# Aerial Photography in Archaeology

2

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## Contents



## 2.1 Historical Overview and Assessment

The interest in aerial photography on the part of those working in our sector of study dates back to the beginnings of photography, with the first aerial photograph taken during flight in 1858 by the Frenchman Gaspard-Felix Tournachon (known as "Nadar"), who photographed the Avenue du Bois de Boulogne in Paris from a hot-air balloon (Fig. 2.1).

In the archaeological field, this technique for obtaining images from above was employed by the German Friedrich Stoltze as early as 1879, to document the state of the excavations in *Persepolis*. However, a leading role in the development of the technique in this phase was played by Italy. Indeed, the first flight undertaken for archaeological purposes in Europe took place in Rome in early June 1899, organised by the archaeologist Giacomo Boni. To document the excavations then in progress in the Roman Forum, in 1899 photographs were taken from a tethered balloon belonging to the Special Brigade of Military Engineers (Figs. 2.2 and 2.3). A few years later in England, in the summer of 1906, R. H. Sharpe took pictures of Stonehenge from a military hot-air balloon (Fig. 2.4).

Despite its pioneering application in the documentation of the excavations of the Roman Forum by Boni and others in subsequent years (Ostia, Pompei, Porto: Fig. 2.5), this study technique in Italy did not experience the development

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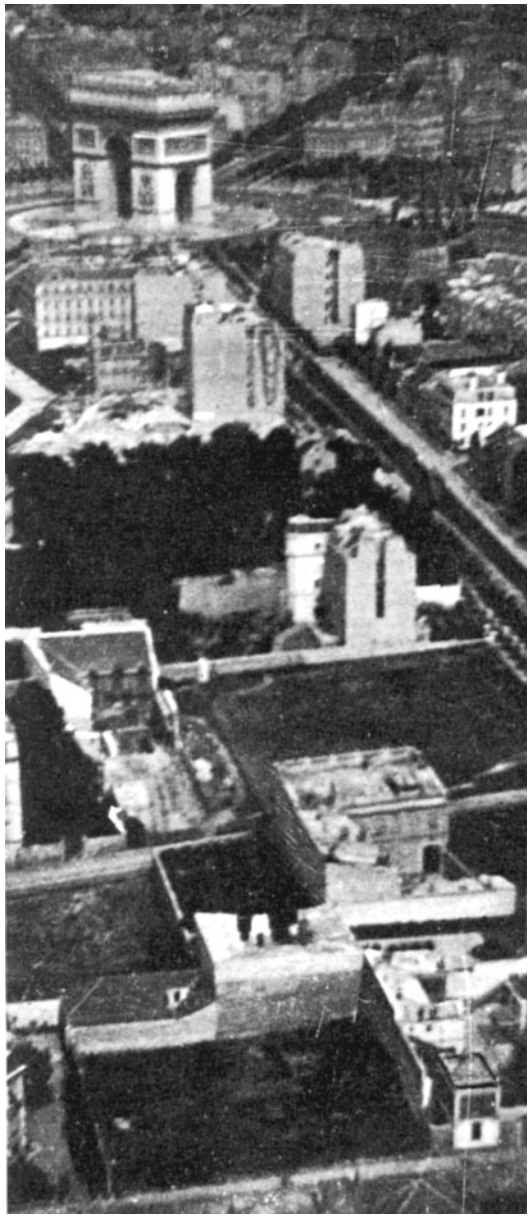

**Fig. 2.1** Oblique aerial photograph of Paris taken by Nadar in 1858 (Piccarreta and Ceraudo 2000)

and widespread adoption that might have been expected. In other countries like the UK and Germany, instead, developments of instruments (cameras and aircrafts) and know-how (photo-interpretation techniques) were progressively achieved.

With the outbreak of the First World War, aerial photography became a key tool in military reconnaissance, and consequently the procedures useful for the reading and interpretation of photographic images began to be codified and refined. From the large quantity of aerial photographs taken for military purposes in those years, lessons were learned that would also be of use to studies of archaeological topography (Fig. 2.6). In Italy however with the exception of a few attempts by Giuseppe Lugli, effective and rigorous applications of this tool began to be seen only after the Second World War with the fundamental work of Ferdinando Castagnoli, John Bradford, Giulio Schmiedt, Dinu Adamesteanu, Nereo Alfieri and others.

In the interwar period, the use of aerial photographs for archaeological purposes saw significant development, including on a theoretical level.

Between 1925 and 1932, important research was conducted at the behest of Father Antoine Poidebard, particularly in Syria (Fig. 2.7). This soldier and clergyman, nicknamed the "Flying Priest", established the foundations of archaeological photo-interpretation and provided valuable insight concerning the timing and the techniques required in order to ensure the appearance of certain archaeological features in the photographic images.

By then, the utility of aerial photography in desert contexts, where the continuity of settlement had been interrupted, was well established. In contrast there remained much doubt about its potential for areas that are still inhabited and cultivated today, where it was assumed that successive human transformations must have obliterated any trace of their most ancient phases. However, the studies by O.G.S. Crawford conducted in Great Britain from 1922 onwards demonstrated the extensive applicability of the method even in areas characterised by long-standing continuity of settlement. In several European countries, and in many of the lands included in their expanding colonial domains, aerial photography for archaeology was applied by amateur pilots but also in the framework of governmental-supported aerial reconnaissance programs.

The start of the Second World War led to the interruption of the research, but it also provided

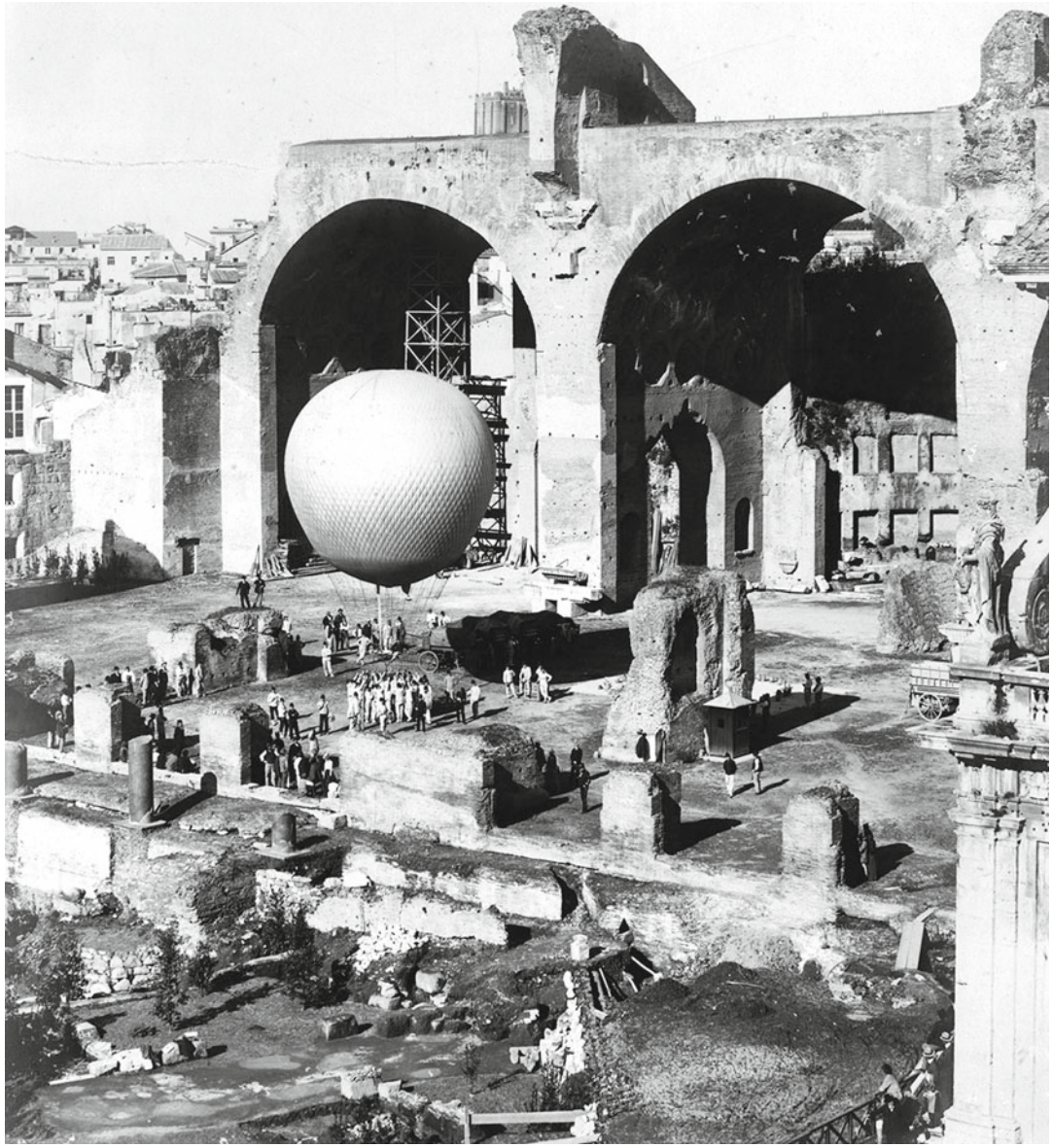

**Fig. 2.2** The captive balloon of Brigata Specialisti of the Military Engineers of Italian Army inside the central nave of the Basilica of Maxentius (early 1900s) (Ceraudo 2004)

researchers with an enormous quantity of photographic material that had been acquired for military reasons (Fig. 2.8). The result was a considerable boost for this type of study, which by then was well past its pioneering stage. Indeed, a substantial quantity of images from that time is held by a number of important aerial photography archives throughout Europe.

The numerous images acquired in those years today provide us with historic testimony concerning the organisation of territories before the extensive urbanisation and infrastructure building that was to profoundly alter the agrarian landscape of Italy and Europe as a whole in the post-war period. Paradoxically, these images were in some ways more representative of the

**Fig. 2.3** Excavation campaign in the central part of the forum (area of Comizio and of *Niger Lapis*) recorded by G. Boni on a captive balloon of Brigata Specialisti of the Military Engineers of Italian Army (Ceraudo 2004)

ancient layout of places than of the modern situation.

In the subsequent period, from 1960 onwards, Europe saw growing interest in the various techniques used in aerial photography as applied to archaeology. In Italy, however, such images were mostly limited to vertical photos of the military type, more suitable for an overall reading of the terrain. This was a direct consequence of a restrictive law dating back to 1939 which banned private companies and organisations from freely taking aerial photographs at low altitudes.

In contrast, in some European countries (Great Britain, France, Belgium, Germany), there was a tendency for systematic aerial reconnaissance to be conducted by private aviators (two famous names in this regard are Roger Agache and Otto Braasch) or by specially created research centres.

In addition the period saw many important events which provided an occasion for cultural exchange, including the 8th International Congress of Classical Archaeology in Paris 1963; the 10th Congress of the International Society of Photogrammetry, Lisbon 1964 and the 2nd

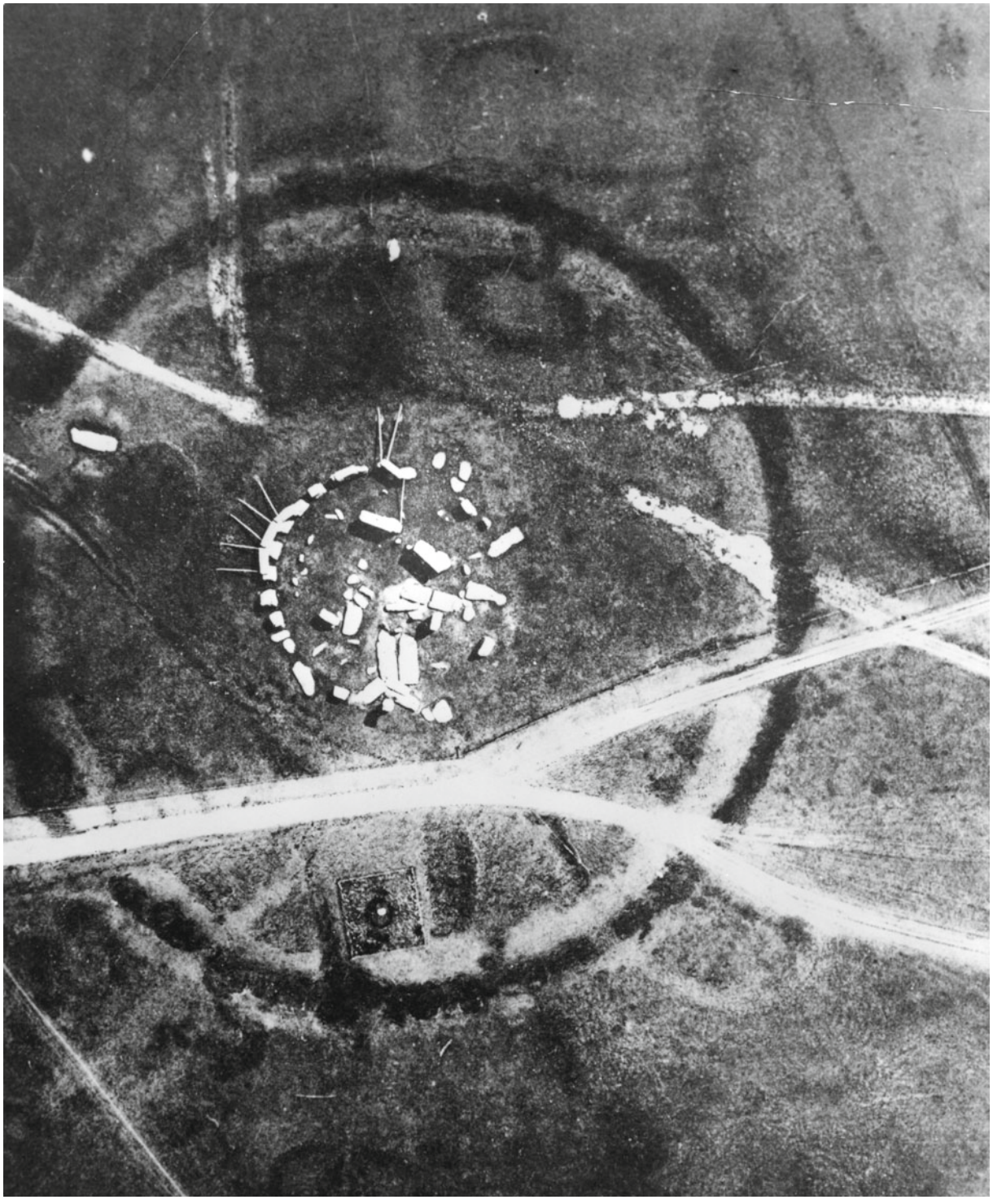

**Fig. 2.4** Stonehenge from an Army balloon (Sharpe 1906) (Bewley 2004)


**Fig. 2.5** Aerial sight of Ostia during the excavations of Vaglieri and of a lost bight of Tiber (1911) (Shepherd 2007)

International Symposium on Photo-interpretation in Paris 1966. Nor was Eastern Europe unaffected by this enormous flourishing of research based on aerial photography, important studies were conducted in Russia (on the remains of centuriation), Poland (systematic territorial research) and Yugoslavia (on the layout of Greek colonies in Dalmatia). More recently, following the fall of the Berlin Wall, work has been conducted in Slovakia and Romania.

From this point onwards, even in Italy, which by then had largely caught up with the other nations, the method spread thanks to the work of proficient scholars: as well as the work of Schmiedt at the Istituto Geografico Militare in Florence, also worthy of mention are the activities of the Istituto di Topografia di Roma e dell'Italia antica of "La Sapienza" University of Rome headed by Castagnoli.

The comparison is useful, concerning the last few years, with foreign colleagues who have for a longer time been developing the activity of aerial recognition and who have promoted and fuelled discussion and comparison in a sector whose fields of action was certainly limited by restrictive norms, now fortunately abolished. Nevertheless, this scientific activity was always vital and dynamic, with deep roots, and it is historically testified in the boundless specialized bibliography.

It must be reaffirmed, however, that this line of research is valid only if founded upon solid cultural bases and connected to a well-rooted tradition of studies, with professionalism and

**Fig. 2.6** Siracusa, the *Neapolis* area photographed from a biplane bomber, the Caproni Ca3. Under the wing of the biplane are the ruins of the amphitheatre and theatre (Ceraudo 2004)

competences tied up to the activity on the territory. We risk starting with inadequate phenomena: some abstractions are unfortunately too technical and, in line with much present-day thinking, are more interested in the projects than in the works themselves, or there may be confusion, due to the lack of formation of a basis, as a result of which the instruments used for the research (we allude, in this sphere, to surveys, aerial recognition and relatively oblique photographs) have sometimes been taken over by disciplines (Fig. 2.9).

Among these "tools", the use of aerial photography has increased notably in different directions: on the one hand the areas interested in the experiences of archaeological photo-interpretation have increased, and on the other hand there is a stronger interest in cartographic representations of the territory, both as basic cartography – an essential support for knowledge and for guardianship – and as photogrammetry adapted for archaeological use.

From the methodological point of view, I remain convinced that the use of aerial photography must be tightly tied to the primary demand of contextualization and the topographical position of the find – its trace – and to its precise survey. The design phase, which is the action to fix a defined object in space and in this case to position it on the map (cartographic positioning), even if as a trace, constitutes the essential

**Fig. 2.7** *Palmyra* view from SW through the Valley of the Tombs in an oblique aerial photo of Poidebard in 1937 (Denise and Nordiguian 2004)

presupposition for the knowledge and protection of the cultural heritage (Fig. 2.10). In the specific case of archaeological traces, even if they are individuated, interpreted and described, but not georeferenced with aerial photogrammetric restitution, they will remain abstract elements, uprooted from their context, and only a passing moment in the research of a determined territory, on which it would thus be impossible to effect exhaustive studies or to practise any action of guardianship.

Even if the digital image is confidently set out to be the only tool to be exploited, the existence of an enormous quantity of traditional aerial images on film, a lot of them still "unpublished", preserved in the aerial photographic archives and still to be read and elaborated, makes it essential to maintain procedures and the "know-how" necessary to competently extract the data contained in them. It is worth remembering that a stereoscopic strip of vertical aerial photographs is readable (and therefore measurable) in three dimensions and that non-perceivable data, at times on a single frame, analogue or digital, can be extrapolated with traditional techniques that permit the employment of suitable instrumentation that can be used for the emphasized perception of the relief (stereoscopes) (Figs. 2.11 and 2.12). In my opinion, a superior refinement of archaeological photo-interpretation is possible that elaborates and will not neglect even the smallest signs that are potentially contained within the aerial images, in the attempt to recover data from indexes that are fragmentary or barely visible on the ground. This is undoubtedly less sensational than some amazing oblique photographs but equally important for an integrated and scientifically valid activity of research.

It is obvious that the data elaborated by the reading of the aerial photographs (vertical and oblique, historical and recent), in the specific case of archaeological traces, obligatorily requires a punctual check on the ground to be able to pass from the level of generic indication to that of archaeological evidence of all the effects: a presumed archaeological trace, seen on an aerial image, has necessarily to be connected to objective data, that can be checked only after

**Fig. 2.8** R.A.F. aerial photograph of March 15, 1944. At the foot of Monte Cassino, with the Abbey already heavily damaged, and the area of the modern town have been bombed to devastating effect. The damage is clearly visible through the dense smoke and dust near the remains of the Roman city of *Casinum* (Ceraudo 2004)

**Fig. 2.9** At the *top*, historical aerial photo of the town of Arpi (IGM 1954); in the *middle* and *below*, in comparison, vertical aerial photos (Aerofotogrammetrica Nistri 1997) and oblique (LabTAF 2005) of two sections of the old town (Ceraudo 2008)

**Fig. 2.10** The archaeological map of Arpi (Guaitoli 2003)

direct verification on the ground by experts on the subject.

In recent years, the evolution of the discipline has become particularly advanced, not so much as regards the basic methodology of the research, by now fixed exactly on the lines established at the end of 1800, but in terms of the availability of new instruments derived from technological progress and from close integration with other disciplines, in both the humanistic and natural sciences fields. Rediscovered in these last few years by sectors of study and research that were previously unconcerned with the problems of topographical research, it is still an object of debate and theories, as attempts are made to fix the guidelines and techniques of execution, although for a long time already these have been defined and routinely applied by employees.

A comparison is necessary, even in these different ways of working, so as to be able to direct our discussion towards the need for refinement and development, a need which is implicit in scientific research.

The limits and merits of this instrument of investigation have, in reality, been well known for a long time to all those people who regularly

operate in the sector. "New" different terminologies are added to the old wording, all of which, among other things, are inherent in the concept and the methodology of the topographical investigation of the territory. To the specific subject of "ancient topography" are added landscape archaeology, field survey and total archaeology. These are unexceptionable terms in themselves, although perhaps more modern and attractive, but they are signs of the fact that there was the need to express a certain multiplicity of interventions on the territory; this multiplicity does not always works out as an enrichment or with a precise definition, but is sometimes a symptom of the introduction of elements of confusion that are unfortunately not always confined to the formal level, but at times risk infecting also the substance of the subject. From the terminology,

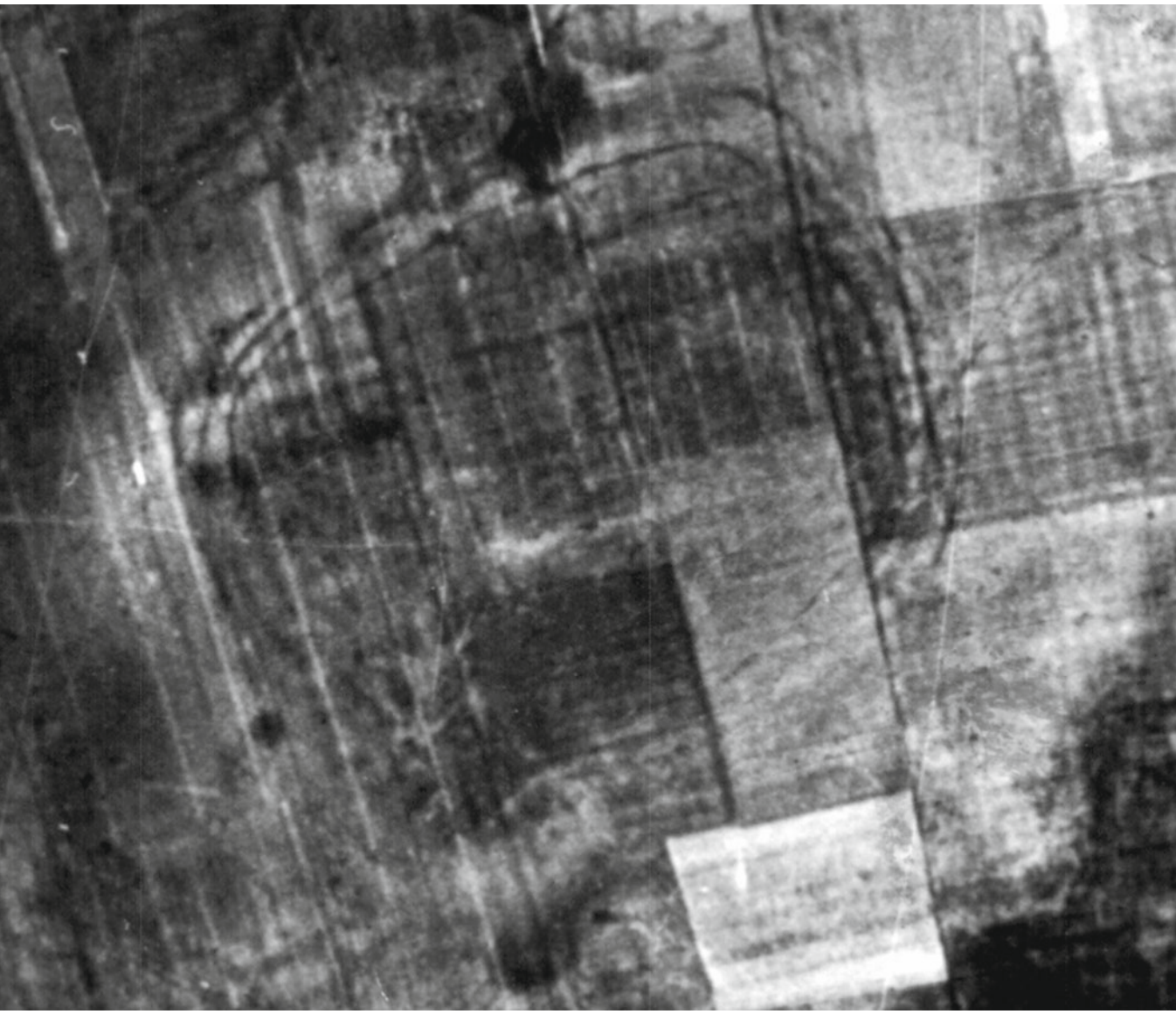

**Fig. 2.11** Neolithic village near Masseria Fongo, S of Foggia. (**a**) Vertical photo, IGM May 1955; (**b**) oblique aerial photo of May 2005 (Archive LABTAF)

**Fig. 2.11** (continued)

sometimes used in a provincial way, it is justifiable to deduce a certain confusion between the means and the goal or rather between the means of study and the instruments that are useful for the research and the scientific goals of the research itself, with an excess of evaluation or a contortion of the traditional instruments of investigation which we are now accustomed to using.

In the meantime, unfortunately, there has been an increase in the abandonment, looting and destruction of the territory, with frequent peaks of cancellation of a less developed morphology that itself constituted historical testimony. To arrest this folly, which is unfortunately very widespread, it would not be enough to rely on the increased availability of technologies whose effect currently remains, for the most part, confined within the limbo of good intentions. Agricultural and public activities, great infrastructural works, cementing over of the outskirts

**Fig. 2.12** Veio. On the *left*, oblique aerial view of the central area of the ancient city (27/09/2010), on the *right* the same area in a vertical photo (29/09/2010) (Archive LABTAF)

and the coasts and building abuses are progressively and irreparably destroying our archaeological heritage.

The last few years have seen significant development in the use of aerial reconnaissance and aerial photography in studies of ancient topography, with archaeologists acquiring their own oblique images, which, together with new remote sensing systems and technologies, represent the greatest advance in the sector: reference can be made here to infrared (false colour and thermal) photographic images, multispectral and hyperspectral scanning sensors, radar and LiDAR (Fig. 2.13) systems and the continuous evolution of the use of satellite images (Fig. 2.14) (see Chaps. 4, 5, 6, this volume).

## 2.2 Aerial Photography Techniques

Aerial photography and aerial reconnaissance are tools with numerous applications in archaeology: in searching for and documenting new evidence, graphic restitution and the presentation and conservation of sites.

The use of aerial photography is thus not limited to the identification and discovery of new archaeological sites, but is a practice which over the years has acquired increasing importance in archaeology, and now plays a fundamental role in all phases of research, from interpretation to documentation, not to mention its potential in the safeguarding and monitoring of the sites themselves. Aerial photographs may be either vertical or oblique images, and their combined use makes it possible to resolve many of their respective limitations and exploit their individual characteristics to the full. The difference between vertical and oblique aerial photographs lies in the techniques by which they are acquired. Vertical photographs are taken with the axis of the camera lens perpendicular to the earth's surface, using sophisticated instrumentation mounted on aeroplanes precisely for that purpose. Initially, vertical photography had a purely military or cartographic function; today it is used above all for environmental monitoring and the planning of new communication networks and infrastructure. In the archaeological field, it has the advantage of providing a synoptic and objective view of the context in question at the moment of the shot, but

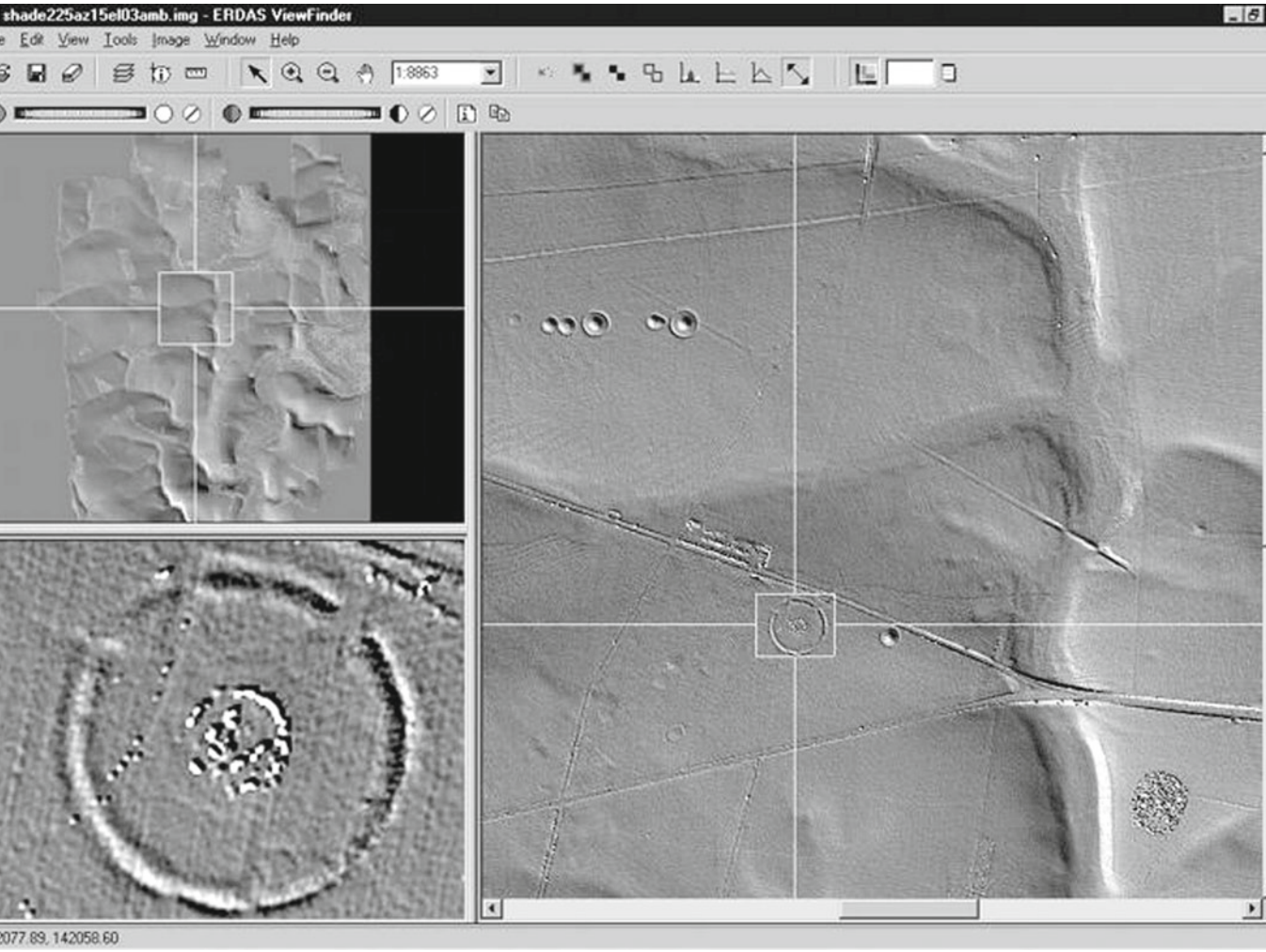


**Fig. 2.13** LiDAR images of Stonehenge taken to test the potential of this new technique (Bewley 2004)

it can also illustrate its phases of development, as documented by successive images over the years. The main limits of vertical photography are its extremely high cost and the fact that in almost all cases the archaeological evidence appears by chance, since flights are only rarely undertaken especially for archaeological purposes. The aeroplane acquires the images by making a series of flights during which the photographs are taken automatically at regular intervals, so that each photograph partially overlaps the previous one and the subsequent one. The overlaps provide a three-dimensional view of the territory being photographed, thereby avoiding gaps in the documentation.

Oblique aerial photographs are taken at a sharp angle to the earth's surface and provide data that is more intuitive and easier to read. They are considered much more suitable for archaeological applications than vertical images, because they are special views selected during the flight by the archaeologist and because they can be acquired under the best conditions in terms of visibility, light and readability of the surface. Moreover, they can be produced at very reasonable cost, they do not require special photographic equipment and ordinary tourist aircraft can be used. However they have the disadvantage of not providing complete and exhaustive documentation of the


**Fig. 2.14** Satellite image of *Hierapolis*, 25-3-2005 QuickBird 2 (Scardozzi 2007)

area being studied. In addition, any evidence that the archaeologist does not recognise, or any views which he or she feels are not worth recording, ends up not being photographed.

Used in combination, vertical and oblique images increase the amount and quality of the information considerably, exploiting on the one hand their ability to provide an overview and on the other their potential for identifying previously unreported archaeological sites and expanding our knowledge of elements that have only been partially described.

## 2.3 Principles of Archaeological Photo-Interpretation

The correct approach to the interpretation of aerial images must be comprehensive; reading an aerial photograph does not mean trying to identify just the elements that indicate past human activities, but must use "the modern" as an element of contrast that helps to bring out the residual components of the ancient landscape. In photo-interpretation the factors that determine the nature of the objects represented in the aerial photographs are shape, size, shadow, tone, texture and associated characteristics. While the first two factors are rather intuitive, the others repay further consideration. Indeed, some objects in some cases are barely comprehensible in the image while their shadow, larger than the object itself and more sharply contrasted, can be much simpler to understand (as is often the case with poles and pylons carrying electricity cables).

Concerning tone, this depends on the colour of the object, the angle of incidence of the light that strikes it and the nature of its surface: the smoother it is, the paler it appears in the photo. The texture arises from the combination of small details whose limited dimensions prevent them from being perceived individually, but which combine to form an image with identifiable characteristics: for example, the various types of crops such as vineyards, orchards and olive groves, where we do not distinguish the individual plants but rather their overall effect. Lastly, the associated characteristics are the result of the way in which the element in question is inserted in and associated with the context.

## 2.4 Genesis and Classification of Archaeological Traces

A very important aspect of aerial photography as an investigative tool in archaeology is archaeological traces. Archaeological traces are the result of a process by which an archaeological object makes an impression in a photographic image not by itself but by means of the effects it has on some of the elements surrounding it, covering it or hiding it. These elements include humidity, humus, vegetation and relief, to which may be added conceptual factors such as the topographical anomalies sometimes seen in the image of a landscape.

The identification of traces is one of the main objectives of aerial photography for archaeological purposes, and the choice of when to fly generally depends on this. Normally, favourable conditions in terms of light and visibility are preferred and the hours of the day when the sun is low on the horizon, so as to exploit the positive effects of the incident light and the resulting shadow.

Aerial photography sometimes highlights objects that are barely or not at all visible on the ground; their degree of visibility in the photographic image ranges from almost imperceptible to strikingly obvious. The photographic process detects the objects in question not in themselves, but indirectly via a series of effects that they have on the surrounding environment. This is why we speak of "traces". The different ways in which these objects reveal their presence depend on the quality of the elements involved in the procedure, which can be illustrated schematically in the following way:

Object→effects on adjacent elements
mediators→trace

The traces can be seen in the photographic restitution of particular nuances of colour (or greyscale in the case of black-and-white images), in distinctive aspects of the morphology of the

landscape and in particular patterns of altimetric variation of the terrain, which is often minimal.

It is above all the *overview* provided by aerial photographs which enables the tonal shifts and nuances of colour to be recorded.

The appearance of the landscape depends on a whole series of factors connected with the natural aspects of the environment and the present and past human activities that have shaped it; the traces of those previous impacts are obviously less evident and more fragmentary.

The presence of hidden objects can alter the appearance of the terrain, influencing the shape of the surface, the degree of humidity and the characteristics of the plant cover.

The above considerations are valid for any type of hidden object, but our interest is obviously in objects of an archaeological nature. By identifying the factors that highlight the presence of the various categories of archaeological object, it is possible to draw up a classification of the traces. Archaeological traces may thus be subdivided into *damp-marks*, *grass-weed-crop-marks*, *soil-sites*, *shadow sites*, *topographical anomalies* and *legacy marks.*

### 2.4.1 Damp-Marks

Damp-marks are seen on terrain with no vegetation cover (generally ploughed fields) in the form of tonal shifts. The phenomenon arises from the fact that the terrain takes on different grades of colour depending on how wet it is. Indeed, after a rain shower, the ground tends to present a patchwork of different colours, reflecting variations in the water content and in the absorption of the soil. In soil that has been "disturbed", either by an irregular settling of the geological layers or by buried elements, after a period of heavy rain, at a certain moment during the drying out process, the soil is characterised by patches with different water content, which essentially depends on the different local thickness of the humus. For example, ancient-walled structures buried at shallow depths below the surface form a sort of upward extension of the underlying bedrock, with a consequent significant thinning of the layer of humus, which will thus hold less water than the area surrounding it and will tend to dry out more rapidly, taking on a paler colour. In contrast, overlying a negative archaeological element such as a pit or trench, there will be a thicker layer of humus, which holds more water and takes longer to dry out, with the consequent appearance of darker patches. Damp-marks are visible for a short period of time, until the terrain dries out.

Another element that affects the visibility of damp-marks is the depth below ground of the archaeological element; if it is too deep, then the effect of the rain will not be visible and the remains may also be affected by rising damp from below. It is not possible to give a precise measure, since it is necessary to take account not only of the depth of the deposit but also of the size and nature of the artefact and the type of terrain, as well as the usual meteorological and climatic variables. Sometimes, there is an "inversion of tone" of the damp-mark, meaning that counterintuitively, a buried-walled structure is signalled by a dark trace and a filled pit by a pale trace. In the former case the phenomenon is generally caused by near-permanent masses of water resulting from the presence of rubble or buried material from collapsed ancient buildings that is able to hold moisture. In the second case the inversion is due to the presence in the pit of clayey soils or very fine sand that accumulate when the negative archaeological elements are filled in very slowly by waters drained from the surrounding land.

Not just rain but all kinds of precipitation are able to trigger indicators of remains, if conditions permit: in some cases the thermal conditions of the terrain, influenced by the presence of structures near the surface, cause tiny anomalies in the melting of snow or winter frost, clearly highlighting the layout of the buried remains.

### 2.4.2 Grass-Weed-Crop-Marks

The mechanisms behind this category of trace are the same as those of the class described above. The main difference lies in the presence of plant coverage, which acts as a mediator for the

appearance of the hidden objects. In the vast majority of cases, the vegetation involved in this process is made up of grasses, usually crops but sometimes weeds, in fields left fallow or used for grazing. In rare cases it might be shrub vegetation or even trees. Indeed, the health of the plants depends on the right quantities of water and nutrients being available; thus, where the vegetation has a greater quantity of moisture and humus, it germinates earlier and grows faster, greener and more densely. Local variations in the "fertility" of the soil are therefore chromatic indicators: dark in the case of negative archaeological elements that have been filled in, pale in the case of buried structures. The deeper the deposit of archaeological material, the larger the archaeological element in question and the plants which mediate its appearance need to be. For example, ancient walls buried in the terrain at a depth of a few decimetres normally disturb the root systems of cereals and grazing plants; structures lying at considerably greater depths generally do not directly affect the roots of grasses and cereals, which do not reach that far down. However, the presence of particularly thick walls or fortifications may be felt indirectly by herbaceous vegetation, due to a local decrease in the quantity of moisture in the soil, and directly by shrub vegetation, whose roots extend to greater depths. In the case of truly imposing structures buried very deep, early leaf senescence in deciduous trees has been reported.

The state of conservation of an artefact also conditions the photographic restitution of the trace: a structure whose walls have been razed to the level of the ground can take the form of a pale quadrangle, while if the walls are conserved to a certain height, it can create a "bath" effect, leading to accumulation of moisture and consequently a dark quadrangular trace. Another type of trace produced by vegetation is the effect generated by local concentrations of organic material, which can give rise to areas of more intense plant growth even when moisture levels are no greater than the surrounding soil, as in the case of hut floors and shaft tombs.

Some underwater archaeological structures that are not directly visible in themselves (since they are similar in colour to the sand of the sea bed) can only be seen due to the seaweed that grows on them, which makes them darker.

### 2.4.3 Soil-Marks

These are seen on terrain that has no vegetation cover and take the form of areas of different coloration from that of the context; the tonal shift is more easily detected if the terrain is moist and has been deeply ploughed and harrowed. They are formed due to the presence in the soil of materials that alter its surface texture, causing changes in its reflectivity and thus its photographic colour, or of materials that directly influence the colour of the terrain itself. Usually these materials have originated from the disintegration of ancient structures that were subjected to ploughing. They are visible in photographs in the form of pale patches as a result of the pulverisation of the mortar. Dark areas are due to the presence of much coarser materials that make the surface of the soil much "rougher" (and thus less reflective) or are due to high concentrations of organic material which is generally darker in colour.

### 2.4.4 Shadow Sites

The surface of the terrain reflects the geological bedrock below it, replicating its forms albeit in a softer and attenuated way. By the same principle, buried archaeological elements sometimes reveal themselves in altimetric patterns that are so subtle and gradual as to be invisible to direct observation. Using aerial photography, however, an expert eye can detect them via a three-dimensional reading or even using individual photographs, if they are taken with the sun low on the horizon (long shadows highlight even small changes in elevation). We are dealing here with micro-relief traces. This indicator can be used for the identification of practically any type of archaeological object, unless the terrain has been levelled mechanically. The relationship between trace and object is direct: a rise corresponds to the wall, a

slight depression to the pit or trench. Even the shape, though greatly "softened", is maintained; in the case of macrostructures, such as buildings used for public spectacles, it is possible to detect a difference between the outer perimeter and the inside of the building, while in other cases we have only a generic rise, roughly corresponding to the volume of the construction.

This category of traces includes underwater structures that have the same colour as the sand of the seabed, from which they protrude only very slightly, and thus they can be detected only with reference to their shadow or their stereoscopic volume.

### 2.4.5 Topographical Anomalies

All the traces described fall within the category of anomaly but there are cases in which the archaeological object is perceived via the mediation of conceptual rather than physical anomalies. This category includes evidence that is foregrounded because it clashes with the general context.

### 2.4.6 Legacy Marks

This category includes indicators generated by archaeological elements that have remained above ground but, due to their extremely fragmentary nature, have little indicative value in themselves. Rather, their importance stems from the possibility they provide of a philological reading aimed at the reconstruction of the ancient situation. Alternatively, they may be archaeological objects that have been handed down to our times not in themselves but thanks to the survival, partial or total, of their function.

The classic example is the remains of the centuriation; when a piece of archaeological evidence of this type has been handed down to us in an almost complete state, the analysis can proceed without difficulties. In this case we are not dealing with traces in the narrow sense, since the boundaries are not physically those of ancient times but rather elements of the modern landscape that replicate them. A quite different case is when the remains of centuriation are now in such a fragmentary condition that their identification requires a broader study based on the detection of anomalous elements that seem to have some logical criterion in common. When subjected to careful analysis, discontinuous, scattered fragments of the ancient division of farmland, which have survived in the form of short stretches of walls and hedges, ditches, field boundaries and rural lanes, diluted and camouflaged in the more modern rural fabric, are found to have a common orientation and are located at regular intervals. On the terrain they can be physically verified, while the overview provided by the aerial image facilitates the task of recognising their original layout.

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