## **Table of Contents**

Foreword	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	11
Introduction	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	15

## **I. HISTORY**

I. 1. Detecting the unknown and seeing the context. The development and transformations of remote sensing	
in modern history	23
Main phases in the history of remote sensing	25
I. 2. The emergence and beginnings of aerial photography and survey from above (from the end of the 18 <sup>th</sup> centu- ry to the twilight of the <i>Belle Époque</i> )	28
I.3. Remote sensing of the Earth, aerial and satellite re- connaissance in the service of army and science: from the Great War to the present	43
I. 4. The application of remote sensing methods and aerial photography in archaeology and ancient landscape studies: historical overview	50
The early years of aerial imaging of architectural and archaeological heritage and the first discoveries from above (from the 19 <sup>th</sup> century to the beginning of the	
First World War)	52
Balloon photography of ancient remains in the Medi-	50
terranean (Italy, Egypt)	53
England and Central Europe	55

The First World War: a breakthrough in the development of remote sensing and its application in detecting the re-	
mains of historical landscapes	56
at the birth of aerial archaeological reconnaissance The Great War and the beginnings of aerial survey	57
of historic landscapes in Europe	59
eology and the dynamic development of methods of vi-	
sual survey of the landscape from low heights	60
Osbert Guy Stanhope Crawford	61
G. S. M. Insall, G. W. G. Allen and the British lead in di- scoveries and the development of methods between	
the two world wars	64
Central Europe: aerial photography as a tool for docu- menting field research projects (Czechoslovakia, Ger-	
many, Poland, Austria)	70
Germany: Hansa Luftbild, Luftwaffe and the first inter-	
national contacts	73
Surveys of Limes romanus in the Near East: P. A. Poide-	
bard and A. Stein	75 79
Archaeological remote survey up to the mid-20 <sup>th</sup> century	
in America and the Far East Charles Lindbergh, Alfred Kidder, Percy C. Madeira and the emergence of aerial archaeology on the conti-	80
nent of America	81
Aerial survey and mapping of the landscape	
of Paleo-Indian cultures in the South and Midwest	
of the USA, early interest in the methodological aspects of aerial archaeology	84
The early years of aerial survey in South America:	04
the discoveries and photographic recording of monu-	
mental sites in Peru	86
The emergence and development of aerial archaeolo-	
gy and photography in Japan	87

From the Second World War to the 1960s: intensive aerial survey and the establishment of photographic aerial ar-	
chives	90
bridge: Kenneth St Joseph and David Wilson "Ancient Landscapes" of John Bradford French surveys of North Africa and its Roman heritage.	91 94
Jean Baradez and Raymond Chevallier	96 98
Central Europe Central Europe behind the Iron Curtain. The Czech lands and the first discovery of a prehistoric site from	99
the air	100
"A matter of time". The development of aerial archaeolo- gical survey from the 1960s to the fall of the Iron Curtain England: the early years of aerial photography proces- sing, interpretation and mapping. Institutionalisation of the field and establishment of a professional organi-	102
sation Archaeological aerial surveys in France. An American project in Burgundy The application of archaeological remote survey in other countries	103 106 108
The emergence and development of satellite archaeology	109
Archaeological remote survey at the dawn of the new	
millennium Descriptive and classification systems. A systema- tic mapping of archaeological aerial data in England	110
(NMPE)	113
ration in Europe. Otto Braasch	114 115
Czech lands: early 1990s – late 2010s	116

7

## **II. METHODS**

II. 1. Introduction. Definition of remote sensing in archae- ology and past landscapes studies, its characteristics, terminology and theoretical foundations	119
II. 2. Aims of remote archaeological survey. The potential, basic characteristics and application of ARS data	123
II. 3. Principles of visualisation of the remains of past an- thropogenic activities (non-portable archaeological	
features)	126
Cropmarks (marks in vegetation)	130
Soilmarks	137
Shadowmarks	141
Snow- and frostmarks	143
Other types of marks that indicate the presence	
of archaeological features	147
II. 4. Types of archaeological remote sensing and the data	
they bring	149
Active-interpretive (observer-based) prospection of the	
surface of the Earth	149
Visual prospection from a low-flying aircraft,	
active-interpretive (synthetic) survey, data search and recording on oblique photographs or video with	
a hand- held camera	150
Conditions for optimal aerial photographic documen-	150
tation of various types of past landscapes (architecture,	
urbanism, concave and convex features, cropmarks) .	152
Main tools and devices: camera, aircraft, navigation	4 5 0
tools and devices (maps, GPS)	152
editing, recording and storage (archiving) of images.	
Analysis and interpretation of oblique aerial photo-	
graphs, plan- and map-making	155

The application of aerial survey image data	161
Definitions and characteristics of remote sensing. The- matic and spatial information in remotely sensed data	161
Using spectral properties of material objects	101
on the surface of the Earth for the interpretation of re-	
mote sensing data	163
Satellite imaging, satellite panchromatic and	
multi/hyperspectral data and their information potential	
in present-day archaeology	164
Satellite systems for remote sensing taking images	
of low and high resolution	166
Satellite systems for remote survey taking images	
in very high resolution.	168
Data taken by imaging radars	171
Processing and analysis of satellite data	172
Satellite images and aerial archaeological survey pho- tographs in Bohemia: a comparison of their potential	175
The application of satellite data in Czech projects	175
abroad	177
Remote sensing data recorded from airplanes	178
Potential of vertical panchromatic aerial photographs	179
Aerial hyperspectral scanning, thermometry	181
	182
Airborne laser (lidar) scanning	182
II. 5. Methods and sources that broaden the relevance and	
value of archaeological remote survey data	193
Introduction	193
Non-destructive methods of field archaeological re-	
search	195
Research of earthworks (more or less ruined man-made	
features preserved on the surface of terrain relief $\ldots$	196
Surface survey (field/plough-walking)	197
Archaeogeophysics	198
Archaeobiological methods. Sampling the top layers	
of soil	200
The testimony of historical maps	201

## III. DATA

III. 1. Sources of aerial and satellite data for the purposes	
of archaeology and landscape history	205
Archives/databases/repositories managed by museums, archaeological and heritage management institutions,	
and web-based access to them	206
Archives of historical aerial and satellite images Online map portals with aerial and satellite images (Google Earth, NASA World Wind, etc.)	208 209
	209
III. 2. Main categories of archaeological sources identifiable	
by means of remote sensing	211
Spot and areal features	212
Typology, interpretation, dating.	212
Classification of areas with spot features	214
Linear features	215
III. 3. Relics of past settlement activities as documented by	
remote sensing and aerial photography	217
Late prehistory (Neolithic, Eneolithic, Bronze and Iron	
Ages, protohistory)	218
Open and enclosed settlements	220
Other types of enclosures	226
Burial sites	230
Production areas	232
Structured landscape components of the Roman Empire	235
Middle Ages	238
Post-medieval and industrial era	243
Conclusion	246
Footnotes	248
References	255
List of Illustrations	271