General plans should also be provided, the spot at which the visitor consults them being marked conspicuously in colour. Certain appropriate signs may be adopted to indicate the spots at which particularly interesting discoveries were made. When the excavation work has been carried out at varying depths, it is advisable to provide, at the different spots, plans and sections showing the different levels excavated.

In this connection, particular care should be taken not to mar the general aspect of the site by unsightly notice-boards, etc.; all signs should be set as low as possible and sheltered from weather.

The possibility of rebuilding certain significant portions of a building or of its walls (at least up to the level of the highest part still standing of the building brought to light) raises a delicate problem.

Obviously, the replacing of a shaft or a drum on its proper base should be done whenever possible, for this will largely contribute to an understanding of the monument discovered. It may even be said that anastylosis, if only in part and however limited it may be, is essential for the education of the public.

But is it permissible to complete, by the use of some other material, architectural fragments found on the site? If so, to what extent should this be tolerated?

This question, which has a more direct bearing on the principles of conservation, was—as stated above—very exhaustively discussed at the Athens Conference and it would be superfluous to return to it here (2). It should be pointed out, however, that anastylosis may be necessary not only for æsthetic and educative reasons, but also for the purpose of preservation,—when there is a defi-

(1) Ancient pits opened during excavations should be sealed before visitors are admitted to the site and the spots marked, with a notice to the effect that the shafts have been thoroughly explored.

(2) It will generally be found of interest to refer to the *Treatise on the Conservation of Artistic and Historic Monuments*, already cited, Part III of which gives the principles that should be observed in the enhancement of excavated buildings and the permanent laying out of an archæological site. Section III of the *General Conclusions of the Athens Conference* deals particularly with these problems.

ciency in the method of construction and the materials employed, as is almost invariably the case in Byzantine monuments. In such cases, anastylosis must sometimes be carried through to almost total reconstruction. Nevertheless, in ancient buildings, durable material permits of anastylosis only as regards the parts that are more or less well preserved and which can be completed when it is a matter of consolidating other parts of the building by such means. For example, if there remains the base of a colum, with a few drums, there is no reason why the column should not be completed if, by so doing, the epistyle above could be saved.

II. Local museums and archæological repositories.

All fragments and débris which, owing to their abundance, are likely to cause confusion, should be removed from the excavation site; they should be arranged in heaps, if necessary at several spots, so that the site may be tidy and clear. They can also be placed in repositories within reach of the site and serving more or less as small museums where they can be sorted, repaired, restored and classified (1).

It is advisable, not to say indispensable, that such museums, whose size will depend upon the nature of the objects they house, should be built near any excavation site of importance (2).

In this matter also, account must be taken of the general space available in the excavation site, which must not be compromised by a building that interferes with the outlook. An endeavour should be made to place the building in a

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(1) Archæological sites should be provided with a repository for the storage, under lock and key, of fragments which have exhibition value neither for the principal museum, nor for local museums, e. g. superfluous débris of pottery, small objects of no interest and too deteriorated, fragments of architectural features. In the case of Egypt, such a repository would be used for the storage of all the objects and fragments which are not of sufficient interest to figure in the distribution that follows excavation operations.

Formerly, in Egypt, all these "by-products were placed in a pit, where they could easily be found again. Today it has become the regular practice to place them in a closed and guarded repository, where they are methodically arranged so that they may, if necessary, serve for supplementary research. (Note addressed to the International Museums Office by the Egyptian Service of Antiquities.)

(2) This museum may be used for housing the ceramic archives of the expedition and would be open to scholars wishing to make further investigations on the site. (See Chapter I.)

hollow of a neighbouring field and to design it in a sober style harmonising with the surroundings. This question was, moreover, discussed at the Madrid Conference and dealt with in the *Treatise on Museography* published by the International Museums Office. Two typical examples may be cited: 1) the museum that stands close to the excavation site of Richborough Castle in England; built in the archæological area of the Roman camp, the museum is low and its design is in keeping with local style; 2) the museum on the Acropolis at Athens; in this case, there was no question of establishing harmony of style; the problem was therefore solved by erecting the museum at a spot where it would not interfere with the perspective of the Acropolis. The idea might even be carried farther and advantage taken of the erection of the museum to incorporate certain subterranean ruins that would become the basement of the new building.

As regards the collections to be housed in a museum of this description, it is appropriate to recall the principle adopted by the International Museums Office and mentioned in the *Treatise* referred to above, namely: the ultimate aim of archæological exploration should in all cases be to leave architectural fragments, and more particularly architectural groups, in their natural surroundings; they should therefore not be removed to a museum unless the requirements to be met for their preservation demand such a course.

These local museums will be the best instrument of education and instruction for the public, and the natural complement to a visit paid to an archæological site. In these museums, where the objects or fragments should, if possible, be re-assembled, the exhibits should be placed on view with sufficiently explanatory labels, supplemented by photographs, plans, sections, restorations and models of the monuments discovered, or of the characteristic portions (e.g., tympana of ancient temples, ambos of Byzantine churches, etc.); wherever possible, casts of typical features or of archæological ensembles should complete this illustrative material.

If the building excavated dates from different periods, these should be indicated by different colours on the drawings.

All these methods serve a twofold purpose:they are helpful to the archæologists who study the monument and are of considerable assistance to the public in that it is better able to understand the significance of the excavation and to visualise, appreciate and admire the building as it originally stood.

If a restoration of the original structure is attempted, the work should be confined solely to a reproduction of those parts concerning which absolutely

reliable and indisputable data are available, regardless of any scientific or other theories put forward.

III. Guide books and reproductions.

In these local museums, arrangements should be made for the sale of clear and concise guide-books specially written for the general public, together with scientific publications dealing with the monument excavated. The public should also be able to purchase post-cards and photographs of the site or monument and of the objects that have already formed the subject of study and investigation. The attendants should, as far as circumstances permit, be trained by the person responsible for the excavation operations so that they may be able to furnish visitors with information that will be of documentary value and educational interest in respect of the work undertaken and the results obtained.

IV. Surroundings and approaches.

The question of the surroundings of archæological sites was discussed at the Athens Conference, both from the point of view of legislation and from the standpoint of the enhancement of the sites explored. The mapping out of conservancy areas is already provided in several national legislations and the principle of this measure was endorsed in the conclusions of that Conference. By way of example, mention may be made of the provisions enacted in Greece for the protection of archæological sites, prohibiting:

(*a*) excavation operations and the extraction of building materials within 500 metres of any ancient monument or of any ancient ruins visible at ground level.

(*b*) the putting into operation of any undertaking which, directly or indirectly, may be prejudicial to such monument or ruins (lime-kilns, etc.). (Law 5, 351, No. 5.)

Needless to say, too intransigeant an attitude should not be adopted when applying principles of a similar character, for the competent authorities would risk arousing opposition likely to compromise their action. In point of fact, present-day requirements in the matter of town-planning and development, and the needs to be met on the score of social progress call for mutual concessions

and the observance of a spirit of understanding in situations that sometimes permit of only one solution.

The part played by vegetation has also been the subject of special study by the International Museums Office. It is a recognised fact that certain kinds of trees and methods of planting harmonise particularly well with certain architectural ensembles. On the other hand, there are some forms of growth which overrun an excavation site and play havoc with any stone structure. Such growth should invariably be destroyed; this question is, moreover, dealt with in Chapter IX in connection with the conservatory measures to be taken for objects that are to remain *in situ*.

With regard to the æsthetic rôle of vegetation in the laying out and organisation of an archæological site, reference may be made to the *Treatise on the Conservation of Artistic and Historic Monuments*, published after the Athens Conference and in which a whole chapter is devoted to this aspect of the enhancement of monuments. When excavation work is undertaken on a fairly large scale, consideration might be given to the possibility of expropriating the surrounding ground within a radius of 50 to 100 metres, with a view to converting it into a park. Such conservancy zones, in addition to isolating a site from the adjoining area, have the advantage of forming an attractive transitional belt which, in a way, prepares the visitor's eye as he approaches the excavation site and the museum.

CHAPTER XI

PROBLEMS RELATING TO INTERNATIONAL DOCUMENTATION ON ARCHÆOLOGICAL EXCAVATION

Publication of the result of excavations. — The organisation of archæological missions is, and should be, such that the results of excavations can be published. It is evident that, if the value of the publication depends, to a great extent, on the method which has guided the work, the data obtained are in turn endowed with a greater demonstrational value in proportion to the manner in which they are presented. The general public is becoming more and more interested in archæology, and this interest is precisely in proportion to the vividness injected by the science into its reconstruction of lost civilisations; everyone who is interested in history wants to be kept *au courant* of what may be called "archæological news". In countries where ancient history had its home, one finds, even in the most modest circles, a justifiable national pride in a new discovery which enriches the common patrimony. Consequently, it is only natural that the governments of countries rich in antiquities wish to keep their people posted, one might say officially, as to the results of excavations carried out in their country.

This question is distinct from that of papers and reports which nearly all legislative texts and all excavation contracts require the beneficiary to present, either periodically or finally, to the competent authority.

Author's rights (1). — A first and incontestable principle is that of the author's right to publish the results of his work This right, which no one disputes in theory, has, nevertheless, often been seriously curtailed in actual fact. In this connection, it would be advantageous if learned societies who subsidise or

(1) See the recommendation voted on this subject by the Cairo Conference, the text of which is given in the Final Act of that Conference, reproduced in this Manual (Section II, § 13 f.): *Scientific ownership of the excavator.*

control the principal scientific publications, as well as the editorial committees of artistic, historical and archæological reviews showed themselves more concerned for the respect due to these rights.

Further, this respect should be shown not only for the author's material interests, but also—which is at least as important—for the integrity of his work, that nothing be changed or misrepresented.

The right of publication carries with it, in most countries, a counter-obligation, imposed on the author: he must send a certain number of copies of all publications made by him concerning his researches, to the Government, or to institutions which are specified.

The right carries with it the implied obligation, on the part of the excavator, to publish the result of his researches.

The rights of public authorities. — The volume published by the International Museums Office on the legislations and regulations concerning the system of excavations contains a certain number of typical provisions in this connection. Some of them set a time-limit for the excavator's right of publication. When this has expired, the authorities themselves may proceed to the publication, if the excavator has not exercised his rights. In other texts, a distinction is made according to the character of the publication: if it cannot be considered as having a scientific character and if it is purely of general interest, the authorities may undertake it. In doing so, they fulfil their function of public educators.

Special rules cover the question of reproducing objects discovered in the course of excavation. Here the authorities have, and should have, prior rights. They have the right to reproduce the objects in any form they may see fit. The only restriction admitted is in regard to the time at which this reproduction may be carried out. According to some excavation contracts, the reproduction must not be done till after the scientific publication of the excavator has appeared. In any case, the authorities' privilege in the matter of reproduction is not absolutely general. For example, in Italy (1), it is permitted, under certain conditions, to take photographic and cinematographic views both on excavations sites and in museums and collections.

The texts which have been analysed do not contain precise information on the various methods of reproduction. In view of the continual progress in

(1) Communication from the Italian Minister of National Education, 1932, *Mouseion* (*Supplément Mensuel*, No. 1, 1932, p. 10).

technique, one must allow the most varied forms. Cinematographic views, especially, seem destined to play a more and more conspicuous part, whether in scientific documentation, or for the information of the general public. In this respect, complex problems are bound to arise, as it is necessary to take into account the rights of a new profession, namely producers (1).

The sale of reproductions of works of art is regulated. Many authorities do not allow it until after the publication of the results of the excavation.

The legal aspects of documentation, on an international basis, are also dealt with in the volume referred to above and published by the International Museums Office.

General information. — Differences in regulations have no great importance. If we have called attention to them, it is because they serve to stress the desire for information shown by the national and international public. Therefore, it is to the interest of the excavator himself to satisfy the curiosity aroused by archæological discoveries as quickly as possible, especially as this very praiseworthy curiosity is concentrated on monuments of exceptional artistic or historic value. Furthermore, it is becoming more and more customary to communicate to the leading illustrated journals or to the local or foreign press photographs and short descriptions of the result of excavations, immediately after the expedition.

But, needless to say, non-scientific communications, which are of general interest, should never—unless with the express permission of the authorities—imply the reproduction or exploitation of the documents which are communicated to the public, whether in a scientific publication or in a popular work, since this would constitute an obvious violation of scientific propriety, as is recognised in the regulations to which we refer.

It is hardly necessary to say that the interpretations and dates suggested in these first communications are only given provisionally and under reserve: to disseminate or criticise them, before they have been confirmed or rectified in a scientific publication would appear to be a veritable abuse of confidence.

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(1) These questions will, in due course, form the subject of a comprehensive study by the International Museums Office, which, on the recommendation of the Cairo Conference, will examine the possibility of constituting an International Committee on Excavations to investigate, among other matters, this form of international documentation and collaboration relating to archæological research.

Scientific publications. — In the law on antiquities promulgated by the Government of Iraq, it is laid down that the right of priority of the excavator in so far as the publication of the results of his work is concerned depends upon the necessity of informing scientific circles of these results without delay. It is necessary to see what the first scientific information of which this article speaks, may contain and how it is to be set forth and completed later.

Communications to learned societies. — The scientific publication of the results of an excavation is usually made in two or three stages. The first includes short communications made to learned societies and notices inserted in the information sections of the principal archæological reviews. The information given immediately after an excavation campaign usually deals with the method and the intentions which guided the work, with the principal results obtained and, if necessary, with the continuation of the existing work.

This information thus allows us, not necessarily to benefit immediately by the discoveries mentioned,—for the reasons which we gave before, concerning communications to the public—but to appreciate the interest of the research in question, to control its method of conduct and to co-ordinate the results with those obtained in other areas of work. It is in this last field that international collaboration can be especially useful and should be assisted.

Reports on excavations and final publications. — In the second stage, the scientific publication comprises either a series of detailed reports which follow the progress of the excavations, usually one per expedition, or a series of articles in which the various kinds of monuments discovered, and the principal questions thereby raised, are examined—these two methods, are in fact, often used concurrently.

This second stage is, in theory, followed by a third—the final publication. In this the monuments are classified according to category and systematically studied, not in the order of their discovery, but in their logical order.

In the case of large excavations, which are undertaken to investigate an important site exhaustively, there are two formulas to consider: one consists in such development of the reports that, if necessary, one can dispense with the final publication; the other, only permits of a final study with the total documentation at hand.

Today the first formula would appear to be the more usual. It unquestion-

ably has the advantage of communicating the complete data to interested scholars more rapidly (1).

Character and utility of excavation reports. — In principle, we may say every explorer should publish reports on his excavations. Moreover, it is advisable that these reports conform at once to the rules cited above. In his report, the excavator should therefore give a precise description of the work undertaken and the buildings cleared in the course of the work, together with plans of the ensemble, sections, detailed plans, and levels, so that the principal discoveries can be placed. Photographs or drawings should accompany the descriptions of the principal monuments discovered, especially those which allow one to appreciate the character of the civilisation to which they belong, or which justify dating the find or which show foreign influence at work. A type of report which is particularly clear is one which, if necessary, runs one year into another, but conforms to a clear delimitation of territory—sections of a city, sanctuaries, burial grounds, etc.

It does not seem necessary to develop "the historic side of excavation". In so far as the technique of the work and the particular methods employed are concerned, these should be described in sufficient detail to permit of judging the value of the results, care must, however, be taken not to overdo picturesque details to the detriment of the scientific aspect. If necessary, supplementary information concerning certain allied questions (division of sites, restorations, constitution of records, etc.) could be given in separate articles.

The excavation report, in placing at the disposal of the reader the greater part of the documentation collected in the course of the work, permits specialists to undertake, without further delay, the study of the monuments which interest them. Scientific collaboration here finds its place, to the maximum benefit of science, and thus facilitates the eventual final publication.

There have been many instances of this scientific collaboration, both national and international, made possible and fruitful thanks to the intelligent liberality of the excavator. We will only quote the case of the subterranean basilica of Porta Maggiore in Rome. This accidental discovery was made on April 23rd,

(1) In this connection, the experts of the Cairo Conference recommended that these detailed reports should be published at fairly frequent intervals, the ideal system being to issue annual reports at the close of each campaign. Some delegates even suggested that excavation operations should be compulsorily suspended if the excavator went more than a year without publishing a report.

1917, and the basilica cleared in the months which followed. In 1918, the *Notizie degli Scavi*, the *Bolletino della Commissione archæologica communale* and the *Rendiconti della Reale Academia dei Lincei* published accounts and articles from Italian archæologists. The same year, a foreign savant, M. Cumont, was authorised to study the basilica and described it in the *Revue archéologique*. Other articles, in various languages, preceded the final publication by M. Bendinelli in 1927 in the *Monumenti Antichi dei Lincei*, amongst which the work of M. Carcopino: *La Basilique pythagoricienne de la Porte Majeure*, which appeared in 1926, was especially noticeable.

It is evident that this was an exceptional case, since it was possible to render the basilica, with all its ornamentation, free for savants to study, with the minimum delay. From this example, however, we can conclude that the amount of detail in excavation reports should be proportional to the inaccessibility of the monument described.

Collaboration of several specialists on the excavation report. — From this it follows, that to publish even the provisional report on an important excavation, it is necessary for several specialists to collaborate. Rarely can one savant publish a report on the sculptural monuments and the buildings and the inscriptions; and, as Professor Wace points out in a note communicated to the International Museums Office on this subject: "it is very necessary that the head of a mission should not be the only member of the staff employed in writing the report, because human life is uncertain".

Method and time-limit for excavation reports. — 1) When an excavation is not sufficiently important to warrant the publication of a special work, it will be the subject of a detailed report, in an archæological review, which report should be accompanied by a catalogue of the objects found and illustrated as copiously as possible. It is desirable that all reviews which publish reports of excavations should add an index, following the example set by most of the leading archæological reviews at the end of the year.

2) It is usual for excavation reports, which should be followed by a complete and final publication, to appear also in the leading archæological reviews, because this method is both quicker and cheaper, besides ensuring a more widespread and immediate diffusion of the results of an expedition.

3) The practice of drafting a self-contained report, published separately, has long been rigorously observed in Egypt, with excellent results. Under the ægis

of archæological institutes, or learned societies, these reports, published regularly one or two years after the campaign, form an important collection, in which the greater part of the documentation, amassed in the course of excavations, is clearly set forth.

The example set by the Oriental Archæological Missions in Egypt proves that reports, whatever the method of publication, can appear in a relatively short time.

Reserved documentation and extension of the time-limit for publication. — Final publication. — Excavation reports cannot, however, always be explicit on every point. Some documents cannot be published in a hurry. We have seen that most regulations allow of these reservations on condition that the excavator and the Department of Antiquities authorising the work have agreed upon this point. It is difficult to make a general rule as to the importance of these reservations, and as to the extension of the time-limit which they may necessitate.

(*a*) In the case of monuments with sculptural adjuncts, and even in the case of ceramics, it is nearly always possible to arrange for delay in publication, on condition that the work of restoration of broken objects is carried out as and when the pieces are found. True, it is more difficult to observe this rule in the case of large sculptured buildings such as the Athenian Acropolis, Delphi, Olympia, etc., of which the numerous fragments are widely dispersed.

(*b*) In the case of stone inscriptions, specialists consider that reports can be published fairly rapidly. But this is not true of papyrus or clay tablets. The case of the excavations now being pursued at Mâri, on the Euphrates, is characteristic : a minimum of ten years is reckoned necessary to decipher the hundreds of clay tablets, often badly preserved, which have been discovered in the course of the first expedition, and to publish the results.

(*c*) Architectural monuments, especially in the case of an art as subtle and precise as is Greek art, are perhaps those which require the longest study, if it is to be carried to its logical end, namely, its restoration, at least in graphic form. This study, in fact, touches points which are difficult to handle, often widely dispersed or difficult to reach; but, one can say that it always requires complementary work and research on the spot, after the excavation is over. The delay in publication here depends upon the importance and state of preservation of the monuments as well as the particular local conditions.

There cannot therefore be any question of laying down a hard and fast rule,

applicable in all cases, touching the publication of scientific excavation records; it is very evident that one cannot compare the exploration of an Hellenic sanctuary with that of a neolithic foundation in northern Europe. What experience shows is that the reports on excavations, whether they be designated or not as preliminary, should be considered for practical purposes as final publications, in cases where, as is more and more frequent, they constitute special works, or when they are incorporated in collections such as those of the *Egypt Exploration Society*, or the *French Institute of Cairo*. A series of reports may, in fact, be followed by a volume of deductions, or a series of monographs concerning important monuments or a group of such monuments. Thus, the final publication, properly speaking, would be limited to putting the whole in its true light and to a study, either of the reserved documentation, or of the monuments, which having benefited by complementary research, require a new presentation. In any case, it is to the interest of the excavator, as well as that of science, that the excavation report should be sufficiently clear and detailed for savants to have the greater part of the documentation at their disposal.

Today, great stress is laid on the necessity of giving an objective character to the scientific publication. It is obvious that under no circumstances should an excavation be undertaken to prove at all costs a preconceived idea. Does this mean that the scientific publication should simply give the reader the "unadorned" results, if one may use the word, of the expedition? Some savants seem to have a tendency to regard the excavator as a kind of registration machine, with no imagination, no memory and no critical sense. What one has the right to expect, however, is that the description be accurate and impartial, and accompanied by photographs, but an excavation report is not an excavation log, and even in a provisional report—still more in a final publication—the excavator has a right, and even a duty, to voice his own interpretation of the signification and date of a monument he describes, especially if his opinion is based on observations made during the course of the excavations and on the circumstances of the discovery. For this reason, the presence, on the spot, of the archæologist who is to draft the report or collect the material, should be considered as essential. But one readily concurs with Professor Wace that "the excavator cannot hope to publish an absolutely final judgment of his finds, however long he may take over it". Which comes to the same as saying that every excavation publication is provisional, as is science itself, and cannot be held back because of exaggerated scientific scruples.

To sum up, the question of the period allowed for really applies only to exca-

vations on a large scale. For these, the method of excavation reports seems to be the simplest and speediest. In order that these reports may possess all the true value of scientific publications, the collaboration of several savants is necessary. In this respect, no doubt the wisest arrangement is to have a publication committee attached to large expeditions, with a director in charge, whose activities shall be concomitant with those of the archæological mission; this committee is responsible for bibliographical research and the classification of documents (see Chapter VI for details of this documentary work).

Finally, it should be a fixed rule that an excavation budget contains a proper provision for the publication of results. One may add that, in respect to the proposed edition, the budget of the libraries which buy these publications on excavation must be taken into account, for it is of interest to both the excavator and the purchaser that the cost of publication be not excessive. In fact, it is an accepted principle that, generally speaking, large, expensive and cumbersome editions are now avoided. It does not seem necessary to exceed the 25 cms × 30 cms size.

International documentation concerning excavations. — Although this chapter has already dealt with the international aspect of publications concerned with excavation, it has till now only touched on national publications. The International Conference on Excavations agreed that, to facilitate research, consideration should be given to the possibility of producing certain publications which would necessitate international collaboration or, at least, a certain amount of international co-ordination. The Cairo Conference accordingly formulated a series of recommendations which find their place in a manual on the technique of excavations, provided that they clearly indicate the conditions of publication, centralisation and exchange of the documentation gathered on the excavation site.

The Department of Art and Archæology of the International Institute of Intellectual Co-operation, comprises, among other Services, as we know, an International Centre for Institutes of Archæology and History of Art, whose purpose is to co-ordinate research in the history of art and archæology: this department also comprises an International Commission on Historic Monuments (composed of representatives of national administrations), under whose auspices the Cairo Conference was held; an International Museums Office, concerned with the work of co-ordinating museography and the protection of national historic and artistic treasures, ensures the liaison of the different activities

of the Department of Art and Archæology of the International Institute of Intellectual Co-operation. The three services mentioned group together and represent the administrations, institutions and persons who, in the various countries display their activity in one or other of the domains which, directly or indirectly, concern that of archæological research.

There is therefore an international nucleus which the Cairo Conference felt should be used to the benefit of research work on the spot. Associating itself with the wish already expressed by the International Academic Union, the Conference voted a recommendation urging the publishers of scientific works on archæological research to add, whenever possible, an abstract in a widely spoken language, or at least a translation of the table of contents. (*Final Act* of the Cairo Conference, Section V § 39.)

The International Museums Office has, moreover, been asked to publish annually topographic surveys giving a synoptic view of the excavation activities going on in the different countries. Surveys of this kind, for Italy, have been published regularly since 1933; they include a map which gives only the names of those places necessary as guides. Conventional signs beside the name indicate: excavation going on—to be undertaken during the year—finished during the year—temporarily interrupted. An index, with the map, gives a summary of the work under the name of each place, as well as the bibliographic references concerning them.

A similar publication issued by the *Ankara Museums and Exhibitions Committee* since 1935 presents a picture of archæological activity in Turkey. It would be well if these surveys, the documentary value of which has already been appreciated by archæologists, were generalised, extended to other countries and assembled by the International Museums Office, which, as occasion arose, would group the results—not according to countries but according to civilisations or historic periods.

Other problems of international collaboration arise concerning the international documentation of excavations. It is hardly possible to study them in detail in this chapter, the main purpose of which is to establish certain general principles of co-ordination. One can, however, here indicate one or two, regarding which the Cairo Conference envisaged a system from its general aspect. For example, to facilitate research in excavation documents, it asked the International Museums Office to constitute a documentation centre for the benefit

of archæologists in the different countries (1) this centralisation will possess especial advantages if an understanding is come to regarding the consultation of the documentation which does not figure in the reports as printed. A similar problem of co-ordination engaged the attention of the experts who assembled in Cairo: to facilitate, for enquirers, the access to photographic documentation (proofs, negatives, etc.) and to aid learned bodies in the constitution of their documentary archives.

Terminology in matters of art and archæology also poses a problem of co-ordination already being studied by the International Museums Office. A polyglot dictionary of these terms is in preparation, in which, with the assistance of specialists an endeavour will be made to establish, as exactly as possible, the equivalent terms used in the different languages in the technique of excavations.

Finally, the Conference agreed that all the technical studies of general import, such as they are outlined in this manual (2) should be grouped in the review *Mouseion*.

One cannot, however, exhaust the enumeration of the various points which require international collaboration, and it will be for the International Committee on Excavations, the constitution of which was advocated by the Cairo Conference (3), to pursue the studies opened by this assembly and to serve as a consulting organ for problems relating to excavations and for all forms of international collaboration arising in the sphere of archæological research.

(1) *Final Act* of the Cairo Conference, Section V, § 31.
(2) *Final Act* of the Cairo Conference, Section V, § 32.
(3) *Ibid.*, Section V, § 40.

CHAPTER XII

THE SCIENTIFIC AND TECHNICAL TRAINING OF EXCAVATORS

Excavation fields are records that are destroyed as a result of the inspection to which they are subjected. In this respect, the archæologist is therefore in a different position from that of the naturalist, who, in the majority of cases, has an opportunity of beginning his research anew and of verifying the results obtained by his predecessors. It is true, of course, that in the archæological strata, there are certain structural features whose significance must not be overlooked; but the analogies that first arrest our attention by no means prevent us from recognising that the elements which differ from one field to another constitute the most valuable proofs of specific phases in a given civilisation. Any person, therefore, who undertakes excavation work should bear in mind, clearly and definitely, that once the work has come to an end, the "record" whose pages he has just brought to light will, as such, be lost for all time. The objects displayed in museum collections will never be anything more than quotations, out of their original context.

It will be realised, therefore, how important it is not only to ensure the international publication of the experiments carried out during the excavations, but also collectively to organise the best training possible for excavators.

Etymologically speaking, an excavator is a person who digs down into the earth to seek what may be buried there. For many centuries past, this digging has gone on in the quest for objects of value which men had entrusted to the soil's keeping, generally with the idea of saving it from the covetousness of others. Not long ago, it was realised that these treasures had, in addition to their intrinsic value, an evidential value of such importance that it could not be disregarded. As time went on, it was found that each object, however inconspicuous it might be and whatever material was used in its making, was—from the very fact that it had been used by human beings—of importance for the study of the past.

Although this is not always clearly understood, this extension of the excavator's programme leads us to seek for a more and more marked distinction—at least in theory—between the excavator properly so called and the archæologist who interprets the evidence that these unearthed objects supply. On reading the accounts of excavation work of the past—for rarely is it possible to speak of reports in such cases—one can but deplore the irreparable destruction that accompanied the discovery of a few objects of notable importance. We should prefer that certain boring operations, abusively referred to as excavations, had not been carried out and that, with methods that are at last considered to have been perfected, real excavations now be undertaken, that is systematic and exhaustive exploration of archæological deposits.

Conceived in this light, however, exploration can no longer be envisaged as the result of one man's work. It needs the co-operation of the excavation technician and of the specialised scientist. Moreover, before going any further, it is necessary to emphasise that the profession of excavator can be acquired only by practice. In point of fact, most of the persons who have attained distinction in the recent annals of excavations owe their training to prolonged experience of field work. The best training that excavators can ever hope to get, therefore, lies in affording them an opportunity of serving as apprentices, under the guidance of experienced master-excavators. We shall return to this point later.

If we were asked to define the most useful preliminary training that an excavator should be given, none would be more appropriate than that undergone by a clerk of works. A visit to a properly organised building job will show us that it is essential to know how to lay and run a narrow-gauge railway; to be able to fix the timbering of shafts and subways with the assurance and ability of a sergeant in the engineers. It is necessary to possess the rudiments of land surveying and the plotting of plans, to have a good notion of drawing and painting, etc.; to be able to use a camera successfully and know how to take a plaster or a gelatine cast. It is no less indispensable to have learned how to use a crowbar, a jack, a geared pulley, or even a hydraulic screw-jack. In the course of excavation operations, it sometimes happens that the quantity of objects brought to light is so great that one or several sheds have unexpectedly to be erected. The excavator thus becomes a builder. Shortly afterwards, he will be obliged to devise special apparatus for the conveyance of heavy objects, to resort to all the tricks of the professional packer in order to safeguard fragile pieces against risk of accident. On some days, he will have to put to practical test all the knowledge to be gained from a thorough training as a joiner, not to mention the ele-

ments of practical chemistry to be applied in ensuring the prompt protection of a variety of materials that are threatened with disintegration as from the moment they are unearthed.

Previous chapters will already have enlarged upon these points and indicated the knowledge of the natural sciences that an archæological prospector should possess in order that he may correctly interpret the lessons that can be gleaned from the earth—in other words, the fundamental notions of geology and mineralogy to which he must be initiated,

It is therefore a question of an ensemble of theoretical and practical knowledge which finds its application on every excavation field of any country, but to which little thought has been given in the universities or institutes of history of art through which most of those who undertake excavation work pass. Consequently, it would be an advantage if, in the different countries, there could be constituted a body of technicians who would be exclusively responsible for the material conduct of excavations in the national territory. Failing such a body, however, it would be highly desirable that steps be taken to organise courses of instruction on the technique of excavations at the institutes of history of art (1). Since the institutes of history of art are generally in close contact with universities, they might arrange with the professors of the Technical Faculty to organise a course of sufficient scope for the benefit of young archæologists. It is in order to meet a similar need that the university programmes include, for example, courses in medical law specially for law students.

Technical courses of this kind would be supplemented to great advantage by travelling lectures which qualified excavators would be invited to give on their own work. There is a tendency among excavators—but a very natural tendency— to give prominence to the results of their own activities. Only on rare occasions do they describe the methods they adopted or refer to the difficulties they had to overcome. Anybody who has paid a visit to several excavation sites, however, knows that there are seldom two sites where conditions are alike. Experienced excavators, invited to report on their work, for the purpose of teaching excavation technique, would thus be led to assign greater importance to the actual organisation of the sites on which they have worked.

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(1) Among the lectures organised by the leading institutions (research institutes or museums) on the technique of excavations may be mentioned those given at the *Ecole du Louvre* by M. Du Mesnil du Buisson, author of a work entitled: *La Technique des Fouilles archéologiques. Principes généraux*, Paris, published by Paul Genthener, 1934.

Following out this idea, the institutes of history of art and archæology should be prevailed upon to set aside, in their libraries and records section, a special department devoted to excavation technique.

There is no need to dwell on the advantage that would fall to a scientist entrusted with the supervision of archæological research in a given area, if, for the organisation of his site, he were able to enlist the services of assistants who had been trained in accordance with these principles.

Once this basic training has been acquired, however, the excavator will soon have to supplement it with a scientific education which takes into consideration the peculiarities of each country, or, at any rate, of the various main fields of the history of civilisation. In this connection, international co-operation has already produced beneficial results. In various specialised branches, arrangements are being made for the publication of corpora. The study of ceramics, for example, has advanced in importance from day to day. In the exploration of an ancient site, a few broken fragments of pottery can play as important a part as a handful of coins where more recent periods are concerned. A few notable handbooks have also been issued, among which should be mentioned: "*How to observe in Archæology*", published by the British Museum in 1929 (2nd. ed.).

The scope of the practical training that the excavation technician will receive on the spot will vary according as the services of professional archæologists are or are not available on the site; the second alternative is the most frequent. In theory, one would be inclined to argue that a good excavator should be able methodically to collect the objects he finds in the successive strata, leaving to the specialist the task of interpreting the documentation submitted to him. The most typical case is that of the discovery of records properly so called; their material preservation will be the duty of the excavator but he will have neither the time nor the competence to start deciphering them. Nevertheless, apart from such cases—which are, moreover, the exception—it is desirable that the excavator should be able to read, at least in their general outline, the evolutions that are registered in the different archæological beds. These notions, moreover, form part of the normal programme of archæological education.

From the foregoing remarks, it will no doubt be concluded that if, in a given instance, it were necessary to choose between the technician and the savant for the direction of excavation work, in the interests of science it might perhaps be wiser to entrust exploration to a qualified clerk of works. As a matter of fact, in the majority of cases, it will be found an advantage to have technicians as well as savants present on the site. The composition of field groups is therefore of

exceptional importance, since the final interpretation of the exploration will largely depend on the collaboration of the greatest possible number of experts on the excavation site.

Without wishing to criticise work done in the past, it must be said that field groups have at times been composed of persons whose qualifications were of a very varied nature, persons brought together as a result of special circumstances. The heads of expeditions, who had succeeded in finding the requisite funds for their work, were too often obliged to content themselves with the services of well intentioned helpers. It has not been the rule for excavation missions to assemble, as was recently done for the excavations undertaken by the Oriental Institute of Chicago, a group of collaborators of different nationalities, chosen essentially for their recognised ability. We have only to read the memoirs of Professor Flinders Petrie to realise—although no express reference is made to them—the difficulties he encountered in making up his party of assistants every winter. It is true that some of his assistants have themselves become masters, while many others have since completely disappeared from the sphere of archæological research.

It was precisely with a view to remedying these drawbacks that the International Conference in Cairo entrusted to the Department of Art and Archæology of the International Institute of Intellectual Co-operation, a definite task in this sphere by asking it to organise an international documentation service for the benefit of excavators. (See *Final Act*, Section V, appended to this manual). This documentation, which will be published in the review *Mouseion*, the organ of the International Museums Office, will deal with administrative, legislative and technical questions relating to excavations, such as they have been discussed in the various chapters of this manual.

With regard to the specific question of the training of excavators, however, this same Department is to draw up an international directory of members of archæological expeditions and of experts, classified according to their particular speciality and indicating the work on which they have been engaged. A list of the assistants attached to these expeditions, with a brief statement of the work allotted to them, would, moreover, be extremely useful to heads of expeditions when recruiting their personnel (1). The Cairo Conference also recommended that courses of lectures on the technique of excavations, based on the papers

(1) *Final Act* of the Cairo Conference, Section V, § 36.

submitted to the Conference (1), should be organised in research institutes, universities and museums.

Furthermore, to facilitate the practical training of young archæologists, the International Museums Office will be kept regularly informed, by the competent institutions or services, as to the sites that are being excavated and the conditions under which these young scientists could be attached to the various missions. These particulars, which will be communicated on request to excavation departments, academies and specialised institutes, will enable the latter to select such young archæologists as they can fully recommend for apprenticeships of this kind (2).

In this connection, stress must be laid on the importance of this practical initiation. The very fact that a young archæologist has spent a few weeks at an excavation camp constitutes an invaluable object lesson whereby he will not only be able to form a fairer judgment of excavation work than would be the case if he merely studied reports and treatises, but he will also be initiated to actual excavation practice, the handling of tools, the treatment of finds and the interpretation of archæological documents.

It will be readily realised from this programme that archæological missions and, more generally, archæological science as a whole will derive immense advantages from such a system of international collaboration. It will likewise be seen that, in the opinion of the Cairo Conference—which, moreover, reflects a tendency that is steadily asserting itself in the sphere of archæology, especially in recent years—the excavator who is to assume the responsibility deriving from the study of these ephemeral records of which an archæological site is composed must have highly eclectic training. The type of work devolving on him, though essentially scientific in character, is made up of administrative, legal and technical factors of paramount importance. He may be a man of great learning, but all his scientific knowledge may not be of much help to him when it comes to ensuring the material safeguarding of objects, devising the most rational plans to prevent pilfering, deterioration and waste of time, and guaranteeing the maximum *yield* of his researches. For this reason, it is of the utmost importance that the future excavator should envisage his training from these various standpoints, as emphasised at the beginning of this chapter.

There is no need to review, in all its details, the programme that should be

(1) *Final Act* of the Cairo Conference, Section V, § 34.
(2) *Ibid.*, § 36.

followed for this scientific and technical training, since the actual plan of this manual provides for all the elements of such training. It will suffice to recall the necessity for understanding—in this training—the various aspects of excavation work, from the administrative and juridical problems to the elementary and practical principles governing the installation of a site, passing through the different disciplines relating to surveying, the interpretation of the data revealed by the ground, etc. This must not, however, be regarded merely as indicative of a desire for eclecticism; the experts of the Cairo Conference assigned a practical as well as a scientific character rather to the actual principle of this training.

Turning to the question of the organisation of the practical and theoretical courses of tuition referred to above, the suggestions contained in the present chapter will already serve to indicate the line of action to be followed, whether it be a matter of completing theoretical notions by lectures given either by professional excavators or by periods of apprenticeship in the field, or whether it be a question of allowing future excavators to profit by the teaching of the allied subjects (geology, chemistry, hygiene, etc.) in collaboration with the university Faculties; or, lastly, whether it be a question of practical notions concerning the various crafts whose contribution is indispensable for excavation.

It was therefore these principles that the Conference had in mind when it formulated its recommendation concerning the organisation of courses on the technique of excavations by universities, institutes of research and museums.

The synthesis of these various subjects which contribute to the training of excavators can obviously be arrived at by mapping out the programmes of the examinations that will form the logical conclusion of these courses. For example, besides archæological knowledge in the strict sense, the purpose of the examinations should be to ascertain the candidate's practical abilities in the matter of organising operations on an excavation site. It would for instance, be appropriate to ask the candidate to draft a specification for the installation of an archæological expedition in a given country. This would perhaps be the most reliable means of judging of his scientific preparation (features of the archæological deposit and consequent requirements to be met in installation), as well as his practical training (means of communication and transport, equipment, distribution and organisation of labour, etc.).

By way of conclusion to this chapter, mention should be made of a certain number of points on which young excavators are, as a rule, incompletely informed owing to the fact that reference is but seldom made to them in excavation reports or technical handbooks. We refer to the practical experience acquired

by a professional excavator in the course of his expeditions with regard, first of all, to the customs and habits of the native populations, their beliefs and superstitions, and to what may at times be the disconcerting and unexpected traits of their idea of civility. Many unfortunate disputes and difficulties of every kind could be avoided by a deeper understanding of the susceptibilities of the persons employed. It is often necessary to urge them to make a special effort and even to demand of them a spirit of devotion on which the success of the undertaking may depend. This question, however, is bound up partly with the ethnographical stock, and partly with the individual sensitiveness and education of those engaged in this work.

It would also be a good plan to publish, from time to time, articles giving advice on health questions for the guidance of archæologists, not to mention practical hints on the humanitarian mission devolving upon excavators as regards their workmen and even their surroundings. Very frequently, the organisation of a medical service is of paramount importance to the successful working of an archæological site.

We have dealt with a variety of aspects not only of the training of excavators, but also, and chiefly, with the essential part that international collaboration conceived along these lines can and should play in this sphere, combined with an ever-increasing co-operation of the various sciences and technique upon which archæology depends for the compilation of its records.

CHAPTER XIII

PRINCIPLES GOVERNING THE ORGANISATION OF ARCHÆOLOGICAL SERVICES

The foregoing chapters of this manual, in which the various elements of excavation considered as a technique have been methodically analysed, may now logically be followed by a synthesis embracing the component parts of a general system of organisation incorporated in that technique and, from the administrative standpoint, governed by it. A description of the actual work of the excavator and of the mission devolving upon him brought out the chief characteristics of field research and thereby indicated the requirements to be met by, and the qualifications that should be found in, a governmental Archæological Service.

In this chapter, which will be more or less a recapitulation, we must first of all define the purpose, nature and scope of this kind of research—a definition which will, at the same time, determine the administrative import and the organisation of an archæological service.

It may be asserted that there is no country in the world where there is a total absence of documents of value to the history of man since the time of his creation.

When we speak of excavations, that is to say the search for records which, in the course of centuries, have been buried under the ground, there cannot *a priori* be any limit of time; this would, moreover, be contrary to the principles of science, for the whole evolution of mankind is bound up with the question of investigation. Furthermore, although in conformity with the example provided by certain legislations, greater importance is usually attached to the archæological aspect of these investigations, their scope needs to be still further extended, so that we may, as regards the interests involved, understand also the palæontological records at our disposal and, by their interpretation, all that concerns the science of geology.

Geology, palæontology, palæo-anthropology, palæoethnology and archæology are continuously, intimately and indissolubly linked up one with the other; all these sciences come into play in the reconstruction of the history of man associated with that of the milieu he expresses and which he later dominated by his intelligence.

It is on these grounds that we can claim that there is no part of the world in which there exist no documents useful to the history of mankind, no spot on this earth where it would not be desirable to organise an archæological service of some kind, in order that these documents may be sought, assembled and studied instead of being destroyed, damaged or dispersed.

It is naturally those countries where such antiquities manifestly exist, or where they are brought to light, that are the most directly interested in this work, but there is also a definite international interest to be considered. The history of civilisation cannot, in fact, be written until we are in possession, absolutely and completely, of all the relevant data for every quarter of the globe. Consequently, it is to the common interest of all nations that the documents concerning every country should be saved, collected and studied. It might even be claimed that, while respecting the principles of territorial sovereignty, science has the right to demand that every single element of whatever value (and there may possibly be some of fundamental significance) for the solution of a problem of general interest should at least be safeguarded.

It was therefore perfectly legitimate that an international organisation, in this case the International Museums Office, should have based itself on general notions in laying the foundations for an ideal system of administration of excavations and that it should have proposed it at least as a model which, sooner or later, could be adopted by all concerned.

The state of affairs prevailing in many countries, the force of habit, the spirit of conservatism and, in some instances, misunderstood nationalism, will prevent general recommendations, formulated in the common interest from being universally approved without reservation.

And yet it is essential that all the problems arising should be stated and the most appropriate solutions suggested. These recommendations may, at all events, serve as a guide for the organisation or creation of an excavation service (1).

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(1) The principles discussed in this chapter were approved by the Cairo Conference, which stated them in Section IV of its *Final Act*, reproduced at the end of this Manual.

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The requirements to be met by an archæological service vary considerably from one country to another. The different regions of the world can be divided into two main groups according to two kinds of considerations, and each of these considerations implies different needs and different solutions.

The first distinction to be made depends on the importance of the antiquities possessed by the country explored.

Case 1: There are certain countries of ancient civilisation (Mediterranean, Indo-Chinese and Central-American cycles) possessing antiquities dating back in some cases several thousands of years and all or nearly all of which are of immense artistic value.

In view of the *quantity* of monuments, the service of archæology in these countries should be an organisation of high standing, but it should also have its individual character according to the *quality* of the monuments.

A work of art, in fact, is an object of universal intrinsic value, and it is likely to be traded. In these countries, the trading in antiquities offers considerable attractions, encourages active search for artistic objects, and is therefore conducive to clandestine excavation and to the concealment of finds, resulting in prejudice to the excavation sites and damage to the archæological strata in a far greater measure than that caused by mere ignorance in other fields.

It is for this reason that, in countries of ancient civilisation, besides the scientific requirements in the matter of the search for, the collection and study of, handmade objects, it is necessary to protect these objects from the perpetual menace of forces which, unfortunately, are very ably directed.

Case 2: Countries of recent civilisation, or which are still in a state of comparatively primitive culture. In these countries, we generally find nothing but early antiquities, those which in northern Europe are called "national antiquities"—objects devoid of great artistic value and usually even without any intrinsic value as regards their material composition, and which through being withdrawn from the archæological setting to which they belong, very often lose the greater part of their scientific value. Such antiquities are more particularly of local interest, at least for amateurs, collectors, etc. They are therefore antiquities which, in practice, are of no great importance from the point of view of trading.

In these countries, the Service of Antiquities has little to fear from clandestine

excavators or from persons who steal the finds; the most serious prejudice caused is due to ignorance of the monuments of the past. Scientific research and study must therefore be supplemented by intelligent propaganda, so that fortuitous discoveries may be announced and the material incidentally recovered may be neither overlooked nor dispersed.

When, however, it is a matter of the organisation properly so called of an archæological service, a distinction must be made between the different countries from the standpoint of the possibilities that exist for the creation and functioning of such a service.

Certain countries possess a State-supported and up-to-date organisation, and their cultural institutions make it possible to recruit or to train the necessary technical staff; the relevant acts are promptly and strictly applied and the work of publication and propaganda on behalf of the national antiquities can be rapidly carried out with success.

On the other hand, there are countries where these conditions are lacking, either totally or in part, and it cannot be said that *a priori* this is true exclusively of countries which are still in an early stage of civilisation, dependent on more highly developed countries which would consequently be responsible for the organisation of the archæological service. There may be sovereign States where, owing to lack of initiative or proper consideration for the national interest in regard to its possessions, any ancient document that is not of evident material value, is set aside; it would, in any case, be extremely difficult, not to say quite impossible, in such countries to find the requisite means for organising and operating an archæological service.

Furthermore, as stated above, scientific interests demand that not a single region of the world should be overlooked, even if at first sight one or other region may seem to be of no importance. In a general system—and such should be our aim—there may be certain points of varying importance, but they are all necessary.

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The differences to be noted between the countries regarding the quantity and quality of local antiquities, the different possibilities of organisation and the different degree or even the different types of culture explain the great variety of results obtained by the excavation services in each of these countries.

Let us take, first of all, the countries which were the cradle of classic civili-

sation: Greece and Italy. They have a permanent State Department with a staff of technical experts divided into different sections with definite juridiction over the whole of the national territory. The Department acts in accordance with an organic law and fulfils its duties as an official State service.

In addition to this type of organisation, there are many variations, derivations and reductions in actual practice. In some countries, instead of being responsible to the Ministry of Public education the archæological service is a department of the Ministry of Public Works (as in several cantons of Switzerland, and in Iceland); in other countries, it is a section of the Ministry of Agriculture (Mexico).

In certain countries it is laid down that the Ministry of Public Education is the competent department for antiquities (excavation permits, protection, purchase, restoration of monuments), but this ministry has no special organisation for such work.

In several northern countries, such as Denmark, Sweden and Finland, the archæological service is responsible to the National Central Museum. In other countries, there exists no special autonomous department but there is a central committee whose duties are especially of an advisory character; in the event of operations being undertaken, this committee generally refers the matter to local administrative bodies (United States; *Advisory Board*; Peru: *National Bureau of Archæology*; Japan: *Committee for the Preservation of National Treasures*).

There exist, of course, more complex organisations, with a Central State Bureau and a staff of technical experts; such is the case in Europe where cultural tradition of long standing has endowed the countries with a well developed administrative organisation, for example: Austria (where the work is, however, divided between the *Zentralstelle für Denkmalschutz* and the *Oesterreichisches Archæologisches Institut*), Great Britain, Germany, France and Spain.

With regard to the decisive influence that tradition, on the one hand, and the importance of the antiquities of the country, on the other, can exercise on the organisation of archæological services, it is interesting to note the peculiar contrasts that exist between the English acts applicable to the home-country (where, in respect of chance discoveries, a distinction is still made between gold and silver objects which, as treasure trove, are Crown property, and other objects for which very liberal legislation has, on the contrary, been enacted) and the legislation which the British have introduced in the countries directly under their rule or placed under British mandate or control (Palestine and Cyprus). In the latter case, the legislation is of an extremely modern form.

It is possible to detect in all these instruments certain irregularities and serious

defects, due to the fact that the legislation on excavations has developed very gradually in the different countries and, in almost every case, autonomously, regardless of the more extensive experience of other countries. It was necessary to meet the local requirements as and when they arose; to respect tradition in the matter of the ownership of fortuitous finds; to pursue, very often, a practical object instead of conforming to an organic and definite conception of the scientific aspect of the problem.

The archæological services organised by the principal European Powers in some of their overseas possessions, which are exceptionally rich in antiquities and works of art, have certain peculiar features. Generally speaking, the service consists of a body of Commissioners assisted by a specialised technical staff, with whom they supervise the preservation of the archæological possessions of the country and arrange for their study in so far as circumstances permit. They are central organs, the nucleus of a more extensive organic service of the future but which, for the time being, are not proportionate to the area of the territory to be explored or to the needs to be met in respect of national archæological property. On the other hand, they exercise very extensive and elastic authority, in keeping with the conditions peculiar to the country. These services must therefore be regarded as commendable bodies, even if they are inadequate, and rather as the expression of a principle and of a praiseworthy intention than as definite solutions of the problem at issue.

In her colonies of Northern Africa and in Dodecanesian territory, all of which are extremely rich in classic and pre-classic antiquities, Italy has introduced her own organisation with legislation of a still stricter character, in keeping with the requirements dictated by the special conditions ruling in these regions.

The service organised by France in Tunisia, Algeria and Morocco is also characteristic.

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By what principles should a model department be guided in the matter of excavations?

It is desirable to limit ourselves to a few very general principles, for all that has been said on this subject shows that it would be futile to attempt to apply the same method or organisation to all cases.

1. The department should be a government service (1); it is only in these

(1) See *Final Act* of the Cairo Conference, Section IV, § 28.

conditions that it can occupy a position of absolute authority and, when the need arises, obtain the prompt adoption of the necessary emergency measures.

It is only in the smaller countries, which are relatively poor in antiquities, that the service can function, without prejudice, in the form of an Academy, a National Central Museum or a specialised Institute, provided that these institutions act on behalf of the Government and that they have the necessary staff and funds at their disposal.

2. An excavation service pursues scientific aims that are of interest to the natural and historical sciences, besides educational aims which are of interest to national culture. It is therefore natural that this service should be responsible to the Department of Public Education; it is only in that quarter that it will find a complete understanding of the duties devolving upon it.

3. There must be no interruption in the resources for the payment of staff, for the smooth working of the Offices, for the control of possible discoveries and for the carrying through of an organic excavation plan to be developed methodically as time proceeds (1). There can be no methodical and effective exploration unless the continuity of resources is assured.

For work of an extraordinary character and exceptional importance, special credits should be voted as and when the necessity arises.

4. An excavation service is a technical service; excavation work must therefore be entrusted to a technical staff. The principle of strict competence should, of course, govern all organisations, both in their structure and in their activities. In order that this may be possible in practice, the staff must be permanent and devote itself exclusively to archæological work. The size of the staff will be proportionate to the local requirements of the service. In a small country possessing few antiquities, it is preferable to have one good specialist than a number of officials belonging to some other department dealing secondarily with antiquities. The various aspects of this question are dealt with in greater detail in Chapters IV and XII.

5. A well organised service necessitates the following technical staff: Head of Service; an advisory Committee; auxiliary technical sections: inspectors, architects, topographers, draughtsmen, photographers, assistants and restorers.

The Head of Service is also the chief of the Department concerned and there-

(1) See *Final Act* of the Cairo Conference, Section IV, § 29.

fore the administrator; but he must also be conversant with the actual subject of the research and excavations undertaken if he is to carry out his administrative duties efficiently.

This delicate point was also discussed at the Cairo Conference and it is of interest to recall the views which were expressed. It is difficult, not to say impossible, to find a person possessing all the requisite administrative qualifications and a scientific training in excavation work. Even if we confine ourselves to one single branch of science, it is no easy matter to find a person with ability to master the various spheres of archæological science such as they present themselves in a service of any size. The head of such a service will be supported by scholars who are specialists in these different spheres and his main task will be to reconcile scientific data with the material requirements of administration and organisation in the field. Thus, it is advisable not to overlook the administrative rôle which devolves upon the head of an excavation service in a country rich in archæological resources. On the other hand, if we consider the case of a service organised on a smaller scale, the question is quite different: the head of a small service cannot rely on a large body of scientific assistants; he himself must be qualified, both technically and scientifically, to organise the work of his service on a rational basis. In conclusion, it may be said that it is manifestly impossible to lay down any hard and fast rules as to the training that the head of an excavation service should possess; everything depends upon the size of the service and the possibility of engaging assistants. It is clear, however, that a good administrator will be a man who has a general knowledge of the scientific problems at issue, gifted with a sense for organisation and thoroughly conversant with administrative practice and the material questions arising in the course of excavation operations and the preservation of archæological specimens.

The service should therefore be able to rely on the advice and collaboration of the most distinguished specialists available in the country, outside the State archæological department. Academies, museums and specialised institutes are well qualified to supply the advisers so valuable to the official authority.

The inspectors should be specialists according to the different requirements to be met in the country or region, or field of antiquity to which they are attached; they may therefore be naturalists, palæo-ethnologists, ethnographers (according to the remains most commonly found in the region explored) or, and more particularly, archæologists or art historians in countries of modern civilisation.

Needless to say, the assistance of architects is eminently necessary in places where monuments of notable architectural value have to be preserved. Topo-

graphy, drawing and photography can very well be entrusted to one and the same person, but, as stated in greater detail in the preceding chapter, all this auxiliary work is indispensable for the preparation of sound documentation in connection with any archæological undertaking. The same is true with regard to the duties of assistants and restorers whose allotted share in the work was defined in the Chapter dealing with the preservation of finds (Chapter IX).

The technical staff can never be too large although it must, of course, be in proportion with the extent of the work to be done; on the other hand, the office staff should be limited to a strict minimum in order that an eminently technical service such as is required for excavations, may not become a cumbersome organisation.

The technical staffs here suggested are given simply in skeleton and will need to be completed for countries of ancient civilisation or very rich in archæological records; a staff can, on the contrary, be reduced to one person—the head of the expedition—assisted by not more than one or two assistants or by a few expert advisers in small countries or in countries where archæological treasures are very rare.

The essential point to be borne in mind is that, in all cases, there should be a specialised technical service, more or less in embryo, composed of reliable representatives of the State and who concern themselves exclusively with the antiquities of the country.

In countries of early civilisation or very rich in antiquities, the official technical staff would be advantageously supplemented by a number of honorary inspectors for preliminary prospection *in loco* and who would give notification of any discoveries made.

6. All excavation services need the co-operation of the museums. Archæology is essentially a comparative science; the museums should therefore be organised in such a way as to facilitate the work of comparison as much as possible (1). Theoretically, it is possible to arrive at an extreme case and say that the ideal arrangement would be to have a single universal museum for the housing of the archæological material of the whole world, thus permitting of every possible comparison. In practice, there can naturally be no question of such an arrangement but it is nevertheless possible to deduce the following conclusion: some reaction is necessary against the opposite extreme, namely an infinite

(1) See *Final Act* of the Cairo Conference, Section IV, § 30.

number of local museums, as was the case at the beginning of the present century (1).

Small local museums are practically unknown to savants; in so far as specialists are concerned, the study of documents is a difficult and costly matter, while the museums themselves can offer but very limited guarantees regarding the proper conservation of material.

The ideal solution would be to organise big central museums, or, at most, good regional museums, leaving to the less important centres merely experimental collections with a view to educating the public and to conducting propaganda when a surplus number of specimens or duplicates are available.

In this connection, it should be pointed out that, in theory, and speaking strictly from the scientific standpoint, there is no such thing as duplicates, not even for purely industrial products, since the number composing a class of handmade objects is itself a useful element of historical information. In the field of art properly so called, the duplicate is *a priori* excluded.

In practice, however, we find handmade objects and objects of art which, after study and publication, are no longer required for a full representation of the historic period to which they belong; they are therefore an encumbrance, useless and, in a word, harmful to the museums in which they are housed.

Museum directors and heads of archæological services should realise that to cede these objects, liberally, as comparative material, even to foreign museums, is to render service not only to science but also to the knowledge and fame of the country in which they were found. Given in exchange, these objects can even very fittingly enrich less favoured collections.

Of course, as has been seen in Chapter X, there is an exception to this rule of big central museums, viz.: the museums established amid or in the vicinity of the ruins of great settlements to receive the works of art and objects found in the neighbourhood and which cannot be left *in situ*. (The Roman Forum, Olympia, Delphi, Delos, the Acropolis at Athens, Leptis Cerene, etc.). They are the indispensable complement to the architectural fragments allowed to remain on the site.

7. When the archæological treasures of a country demand such a course, the territory should be divided into several areas. In order that the principle of competence or jurisdiction may be respected, it is desirable that these areas

(1) *Ibid.*, loc. cit.

should, as far as possible, correspond to the amount of available information concerning these sectors and to homogeneous archæological zones, rather than to administrative areas such as are fixed to-day. The regional museums that might be established within their boundaries would then be all the more homogeneous as regards their exhibits.

In these different areas, the material relating to the natural sciences, to prehistory and to archæology can vary very considerably in importance, so that some of the specialists dealing with each of the scientific fields may not find sufficient justification for their attendance. In such an eventuality, responsibility for a branch of study that is only sparsely represented must not be entrusted to a specialist in another branch; it is better to create larger areas for that subject, corresponding to, say, two or three areas of the branch that is the most intensively represented. In this way, the principle of competence will likewise be observed in this case, and the work more equitably distributed.

8. The archæological exploration of a country is such an important and onerous task that the government department concerned will readily accept the collaboration of foreign organisations.

The right to excavate should consequently be generously accorded to academies, universities and other scientific organisations, subject to all the precautions and guarantees that the Government may see fit to demand (1). Here, we can do no more than outline the principle of this collaboration without going into the details of the conditions in which it is secured; that point is dealt with in another publication of the International Museums Office.

As emphasised at the beginning of this chapter, the undertaking of excavations means the destruction of the archæological records buried in the ground; before authorising excavation work, it must therefore be ascertained whether the person who undertakes the excavations possesses the means and the ability to carry them out properly.

The Government can rightly demand that the excavator shall furnish sound guarantees in respect of the means at his disposal, not only for carrying out the work successfully but also for organising the site and the ruins it contains, in conformity with the conditions set forth in Chapters VIII and IX.

Plans, photographs, the diary, the object register and any other document cannot be regarded as the personal property of the excavator (officer or repre-

(1) See *Final Act* of the Cairo Conference, Section II, § 8.

sentative of another organisation), but with the exception of his priority rights in the matter of publication within a reasonable time-limit, these documents, in so far as they replace the original records destroyed by the excavations, constitute a common scientific heritage and consequently, are the property of the concessionary State. These considerations are, moreover, discussed in Chapter XI.

The possible assignment of finds should not be made in accordance with one or other of the surviving practices in force but in accordance with the following scientific principle: a complete record of the excavations should remain in the possession of the country on whose territory they have been carried out. As stated in the *Final Act* of the International Conference on Excavations (1), the government department concerned may hand over to the excavator some of the objects which he has discovered, with a view to promoting—outside the country—archæological studies by spreading information concerning the original monuments. This share in the finds shall, as far as possible, be "fully representative of the civilisation, history and art of the country".

In principle, the right to excavate should not be given to individuals, and in no case to persons wishing to trade in the finds. In all cases, archæological material should be assigned exclusively to museums or collections regularly open to the public.

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With regard to the legislation governing excavations, their exploitation, foreign collaboration and, in general, international relations in the matter of antiquities, reference should be made to the volume published by the International Museums Office on the System of Excavations and Antiquities in the various countries (2); these points could not be approached within the scope of the present chapter although, directly or indirectly, they are connected with the major problem of the organisation of the administrative services responsible for excavations.

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(1) *Final Act*. Section I, §§ 12 and 13, *a*) to *e*).

(2) The contents of this volume are given, more or less in abstract form, in Sections I to III of the *Final Act* of the Cairo Conference reproduced at the end of this *Manual*.

CHAPTER XIV

FINAL ACT
OF THE INTERNATIONAL CONFERENCE ON EXCAVATIONS

Preliminary Observations

The Assembly of the League of Nations approved, on September 30th, 1937, and on the recommendation of the International Committee on Intellectual Co-operation, the principles set forth in the Final Act of the International Conference on Excavations held in Cairo in March 1937. These principles, the full text of which is given below, constitute in a way the International Charter of Antiquities and Excavation which henceforward will govern the framing of national legislations and imbue international relations in the field of archæology with the confidence and order indispensable to their development.

The recommendations drawn up by the Cairo Conference are divided into five sections:

I. Principles of Internal Legislation.
II. The System of Excavations and International Collaboration.
III. Repression of Clandestine Excavations.
IV. Principles governing the Administrative Organisation of Services.
V. Organisation of International Documentation.

Section I proposes a certain number of principles which should be embodied in national legislations relative to the protection and preservation of archæological property: recognition of uniform concepts concerning the definition of the "antique object" and the ownership of the archæological subsoil; establishment of a certain regulation of the commerce in antiquities by all States, in the higher interest of a common heritage; creation of zones of protection; introduction of legislative provisions on the system of archæological excavations and finds, in countries where they do not yet exist.

Section II, referring to the resolutions of the Assembly of the League of Nations of October 10th, 1932, which recommend a large current of exchange between public collections, tends to reconcile the interests of the State on whose soil

excavations are undertaken with the requirements of international collaboration. Consequently, the recommendations deal with the system of excavation concessions: guarantees of supervision and of competence; duration of work; assignment of the objects discovered, etc.

The provisions contained in Section III deserve special attention in view of the importance attaching to the new form of collaboration provided for between museums of antiquities. Furthermore, they complete legal clauses that figure in the Draft International Convention on the Protection of National Artistic and Historic Possessions drawn up by the International Museums Office.

The Conference sought, first of all, to establish a very sharp distinction between the type of objects designated by the above Convention, and objects abstracted in the course of clandestine excavations. The Convention was designed to secure the acceptance of the principle, in international relations, that the inalienable character and the prohibition of exportation which are attached to certain objects follow them henceforth on foreign soil. But if governments consent to this extension, it is because it applies to objects which are public property; the claim of the State for their repatriation is therefore justified because it aims at the reparation of an offence committed to the detriment of a specified public body. Like a claim in common law, it implies that the thing claimed has been the object of a regular and clearly individualised appropriation or possession on the part of the institution which demands its return. Possession implies, furthermore, that the objects claimed were known to this department and inventoried by it; it is this character of restitution that forms the essential and also the most solid basis of the proposed Convention.

The same cannot be said of objects discovered in the course of clandestine excavations or even of those stolen during regular excavations, since the department was ignorant of their very existence. To seek to make this Convention applicable to this type of objects would compromise the basis of regulation which it is intended to set up, for prior possession, in the sense just defined, which is the indispensable condition of the claim, has not been exercised in these cases, for want of opportunity.

For these reasons, the International Conference on Excavations preferred to seek a moral agreement among the museums, embodying the principles which it formulated concerning the protection of excavated objects. It also believed that it would obtain more immediate results on this point by appealing to the direct collaboration of these institutions than by seeking to secure engagements of a legal character.

In addition to the agreement summarised above, Section III contains a certain number of recommendations regarding the duties and responsibilities incumbent upon museums acquiring archæological specimens. It also mentions means calculated to facilitate exchanges between museums (cession of duplicates, publication of specimens or parts of available collections, etc.).

Section IV proposes certain principles that should govern the organisation of the administrative services responsible for excavations, in order to ensure the proper conduct of the work, its safety, its continuity and the constitution of collections on sufficiently broad bases to make possible comparative studies, which are essential in archæological questions.

Lastly, Section V concerns the organisation, in the interest of excavators, by the Department of Art and Archæology of the Institute of Intellectual Co-operation, of an international service of documentation and information; and of a list of members of archæological missions and experts in this field, grouped according to the subjects in which they specialise. It recommends the organisation of courses on excavation technique in institutes of archæology and history of art, and an information service for young archæologists, on work in progress and possibilities of appointments as probationers. Finally, the Department of Art and Archæology of the Institute is invited, in order to ensure the continuity of the work accomplished at Cairo, to consider the creation of an International Committee on Excavations.

Such, briefly summarised, are the provisions of the Final Act of the International Conference on Excavations. The formal endorsement given to them by the League of Nations makes this document, as stated above, a veritable international charter of antiquities and excavations.

We are convinced that the application of these measures will be conducive to mutual confidence and better organised international collaboration, in the interest of archæological science and the preservation of those testimonies of past civilisations which are the common heritage of all peoples.

E. FOUNDOUKIDIS,
Secretary-General
of the International Conference on Excavations

FINAL ACT

Section I

PRINCIPLES OF INTERNATIONAL LEGISLATION

The International Conference on Excavations,

Convinced that it is requisite that the different national legislations governing the protection and preservation of archæological treasures should be inspired by policies that are as uniform as possible,

Formulates the following recommendations:

1. *Definition of an "object of antiquity"*. — It is desirable that legislative texts should adopt the same interpretation of the notion of an "object of antiquity", even if it has to be varied according to whether it is a question of the scheduling or preservation of national archæological treasures, or of compulsory declaration by the excavator or finder.

a) In the former case, and unless there are specific conditions to be fulfilled regarding the archæological possessions of given States, it is desirable to abandon the fundamental rule according to which any object prior to a given date is considered to be an object of antiquity. It is preferable to adopt the fundamental criterium which consists in regarding as antiquities, in the legal sense indicated above, all objects belonging to a given period or having the minimum number of years of existence fixed by law. In this way, all objects to be protected will automatically be covered by the relevant law as soon as they reach the age fixed once and for all by law;

b) This basic principle having been adopted, the legislation of each State could establish, as a second criterium for the purposes of selection, that constituted by the interest attaching to, or the value of, the object as evidence of the historical period to which it belongs;

c) In the second case, that is when it is a question of compulsory declaration, it is desirable that the legislation of each State should adopt criteria of a much broader character than those referred to above, placing the excavator or finder under the obligation to declare any object, movable or immovable, which he has

brought to light as the result of excavation or discovery. An exception would be made only in the case of movable objects which, by virtue of their external appearance, can be included among objects at present intended for current use and likely, therefore, to be found commonly on the open market.

2. *Ownership of the archæological sub-soil.* — The Conference notes that the laws of certain countries explicitly or implicitly recognise the principle that the archæological sub-soil is State property; this principle naturally implies the following consequences:

a) Exclusive right of the State to carry out archæological excavations or to have them carried out, even on privately owned sites, individuals not being allowed to undertake such work without previous authorisation;

b) *De jure* ownership of the State in respect of all objects found in the course of excavations undertaken by the State or with its authority, even on privately owned ground, as well as in respect of chance finds or objects discovered in the course of illicit excavation, compensation being limited to the damage caused to the surface of the site.

3. The Conference further notes that the legislation of other States, even in the matter of archæology, is characterised by the persistence of the notion of private ownership of the sub-soil, without this notion preventing them, however, from undertaking public utility work inherent in the preservation of archæological possessions.

Considering that there is here a difference of method due to various causes and that it is impossible to advocate one system to the exclusion of another,

The Conference recommends:

a) That all national legislations, to whatever system they may belong, should endeavour to ensure the most effective protection of their archæological treasures in the meaning of the present recommendations with due regard to the public utility aims which have inspired them;

b) That, in order to avoid all possibility of dispute as to the practical or legislative rules, the States which accept, but do not actually mention in their legislation, the principle that the archæological sub-soil is State property, should consider the desirability of formulating it more expressly;

c) That, within the limits which they shall fix, national laws should not exclude the possibility of granting to private individuals the ownership of anti-

quities found in the course of excavation, when the department concerned is willing to waive its right to them;

d) That every excavator or finder should be required to declare his finds and that the competent department should see that this obligation is duly fulfilled;

e) That all persons infringing the foregoing provisions shall be liable to the penalties laid down by law and that all objects which have not been declared shall be liable to confiscation.

4. *Trade in antiquities.* — The Conference, observing that the laws most recently passed in certain countries control the trade in antiquities by means of licences issued by the Government and stipulate that all changes in the ownership of antiquities must be recorded in an official register,

Recommends that all Governments should consider the question of controlling the trade in antiquities in the general interests of the common archæological heritage.

5. *Protected areas.* — The Conference draws attention to the interest which some countries, whose subsoil is particularly rich in archæological treasures, may have in creating protected areas.

6. *Need for legislation in the matter of excavations.* — The Conference recommends that countries which have as yet introduced no legislation concerning the protection and conservation of ancient monuments, or regarding the system of archæological excavations and their proceeds, should consider the desirability of drafting such provisions, taking into account their particular requirements and conditions and following the lines laid down by the International Conference on Excavations.

Section II

THE SYSTEM OF EXCAVATIONS AND INTERNATIONAL COLLABORATION

The International Conference on Excavations,

Considering that the knowledge and study of ancient civilisations are equally interesting to all peoples;

Referring to the resolutions of the Assembly of the League of Nations of October 10th, 1932, which contained the following recommendations:

a) a wide scheme of exchange and co-operation between public collections,

with the object of giving them an increasingly universal character and enhancing their educational value;

b) the principle of the transfer by Governments, in the form of alienation, exchange or deposit, of objects which are of no interest to their national museums;

c) educational work by public authorities with the object of awakening and developing respect and appreciation in the inhabitants of different countries for their ancient historical remains;

Recalling the conclusions of the Conference convened at Athens in 1931 by the International Museums Office, and the recommendations previously voted by archæological congresses and learned societies, in particular the Archæological Joint Committee of London, and the International Academic Union;

Considering that, although the system of excavations is of primary interest to the country in whose soil the excavations are carried out, and is therefore primarily dependent on the internal laws of the country, it is of essential importance that this principle should be reconciled with the requirements of a broadly conceived and freely accepted system of international collaboration;

Adopts the following recommendations:

7. *Authority to excavate.* — It is for the internal law of the country where the excavations are to be carried out to lay down the general rules governing the granting of excavation rights, the obligations imposed on the licensee, in particular with regard to the supervision exercised by the national authorities, the duration of the concession, and the causes which may justify its cancellation, the suspension of operations or the substitution of the national authorities for the licensee with a view to completing the work.

8. In order to meet the higher interests of archæology and international collaboration, the State shall endeavour to encourage excavations by granting liberal and equable conditions, guaranteeing without distinction of nationality to every learned institution or qualified person, according to national legislation, the possibility of competing for excavation licenses.

9. It is desirable that the conditions imposed on the excavator should be those stipulated by the ordinary laws of the country and that, in consequence, the concession contract should as far as possible refer to those laws and avoid the unnecessary formulation of specific or individual requirements.

10. Excavation licenses shall be issued only to institutions or persons who offer sound scientific, moral and financial guarantees of a nature to ensure that

the excavations undertaken will be completed according to the terms of the concession contract and within the time stipulated therein or during the maximum legal period for which it may be renewed.

11. The right to excavate granted to foreigners shall be accompanied by guarantees regarding time and security, such as will enable them to work under favourable conditions and protect them from unjustifiable cancellation of the licence, especially in cases where they are obliged temporarily to suspend operations for reasons which are recognised as genuine.

12. *Assignment of Finds.* — The rights of the excavator in respect of the ownership of movable objects found in the course of the excavations shall be determined by the internal legislation of the country.

13. The Conference considers it highly desirable that Governments should recognise and embody in the laws of their country the following principles calculated to further the true interests or archæology and the international collaboration necessary to those interests:

a) It is essential that the objects found in the course of excavations should be set apart, in the first place, for the formation, in the museums of the country where the excavations are carried out, of complete collections fully representative of the civilisation, history and art of that country.

b) In order to encourage archæological studies in other countries by the distribution of original remains, the national authorities may present the excavator with a share of his finds. This share shall consist of duplicates, or, generally, of objects or groups of objects which the authorities are able to relinquish because of their similarity to those already in the possession of the national museums. The said share shall likewise, as far as possible, be representative of the civilisation, history and art of the country.

c) In order that the aim of paragraph *b*) above may be attained, it is desirable that the internal laws of the country concerned should recognise the principle that objects which are of no interest to its national museums may be ceded, exchanged or deposited for the benefit of foreign museums.

d) Except in circumstances which the national authorities may judge exceptional, the handing over of finds to the excavator or their entrustment to him on deposit, imposes on him the obligation to place them in public collections so that they may be available for the purpose of examination and study; failing such assignment, the finds shall be returned to the country of origin.

e) The granting to the excavator of objects which form a whole carries with it the obligation to respect that unity.

f) Excavator's scientific ownership of his finds. — The right to excavate implies an obligation on the Government granting that right to guarantee to the excavator the scientific ownership of his finds; it also imposes on the excavator the obligation to publish, within the period stipulated in the concession contract, or in the absence of such a clause, within a reasonable period, the results of his work. It is desirable that the Department of Antiquities and the excavator should, either during or at the end of each excavation expedition or season, agree as to the best method of bringing the main results to the notice of the public.

Section III

Repression of Clandestine Excavations

The International Conference on Excavations,

Convinced that clandestine excavations, that is excavations undertaken without the permission of the national authorities, are highly prejudicial to the interests of archæological science and that the common archæological heritage should be protected against such practices;

Considering that, under the present internal laws of the majority of countries, it would be difficult to give to objects found in the course of illicit excavation the legal protection provided for in the draft international convention drawn up by the International Museums Office concerning national artistic and historical possessions;

Believing, nevertheless, that it would already be possible to ensure effective protection by seeking the amicable and confident collaboration of Government services and museums;

Noting that this collaboration is at present facilitated by the fact that, in their mutual relations, these institutions display an ever more enlightened spirit of international solidarity and understanding.

Formulates, for the future, the following rules:

14. It behoves all Governments to take all possible steps in their respective territories to prevent clandestine excavations and damage to historical remains, and the export of objects found therein,

15. Before definitely acquiring an archæological specimen, the museums should institute the most searching enquiries to satisfy themselves that nothing

in its intrinsic character or the circumstances in which it is offered, or any other condition, warrants the belief that the object is the result of clandestine excavation or any other illicit operation and is therefore excluded from trade by the laws of its country of origin.

16. Any museum receiving the offer of an object that gives rise to suspicion should notify the departments concerned and furnish them with all the necessary details of the case.

17. The departments and museums should collaborate for the purpose of ensuring or facilitating the repatriation of objects found in the course of clandestine excavations or other operations regarded as illicit in their country of origin.

Should the occasion arise, the Governments should lend their good offices for this purpose.

18. In order to assist in the prevention of clandestine excavation and to enable public collections to fulfil their scientific and educational mission, it is necessary that the Governments should afford foreign museums the legal possibilities of acquisition mentioned in paragraphs 13 *b*) and *c*) of the present recommendations and in the recommendations voted by the Assembly of the League of Nations on October 10th, 1932.

19. The International Museums Office shall publish periodically, in its review *Mouseion*, lists of objects which the museums and departments would be prepared to cede to other collections.

20. The competent national departments should bring to the notice of the International Museums Office and, if necessary, of foreign museums, by means of the same publication, all cases of clandestine exportation of archæological specimens.

21. Museums should be allowed to acquire objects in cases where, after having been consulted, the department of the country of origin waives its right to recover them. These museums should also have the right freely to acquire any objects regarding which the said department can be directly informed by the same means of publicity as that available to foreign museums (for example: objects figuring in public sales or brought to the notice of museums in a scientific journal).

22. Foreign museums should be able freely to acquire any objects the trading in which is subjected to no restrictions whatsoever by the laws of the country of origin. In this case, the museum acquiring the object shall observe the period of foreclosure stipulated in those laws.

23. In the event of a divergence of opinion between the department of the country in which the excavations have been carried out and a foreign museum as to the application or interpretation of the foregoing rules, appeal may be made to the good offices of the International Museums Office or of a person appointed either by the latter or by the parties themselves.

24. If it is impossible to settle the dispute by resorting to these good offices, one of the parties concerned shall have the right to inform public opinion of the facts of the case by a statement in the publications of the International Museums Office. This Office shall arrange for the publication of the statement thus requested to be followed by the publication of the reply which may in due course be given by the other party.

25. Generally speaking, it is desirable that the International Museums Office should be kept informed of any requests that may be made regarding the form of collaboration suggested in the present recommendations.

26. The International Museums Office shall approach the national departments and museums with a view to obtaining their adhesion to the principles formulated in Section III of the present recommendations and shall give notice of these acceptances in its publications as and when they are received.

27. The Conference recommends the signing, under the auspices of the International Museums Office, and in accordance with the principles set forth in the present Section, of bilateral agreements between the States whose internal legislation contains nothing of a nature to prevent the conclusion of such agreements.

Section IV

Principles governing the administrative organisation of services

The Conference,

Recognising that although varying traditions and resources make it difficult to adopt, for all countries, a uniform system of organisation for the official ser-

vices in charge of excavations, it is nevertheless possible to suggest certain principles which should be common to all national services,

Believes that it can accordingly recommend the following rules:

28. The Department should, as far as possible, be a Government Department or an organisation legally empowered to have such measures as may be necessary taken without delay.

29. A continous supply of funds should be guaranteed for: *a*) carrying out an organic plan of operations; *b*) supervising any discoveries that may be made, and *c*) the efficient working of the offices.

30. In view of the fact that archæology is preeminently a comparative science and that any excavation service needs assistance from the museums, museums should be organised in such a way as to offer every facility for the work of comparison and should, as far as possible, form central and regional collections rather than small local collections with limited access and offering but little guarantee that specimens will be kept in a good state of preservation.

Section V

Organisation of International Documentation

The International Conference on Excavations makes the following recommendations:

31. The organisation, for the guidance of excavators, of an international Service of Documentation and Information at the Department of Art and Archæology of the International Institute of Intellectual Co-operation; such documentation to deal with the administrative, legislative and technical problems of excavation, as they appeared on the agenda and developed in the course of the Conference proceedings.

32. This documentation shall be collected and diffused by the review *Mouseion*, the official organ of the Department of Art and Archæology of the International Institute of Intellectual Co-operation.

33. This same Department shall keep an international register of members of archæological expeditions and experts, classified according to the questions

in which they specialise and mentioning their qualifications and previous activities.

34. The organisation at research institutes, universities and museums, of courses on excavation technique, suggested by the proceedings of the Conference.

35. The assembling, in all important museums, of ceramic records, in the form of collections of fragments. With a view to the teaching and preparation of excavation work, it is recommended that such ceramic records should be extended so as to include all the civilisations represented in the museum.

36. In order that young archæologists may become acquainted with excavation work, the Conference recommends that the Department of Art and Archæology of the International Institute of Intellectual Co-operation should ask the competent institutions or services to keep it informed of the sites where such visitors could be received, with an indication of the date, number and conditions. This information would then be communicated, on request, to the different excavation departments, universities, academies and special institutes, thus enabling them to nominate the young archæologists, indicating their qualifications and vouching for their reliability.

37. Reports drawn up by excavators and communicated to the press by the Service of Antiquities should be sent to the Department of Art and Archæology of the International Institute of Intellectual Co-operation so that they may be placed at the disposal of such institutions and reviews as may ask for them.

38. The national archæological services should place their documentary material at the disposal of excavators who have applied for and been granted a concession for a given site.

39. Publishers of scientific journals and works dealing with archæological research and written in a little spoken language should, whenever possible, adopt the practice of adding an abstract, or at least a translation of the table of contents, in a more widely used language.

40. The Department of Art and Archæology of the International Institute of Intellectual Co-operation should consider the possibility of setting up an International Committee on Excavations whose function it would be to continue the studies begun at the Cairo Conference and to act as an advisory body on excavation questions as well as on all forms of international collaboration arising out of archæological research.

RESOLUTION OF THE LEAGUE OF NATIONS ASSEMBLY

(September 30th, 1937)

"The Assembly,

"Considering that our inheritance from the distant past of mankind cannot be effectively brought to light in the absence of a good international understanding;

"Referring to the recommendations which it made to Governments on October 10th, 1932;

"Being convinced that, although the regime of excavations is essentially the concern of the country in whose territory such excavations are undertaken, and must therefore be primarily governed by its domestic legislation, it is highly important that the principle should be reconciled with the demands of a largely-conceived and freely-accepted international co-operation;

"Being of opinion that the rules drawn up for that purpose by the International Excavations Conference convened at Cairo by the International Museums Office with the generous support of the Egyptian Government are admirably designed to attain that end:

"Requests the Secretary-General to transmit the text of the conclusions of the Cairo Conference to the Governments of Members of the League and non-member States for their guidance in legislating on the subject of antiquities and excavations.

INTERNATIONAL CONFERENCE ON EXCAVATIONS

(Cairo, March 9th to 15th, 1937).

LIST OF PARTICIPANTS

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Representing the International Institute of Intellectual Co-operation: M. Henri BONNET, Director; M. Raymond WEISS, Legal Adviser. M. J. D. de MONTENACH, represented the Secretary-General of the League of Nations.

Secretary-General of the Conference: M. E. FOUNDOUKIDIS.

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