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Wazigang – A Palace of Qin Shihuangdi, the First Chinese Emperor

An international research project of geophysical prospection was carried out at Wazigang, Qian County, Shaanxi Province, China, in September 1999 and 2000, a co-operation of the Bavarian State Conservation Office, the Department for Archaeological Prospection and Aerial Archaeology, Munich, and the Shaanxi Province Conservation Centre for Historical Monuments, Xi'an. Involved in the fieldwork in China were the geophysicists Dr. H. Becker and Dr. J. Faßbinder (Bavarian State Conservation Office), Prof. Dr. Qin Jaoming, Dr. Jiang Baolian und Dr. Liang Xiaoqing (Technical Centre of the Shaanxi Province Conservation Centre for Historical Monuments), Prof. Ye Xinshi (Northwest Polytechnical University, Box 189, 710072 Xian) as well as the archaeologist Dr. W. Irlinger and the cartographer J. Lichtenauer from the Laboratory in Munich.

Introduction

In the third century B.C., the power of the principality of the Qin in the central plain of today's Shaanxi Province was strongly increasing. Step by step the Qin state was annexing the other six powerful states of its neighbours. During the time of the First Emperor Qin Shihuang the Qin state created a very powerful empire covering a large territory. The capital of the Qin Empire Xianyang, named "Wangji", was situated in the central Shaanxi plain, close to the actual capital Xi'an. In this area the Qin people built many palaces and parks. Written records describe about 270 giant projects: palaces, gardens and other big buildings. Most of these palaces included administration buildings, working rooms and living rooms. Today, however, all of these palaces are in ruins and only the remains of some of them have been found or confirmed by archaeologists. The best-known monument of Quin Shihuangdi, however, is the famous Terracotta Army at Lintong (see fig. 1).

Qin Shihuang (259-210 B. C.), born as Ying Zheng, became king of the Qin State in 247 B.C. At the age of 22 he came to power after having annexed the six rival principalities of Qi, Chu, Yan, Han, Zhao and Wei, and established the first feudal empire in China's history. In the year 221 B.C. when he had unified the country, he styled himself emperor and named himself Qin Shihuangdi ("First Heavenly Emperor of Qin"), hoping that his successors would be the second, the third and so on. Emperor Qin had over two hundred palaces built in the Guanzhong Plain around the capital, one of which is Wazigang palace.

The Wazigang site was discovered in the 1980s. Wazigang in the community of Wudian is a small village, situated about 80 km north-west of the city of Xi'an and about 15 km north-east of the city of Qianxian. The very exposed site is situated on top of a large loess hill measuring about three times 5 km, which is enhanced in its height about 60-70 meters above the surrounding area.

Among others, this site was suggested as testing site by our Chinese colleagues in 1999. The topographical top of the place can be seen from far away because of its small rammed earth pyramid at the summit of a large loess hill. The geographical coordinates of the rammed earth pyramid were measured by a GPS instrument as N: 34° 37,902' ± 0,02' E: 108° 08,710' ± 0,02'. During the past 20 years, Chinese archaeologists have undertaken a series of surveys around Wazigang and found the ruins of a palace site of the Qin Dynasty (221-206 B.C.). The site was chosen by us as test area because all crops had already been harvested and because of the loess subsoil which we expected to be the best from experiences in Bavaria and Siberia, but also because of the archaeological conditions.

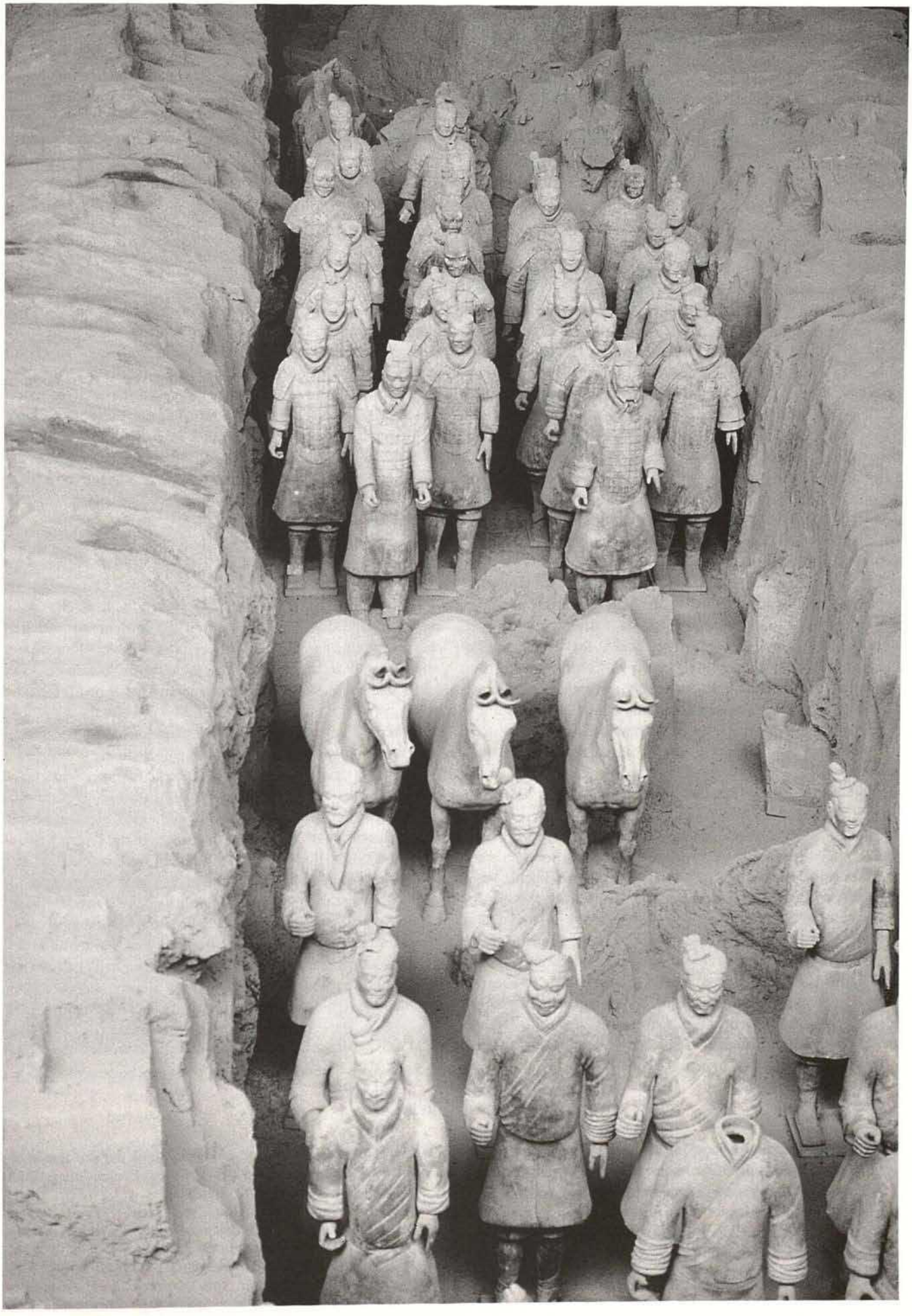
The farmers had found pottery as well as roof tiles decorated with a decoration typical of the temples, palaces or residences. The stamps of the roof tiles proved that the site had been a residence of the Emperor Qin Shihuang. A variety of construction materials, bricks, roll roof tiles, tile-ends and pottery had been unearthed in the ruins of the palace. They are hard and solid, and most are dark grey. Hollow bricks were used for paving the stairs; they mostly were decorated on the surface with patterns of dragons, phoenix clouds and thunder. The floor tile bricks show seven types of decoration; plain, check, rhombus, saw tooth, sun and flower. However, no one knew the archaeological structures of the ruined palace site in detail until 1999.
From the surface nothing can be seen except the earthen pyramid measuring 30 meters from east to west, 25 meters from north to south and about 5,8 meters in height. This pyramid is made of air-dried mud bricks. Around this pyramid we performed our first magnetometer tests. These tests confirmed our assumption that the site might have archaeological structures beneath the ground.

In spring and summer of 2000 our Chinese colleagues performed further surveys. Furthermore, they made a complete topographical map of the site. Now we were able to estimate very precisely the total extension of the area of about 800 x 1000 meters. Along the modern loess terraces the extension of the mud brick structures could be verified on many decisive sites.

Methods of geophysical prospection

In recent years archaeological field work has become much faster and more sophisticated by the use of new devices, high-tech methods and evaluation possibilities. Air photography, geophysical methods, remote sensing, GPS, GIS, VR and 3D animation and reconstruction have proved to be successful applications in archaeology.

Fig. 1. Lintong: Soldiers of the Terracotta Army of the First Chinese Emperor, Qin Shihuangdi. ▷



Magnetometry as a non-destructive geophysical method for archaeological prospection was used in China for the first time on the ruins of the palace site. In 1999 we undertook a trial magnetometer survey with the so-called duo-sensor configuration of this area. The preliminary results clearly indicated the remains of large walls and other structures.

In the year 2000 we continued the caesium magnetometry. For the measurements we used the caesium Scintrex SMARTMAG SM4G special magnetometer with a sensitivity of ± 10 pT at 0.1 sec cycle. A 40 m-grid over 400 x 240 m, later enlarged to 400 x 480 m (~18 hectares), covered the site which was topographically surveyed and marked by wooden pegs before the prospection started. The instrument was applied in the duo-sensor configuration at 0.5 m traverse interval and 0.25 m sample interval as a total field magnetometer. The sensors were configured at a horizontal distance of 0.5 m, the sampling rate was set to 0.1 sec, which at normal walking speed gives a spatial resolution of 0.1 x 0.5 m. The distance control was made manually by switching every 5 m over the 40 m line. The high frequency part of the diurnal variation (natural micro-pulsations and technical noise) was cancelled by setting a bandpass filter of 1 Hz in the hardware of the magnetometer processor. The slower magnetic changes of the daily variation of the geomagnetic field were reduced to the mean value of all measured data of a 40 m-line and also to the mean value of all data of a 40 m-grid. All data were interpolated to 25 cm in each direction and on the line, depending on the walking speed.

The data were dumped and finally processed on a notebook computer, resulting in an almost complete visualisation of the measurement in grey shading technique. Data processing was done using software with graphic facilities for visualising the measurement as grey-shading plots. The fit of adjacent grid sides were corrected by digital image techniques like edge matching and desloping, which resulted in a rather smooth image for the magnetogram even of the raw data (fig. 3).

With this method, the archaeological structures appear as negative or positive anomalies, indicating the remnants of earth-rammed structures, architectural foundations, pillar holes and garden areas.

The aim of the second survey (September 2000) was to provide complete coverage of the inner palace area. For the detection of stamped mud brick structures in loess over such a large area a narrow sampling interval of 25 x 50 cm was necessary, in addition to rapid survey. Caesium magnetometry covered a total area of about 18 hectares at Wazigang in 10 days. This was made possible by very good planning and organisation by our Chinese colleagues. Furthermore, we had access to all the fields because they were already harvested. If not, our Chinese colleagues organised the harvesting of these fields so that it was possible to measure almost all the areas of interest.

Results

The mud brick structures show mostly as strong positive magnetic anomalies. The results of the magnetic prospection resulted in a detailed map of the Emperor's residence. They revealed the structures of the palace garden, administration buildings working quarters and barracks, as well as the remnants of the main palace. The main palace was found to be in the central line of the main axis from the south gate to the still visible mud brick pyramid, which was part of the palace buildings (basement construction for the palace). Furthermore, we found garden structures and, on the western side of the area, the structure of a garden palace. Up to now, similar maps of garden palaces have not been found yet and are not known to Chinese archaeologists. The central area of the site is restricted by the south gate. In the west we clearly detected the wall. Parts of the northern wall have also been detected in the northwestern area. However, in the east and the north, modern terraces of the loess are responsible for the disappearance of the antique structures. An outer wall which could be in a distance of more than 700 m from the earth pyramid has not yet been detected.

Trench excavation

During our survey the Chinese colleagues were performing a trench excavation at the south gate and cutting a wall segment of the north side of the area. The excavation confirmed the results of the magnetic prospection and revealed rammed earth structures, but also allowed an exact dating of the archaeological structures. The excavation also confirmed that these strong magnetic anomalies are due to the enrichment of the hundreds of pieces of pottery and roof tiles covering the earth rammed structures of the wall. Obviously these roof tiles covered the wall to protect it from erosion caused by rain.

Evaluation and interpretation

In October 2000 Mr. Ye and Mr. Qin visited the Munich laboratory of prospection. Together we finished the data processing of the measurements of 2000 and performed the combined geophysical and archaeological interpretation of the data. Josef Lichtenauer digitised the cartographic map made by the Chinese colleagues.

Based on the magnetogram, the Chinese colleagues reconstructed the main halls of Wazigang palace, using software for 3D modelling technique. The size of the halls was reconstructed using the map of archaeological interpretation and additional knowledge from already excavated buildings of the Qin period. The Chinese books "Kao Gong Ji" written in the Warring States Period (475-221 B.C.) and "The Rules of Architecture" written in the Song Dynasty (420-479 A.D.) also give important references. In general, the Qin palaces consisted of halls, corridors, gardens, pavilions, living rooms, bath rooms, winding lobbies, watchtowers, warehouses and cellars, set into a graceful entity. At the Wazigang archaeological site, the main halls had hip and gable roofs, earth-rammed foundations, sloping entrance stairs and doorsteps, corridors, courtyards and enclosure wall.

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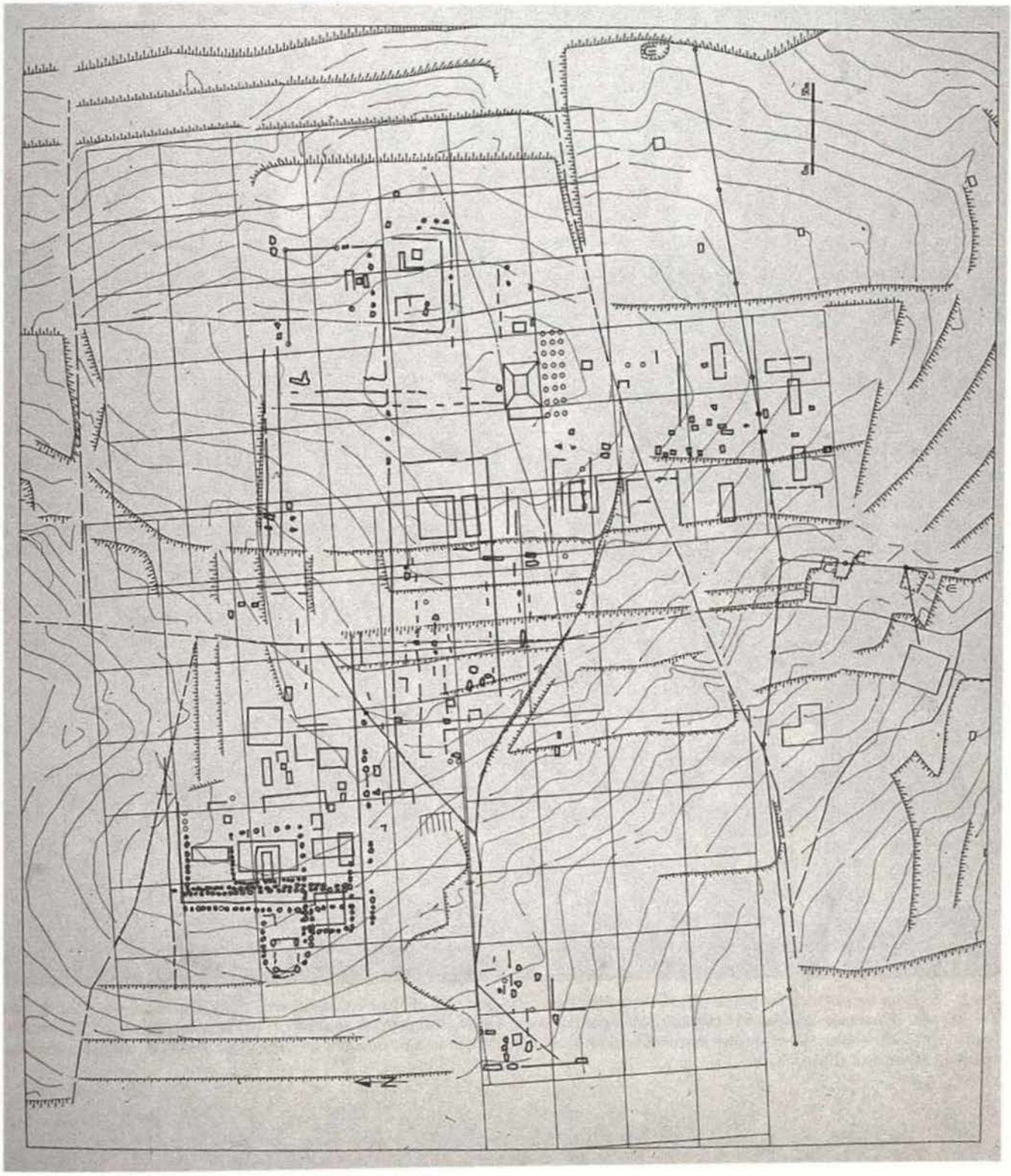

Fig. 2. Interpretation map of the total measured area of the Wazigang palace.

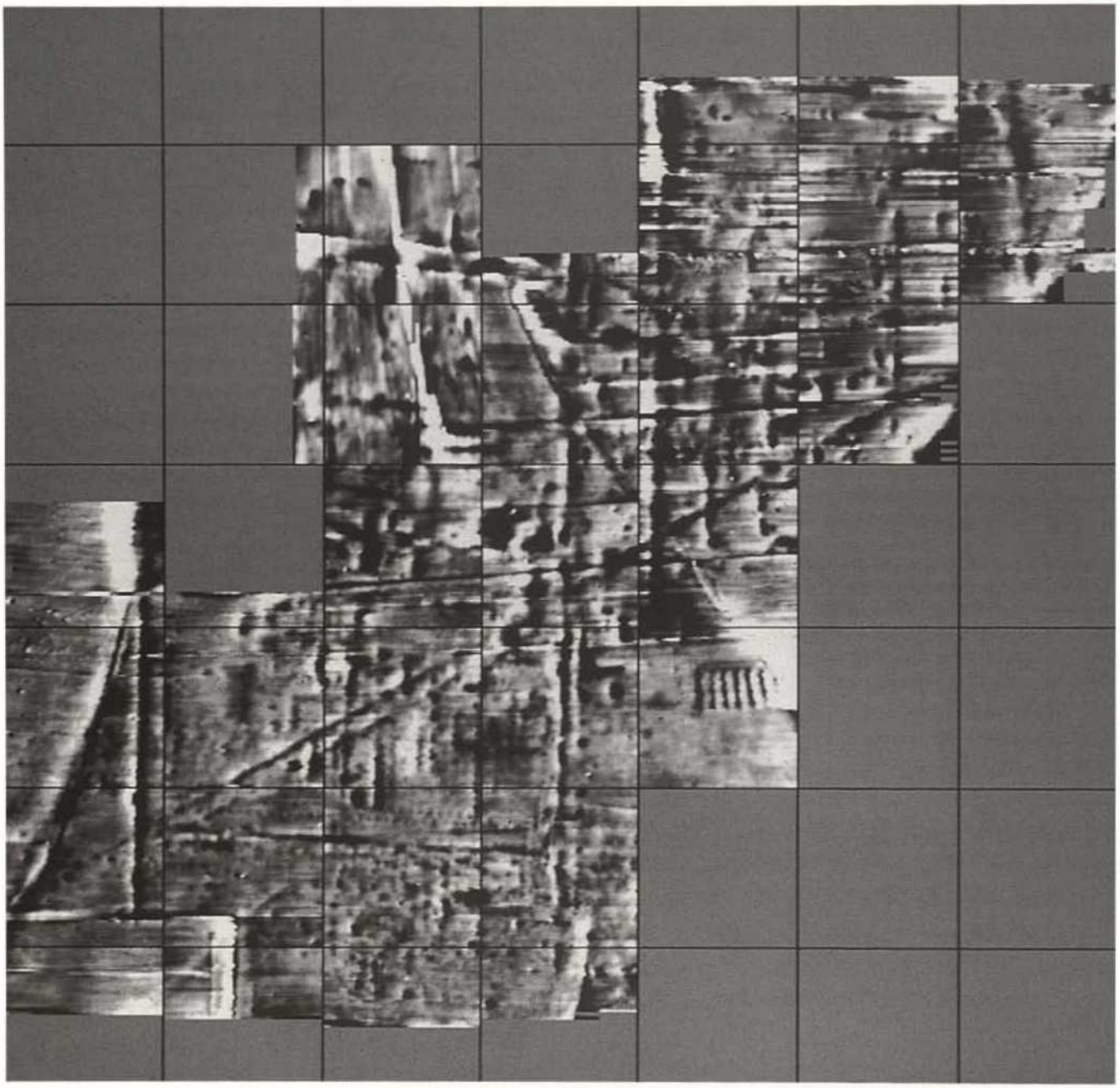

Fig. 3. Magnetogram showing the garden palace. A portion of the north-western part of the residential area. Magnetogram in grey shading with 256 greyscale. Caesium magnetometer Smartmag SM4G-Special in duo-sensor configuration, sensitivity +-10 Picotesla, raster 0.5/0.2 m interpolated to 0.25/0.25 m, dynamics of the total magnetic field 52.220 ±10.000 Nanotesla nT (white to black), line mean over 40 m, desloping and edge matching, 40m-grid, north to the left.