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Martin Davis

A Cartographic Analysis of Soviet Military City Plans

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Martin Davis

A Cartographic Analysis of Soviet Military City Plans

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Supervisor's Foreword

On the cold and wet afternoon of Wednesday 17 November 2010, I delivered a talk with the somewhat ingenuous title of 'The Magic of Maps' as part of a departmental geography conference arranged for local secondary schools. The aim of the event was to inspire 16–18-year-olds to study geography at university. In the audience of my talk was Martin Davis, who had taken it upon himself to organise a group from his school to make the journey to Canterbury. My first slide presented a Soviet topographic map of the city and its surrounding area. I explained that the map, with its strangely familiar, yet distinctively foreign appearance, was produced as part of the USSR's secret global mapping endeavour—the details of which were only just beginning to emerge. As John Davies and I had started working on The Red Atlas, I was keen to point out that this was an exciting new topic with plenty of scope for cutting-edge research still to be done.

Something must have sparked an interest, because Martin enrolled on our Geography Honours degree course at Canterbury in the following September. Enthusiastic about all things cartographic from the start—and not forgetting his initial gaze on that Soviet map—Martin assessed the spatial accuracy of the Soviet city plans of Edinburgh, Cambridge and Chatham for his final-year dissertation project, which the programme's external examiner noted as 'an exceptional piece of work'. Subsequently, Martin's dissertation fought off strong competition to win the British Cartographic Society's first Ian Mumford Award for original research undertaken by students.

In due course, an opportunity arose in the department for a Ph.D./Instructor post, which Martin secured to further his studies on Soviet maps. He made valuable progress in learning Russian and translating Soviet map production manuals as they became publicly available for the first time. Martin also relished the opportunity to engage with current thinking on cartography and post-representation, for which the Soviet maps presented an ideal example to discuss.

The fieldwork associated with Martin's research was certainly memorable. I accompanied him on a trip to visit several archives in the Baltic States, where I had arranged accommodation in an isolated former Soviet sanatorium that also housed a former nuclear bunker complex underground. I am still not sure if Martin was entirely grateful for that experience, even if it brought to life a sense of the era in which the Soviet maps had been made. That sense was also felt when we were faced with a robust denial of the maps' existence, coming from a rare breed of archivists for whom the Soviet era had not appeared to have ended.

Martin's thesis not only proves the opposite, but makes a substantial advance towards understanding the global military mapping project that was conducted in secrecy by the Soviet Union. As the first Ph.D. to be completed on this emerging and significant topic, it addresses some of the most fundamental questions and provides a solid foundation for future research. His analysis of Soviet map symbology makes an original contribution to knowledge that can inform current global mapping initiatives, while his examination of its implementation offers new appraisals of that curious nexus between a map and its specification documents.

This thesis therefore marks an important chapter in what has been termed 'the greatest cartographic story never told'. Thanks to Martin's perseverance in bringing his work to fruition and to the support of Canterbury Christ Church University, the telling of that story has made a huge step forward that could not have been foreseen on that November afternoon. The magic of maps, indeed.

Canterbury, UK
June 2021

Dr. Alexander J. Kent

Abstract

The collapse of the Soviet Union has seen the emergence of its unprecedentedly comprehensive global military mapping programme and the commercial availability of a vast number of detailed topographic maps and city plans at several scales. This thesis provides an in-depth examination of the series of over 2,000 large-scale city plans produced by the Military Topographic Directorate (Военное топографическое управление) of the General Staff between the end of the Second World War and the collapse of the USSR in 1991. After positioning the series in its historical context, the nature and content of the plans are examined in detail. Aspects of the post-structuralist deconstruction of texts, as advocated by Jacques Derrida, are fused with ideas from the emerging post-representational framework within cartography to form a pseudo-representational paradigm which acts as the theoretical framework through which the Soviet plans are analysed. This new perspective brings forth possibilities to utilise and apply the maps in new contexts, which this thesis facilitates by providing a systematic, empirical analysis of the plans' symbology at 1:10,000 and 1:25,000, using new translations of production manuals and a sample of the maps. This reveals new details of the most comprehensive, globally standardised topographic symbology ever produced, incorporating 630 graphical symbols in total, with 47.0% and 52.1% of these used in the sample of maps at both scales, respectively. Elements of the physical environment account for the largest components of the symbology, with 'Hydrography and Coasts' the largest feature class at 1:10,000 (84 symbols) and 'Vegetation and Soils' at 1:25,000 (66 symbols). A comparative analysis with the *OpenStreetMap* symbology indicates scope for Soviet mapping to be used as a valuable supplementary topographic resource in a variety of existing and future global mapping initiatives, including humanitarian crisis mapping. This leads to a conclusion that the relevance and value of Soviet military maps endures in modern applications, both as a source of data and as a means of overcoming contemporary cartographic challenges relating to symbology, design and the handling of large datasets.

Elements of the research presented in this thesis have been developed further in the following publications and conferences:

1. Davis, M. and Kent, A. J. (2016) Improving user access to Soviet military mapping: a guide for map libraries around the globe. 6th International Symposium on the History of Cartography, 13th–15th October 2016, Dubrovnik, Croatia.
2. Davis, M. (2017) Rethinking cold war cartography: destabilising the ontology of Soviet military city plans. 28th International Cartographic Conference, 2nd–7th July 2017, Washington, D.C., USA.
3. Davis, M. and Kent, A. J. (2017) Improving user access to Soviet military mapping: current issues in libraries and collections around the globe. Journal of Map and Geography Libraries, 13(2). pp. 246–260. doi.org/10.1080/15420353.2017.1300206
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8. Davis, M. and Kent A.J. (2021) Soviet city plans and OpenStreetMap: a comparative analysis. 30th International Cartographic Conference, 14th–18th December 2021, Florence, Italy.

Acknowledgements

The presence of a solitary name on the cover of this thesis masks the contributions, interest and support of many individuals and organisations, without which the completion of this thesis would simply have been impossible. I would like to express my sincere gratitude to all who have contributed to this work in any way.

Foremost thanks are due to my Principal Supervisor, Dr. Alexander J. Kent, who has supported me and my work with genuine interest and an unwavering willingness to help. In his support, Alex has gone the extra-mile on occasions too numerous to mention and without his expertise, advice and encouragement, this work would never have been started, less so completed. Beyond being an exemplary research supervisor, Alex has continually displayed his dedication and integrity as a colleague, mentor and friend, and I am hugely indebted to him for his input of time and support throughout my studies. Thanks are also due to my Second Supervisor, Prof. Peter Vujakovic, whose willingness to advise, support and candidly discuss all aspects of this work has been of great value. I am also grateful to have been supported by two excellent Supervisory Panel Chairs, Prof. Kevin Ruane and Dr. David Bates, whose counsel and engagement with my work has provided very helpful perspectives, without which this work would be poorer. I am hugely grateful for the generosity of Canterbury Christ Church University and the opportunity to undertake this research while undertaking my role as a University Instructor. I am additionally grateful to Dr. Marion Stuart-Hoyle and the Section of Geography, Events, Leisure and Tourism whose further support has made the process considerably more productive and rewarding. I would also like to thank Olga Godsell (University of Kent, UK) for her skill and patience during two fruitful years of Russian language tuition undertaken during the course of this research.

This work was dependent on access to the collections of several institutions, to whom I am grateful for admitting me to their facilities and for their gracious cooperation with my requests for the retrieval of large quantities of materials. I would therefore like to thank the staff of the Maps Reading Room at the British Library (London, UK), the Geography and Map Division of the Library of Congress (Washington, D.C., USA), Latvijas Nacionālā Bibliotēka (Riga, Latvia), Maa-amet Eesti (Tallinn, Estonia), Eesti Rahvusraamatukogu (Tallinn, Estonia), Rahvusarhiiv (Tallinn, Estonia) and Kansalliskirjasto (Helsinki, Finland).

I am also indebted to Arvīds Ozols, Laura Veinberga and Guuta Grube (Latvian Geospatial Information Agency, Riga, Latvia) and Eugenija Šleiterytė-Vilūnienė (National Land Service, Vilnius, Lithuania) for their insightful guides to topographic mapping in their respective countries and for accommodating me in their busy schedules. Thanks are also due to Aivars Beldavs (Jāņa Sēta, Riga, Latvia) for his helpful input and cooperation. I would also like to thank the Library Services staff of Canterbury Christ Church University for their assistance in sourcing various reference materials. Gathering information regarding the scope of the Soviet city plan series and the current locations of the maps required the input of many further libraries and archives. I am grateful to each of these institutions for their provision of information remotely, and to the staff who kindly responded to my exacting requests for information, particularly the National Library of Australia and Institut Cartogràfic i Geològic de Catalunya (ICGC) for providing some of the map images used in this thesis. In addition to these institutional collections, I am grateful to John Cruickshank who, by inviting me to explore his personal collection of Soviet maps and related materials and supplying me with various translated documents, has made an invaluable contribution to this work. I would also like to thank John Davies and David Watt for their continued interest and support.

The constant support of my family—Margaret, Greg and Emma—has been no less vital to my work than any academic support I have received and should not go unmentioned. Above all, I am grateful to God for leading me to all of the people above just at the right time, for providing me with opportunities I could never have previously imagined and for His sustenance and blessings throughout my time in Canterbury and beyond.

Introduction

Throughout the Cold War, the Military Topographic Directorate of the Soviet General Staff produced one of the largest series of topographic maps ever produced (Kent and Davies 2013). While the maps available to the general public of the Soviet Union have long had a reputation for deliberate distortion and ambiguity (Postnikov 2002), militaries east of the Iron Curtain were concurrently producing the very opposite; accurate and detailed maps, in total secrecy and in great quantities. From small-scale aeronautical charts to highly detailed plans of Soviet towns at 1:500 in addition to standardised topographic and city plan series covering virtually the entire globe, the cartographic output of the USSR was undoubtedly vast. The years following the collapse of the USSR in 1991 have seen many of these maps leave the concealment of military map depots and arrive in the stock rooms of commercial map retailers across the former Soviet Union and beyond. Today, the maps are found in dozens of public and private map collections around the globe, many of which are accessible and ready to be harnessed, both as a means of providing historical insight into their original context and as a source of topographic information in modern and future contexts.

Over 25 years after the dissolution of the USSR, it is perhaps surprising that this previously inaccessible global map series has not attracted the focus of more scholarly research, either within cartography or in a plethora of other fields in which these maps may find considerable use. The investigation into the maps mentioned by Collier et al. (1996) has not materialised, and it was not until 2005 that an initial general survey of the Soviet mapping programme appeared, in the first of a series of articles by John Davies (Davies 2005a; 2005b; 2006; 2010) in *Sheetlines*, the journal of the Charles Close Society for the Study of Ordnance Survey Maps. This was followed by further contributions by David Watt (2005) and John Cruickshank (2007; 2008; 2012) and a more panoptic perspective from Kent and Davies (2013). These articles, despite not incorporating detailed, systematic analyses, provide a valuable introduction to the Soviet mapping programme and offer an accurate impression of its scope and content, particularly in relation to Soviet mapping of the UK. A more detailed look at Soviet mapping has been provided by Davies and Kent in *The Red Atlas* (2017) which includes dozens of colour reproductions of the maps, continuing to increase their profile and foster a growth in interest around the world. Applications of the

Soviet data have been even scarcer, however, with Rondelli et al.'s (2013) use of 1:10,000 topographic sheets of Samarkand, Uzbekistan for archaeological purposes being a rare example. Soviet maps have proved particularly useful in areas without detailed indigenous mapping. Davies and Kent (2017: 134–137) cite examples of Soviet topographic sheets being utilised by the allied militaries in Afghanistan and Iraq, as well as by oil exploration and water resource management organisations.

A large proportion of the maps which are now found in libraries around the globe are from the series of Soviet Military City Plans produced between 1944 and 1991, mostly at 1:25,000 and 1:10,000, with a handful of others at 1:5,000, 1:15,000 and 1:20,000. This is likely to be because of their appeal to international collectors as the largest-scale Soviet maps of foreign territory available. In any context, the moment in which insight is gained into the perspective of another is always enlightening. The curiosity evoked by seeing a familiar place mapped in an unfamiliar way using an unfamiliar script no doubt explains widespread interest Soviet maps of other parts of the world; an inward-looking perspective from the outside can challenge the way in which we view geographical spaces that we, post-Cold War map readers, have long considered familiar. This thesis contends that the value of Soviet maps extends well beyond an initial curiosity; that Soviet mapping provides an untapped resource, the potential applications of which extend far outside the remit of cartography or Cold War history. By providing a systematic investigation into one aspect of Soviet mapping, military city plans, this thesis is conceived as a preliminary step into this field which will aid future users of these maps.

Standardised Mapping of the World

A programme of standardised mapping of the entire globe in the twentieth century was by no means a uniquely Soviet ambition. Some years before the advent of Stalin's cartographic endeavours, the German geomorphologist Albrecht Penck proposed a standardised 1:1,000,000 International Map of the World (IMW) at the 1891 International Geographical Congress in Switzerland (Pearson and Heffernan 2015: 58). Whereas topographic mapping had previously been the exclusive domain of National Mapping Organisations (NMOs) and military topographic organisations, Penck's proposal included a common specification of conventional signs, which would transcend national boundaries. His vision was for global coverage across 2200 sheets, which would boost trade, as well as aid navigation and administration. Rhind (2000: 298) suggests that a global standard for topographic mapping would also bring other benefits, such as the interoperability of data and a simplification of trans-national licencing agreements. Although a specification for the IMW was established within twenty-five years of Penck's initial proposal, disagreements between various NMOs regarding, among other issues, the use of metric units and the placement of the Prime Meridian, hindered progress (Pearson and Heffernan 2015: 59). By the time the project ended, a total of 750 sheets had been produced, although some of these deviated from the agreed specification (Rhind 2000: 299). In the end, the IMW's lack of a centralised system of funding brought the project to a conclusion, never fulfilling Penck's initial ambition for global coverage.

Tsarist Russia had originally joined the IMW programme although, during the 1917 revolution, permanently withdrew (Pearson and Heffernan 2015: 63). While this was a major setback for the IMW, it gave the newly formed Soviet Union the freedom to create its own standardised mapping programme. With an established tradition of strong, centralised control and a willingness to direct significant resources to the programme, the Soviet mapping of the world was able to overcome the problems which were simultaneously hampering the general progress of the IMW. Not only did the Soviet Union succeed in creating a 1:1,000,000 map of virtually the whole globe, it also far exceeded the achievements of the IMW by producing series of maps at larger scales. Between the 1950s and 1970s, IMW mapping of the USSR was undertaken by the US military, which achieved almost complete coverage of its territory at 1:1,000,000. However, by the late 1980s, the USSR had completed full topographic coverage of its territory at 1:200,000, 1:100,000, 1:50,000 and 1:25,000 (Vereshchaka 2002). Among the other impressive cartographic achievements of the USSR is the series of over 2000 plans of cities outside the USSR. Including rich hydrographic detail, classified buildings and terrain, the city plan series alone would have been a major achievement. The scope and *raison d'etre* of the city plan series are discussed in greater detail in Chaps. 1 and 2, although it is clear that the Soviet Union saw long-term strategic value in producing standardised city mapping across the world, most likely to facilitate future Soviet administration.

In the twenty-first century, this value continues to be apparent. Today's consumers of maps, often via web-based apps, expect seamless global coverage at multiple scales as a standard requirement, rather than an ideal. Today, mapping is very much global, rather than national. After the publication of a Web Map Server (WMS) interface implementation specification in 2000 (Open Geospatial Consortium 2000), several web maps offering global coverage emerged within five years, including *Esri ArcIMS, Google Maps* and *WikiMapia*. *OpenStreetMap*, founded in 2004, are unreservedly 'an international project, and [its] community spans the globe' (Ramm and Topf 2010: 315). Although the medium through which global maps are presented has changed, even since the end of the Cold War, the fundamental challenges of mapping the world remain the same. Organisational structures and resources need to be in place and, from a cartographic perspective, a suitable specification of conventional signs needs to be devised; versatile and comprehensive enough to be applied to any location on Earth. While these cartographic endeavours continue today, the successes and limitations of the pioneering Soviet mapping programme perhaps have the greatest to offer current and future mapping initiatives.

Objectives of the Research

The overall aim of this thesis is threefold: firstly to comprehensively set out the background and scope of the Soviet Military City Plan series in detail, secondly to frame the series within an epistemological context within cartography and thirdly to understand the nature and application of its symbology through an empirical analysis, helping to facilitate future applications of the maps. This will be achieved by engaging with two principal objectives:

- **To examine the extent to which the symbology of Soviet military city plans was successfully implemented across a variety of socio-cultural and physical environments across the globe.**
- **To explore the extent to which the symbology of Soviet military city plans can inform and supplement the global, standardised symbology of *OpenStreetMap* (OSM); successfully transcending socio-cultural, political and physical boundaries.**

Before undertaking an empirical analysis of symbology, it is necessary to contextualise the Soviet military city plan series by placing it in its historical and institutional context. Chapter 1 addresses this theme, highlighting the persistent traits of Russian cartography that have been inherited by the city plan series and contribute to its nature and scope, particularly state control, secrecy and the pursuit of accuracy. This scope is explored in greater detail in Chap. 2, which explains the series in detail, incorporating the map production process, the content of map sheets and the stylistic development of the plans. In order to formulate a suitable approach to addressing the research objectives, Brian Harley's landmark text 'Deconstructing the Map' (1989) is used as the starting point for an exploration of deconstruction in the broader context of cartography in Chap. 3, drawing particularly on the work of the post-structuralist, Jacques Derrida. Aspects of Derrida's deconstruction of texts are fused with more recent post-representational assessments of cartography in order to form a pseudo-representational framework through which to view the Soviet mapping programme as a whole, conceptualising its enduring potential for application. Supported by this framework, the methodology of the empirical component of the thesis, outlined in Chaps. 4 and 5, pursues this potential in addressing the systematic analyses required by both research objectives, building on the methods used in previous studies of topographic maps. This results in a two-tiered classification for organising the Soviet military city plan symbology for analysis. Chapter 6 presents the findings of this analysis in relation to the themes of the research objectives and provides empirical evidence of the scope of the symbology, the relative importance given to different feature types and the variation of the implementation of the symbology across a sample of Soviet military city plans. A comparative analysis of this symbology with that of *OpenStreetMap* highlights the similarities and differences between these two disparate global mapping projects, providing the main basis of the discussion in Chap. 7 which, building on the theoretical framework identified in Chap. 3, explores the potential for Soviet maps to be applied in order to benefit existing and future global mapping initiatives. This investigation serves to highlight the enduring value and versatility of Soviet military mapping, both as a source of data and as a means of overcoming contemporary cartographic challenges relating to symbology, design and the handling of large datasets.

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Contents

Chapter 1
Russian and Soviet Cartography: A Concise History

Russia is a state that tends to conjure up a sense of mystery and unfamiliarity in Western imaginations; perhaps coloured by the secrecy that characterised the Soviet era, or the long history of tsarist absolutism that preceded it. Indeed it is possible to claim, with some validity, that the development of Russian culture and science has deviated, significantly at times, from the progressivist narrative of European enlightenment, innovation and global eminence. Russian cartography is not excluded from such perceptions, with a propensity for secrecy, censorship and even deliberate misinformation being exhibited during several stages of Russian cartographic history [38, 51]. This has plagued much research in the field, leading to a relative lack of literature on the subject, particularly in the English language, the extensive works of Leo Bagrow (1881–1957), Leonid Goldenberg (1920–1989) and latterly Alexey Postnikov (b. 1939) perhaps being the most notable exceptions to this. As in many states, cartography has been, and remains, a practical and effective means of claiming, defending and administering territory, the vastness of which has also fostered notions of identity at times and frequently reinforced the authority of a centralised state or sovereigns themselves.

Given that indigenous Russian cartography has continued in some form for over half a millennium, it is beyond the scope of this chapter to give a comprehensive account of the entire mapping output of Russia or the states which preceded it; nor is this necessary, given the substantial collections of cartographic inventories and specimens being restored and preserved in the Russian Federation today [34]. Instead, it proposes several maps, methods, individuals and organisations which have contributed most significantly to the development of Russian cartography as a whole; from the earliest cartographic references to 'Russia' until the collapse of the Soviet Union in 1991, providing a summary of literature in this field and highlighting traits which persist throughout. Although this is broadly organised by chronology, occasional departures from this are necessary to support the aims of the thesis.

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1.1 The Origins of Cartography in Russia

1.1.1 Maps for an Emerging State

The inception of cartography in the area now known as Russia is somewhat difficult to define with precision, given that many early examples of Russian mapping have been lost [5]. Consequently, research in this area is based on a patchwork of surviving examples, together with various inventories and other documentation referring to lost maps [23, 38]. Virtually all of the known maps which use the term ‘Russia’ before the mid-sixteenth century are foreign-made, such as the Henry of Mainz map (c. 1110), the Hereford *Mappa Mundi* (1290) and various sixteenth century maps by Martin Waldseemüller and Gerardus Mercator, the latter two with strong Ptolemaic influences [4]. However, Goldenberg and Kivelson [23, 38] trace the use of Russian sources in many such foreign maps, including a 1525 map by the Italian cartographer Battista Agrese, who listed materials provided by the incumbent Russian envoy in Rome among his sources. Many other maps drew heavily on sources obtained by Western Europeans during visits to Moscow [4].

The first known map specifically of Muscovy dates from 1497 [23], although the degree of Russian involvement in its production is disputed [36]. However, if this is an early example of indigenous Russian cartography, it is unlikely that it represents the first case of mapping in the country. The earliest surviving reference to a map created inside Russian territory appears in a document regarding fishing rights in the Pererva River in 1483, suggesting very early legal applications of cartography [5]. In all likelihood, cartography elsewhere in the territory that would become the Soviet Union had similarly foreign origins. The first known map covering part of the Baltic was drawn by Arabian cartographer Idrisi and dates from 1154 [30].

The centralisation of states and the growth of mapping have a tendency to correlate with each other—with established evidence for a mutual dependency of the two in, for example, Japan and most Western European states [38]. In Russia, at the most basic level, maps presented vital information about terrain and rivers—of constant practical importance during the exploration and settlement of new territory [48]. The fifteenth century saw the Grand Prince of Moscow compile a cadastral census just as the centralised monarchy was being formed, likened by Postnikov to the Domesday Book in Britain. The census provided a good amount of geographical information which would be useful in future cartography (ibid.).

It was not until the mid-sixteenth century that a need for indigenous mapping slowly emerged in the growing Muscovite state, for ‘land description, defense, city-building and diplomatic uses’ [23], though mapping remained rare and unsystematic [37]. Map production grew further as the centralised Russian state expanded under Ivan IV (the Terrible) (1533–1584); the oldest known Russian manuscript map originates from this time (1536–1537) and depicts a basic plot of land near the village of Marinsk [23]. This is the only known indigenous sixteenth century Russian map still in existence [37], though copies of European maps and atlases were made at Ivan’s instruction, and cadastral surveying had also begun before the turn of the seventeenth century [38].

1.1.2 The Legacy of the Pre-Petrine Era

While some historians commence their review of Russian cartographic history during the rule and reforms of Peter the Great from around 1700, ignoring or even belittling the achievements that precede this date due to their lack of mathematical or geodetic basis (e.g. [25]), pre-Petrine Russian cartography very much laid the foundations for the progress that was to be made during the eighteenth century and established some broad principles which would characterise Russian and Soviet cartography for at least the subsequent three centuries.

Undoubtedly, it is true that Russia lacked the mathematical knowledge, precision and indeed literacy of Western Europe during the seventeenth century [62], and that the lack of commercial involvement in the former virtually led to a monopoly of highly-centralised state cartography [56]. Maps prior to this point had no coordinates, projection or consistent scale, instead relying on the framework provided by rivers and routes to support some degree of relative positional accuracy [48]. As a result, Russian maps looked dissimilar to European maps and were often accompanied by a tome of accompanying text (such as the *Kniga Bol'shomu Chertëzhu*) to accommodate a relative lack of familiarity with visual representations of geography, in addition to the practical issues associated with reproducing maps by hand. However, Shaw [56] argues that the fundamental purpose of cartography in Russian and European schools was the same—state-building through control and defence. Given that Russia was virtually landlocked, with very little access to navigable seas, Shaw argues that there was less need for Russia to develop accurate maritime charts, imitating Mercator or Ortelius and reviving the work of Ptolemy. The eminence of the Netherlands in European cartography had little consequence in Russia, which continued to use river systems as a basis throughout the seventeenth century [5]. The fact that, by the time Russia entered the eighteenth century, a handful of its cartographers had already mapped the full extent of the vast territory that would become the USSR using this method is highly impressive in a different respect, given the lack of resources at their disposal, and indicates that the value of cartography to the expansion and administration of the empire, as well as the exploration of other territories, had already been well recognised.

Pre-Petrine cartography paved the way for the future cartography of Russia in two respects. A centralised, state-led structure emerged in the seventeenth century, reflecting the general shift towards absolutism in Russia. With the exception of some litigatory maps used in property disputes [36], maps were made by the state for the benefit of the state. Commercial map production was insignificant, if extant at all [56]. These principles of organisation and production arguably remained until the dissolution of the Soviet Union in 1991. Secondly, despite maps being deficient in consistent scale and orientation as a consequence of the lack of scientific instruments and mathematics, early indications of attention to accuracy exist. This manifests itself in the widespread inclusion of measurements on maps, such as the distance between towns or the length of rivers, in versts (one verst is approximately 3,500 ft) (ibid.), and the use of the hydrological system as a base to give maps structure and some degree of relative positional accuracy. For the time, the standards in place and the accuracy achieved were remarkably high [22]. This predisposed concern for accuracy, though in an entirely different political and technological context, remained a fundamental focus of Soviet cartographers in the twentieth century, albeit not before it was an inherited priority, if not a stimulus, of the reforms instigated by Peter the Great.

1.2 The Reforms and Legacy of Peter the Great

1.2.1 European Influence

The reign of Tsar Peter I (the Great) (1682–1725) was a time of significant and unprecedented change in all aspects the Russian state; cartography was not excluded from this but rather played an instrumental role. Peter (Pyotr Alekseyvich) was born on 9th June 1672 and took to the throne at the age of ten, together with his brother Ivan. From a young age, Peter had a great interest in mathematics and military affairs and, in March 1697, first travelled to Western Europe to study achievements in these fields [5]. He also intended to establish contacts and commandeer skilled scientists and craftsmen—putting them into his service in Russia [38, 48, 55]—underlain by aspirations to establish pseudo-European scientific methods and institutions on his return [1, 22]. Seeing the importance of accurate maps to imperial expansion, Peter's new Russian cartography would grow in rigour and accuracy, in terms of its use of projections and geodetic bases [31, 62]. This, however, would come at the expense of the rich, descriptive geographical information that characterised Russian cartography before this point, particularly exhibited in the work of Remezov [22].

The European influence brought to Russia by Peter would also manifest itself in a less tangible way, in terms of the development of Russia's national identity and its self-perceived degree of 'Europeaness'; a complex fabrication given the simultaneous input of Asiatic influences as a result of continual exploration in the Far East [6]. Peter wasted no time in implementing the newly-acquired knowledge and personnel from his travels, an act which was to have far-reaching consequences that would far outlive his reign. Initially, Peter spent five months working in the Dutch Navy in Amsterdam, during which time he met several eminent Dutchmen; notably Nicolaas Witsen (whom Peter had contacted in the past) and Jan Tessing, who set up a Russian typography in Amsterdam as a result of Peter's visit. Peter gave Tessing a sketch map of Southern Russia and the Black Sea, drafted by Jacob Bruce, a Scot, and Major General Yuriy Mengden during Peter's campaign at the fortress of Azov in 1695 [3]. Tessing published two versions the map—one in Latin and the other in Russian—thereby creating the first printed map to use the Russian language [5], though Tessing's death in 1701 limited its circulation [3]. Also during his stay in the Netherlands, Peter took lessons in engraving from Adrian Schonbeck [49] and commissioned him to travel to Russia in order to produce engravings of 'battle scenes, maps and plans' [5].

By 1698, Peter reached London and was highly impressed with the British Navy, recognising its strong provision of scientific training. While in Britain, Peter resolved to establish a navigation school in Russia, staffed by British cartographers, and enlisted Andrew Farquharson (of Aberdeen University) to teach mathematics and Stephen Gwyn and Richard Gries (students at the Royal Mathematical School of Christ's Hospital) to teach navigation at the new institution [1, 27, 49, 55]. The school was to be modelled on the Royal Mathematical School, which had been founded in London by Charles II in 1673. Although there is no evidence that Peter visited the School, Gwyn and Gries, as well as many personnel in the Royal Navy who were also among its alumni, doubtless gave him information on request [27]. After a brief stop in Vienna, Peter returned to Moscow and established the Navigation School on 14th January 1701, with two hundred students enrolling by July 1702 and the first graduates emerging in 1705 [5, 21, 24, 55, 62]. Instruction was initially given in English, while Farquharson, Gwyn and Gries learnt Russian [27]. Leonty Magnitsky, who assisted Farquharson in the teaching of mathematics, published a handbook on the subject in 1703, including its applications in geometry, trigonometry, astronomy, geodesy and navigation. This was the first such technical manual in Russia and was used to train Russian geodesists for at least the subsequent fifty years [2, 5, 21].

1.3 The Emergence of Russian Military Cartography

1.3.1 Foundations of the General Staff

Although virtually all Russian cartography remained centralised within a handful of state institutions before and throughout the eighteenth century, none had an exclusively military focus, besides the Admiralty which, naturally, was focused on the production of hydrographic charts. Nevertheless, since the very early surveys of Russian territory, defence and the construction of fortifications has been a stimulus, and a plethora of military officers have been involved in various capacities [5]. However, in terms of the organisational framework of Russian cartography, the establishment of the Cadet Corps for the Gentry in St Petersburg in 1731 represented the first step away from a predominantly civilian framework. Although the Navigation School in Moscow and the Naval Academy in St Petersburg remained the primary educational institutions at this time, the Corps provided training in arithmetic, geometry, drafting and geography in a military setting; producing graduates of tolerable competence [50].

A larger military establishment did not emerge until after the end of the Seven Year War with Prussia (1756–1763), when the General Staff of the Russian Army was founded by Catherine II in 1763, prompting rapid development in military cartography [41, 48, 55, 62]. The General Staff was engaged with compiling battle plans and local surveys but did not last long in its first incarnation, being replaced by His Majesty's Own Drawing Office in 1796 by Paul I, Catherine's son [50]. One year later, the Drawing Office was renamed His Majesty's Own Map Depot and acted as a state cartographic archive, as well as a facility for engraving a broader range of maps for military use [62]. Headed by Major-General of Engineers Karl Opperman, the Map Depot was staffed by eight engravers and a team of cartographers who had been moved from the Senate [50]. The most significant shift came in 1800, when the Geographical Department of the Academy of Sciences merged with the Map Depot, firmly placing the military establishment at the forefront of cartography in Russia [5]. The General Staff re-emerged in 1797 for military administration, though mapping activities remained separate, at the Map Depot [41].

The relocation of the Geographical Department to the military Map Depot represented a major alteration to the nature of Russian cartography and the start of a lasting rift in its organisation. The single system of state cartographic production, established under Peter, was divided into two distinct components. Civilian mapping was the remit of the Land Survey department, engaged primarily with Catherine's General Land Survey, whereas virtually all other cartography had become a well-resourced military venture [48]. These two applications of cartography naturally had different requirements and before long different approaches to surveying and mapping emerged, reflecting the separation of the training for land and military surveyors. By the end of the eighteenth century, due to the reduced spheres of activity in both schools, specialised thematic maps became more commonplace where general surveys had dominated previously. In addition to carrying out the General Survey, the survey department produced detailed maps of natural resources, becoming the Ministry of State Properties in 1837.

By the second Russo-Turkish war (1787–1792), the Russian Navy had a permanent fleet in the Mediterranean and was able to bring the entire Ukrainian coast under Russian control, allowing the formation of a permanent Black Sea fleet, naturally straining relations with Turkey further [50]. In contrast with the First Archipelago Expedition, the main area of contention had largely shifted away from the sea, to coastal areas, islands and fortifications, necessitating large amounts of land surveying in the region. In 1804, the Map Depot responded by commencing Russian cartographic training on Corfu in 1804, supervised by Opperman (ibid.). This was beneficial to the Russian Army in the third Russo-Turkish war (1806–1812), as maps produced by the newly-trained land surveyors were far more suitable than charts drawn by naval officers, who had produced the maps in the 'Atlas of the Archipelago' (ibid.). By separating Army land surveys from marine charting, the Navy was able to continue to chart the Black Sea. Russian military topography and hydrography could now advance and progress concurrently, supported by all the cartographic resources of the Map Depot.

1.4 The Changing Agenda of Russian Cartography in the Nineteenth Century

1.4.1 Expressions of Enlightened Governance

Under Peter the Great, cartographic methods developed beyond recognition but retained highly practical purposes; namely defence, administration, exploration and imperial expansion, with Peter more interested in science and technology than any form of art [7]. The era of Catherine the Great in the latter half of the eighteenth century saw all of these applications continue, though there was some degree of diversification. Although cartography remained highly-centralised, the gradual advent of using 'maps as expressions of enlightened governance' began to manifest itself alongside more established applications [55: 35]. Together with this 'enlightenment project', the early years of the nineteenth century saw the growth of a Russian nationalist movement, in which increasingly censored maps were to play a role alongside other aspects of Russian culture [6]. Nevertheless, the nineteenth century saw several significant Russian military campaigns, starting with war against Napoleon, allowing military institutions, though constantly evolving in name and organisation, to play an increasingly substantial part in Russian cartography.

1.4.2 The Institutional Framework in the Early 1800s

By 1800, triangulation with astronomical points was well-established as the preferred and most commonly-used method of survey in Russia, with the fixation on improving accuracy more palpable than ever, particularly in contested border regions [55]. Catherine's General Land Survey of the Empire was a venture which continued into the nineteenth century, a necessity of expansion and the pursuit of access to warm water ports. To this end, Russian surveying also took place in areas outside of the Empire, with a view to annexation and enlargement; starting with Poland-Lithuania in 1814. In 1810, the Map Depot was absorbed by the War Ministry and was primarily engaged with the triangulation of Russian territory. The General Staff now also had a small Topographical Section, though it only mapped localities currently or imminently expected to be involved in war.

On 27th January 1812, the Map Depot became the Military Topographical Depot (VTD) [62]. On its establishment, the VTD was given six objectives, completing special assignments, triangulation with astronomical points, compiling and drawing maps using the best available sources, archiving military maps and plans, management of funds and engraving and printing [55]. Only four years later the VTD was absorbed by the Quartermaster Corps of the Army, but continued to carry out these objectives (Fig. 1.1). In 1822, Alexander I once again reorganised the military, establishing the Corps of Military Topographers within the General Staff, alongside the

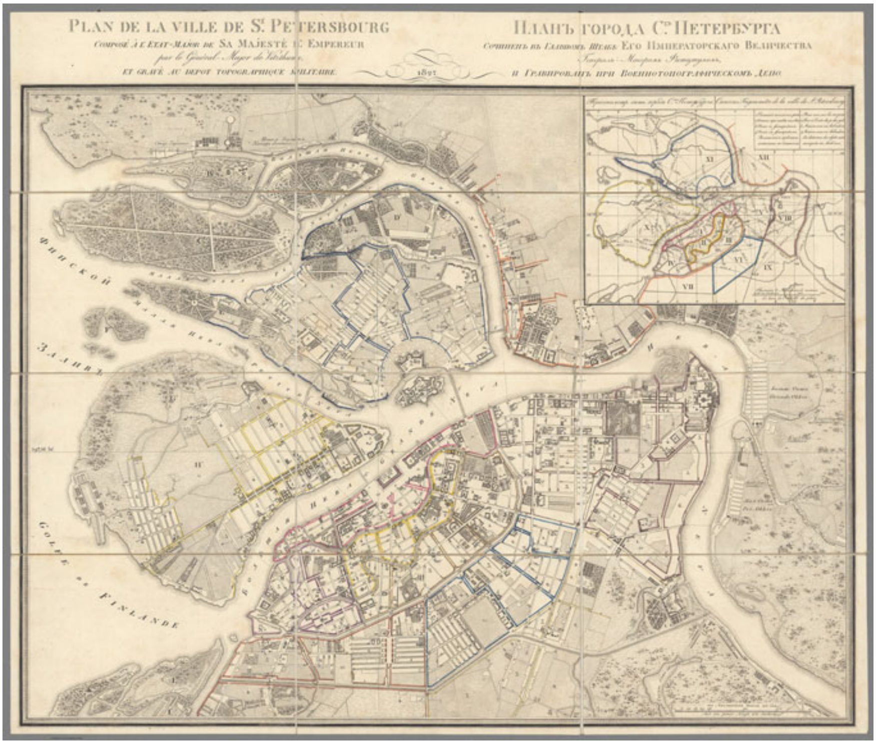

Fig. 1.1 *Plan goroda Sankt-Peterburga* [Plan of the city of St Petersburg] (1827), composed by the General Staff and engraved by the Military Topographical Depot (VTD). Original size 61 × 51 cm (David Rumsey Map Collection, Stanford Libraries)

VTD; a surveying corps, as well as a full academy for the training of army topographers, staffed mainly by cartographers who had worked on the General Land Survey [55, 62]. The Corps of Military Topographers undertook geodetic and topographic surveys, initially at 1:21,000 and 1:16,800 [62, 63].

Mapping endeavours in foreign territories were not always overtly hostile enterprises. Between 1798 and 1804, the General Staff undertook a large-scale survey of Finland with input from Finnish cartographers and material. Typical of maps at the time, the resulting 'Atlas of Old Finland' was never published, but instead was archived internally in manuscript form. This was partly due to the lack of printing infrastructure and an ongoing lack of paper supplies in Russia, but also the result of censorship policies. When Finland was incorporated into the Russian Empire in 1809, the Finnish topographical office was integrated with the Russian system [48].

After Poland was annexed by the Empire in 1815, a similar merger took place with the Polish topographical office. The first Russian cartographic project in Poland was a topographic map at 1:126,000. Although this was initially undertaken by Polish officers using Russian manuals, Russian officers took control of the project after the

Warsaw uprising of 1830–1831 (ibid.). From the 1830s to the 1850s, the mapping of Western provinces, including Poland, was consequently a priority of both the Corps of Military Topographers and the VTD. Fyodor Schubert, Karl Tenner and Karl Richter were among the notable Russian officers involved in triangulating these regions, for works including the general topographic map, relief maps and city plans of Warsaw. After the Warsaw uprising, the Russian tsar, Nicholas I, took increasingly direct control of Polish regions and any local autonomy was discontinued. The Imperial University of Vil'na (Vilnius) was closed as a perceived source of Polish nationalism, Polish mapping organisations were disbanded and, in 1832, Nicholas claimed that all Polish territory had become a permanent part of the Russian Empire [55]. In 1839, new Russian maps of all Polish territory were completed and replaced the existing Polish maps (ibid.).

1.4.3 Developments in Ethnic Imperial Cartography

Ethnographic geography played a substantial role in Russian claims to Poland, Lithuania and other parts of Eastern Europe, becoming the subject of several notable thematic maps. In 1840, the 60-sheet 'Topographic Map of the Kingdom of Poland' was published, displaying information regarding ethnic composition, as well as geology and natural resources. Seegel [55] argues that there were three major stimuli of the ethnographic and linguistic mapping which took place at this time. Firstly, structuring and rationalising the complex ethnic composition of the European part of the Russian Empire made it seem more intelligible and organised. Secondly, in order to continue its establishment as a major European power, Russia displayed its 'right' to explore and map other, uncivilised territories and incorporate them into a Russo-centric framework, very much akin to Western European colonial mapping. Finally, the maps could be used as persuasive educational tools with the aim of assimilating populations into the Empire; constructing coherent Russian and Orthodox identities at the expense of the Polish, Lithuanian, Ukrainian, Jewish and Catholic identities which were already prevalent in the region. In light of this, the map of Poland was published, contrary to common practice [48]. For the first time in Russia, maps were being used to support geopolitical arguments, rather than more functional Petrine-style projects [47].

In 1859, a rare commercial cartographic firm was established by Aleksei Il'in and Vladimir Pol'toratskii, two officers of the General Staff [48, 55]. Il'in gradually took control of the company during the 1860s. Though not a state body in itself, the firm produced virtually all Russian Imperial maps from 1859 until its demise, including maps intended to 'educate' the general populous about the vastness and prosperity of the Empire.

1.4.4 The Imperial Russian Geographical Society (IRGO)

Instrumental in the inception of ethnographic mapping was the founding of the Imperial Russian Geographical Society (IRGO) on 7th August 1845, modelled on the British Royal Geographical Society (RGS), founded in London fifteen years earlier. However, rather than being concerned with exploring colonies around the world, as the RGS and other Western European geographical societies were, the IRGO's focus was the exploration of its own territory and areas contiguous with it (Fig. 1.2), with departments focusing on mathematical geography, physical geography, ethnography and statistics, and members of each producing a sizeable thematic map output [47]. Although the IRGO's primary function was general gathering of geographic information, rather than cartography, maps naturally formed a large part of the Society's output and further bolstered nation-building efforts across the Empire. Although it saw more civilian scholars become actively involved in Russian mapping, the founding of the IRGO did not represent a move away from highly-centralised state cartography, as its activities were closely monitored by the Ministry of Internal Affairs (MVD). From the 1850s, the IRGO established several regional departments to aid data collection and settlement in more distant regions. However, on the advice of the MVD, those in Kiev and Vil'na were closed in 1876 due to 'member disloyalty' [55].

Perhaps the most influential member of the IRGO was Pyotr Semyonov, whose five-volume 'Geographical-Statistical Dictionary of the Russian Empire' (1863–1885) described the geography of Russia region by region, while introducing Russian toponyms for all notable features on the landscape of the entire Empire. Reflecting the diverse work of the IRGO, the volumes included subjects ranging from climatology to botany and ethnography to art. This broad approach to information-gathering perhaps represents an early indication of the emergence of Russian 'landscape science', in which the landscape was studied in the context of its 'potential for utilization or transformation by humanity' [57: 111]; a necessary part of the expansion of Russian civilisation. In Semyonov's history of the IRGO, published in 1896, he claimed that the organisation had produced 460 volumes about Russian geography in its first 50 years, as well as amassing a substantial collection of overseas publications. Among these were British publications acquired via an exchange programme with the RGS; the books and periodicals sent to London by the IRGO remain in the Anniversary Room at the Society today. By 1916, the archive of the IRGO included 227 million volumes, highlighting the scale of its undertakings.

Throughout the nineteenth century and into the early twentieth century, Russia remained focussed, not only on maintaining its vast empire, but also on publicising its imperial might, scientific eminence and educating the public about these achievements. Organised by the IRGO and the MVD, the Russian Geographical Exposition in August 1892 well exemplifies these efforts and was an opportunity for the Russian state to display its progress, and European status, to a distinguished international audience, including displays of notable Russian maps from throughout history [55].

Fig. 1.2 Extract from *Karta Yuzhnoy Pogranichnoy Polosy Aziatskoy Rossii* [Map of the Southern Border Region of Asiatic Russia] (1895–1900) showing Vladivostok, part of the eastern coast of Russia and adjoining Chinese territory. The maps were issued by the Military Topographical Department of the General Staff, informed by IRGO expeditions (David Rumsey Map Collection, Stanford Libraries)

1.4.5 Nineteenth Century Military-Cartographic Reforms and the Demise of the Empire

Between 1800 and the 1860s, the VTD's output focussed heavily on the Western provinces and Poland and included 435 large-scale sheets of these areas. As part of Alexander II's sweeping reforms, instigated in the wake of the Crimean War, a Special Military-Topographic Section was established within the General Staff in 1864, continuing the triangulation exercise started during the General Land Survey in 1766. However, besides official duties, some military personnel compiled several unauthorised atlases, often based on French and German material, including S.P. Loskutov's 'Textbook Geographic Atlas of the Terrestrial Sphere' (1853) and Nikolai Zuev's 'Geographic-Encyclopedic Atlas' (1859). State-produced thematic atlases were also ubiquitous, covering topics including economics, industry, forestry and climate; each produced for internal use by various government departments (ibid.).

The VTD did not escape the reforms unscathed. In 1861, Dmitrii Miliutin became head of the Ministry of War and in 1863 the functions of the VTD were updated: proposing astronomical, trigonometrical and topographic work, calculating projections, compiling, correcting and proofreading maps and checking all calculations (ibid.). In addition, the geographical extent of the most detailed surveys was broadened during the reforms, incorporating all border regions rather than only the Western provinces [62]. Further change came in 1866 with new regulations for the Corps of Military Topographers, which was required to produce military-topographic surveys in both peacetime and wartime. In the same year, a school of military topography was established, providing broader training for the 643 staff of the VTD and the Corps of Military Topographers, including tuition in French and German.

The rule of Alexander III led to yet more changes in the structure of military cartography, though the direction of change differed somewhat. Alexander was seemingly more suspicious of new technology and European methods than his predecessors and was concerned about disloyalty among military personnel [55]. In 1882, Dmitri Tol'stoi was appointed head of both the MVD and the Academy of Sciences, who shortly afterwards appointed Pyotr Vannovskii as head of the Ministry of War. Although it had arguably been a highly-successful venture which had driven up the standard of military mapping, Vannovskii closed the Military-Topographical School, due to suspicions of seditious personnel, and the use of all foreign languages was banned throughout the military. By 1886, the tsar called for a new school to be established, though it was poorly staffed and the quality of training given was poor. Collaborations with other European schools of cartography were severed and military-cartographic output declined. Pyotr Stolypin became head of the MVD in 1906 and immediately attempted to reverse this trajectory, reintroducing French, German and geodetic training, just as Alexander II had done in the 1860s, and the nature of work undertaken largely reverted to being typical of that era. Nevertheless, given the enormity of Russian territory, the relatively modest and declining number of military topographers in active service, 454, made the long-standing task of triangulating all Russian territory very difficult to accomplish (ibid.; [12]). By the end of the nineteenth century, only two-thirds of European Russia had been triangulated, somewhat irregularly, and very little else [63]. Though perhaps best known for its 1874 'Statistical Atlas', Il'in's firm continued to produce Imperial-ethnographic maps into the early twentieth century, the last being a 'Dialectological Map of the Russian Language in Europe' (1914) which grossly generalised and belittled the extent and nature of other languages, particularly Belarusian and Ukrainian; still aiming to portray Russia as a dominant power in Europe.

Within the Academy of Sciences in 1915, Nicholas II launched a 'Commission for the Study of the Natural Productive Forces of Russia' (KEPS). Overseen by Sergey Ol'denburg, it aimed to devise means of aiding Russia's recovery from World War One, and included a Cartographic Commission tasked with reviving mapping activities [55]. The resulting report, read at a meeting of the Academy of Sciences in 1916, highlighted the ever-present lack of an accurate map of the whole country as the most serious issue facing Russian topography [62]. Though defence mapping was naturally important during the war, and the Academy of Sciences was drafted in to assist with this, propaganda maps were also rife. The aspirational 'Map of Europe in the Year 2000?' (1914), showing a fragmented Germany, Poland as a Russian protectorate and the Ottoman Empire fully absorbed by Russia is one such example. Evidently, such a scenario did not materialise and the Empire crumbled after the Revolution of February 1917 when Alexander Kerensky formed a provisional government.

1.5 New Cartography for a New Ideology: The Development of Soviet Mapping

1.5.1 Origins Under Lenin

An accurate and comprehensive account of the development of Soviet mapping has yet to fully emerge, given that the secrecy which shrouded the era exceeded even that of the tsarist regime. While histories of cartography were published by Soviet authors, often marking an anniversary or important milestone in Soviet history, these are evidently incomplete and heavily influenced by politics. One such example, authored by Virovetz [63] to mark the twentieth anniversary of Soviet geodesy and cartography, is scathing of imperial cartographic efforts, before reassuring the reader, 'Lenin, the genius of mankind (genius indeed!), indicated the new route for the development of geodesy and cartography of our fatherland' (ibid.: 21). Nevertheless, such texts remain an important source of information, alongside various maps and other documents which have emerged since the collapse of the USSR in 1991.

After the Bolshevik Party came to power during the October Revolution of 1917, Lenin approved the creation of a new Bolshevik Corps of Military Topography, independent of Ol'denburg's Cartographic Commission, which initially remained loyal to the interim provisional government that had been in power since the monarchy was overthrown in February of that year. This enabled the Red Army to coordinate its mapping activities centrally, aiding its success in the ensuing civil war. However, Lenin recognised that creating a new state entirely from scratch, including a new cartographic organisation, would be impossible; necessitating the retention of experts from the pre-Bolshevik era [55]. These were shadowed and monitored closely by Bolshevik loyalists [12]. Nonetheless, Lenin was aware of the potential function of maps as instruments of the state and effective propaganda vehicles [45]. Given that late imperial mapping had focussed on border areas, particularly in the West, many interior areas heavily involved in the civil war were not adequately mapped. In a hurried attempt to remedy this, scores of old unpublished surveys were hastily updated in the field to meet the high wartime demand for maps [12]. In line with Lenin's changes across the Bolshevik state, all measures became metric, leading to an overhaul of surveying equipment. A new system of sheetlines was based on the system proposed for Albrecht Penck's International Map of the World (IMW), devised in 1913, and the first maps at 1:1,000,000 were completed in 1918. A standard specification for military topographic maps was introduced in 1921 but, according to Vereshchaka [62], this was revised no fewer than nine times during the Soviet era (1924, 1931, 1934, 1940, 1946, 1951, 1959, 1963, 1973 and 1983) (Fig. 1.3). A selection of seven topographic scales was chosen (1:10,000, 1:25,000, 1:50,000, 1:100,000, 1:200,000, 1:500,000, 1:1,000,000) and the specification included instructions for compiling maps at each of these (ibid.). Despite this, maps in the 1920s and 1930s did not always follow a standard symbology, nor was their content consistent; discrepancies in contour intervals and road classifications were particularly apparent (ibid.).

1.5.2 Stalinist Expansion of Military Cartography

At the end of the civil war in 1923, the now Soviet Corps of Military Topographers was once again absorbed by the General Staff of the Army, becoming the '7th Department' shortly before Lenin's death. Civil mapping became the responsibility of separate organisations and some cartographers, who had survived Stalin's purges, moved to these. Such organisations tended to be responsible for surveying, including aerial surveying, and the production of large-scale maps and industrial atlases. Throughout the 1920s and 1930s, military mapping was fairly sporadic and remained heavily reliant on the revision of nineteenth century material. It was not until the late 1930s, when Stalin ordered a 1:1,000,000 survey of the whole country, as well as parts of Europe and Western Asia, that this practice began to wane. The leading geodesist of the time, Feodosy Krasovsky, established an eponymous ellipsoid on which future Soviet maps would be based [40]. Despite being famed for his work in developing geodetic precision, Krasovsky was also strongly of the view that Soviet maps should display 'geographic compliance'—accuracy and completeness in terms of descriptive content—a philosophy which remained an important part of Soviet mapping throughout its history [62]. Cartographic training also saw change at this time, with

Fig. 1.3 Extract from *Spravochnik po voyennoy topografii* [Handbook of Military Topography] (1946) showing elements of symbology for ground cover and relief (private collection)

the establishment of the Central Scientific Research Institute of Geodesy, Aerial Photography and Cartography (TsNIIGAiK) in 1929, under Krasovsky's direction. In many ways, TsNIIGAiK assumed the role the IGRO had formerly occupied; promoting links between geography and topography, while arranging geographical expeditions to inform mapping activities [51].

The use of Gauss-Krüger grids was introduced in 1931, though different coordinate systems remained in use in different parts of the Soviet Union until the establishment of the Pulkovo system in 1942, named after the observatory in a St Petersburg suburb which acts as its datum [12]. Pulkovo 1942 was introduced in Soviet mapping after its approval in 1946 [59, 62].

1.5.3 The Inception of Soviet Civil Surveys

As had been the case in nineteenth century Russia, military-cartographic establishments remained dominant in Soviet mapping. Nevertheless, state civil surveys were a necessary and important part of implementing domestic policy from the early years of the USSR, and a civil geodetic organisation was responsible for facilitating this, albeit overseen and organised by the General Staff, with which it shared its output. Though its role largely remained the same, the civil body was renamed several times early in the Soviet era, known originally as the Higher Geodetic Administration (1919–1926) and latterly the Geodetic Committee (1926–1928), the Chief Geodetic Committee (1928–1930), the Chief Geodetic Administration (1930–1932), the Chief Geological-Hydrological-Geodetic Administration (1932–1935), the Chief Administration of State Survey and Cartography (GUGSK) (1935–1938); finally settling on the Chief Administration of Geodesy and Cartography (GUGK) (1938–1991) [51].

As had been the case with military cartography, the Higher Geodetic Administration had been reliant on nineteenth century material during the civil war, due to the difficulties of surveying in wartime; its output largely consisting of small-scale, reprinted military communication maps. Therefore, in practice, civil surveying did not start until around 1923. In an attempt to develop and advance geodetic technology, the Chief Geodetic Committee went so far as to establish contact with the United States Coast and Geodetic Survey and several commercial firms in the USA. However, this practice came to a swift close in the early 1930s as Stalin's regime became markedly more oppressive. External contacts were severed and civil surveying was subsequently supervised by the Soviet security police (NKVD) (ibid.). This led to a far more tyrannical approach which strengthened the state's cartographic monopoly. The NKVD's regulations for GUGSK stated that 'all persons found guilty of publishing maps failing to conform to the standards created by the Chief Administration of the State Surveys and Cartography of the NKVD, or of compiling maps without the said Administration's permission, would be prosecuted as criminals' (original emphasis). Such austere regulations were reportedly based on the German 'Law on the State Cartographic and Topographic Surveys', implemented by Hitler in 1934 (ibid.: 248).

Guidelines approved in 1940 set out the remits and responsibilities of both GUGK and military topographers. These guidelines prohibited GUGK from mapping territory within 10 km of state borders or military sites. Astronomical observations and triangulation in other areas of the USSR were carried out by GUGK. Common instructions and accuracy standards applied to both civil and military surveying.

1.5.4 Mapping in the Great Patriotic War (1941–1945) and its Aftermath

Despite the ratification of the Molotov–Ribbentrop Pact in 1939, the Soviet Union suffered heavily from German invasion in World War Two, or the Great Patriotic War, from 1941. This had a particular impact on Soviet mapping when German forces captured the topographic factories in Minsk, Kiev and Kharkov, supplying them with a complete inventory of Soviet maps at that time, thousands of map sheets, original materials, printing plates and a large amount of machinery (ibid.; [12]). Stocks of maps became scarce and many were reused and overprinted with local tactical information. Soviet troops never used foreign maps on the ground, instead, Soviet-specification maps at 1:100,000 were often drawn of other territories where the Red Army was engaged. Some large-scale maps of foreign territories were prepared during the war, such as 1:25,000 and 1:50,000 maps of Berlin and its approaches (see Fig. 1.4) (ibid.).

At the end of the war, Stalin's initial priority was the completion of 1:100,000 coverage of the entire territory of the USSR, which now extended as far West as Königsburg, promptly renamed Kaliningrad [46]. This project was completed in 1954, utilising new air surveys in the Far East where astronomically determined points remained scarce. Nevertheless, field survey supplied vast amounts of information for the map, frequently in inhospitable conditions; proving fatal for scores of Stalin's poorly-resourced surveyors [51]. Around this time, four classes of secrecy were introduced which incorporated all subsequent maps produced by the USSR, unclassified, for official use (*dlya sluzhebnogo pol'zovaniya*), secret (*sekretno*) and top secret (*sovershenno sekretno*) [30]. The latter three were typically indicated in the top-right corner of each map sheet. As a military scale, 1:100,000 maps were classed as secret. The completion of the 1:100,000 series was marked by the start of efforts to achieve full coverage at 1:25,000, leading to a vast output of topographic sheets. By the collapse of the USSR, full coverage at 1:200,000, 1:100,000, 1:50,000 and 1:25,000 had been achieved [62]. In the late 1950s and early 1960s, some northern and eastern regions were mapped at 1:10,000 in the interest of natural resource exploration, and sheets at all scales were updated frequently throughout the 1970s (ibid.). Throughout the 1950s, mapping in Soviet satellite states was gradually incorporated into the Soviet system. Materials were duplicated and sent to the USSR, though satellite states typically did not have access to Soviet mapping. This framework accounts for the existence of Soviet-style maps which use Polish or German, rather

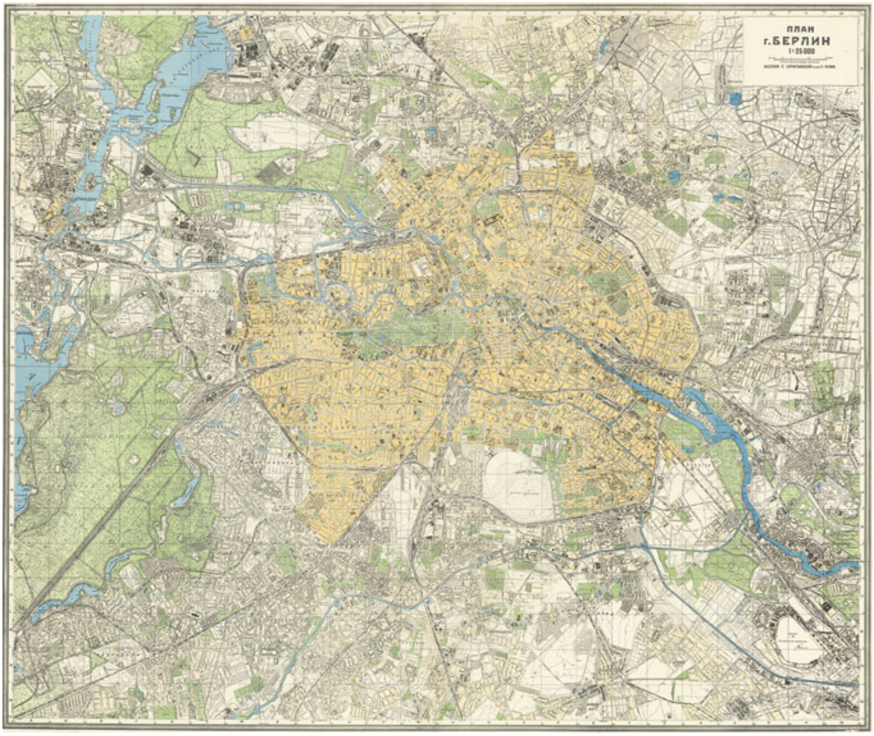

Fig. 1.4 Soviet military topographic map of Berlin (1945, 1:25,000). Original size approximately 100 × 82 cm (private collection)

than Russian [12]. The production of maps in satellite states included both civilian and military maps, although tactical maps covering larger areas could be based on a composite of Soviet topographic sheets, such as that examined by Nielsen et al. [46].

1.5.5 Civil Cartography After Stalin

The sole focus of GUGK remained civil domestic survey; any maps it produced of foreign territory took the form of small-scale tourist or educational maps and atlases for public use. All maps for public use were based on military maps at 1:2,500,000 or smaller [51]. As well as being highly generalised as a consequence of this, they were stripped of any sensitive military information, coordinates and grids, thereby removing any remaining strategic value from them (ibid.). In some cases, settlements were displaced by up to 25 miles, while tourist plans of Soviet cities were often presented without a scale [44].

In 1969, the Research Institute of Applied Geodesy (NIIPG) was established and subsequently guided the activities of GUGK. Throughout the 1970s, there was an increasing focus on larger-scale civil surveys; 1:10,000 surveying became more widespread and, in 1970, 1:5,000, 1:2,000, 1:1,000 and 1:500 were adopted as topographic/cadastral scales with the aim of supporting activities in land reclamation, agriculture, geological study, exploration and mining, industry, hydro-electric energy and planning.

The quality of maps intended for the public deteriorated further in the 1970s when Professor Georgiy A. Ginzburg, a mathematician and cartographer at the NIIPG, was ordered to create a polyconic projection that would deliberately introduce random distortions to the 1:2,500,000 map, and therefore its derivatives [51]. Ginzburg had worked on several earlier projections used in civil cartography since the 1930s, including several used to distort maps used in schools. The Ginzburg VI projection, used in the second edition of the *Bol'shoy sovetskiy entsiklopediya* or 'Great Soviet Encyclopedia' (1950), used a central meridian of 40°E to ensure the centrality of Moscow and the enlargement of the USSR relative to other areas (see Fig. 1.5) [58]. These projections were neither conformal nor equal area and Ginzburg received the state prize for his work [51].

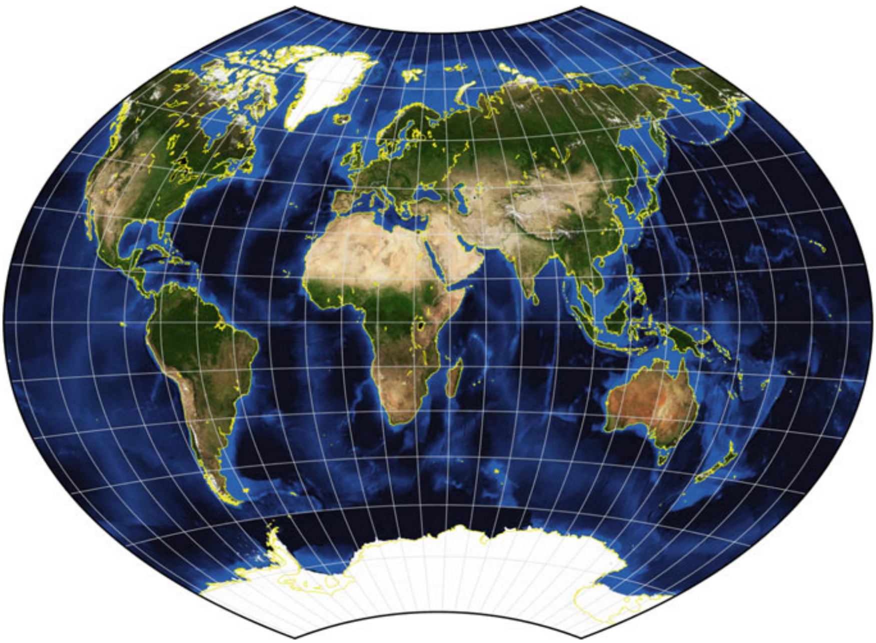

Fig. 1.5 The Moscow-centric Ginzburg VI polyconic projection, used in the *Bol'shoy sovetskiy entsiklopediya* [Great Soviet Encyclopedia] (1950) (NASA/Goddard Institute for Space Studies)

1.5.6 The Soviet Mapping of the World (1945–1991)

Communism was designed to be a global paradigm and way of life. Karl Marx and Friedrich Engels's 1848 *Communist Manifesto* [43] envisaged that politics and states themselves would eventually 'wither away' and that communism would ultimately prevail globally. As a young revolutionary, Lenin was well aware of this ultimate goal, believing that a socialist revolution in Russia would break the 'chain' of international capitalism and that the world's largest capitalist empires—Britain, France and Germany—would collapse and follow Russia's course [29]. After the October Revolution it became clear that this progression would not materialise organically, leaving Russia—still a relatively underdeveloped, agrarian society—ideologically isolated. Nikolai Bukharin's subsequent writings, implemented in state policy by Stalin, adapted Marx's vision of communism by formalising the notion of 'Socialism in One Country' in the mid-1920s; forming the basis of highly-centralised Soviet economic planning, state self-sufficiency and the collectivisation of land and agriculture (ibid.). While this approach may have been initially more popular than Leon Trotsky's preference of continuous revolution and expansion, the aspiration that, one day, communism would prevail across the world—peacefully or otherwise—seems the only plausible explanation for the direction taken by Soviet cartography after the Great Patriotic War.

Although some Soviet military maps covering foreign territory had been produced previously, systematic production of such maps began in the 1950s and continued until the collapse of the Soviet Union. Given the adoption of IMW sheetlines for domestic mapping as early as 1918, shortly after Russia left the IMW project, it is possible that the expansion of Soviet mapping beyond the borders of the USSR had been proposed as early as this. Initially, during the 1950s, Western Europe was mapped at 1:100,000, followed by North America at the same scale and then much of the rest of the world, although the full extent of this vast undertaking remains unknown [12]. The project was undertaken by the Military Topographic Directorate (VTU) under the General Staff, though there may have been some delegation to sister organisations in satellite states [9, 12]. Output grew throughout the 1960s—perhaps reflecting the increase in military spending under Brezhnev in the wake of the 1962 Cuban Missile Crisis—and reached its zenith in the 1970s and 1980s.

Earlier topographic maps from the military project list indigenous, though often dated, topographic material among their source material. Ground survey also played a vital role, with a 1946 handbook for military cartographers providing extensive guidance on field measurement, triangulation and the establishment of astronomical and control points (Military Topographic Directorate of the General Staff, 1946). Following the launch of the Zenit-4MT military-cartographic satellite on 27th December 1971, these sources were supplemented and updated by satellite imagery. Zenit-4MT featured a SA-106 stereo topographic camera, a laser altimeter and a Doppler apparatus [28]. Although the first Zenit satellite launched in 1961, Zenit-4MT was the first to be designed specifically for map-making, rather than reconnaissance. The stereoscopic images produced by Zenit-4MT could be used for detailed measurements of terrain, while the comprehensive metadata captured with each photograph regarding the satellite's position and line of sight at the time enabled the photographed location to be precisely identified [35: 23]. The consequent imagery was used to update existing topographic maps as well as create new large-scale maps of domestic areas and 'many foreign territories' (ibid.: 23) Satellite imagery was crucial in areas where indigenous mapping was non-existent, or of poor quality. Several editions of *Voenaya Topografiya* or 'Military Topography'—a handbook on the use and compilation of Soviet military maps—were produced throughout the duration of the global mapping project. Early editions include a section entitled 'Maps of the Capitalist Nations' which, together with several stand-alone volumes concerned with foreign topographic symbols, confirm the use of indigenous mapping as source material, though this section had been removed by the 1977 edition indicating that, by this time, Soviet maps and satellite imagery alone were sufficient sources of topographic data [10, 11].

In the absence of a full inventory of maps, extant sheets have been the basis of any estimations of the scope of the global Soviet military mapping project. Watt [65] suggests a high likelihood that the entire world was mapped at 1:1,000,000, 1:500,000 and 1:200,000. This alone would have well surpassed the 750 completed sheets of the ill-fated 1:1,000,000 IMW, with Watt estimating that this coverage would have required the production of around 870,000 sheets. Topographic sheets at 1:100,000 and 1:50,000 are also known to exist, covering Europe, much of the Americas, the Middle East, East Asia and populated areas of Africa. While GUGK produced cadastral plans within the USSR, there is evidence that the VTU produced sheets at 1:5,000 elsewhere to the same specification. Thematic maps of areas outside the USSR have also been identified in recent years. These include communications maps, highlighting strategic objects and transport systems at a regional scale, and hydrographic charts at various scales. Geological maps were also produced, parts of the East Antarctic Shield are known to have been mapped at 1:500,000 and 1:200,000 [32]. In addition, the VTU produced a large number of city plans at 1:25,000 and 1:10,000 and occasionally 1:15,000 and 1:5,000 [13, 14, 16, 17, 33]. The plans feature street indexes, a list of notable buildings (which are numbered and classified by colour; see Fig. 1.6) and a *spravka* or description of the settlement. All toponyms are transliterated into the Cyrillic alphabet. Over 2,000 city plans are presently known, though it is likely that the true number exceeds this. The production of such varied maps and plans at these scales, to a standardised specification and with this degree of global coverage, indicates that the Soviet global mapping project represents the largest mapping project undertaken to date (ibid.), with Watt [65] tentatively suggesting that around 1.1 million sheets were produced. Equally vast is the size of mapping organisation that would be required to produce an output this substantial. The VTU operated dozens of cartographic factories around the USSR which contributed to the project, including Chita, Leningrad, Rostov, Kharkov, Sverdlovsk (relocated from Minsk and Riga in 1941), Saratov, Tbilisi, Dunayev (Moscow), Kiev, Tashkent, Omsk and Khabarovsk [20]. In addition, the VTU operated 25 topographic depots around the USSR [14].

Fig. 1.6 Extract from a VTU city plan of Colombo, Sri Lanka (1979, 1:10,000) (National Library of Australia, nla.obj-234559550)

Outside of military-cartographic organisations, Soviet academic cartography was buoyant. Among its most influential figures was Konstantin Alekseevich Salishchev, who worked on the *Bol'shoy sovetskiy atlas mira* (Great Soviet Atlas of the World) project in the 1930s and went on to hold various positions within Moscow University, becoming chair of the Cartography Department in 1950 and president of the International Cartographic Association in 1968. Salishchev also made significant contributions to cartographic theory, which are outlined in Chapter Three. Salishchev was a pioneer of the use of technology in cartography and foresaw something of the transformative impact it would have on the practical elements of map production. As early as 1970, Salishchev observed that 'electronic computers and special cartographic automation are not only leading cartographic production to a new technical revolution but are opening a way to finding original methods of solving spatial problems, in some cases bypassing geographical maps,' [53: 82] and by 1987 he was advocating the adoption of GIS (Geographic Information Systems) by Soviet cartographic organisations [54: 18].

Of Salishchev's myriad of contributions, perhaps the most pertinent to the General Staff's city plans, particularly after 1971, is his work regarding the use of remote sensing technology in cartography. Establishing the Laboratory of Remote Sensing at Moscow University in 1953, Salishchev pioneered research into the extraction of data and compilation of maps from satellite imagery [26, 39]. It seems highly likely that at least some of the Soviet cartographers involved in the global mapping programme will have studied under Salishchev and that the Military Topographic Directorate will have taken an interest in his work, given its close relevance to their endeavours after the launch of Zenit-4MT. It seems an unlikely coincidence that the advancement and growth of the Soviet military city plan series due to the availability of satellite imagery occurred at the same time as academic discourses were occurring advocating cartographic uses of this and other technologies. Until the final years of the Soviet Union, Salishchev encouraged greater use of modern technologies as a means of overcoming inefficiency in the long-established map production processes, as exemplified by the following statement, made two years prior to its publication:

> The low productivity of traditional manual methods of map preparation and the imperfection of methods for obtaining and processing initial information (which is particularly noticeable with the exponential growth of information over the past decade), have become a technological barrier to the development of cartography. At the same time, scientific and technological progress has provided the means for overcoming the crisis in cartography: computer technology, automation and remote sensing. [54: 17]

1.5.7 The Dissemination of Soviet Military Maps

Since the 1940s, the USA and its allies had been aware of the existence of a Soviet topographic mapping project, but not of its full extent. US military Technical Manuals TM 30-430 (1946) [64] and TM 30-548 (1958) [19] provide an aid to the interpretation of a selection of Soviet topographic symbols at 1:10,000, 1:200,000, 1:500,000 and 1:1,000,000, while TM 30-546 (1957) [18] constitutes a glossary of abbreviations commonly found on Soviet maps. However, these manuals demonstrate no awareness that Soviet mapping was taking place outside the territory of USSR and its allies. In TM 30-548 ([19]: 1), a short statement regarding Soviet mapping responsibilities seems to indicate a lack of awareness of the VTU and the substantial map output of the General Staff, separate to that of GUGK:

> The principal topographic map producing organization of the USSR is the Chief Administration of Geodesy and Cartography (GUGK) under the Ministry of Internal Affairs (MVD). This vast organization, controlling mapping functions throughout the USSR, is responsible for the production of all military-topographic, economic and civil-use mapping.

The level of secrecy of the VTU's output meant that the West was unaware of the full extent of the unrivalled Soviet cartographic programme that was taking place throughout the Cold War. In 1993, Aivars Zvirbulis established a small map printing press in Riga, the capital of the newly independent Latvian republic. Having closed in 1992, the military topographic depot in the town of Cēsis (see Fig. 1.7), 100 km from Riga, was due to dispose of its stock as waste paper. Zvirbulis, on hearing this, salvaged a small proportion of the sheets and advertised them on an A4 flyer at the 16th International Cartographic Conference in Cologne, Germany, in May 1993. The maps were purchased by individuals and libraries across the world, of which the Library of Congress, USA, currently has the most sizeable collection. At the time of writing, the *Jāņa Sēta* map shop in Riga, which subsequently obtained more stock from another defunct topographic depot in Jelgava, continues to sell the remaining maps (see Fig. 1.8).

Fig. 1.7 The abandoned military topographic depot in Cēsis, Latvia (2015)

In the academic community, the maps received mention in the ensuing years (e.g. [8]) but more thorough study or application of this ‘new’ geospatial data has been slow to manifest itself, not emerging until the mid-2000s (e.g. [9–11, 13–17, 33, 65]). More recently, VTU maps have become commercially available in digital formats, notably from two American firms, *East View Geospatial* and *LandInfo*. Both have stressed the potential for Soviet spatial data to be used for a variety of contemporary applications, particularly environmental impact assessments and the construction of Digital Elevation Models (DEMs) [42]. Rondelli et al. [52] utilise 1950s 1:10,000 Soviet (GUGK) topographic coverage of Samarkand, now Uzbekistan, in an archaeological study of the area; using the maps alongside modern satellite imagery to locate archaeological remains with a view to supporting the management of such sites. Davies and Kent [17: 134–137] recount examples from military and UN personnel who used Soviet mapping on operation in Afghanistan and Iraq, as the maps constituted some of the most detailed terrain information available. The maps have also found new life in resource management. The detailed symbology of the maps has proved vital for the identification of artesian wells during water management projects in the Ararat Valley, Armenia (ibid.: 135). Soviet topographic sheets have also functioned well as records of land use, aiding the oil exploration process (ibid.: 135), while gold, copper, mercury and iron deposits near Herat, Afghanistan have been rediscovered by US Geological Survey (USGS) using Soviet geological maps [61]. USGS has also digitised and re-indexed Soviet topographic sheets covering Afghanistan in a project in conjunction with United States Agency for International Development (USAID)

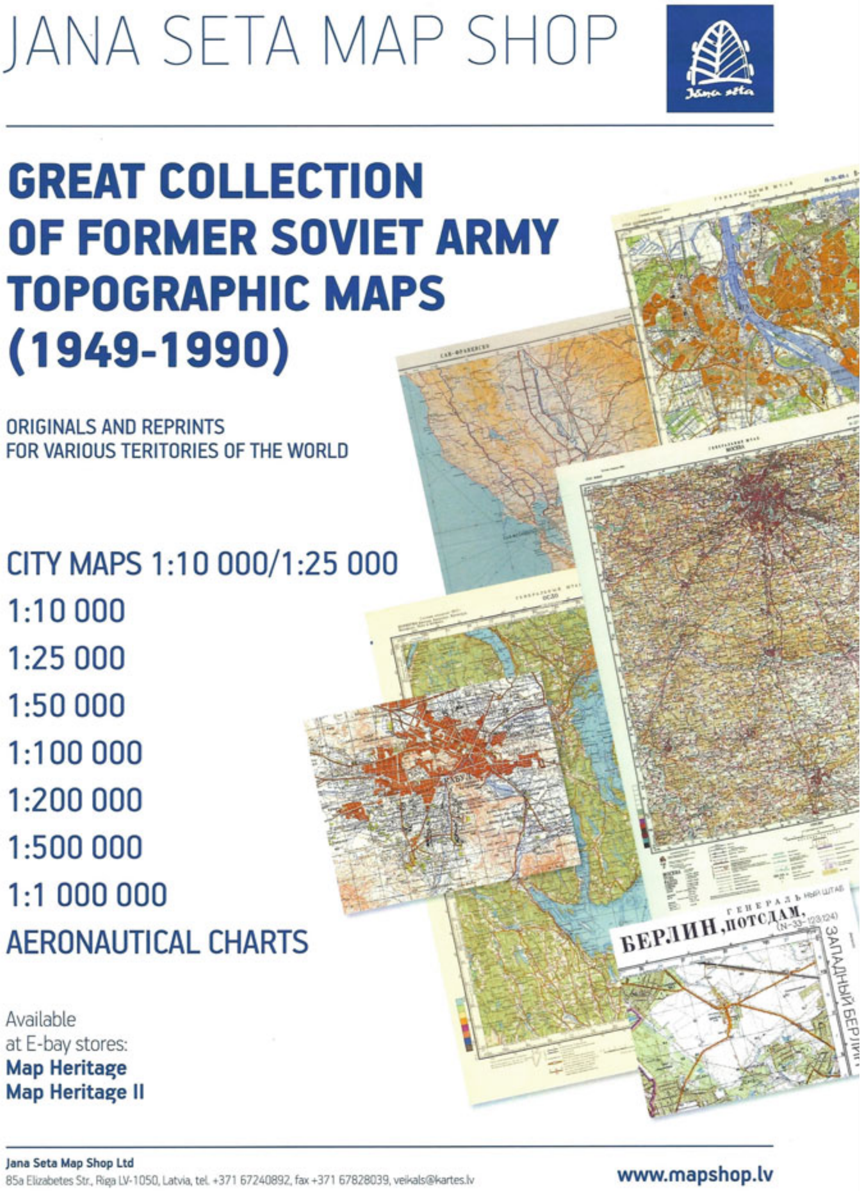

Fig. 1.8 A poster advertising Soviet maps at the *Jāņa Sēta* map shop in Riga, Latvia (2017)

[60]. Nevertheless, these applications are relatively rare and there remains vast scope for applications of Soviet maps and their data.

1.6 The Persistent Traits of Russian Cartography

As would be expected given its long heritage, cartography in Russia has seen immense change since its inception. Although Russian cartography prior to the reign of Peter the Great is often seen as primitive, relative to contemporary Western European cartography, by the Soviet era this state of affairs had reversed to such an extent that, in total secrecy, the military of the USSR was able to compile a standardised series of maps covering virtually the entire surface of the Earth—far surpassing Western attempts at global topographic mapping projects before or since. Nevertheless, despite the vast change and progression seen in Russian cartography throughout its history, three key elements have remained almost continuously—enduring wars, ideological revolutions and centuries of political change and technological advancement.

The first, state control, is perhaps the most pronounced. Commercial or private cartography, with a very small number of exceptions, has never played a substantial part in Russian cartography. Even today, state jurisdiction over cartographic activities forms part of the current constitution of the Russian Federation, and mapping is headed by *Roskartografiya*, a state-owned company. Broadly speaking, Russian cartography is an endeavour that exists for the benefit of the state and thus the state has seen a need to exert full control over it—this concept can equally be applied to the earliest days of tsarist autocracy and more recent times.

Relating to this, the second characteristic, censorship, emerged from the sensitive nature of early applications of Russian mapping—defence and the securing of borders. However, a propensity to severely limit the quality and amount of topographic information available to the general public remained over subsequent centuries, reaching its peak in the 1970s with GUGK's introduction of Ginzburg's distorting polyconic projections. Topographic mapping at 1:50,000 or larger remains secret in Russia and it is not possible to export maps at 1:200,000 or smaller.

The third inherent characteristic in Russian cartography is a perpetual thirst for ever-increasingly accurate and precise geographic data—in the right hands. In the pre-Petrine era, this took the form of using the river system to provide maps with structure and a framework around which to place other topographic features, while mathematical and geodetic training has long formed a fundamental part of the training of Russia's more recent military cartographers. The nature of Russian and Soviet cartography has clearly evolved a great deal throughout its long history; although state control, secrecy and a drive for accuracy seem to have endured the journey intact. Chapter Two focusses in more detail on Soviet Military City Plans, examining how these inherited historical traits manifested themselves in the scope and content of this particular map series.

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Chapter 2
An Introduction to Soviet Military City Plans

The previous chapter concluded that state control, censorship and a desire for ever-increasing accuracy are three trends which have characterised Russia's cartographic history. Of the map series which have emerged from the Soviet era since the fall of the Iron Curtain, the extensive global series of topographic city plans perhaps exhibits these qualities most clearly. Not only does the city plan series exemplify Soviet consistency with the values of pre-revolutionary Russian cartography, its rigour, unprecedentedly extensive coverage and use of the most up-to-date technologies available also display a desire to firmly place the Soviet Union at the forefront of cartographic progress during the twentieth century. As the maps were produced and stored in total secrecy, the aim of this impressive cartographic project was not to provide a celebrated showpiece of Soviet innovation and achievement. Nevertheless, the amount of resources that would have been required to undertake the project (rather than, for example, simply relying on satellite imagery) suggests more than a passing importance to Soviet strategy. Initiated by a decree from Stalin in the mid-1940s and continuing throughout the existence of the Soviet Union, the city plan series represents the largest scale mapping undertaken by the Soviet Union which incorporated areas outside its own territory.

Compiling lists and catalogues from current public collections of Soviet city plans produces a list of 2445 maps of settlements around the world, although only 1899 of these can currently be verified—295 of which are plans of cities within the former Soviet Union. Verified plans are those which are listed by more than one source or those which have been seen during the undertaking of this study. Military city plans were produced by the Military Topographic Directorate (VTU) of the General Staff and many carry the label 'General Staff' above the plan title. A parallel civil series of city plans was produced for cities within the USSR only. These were compiled by the Main Administration of Geodesy and Cartography (GUGK) and do not carry the 'General Staff' label. The differences between the military and civil series are outlined later, in Sect. 2.6, although the military plans are the main focus of this chapter. However, given the similarity of the series and the fact that many records and catalogues do not distinguish them, both are included in the enumerations below.

M. Davis, *A Cartographic Analysis of Soviet Military City Plans*, Springer Theses,
https://doi.org/10.1007/978-3-030-84017-4_2

Table 2.1 Summary of verified Soviet military city plans by scale and number of sheets

	1:5,000	1:10,000	1:15,000	1:20,000	1:25,000	Unknown scale	Total
1 sheet	1	961	24	–	199	–	1185
2 sheets	–	390	2	–	87	–	479
3 sheets	–	12	–	–	1	–	13
4 sheets	–	137	–	1	30	–	168
6 sheets	–	34	1	–	2	–	37
7 sheets	–	–	–	–	1	–	1
8 sheets	–	–	–	–	2	–	2
9 sheets	–	3	–	–	–	–	3
12 sheets	–	–	–	–	1	–	1
Unknown number of sheets	–	8	–	–	1	1	10
Total	1	1545	27	1	324	1	**1899**

Given the tactical scale of city plans, both General Staff and GUGK plans were classified ‘secret’ and carry the label *sekretno* in the top-right corner.

Whereas Soviet topographic sheets adhere to IMW sheet lines and use a Ginzburg projection, city plans are centred on towns or cities, regardless of their location on the IMW grid, and use a Gauss-Krüger projection. The earliest known city plans are of a trio of Iranian cities from 1944—Sari, Semnan and Shahrud. During 1991, the year in which the USSR was dissolved, 32 verified plans were produced. The most common scale used in the series is 1:10,000 (1545 plans), followed by 1:25,000 (324 plans). A few other scales are used rarely, including 27 plans at 1:15,000, a 1:20,000 plan of Tokyo (Japan) produced in 1966, and a 1:5,000 plan of Milford Haven (UK) produced in 1950. The practice of using of scales other than 1:10,000 and 1:25,000 stopped in the late 1960s and the exclusive production of plans at these two scales became mandatory during the 1970s ([6]: article 3). Although over 1000 city plans comprise a single sheet, many span multiple sheets, the largest being a 12-sheet, 1:25,000 plan of Los Angeles, USA (1976). Table 2.1 shows a summary of verified plans by scale and number of sheets (see also Figs. 2.1 and 2.2).

2.1 Coverage, Rationale and Basic Characteristics

City plans were produced of cities and towns around the world with the aim of facilitating orientation, accurate measurement and detailed studies of urban areas and their surroundings ([6]: article 1). A more recent manual ([12]: 49) adds ‘calculations in the organization and conduct of combat’ to the purpose of city plans. The underlying *raison d’etre* of the series has been the subject of speculation, although the 1978 production manual for the plans states that these purposes are pertinent to both ‘the

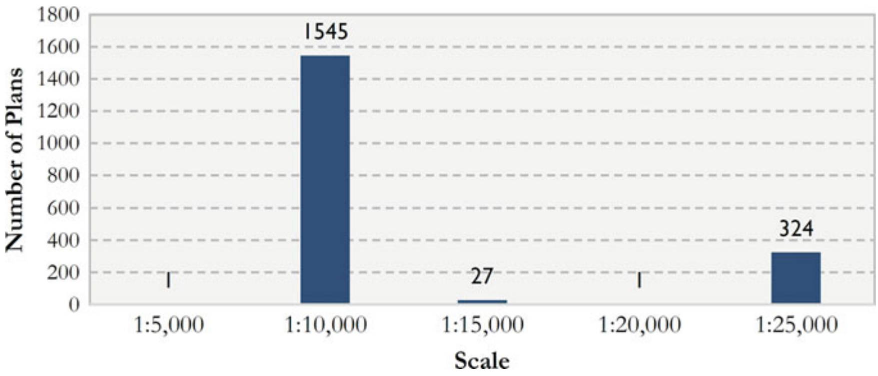


Fig. 2.1 Numbers of verified Soviet military city plans by scale

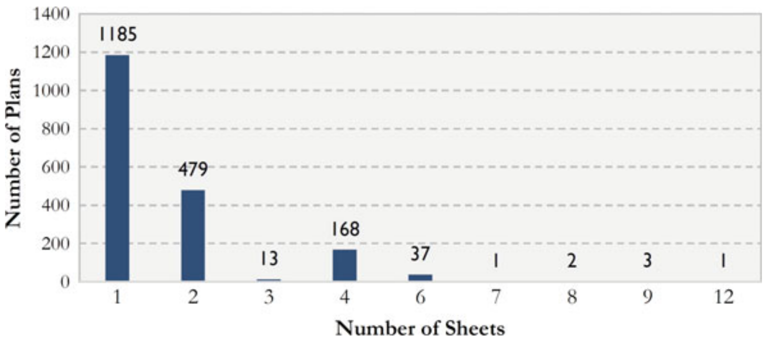


Fig. 2.2 Numbers of verified Soviet military city plans by number of sheets

people's economy and defence' ([6]: article 1). Kent and Davies [8] highlight the perceived threat of mutually-assured destruction (MAD) from nuclear weapons that existed throughout long periods of the Cold War but note that detailed topographic data of a city would be of little use after such an attack. Kent and Davies also highlight the possibility of a Soviet '*blitzkrieg*-style' invasion of Western Europe with the intention of overpowering NATO defences in order to dissuade the USA from using nuclear weapons. It is clear from the plans, however, that strategic sites are not the main focus of this detailed series, which instead focusses on settlements, rather than airfields, barracks and other sensitive sites located outside of urban areas. In light of this, Kent and Davies [8] suggest that perhaps the most feasible motive for the production of this comprehensive series was possible civil administration after successful coups or socialist revolutions in different parts of the world [4].

This notion certainly ties in with the breadth of coverage of the city plan series, as well as the concentration of mapped cities in more developed countries—a prerequisite for a socialist revolution as identified by Karl Marx and Friedrich Engels in *The*

Communist Manifesto [10]. *The Communist Manifesto* makes clear that socialist revolutions should take place in advanced economies where the proletariat would be able to participate in its entirety. Once this economic premise is satisfied, the foremost goal of Marxist communism is the abolition of private property and land ownership. As the product of collective labour and production, Marx believed that capital itself should be collectively owned. Naturally, this collectivisation of property and other capital together with the ensuing centralisation of administration would require some form of geographic data, to which the city plan series may have contributed. This possible rationale may also explain the reference to the 'national' or 'people's' economy in the plans' production manual. Nevertheless, the use of a conformal Gauss-Krüger projection (allowing accurate artillery targeting) and the common practice of highlighting strategically important sites within cities suggests that military applications of the plans were not entirely overlooked.

On the basis of current political boundaries, the city plan series incorporates settlements in 136 countries, with notable concentrations in Europe, North America and the Far East (Fig. 2.3). While many of the world's largest cities are included, such as Shanghai (China), Tokyo (Japan), London (UK), New York (USA), Paris (France), Istanbul (Turkey) and Cairo (Egypt), there are several large cities of which no Soviet plan is currently known to exist, such as Rio de Janeiro (Brazil), Bogotá (Colombia), Melbourne (Australia) and Lagos (Nigeria). Concurrently, some remarkably small settlements have not been overlooked, presumably because of their local administrative importance, military utility, function as a transport hub or proximity to international borders. Examples of such towns are Hamilton (Bermuda), Demblin (Poland) and Vardø (Norway), which together have a population of approximately

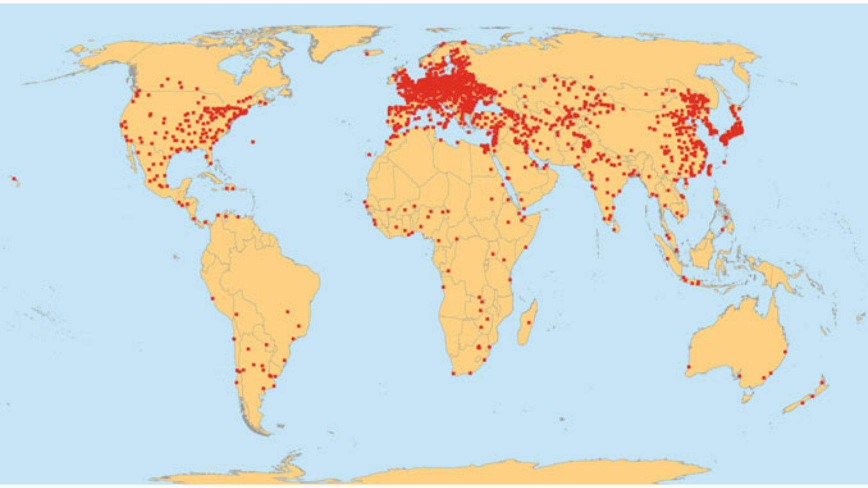


Fig. 2.3 Modern political map of the world showing cities known to be mapped under the Soviet city plan series outside Russia

6,000. Although some cities were mapped more than once, duplication of cities is relatively rare across the series.

The cartographers tasked with producing this vast map series were given several basic requirements which each plan needed to fulfil. Firstly, the plans should ‘reliably and accurately’ portray the location, condition, outline and character of structures in and around cities, while facilitating the ‘rapid detection’ of important or prominent landmarks and major roads ([6]: article 2). Potential military applications are alluded in the requirement of the plans to be ‘clear and legible’ in the interests of ‘dependable orientation’ and the provision of ‘accurate targeting information’ (ibid.). Unlike the distorted maps made available to the Soviet public [11], geodetic precision was of prime importance in the city plan series providing ‘the possibility of rapid determination of rectangular and geographic coordinates and the absolute and relative heights of points’ ([6]: article 2). Both qualitative and quantitative characteristics of objects were also to be included (ibid.). Although the series is a standalone entity from other Soviet map series, city plans were required to be consistent in terms of content with both topographic maps and marine charts ‘of the next smallest scale’ (ibid.). Flexibility of use was also a priority, with the plans expected to be produced with enough empty space to allow the addition of extra information at a later stage (ibid.).

2.1.1 Production Trends

Although the earliest known Soviet military city plans date from 1944, production remained fairly limited for the 25 years that followed. By 1969—more than half way through the duration of the project—fewer than 200 plans are known to have been produced; a mere eight per cent of the total. Figure 2.4 shows a clear surge in production from 1970 onwards, with the number of known plans issued growing significantly during almost every year of the 1970s. The number of known plans from 1970–1973 alone exceeds that of the previous three decades. By the end of the 1970s, 150–170 known plans were being issued annually; representing the zenith of the programme. Throughout the 1980s, production remained well above pre-1970 levels but began to wane—a trend that would not be reversed. By 1988, production receded to its lowest level since 1971. Of course, these figures only represent the city plans which have emerged since the dissolution of the Soviet Union in 1991; and the existence of many of these have yet to be verified beyond tenuous records. It therefore remains unknown to what extent these trends are representative of total production within the series.

Nevertheless, it seems more than coincidence that such a difference is visible before and after 1970; a trend almost certainly instigated by the launch of Zenit-4MT, the USSR’s first photogrammetric imaging satellite, on 27th December 1971 [3]. The growth of the project at this time is also reflected in the geographical spread of its coverage. Although Europe and Asia were mapped from the inception of the project, consistent with the early coverage of the Soviet topographic series, city

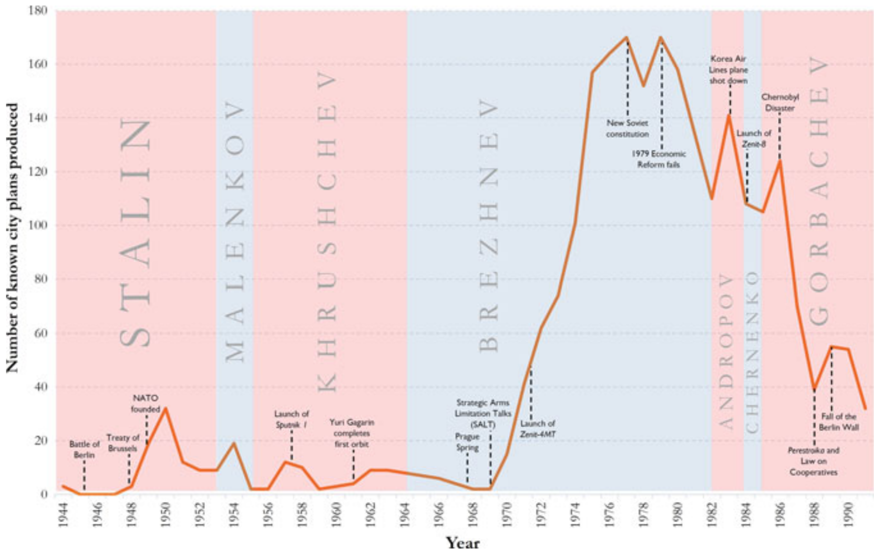


Fig. 2.4 Timeline of the production of known Soviet city plans (verified and unverified)

plans of only two North American cities and two African cities are known which date from before 1970—and no such plans are known to exist of South American or Australasian cities. The mapping of the Soviet Union's own territory at 1:100,000 was completed in 1954, perhaps freeing some capacity in military topographic factories across the country. Notwithstanding these points, without the availability of definitive production inventories such matters remain in the realms of speculation. Zenit-4MT flew over 20 missions before it was decommissioned in 1982 to be replaced by Zenit-8 (1984–1994) (ibid.).

2.2 Plan Content, Components and Layout

Given that the vast majority of Soviet city plans were produced after 1972, and the only available compilation manual for city plans is the edition of 1978, the main focus of this section is plans of the 1970s and later. However, reference is made to earlier practices where these deviate significantly. Soviet military city plans were required to include eight major elements of content, namely mathematical elements (including grids and margins), geodetic points, streets, structures, hydrography, relief, vegetation and boundaries ([6]: article 7). In addition, all city plans were required to include geographic names and annotations providing both qualitative and quantitative characteristics of objects ([6]: article 8). The content of a particular city plan depends partly on the number of colours used to print it. Although some early plans are printed in six colours, from the early 1970s, plans were required to be printed in either eight or ten colours. Plans printed in ten colours were required to distinguish important buildings and structures by colour coding them ([6]: article 7) (see Fig. 2.6). The scope of the content and symbology used in the city plan series is very similar to that of Soviet topographic series at the same scales. Consequently, the conventional signs of city plans are drawn from a threefold combination of those for 1:25,000 topographic maps, 1:10,000 topographic maps and a small supplement, appended to the city plan compilation manual ([6]: article 11). Nevertheless, the regulations did permit the creation of additional conventional signs if no existing symbols were suitable, on the condition that these were explained in the margins of the plan in the form of a legend. However, in most cases, the legend is used to describe between three and six of the most common symbols on the plan (Fig. 2.5).

As well as the entire urban area, city plans include a buffer zone of at least 1.5–2 km around the city. This band is larger if important landmarks, commanding heights, communication nodes or industrial facilities are located outside of the area immediately adjacent to the city ([6]: article 3). In order to accommodate this need for flexibility, city plans have no standard sheet size. Instead, city plans have a maximum sheet size of 88 × 125 cm, including marginalia (ibid.). If a plan of a particular city at the chosen scale would exceed these dimensions, a multi-sheet plan was produced. Plans are presented in either portrait or landscape orientation, depending on the morphology of the city.

Sheets in a multi-sheet plan do not overlap but are instead arranged in a grid layout and assigned sheet numbers. This can lead to some unfortunate placement of sheet boundaries, which sometimes divide city centres across two or even four sheets [4]. The sheet arrangement and the location of a particular sheet within this framework is indicated by a diagram in the margins of each sheet (see Fig. 2.7).

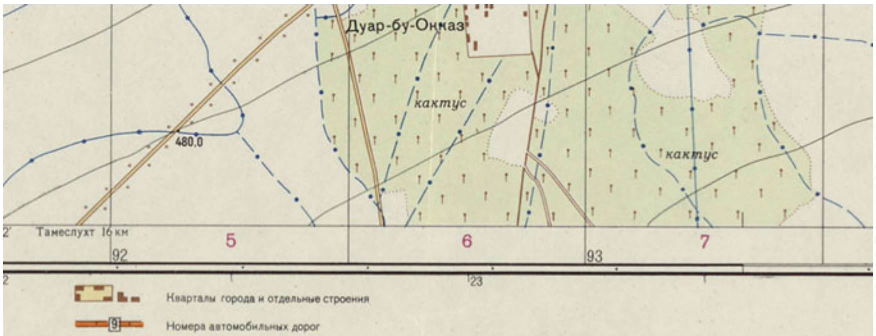


Fig. 2.5 Part of the legend on the Soviet plan of Marrakesh, Morocco (1973, 1:10,000) showing urban blocks and individual buildings (top) and a highway number symbol (bottom) (ICGC, RM.165430)

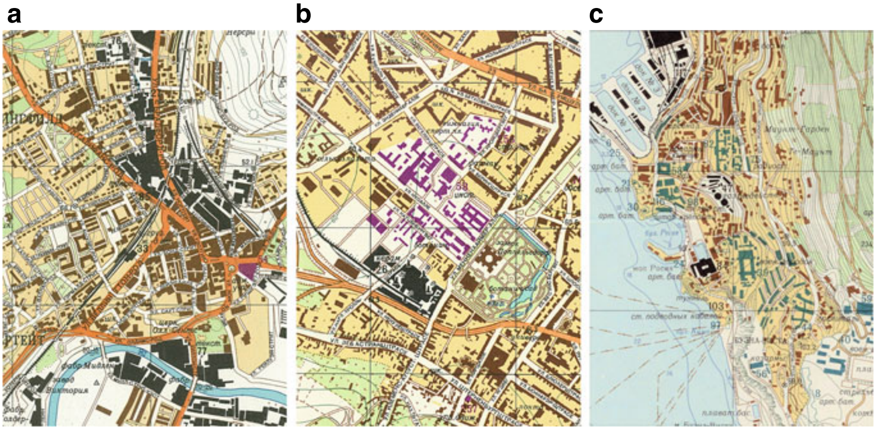


Fig. 2.6 **a** Military-Industrial buildings (black) in the centre of Dewsbury, UK (1983, 1:10,000) (private collection). **b** Administrative/Government buildings (purple) in the centre of Bonn, West Germany (1987, 1:10,000) (private collection). **c** Military/Communications installations (green) in Gibraltar (1974, 1:10,000) (ICGC, RM.165479)

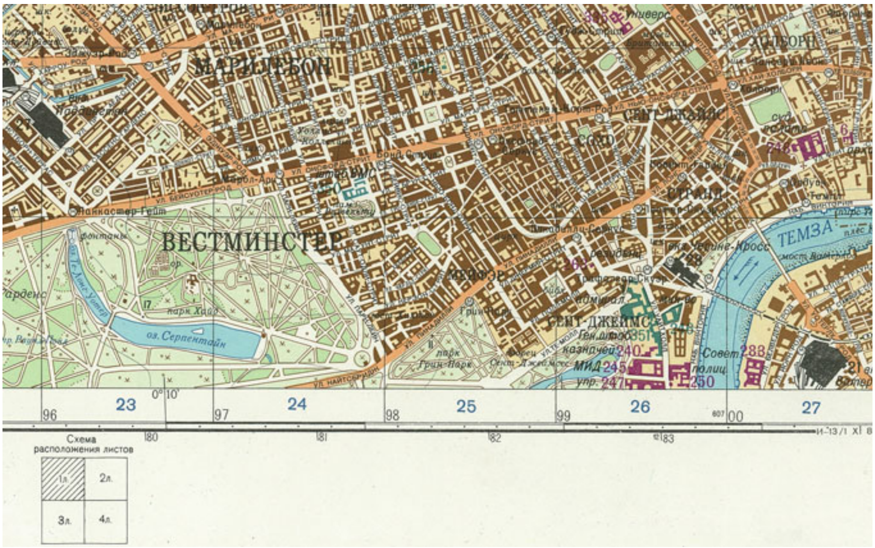


Fig. 2.7 An extract from sheet 1 of the Soviet plan of London, UK (1985, 1:25,000) showing the sheet arrangement diagram in the margin. To the right, the edge of the sheet runs through government buildings in Westminster (private collection)

2.2.1 Title Blocks

The most noticeable element of marginalia is the title of the city plan, which is stated in a bold, serif typeface at the top of the plan. Consistent with all toponyms on the plans themselves, plan titles are phonetically transliterated into the Cyrillic alphabet. Generally, this is a straightforward process, although some names lend themselves to the Cyrillic alphabet better than others (see Table 2.2 for examples). On each plan, the title is located in such a place that it would be at the top-centre of a plan if all of the sheets were to be laid out in their correct relative positions, as indicated by the sheet layout diagram. This is straightforward on single-sheet plans, on which the title appears at the top-centre of the sheet (see Fig. 2.8). On plans with two laterally-arranged sheets (or with two sheets in the top row of the sheet layout diagram), the

Table 2.2 Examples of transliterated toponyms used as titles for Soviet city plans

Cyrillic title	Approximate pronunciation	English toponym, Country
Хаддерсфилд	Khaddersfild	Huddersfield, UK
Гаага	Gaaga	The Hague, the Netherlands
Тегеран	Tegeran	Tehran, Iran
Глостер	Gloster	Gloucester, UK
Суэц	Sooets	Suez, Egypt
Лакхнау	Lakkhnaoo	Lucknow, India
Бадахос	Badakhos	Badajoz, Spain
Танжер	Tanzher	Tangiers, Morocco
Кале	Kalye	Calais, France

Accurate phonetics are prioritised over accurate spellings, although the Cyrillic alphabet does not always facilitate this

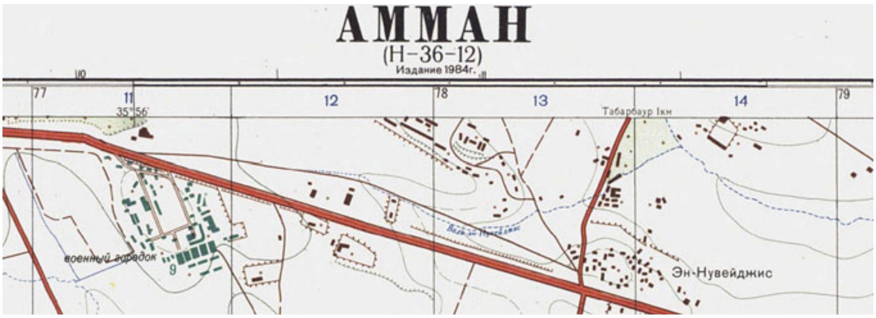


Fig. 2.8 Title block from the single-sheet Soviet plan of Amman, Jordan (1984, 1:10,000). The entire title is given in a bold typeface at the top-centre of the sheet (National Library of Australia, nla.obj-234528465)

first (left) sheet shows the title in the top-right corner of the plan, with the first part of the city name in bold, and the remainder in a much finer typeface at two-thirds of the height of the former.

The second sheet of a plan does the reverse, with the title appearing in the top-left corner of the plan; the first part in a fine typeface and the second in a bold typeface. Any subsequent sheets have a centralised title, sometimes with the sheet number (e.g. Лист 3 to denote sheet 3), using the finer typeface for all lettering (see Fig. 2.9). Sometimes, the title on subsequent sheets instead appears in one of the side or bottom margins. On plans with three laterally-arranged sheets (or with three sheets in the top row of the sheet layout diagram), the main title block will appear in the centre of sheet 2 (the central sheet at the top of the plan). Many military city plans include a widely-spaced label reading 'General Staff' above the title (see Figs. 2.10 and 2.11). This label, however, does not appear on all plans, notably civil plans produced by GUGK. Until the early 1970s, city plan titles were preceded by the term План г. (an abbreviation of *Plan gorod* or city plan) (see Fig. 2.11). Under each title, the nomenclature of the Soviet 1:100,000 topographic sheet(s) which cover the area of the plan is stated ([6]: Appendix 4). Soviet topographic maps use the IMW nomenclature system (retaining the Roman lettering), which covers the whole world. This means that such a reference can be given on all plans, even in areas where a Soviet 1:100,000 sheet had not been produced at the time the plan was issued. The exception to this is early plans from the 1940s and 1950s, before the global 1:100,000 programme had become established.

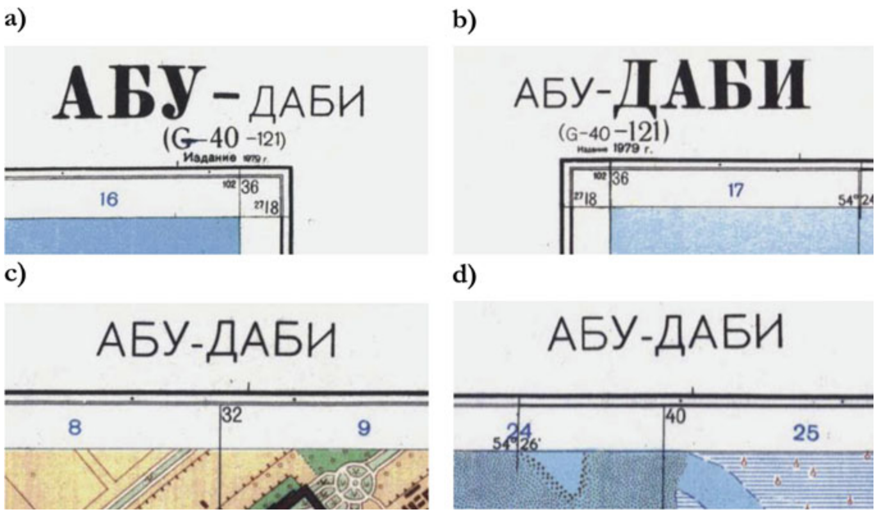


Fig. 2.9 Title blocks from the 4-sheet Soviet plan of Abu Dhabi, UAE (1979, 1:10,000) in the correct relative layout. **a** Top-right corner of sheet 1. **b** Top-left corner of sheet 2. **c** Top-centre of sheet 3. **d** Top-centre of sheet 4 (National Library of Australia, nla.obj-234555319)

Fig. 2.10 Title block from the Soviet plan of Lucknow, India (1986, 1:25,000), including the General Staff label (National Library of Australia, nla.obj-234559035)

Fig. 2.11 Title at the top-centre of sheet 2 of the 6-sheet Soviet plan of Budapest, Hungary (1962, 1:15,000), reading *Plan g. Budapesht* [plan of the city of Budapest] (ICGC, RM.165448)

2.2.2 *The Spravka*

For each city plan, a 1000–2000-word *spravka*, or reference text, is compiled with the purpose of '[complementing] the plan with information not receiving graphical representation' ([6]: article 49). The *spravka* gives a descriptive overview of the terrain in and around the city as well as an outline of notable features in the area covered by the plan, including but not limited to the major industrial sites, railway stations, sea and river ports, airports, power stations and dams. Important sites outside the area of the sheet can also be described, as long as the direction and distance of the feature from the centre of the city is stated (ibid.). The *spravka* is most frequently included outside of the plan margins or on the plan itself inside a white box, typically on the final sheet across an area of little importance (see Fig. 2.12). Occasionally, the *spravka* appears on a separate sheet and, in exceptional cases, in a separate booklet ([6]: article 9).

The content and format of *spravka* texts follows a predefined framework, ensuring that the *spravka* on each plan gives similar information with comparable levels of

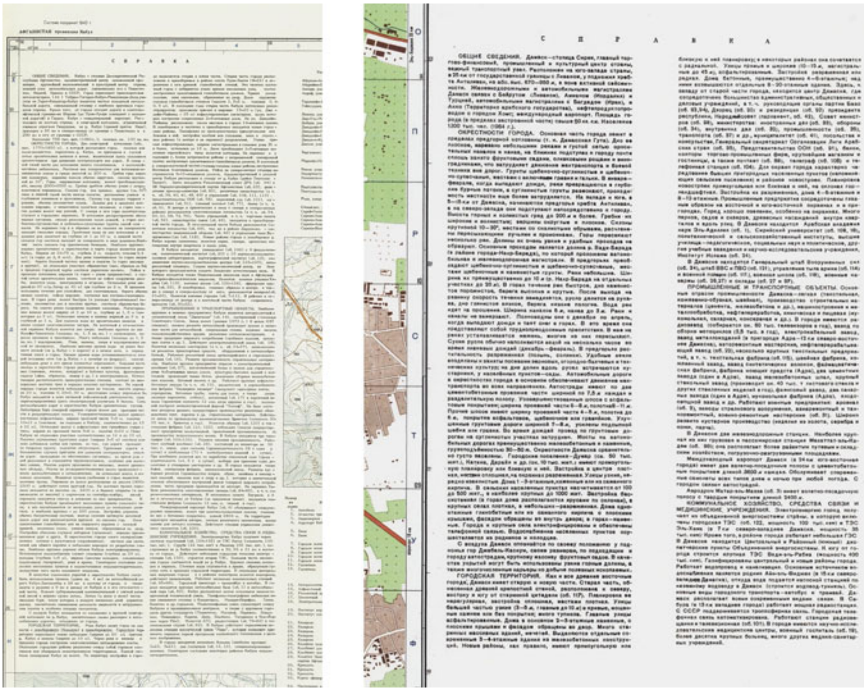


Fig. 2.12 Varying placements of the *spravka*. On the plan of Kabul, Afghanistan (1984, 1:10,000) the text is placed in a white box across a rural area (left). On the plan of Damascus, Syria (1987, 1:10,000) it is placed outside of the margins (right) (National Library of Australia, nla.obj-234130751 and nla.obj-234529475)

detail ([6]: Appendix 1). This framework is set out in Table 2.3. When a specific site or object is first mentioned in the *spravka*, the number of this object in the list of important objects (see Sect. 2.2.3) is placed in brackets after its name.

A variety of sources were used to compile the *spravka* on each plan, including existing large-scale topographic maps of the area, physical, economic and military descriptions of the city, any texts regarding local hydrography, climate or transport, local newspapers, atlases or any other specialist maps and aerial photographs (showing a plan or oblique view) ([6]: article 49). Information from all of these source materials was assessed for its accuracy and current relevance before being included in a *spravka* (ibid.). In order that the whole of the relevant area can be referred to in the *spravka*, the writing of the text took place after master copy of the plan itself had been completed.

Table 2.3 The typical organisation of content in a *spravka* reference text, which accompanies each city plan (translated and adapted from the compilation manual for city plans [6])

	Organisation of content
Paragraph 1 Overview	• Political, economic and cultural importance of the city • Number of railways, major roads and pipelines which enter the city (most important examples are named) • Presence of sea or river ports and access to navigable waterways • Presence of airports • Geographical location relative to boundaries, notable physical features, large administrative/economic centres and sources of raw materials • Population (separate figures for the suburbs and city proper, if available, and the year in which these data were collected) • Area of the metropolitan area
Paragraph 2 The Surroundings of the City	• General summary of topography, soils, hydrology and water bodies (including crossings), vegetation, climatic conditions, seismic activity and the duration of the polar day and night (for cities within the arctic circle) • Influence of terrain and climate on the movement of transport and the range of visibility in different parts of the city • Characteristics of roads (classifications, surfaces etc.) • Characteristics of surrounding settlements (towns, villages etc.) • Characteristics of beaches, coastal zones and tides (for coastal cities) • Guidance on approaching and recognising the city from the air • Presence and characteristics of underground shelters (mines, caves, tunnels etc.)
Paragraph 3 The Urban Area	• The nature of the terrain within the city • The nature of planning and construction within the city, with a particular focus on administrative, industrial and business districts • Characteristics of streets • Typical construction materials and number of storeys in buildings (including reference to basements which can be used as shelters) • Characteristics of green spaces in the city • Important educational and research institutions

(continued)

Table 2.3 (continued)

	Organisation of content
Paragraph 4 Industry and Transport	• Main industries in the city and the types of products produced there • Summary of secondary industries • The most important companies • Presence of warehouses and storage facilities • Major railway stations (passenger, freight, postal etc.) and the nature of the station buildings • Number of railway tracks and the presence of loading areas, workshops, depots and warehouses • Sea or river ports—their purpose, turnover of goods, traffic and water area. Types and numbers of mooring facilities and the length of the mooring line, depths of docks, loading facilities, and the presence of warehouses, cold storage, oil storage, access railways, pipelines and ship repair facilities • Airports—the number of runways and their surfaces, navigation and lighting facilities and the presence of hangars, workshops, warehouses and weather stations • Pipelines—types, numbers, performance characteristics and the presence of pumping stations
Paragraph 5 Utilities, Communications and Medical Facilities	• Sources of the city's electricity • Sources of the city's gas supplies • Water systems and sources, including the sewerage network • Main types of urban transport (e.g. metro systems—lengths of lines and typical depth of stations) • Information about telephone lines and radio and television broadcasting stations • Medical facilities—clinics, hospitals, sanatoriums and rest homes

2.2.3 *Lists of Important Objects*

Many city plans assign a number to important buildings or structures within the territory of the city. This number refers to a numbered list of important objects which can be placed inside or outside of the margins of the plan or on a separate sheet or booklet, alongside the *spravka*. Lists are compiled in alphabetical order by type of feature (e.g. aerodrome, factory, power station and so on) with this category repeated at the start of each relevant entry. Within each category, entries are listed by alphabetical order of the name of the relevant company or organisation. Next to each item in the list, the relevant grid reference is included (Fig. 2.13). This grid reference can refer to an inset, if the object is outside of the main area of the plan

([6]: article 50). Groups of similar buildings which form part of the same site (e.g. multiple buildings which make up a factory) can be grouped under one number on the list. This rule is not adhered to if a particular part of a site is of more importance than the rest, in which case it is listed separately (ibid.). If large numbers of objects make up each category (typically in larger cities), these categories are listed as subtitles and the individual objects are then listed in alphabetical order by company name under each subtitle (ibid.). Names are never abbreviated or given in quotation marks (ibid.).

After the practice of colour-coding buildings was introduced in the early 1970s (facilitated by printing plans in ten colours), the numbering and listing of important buildings became reserved for plans which made this distinction ([6]: article 9). Building numbers and lists of important objects are not provided on GUGK plans of cities within the Soviet Union, which continued to be printed in eight colours. It could be speculated that this level of detail in domestic cities was reserved for a higher level of classification (*sovershenno sekretno*, or top secret). No maps with this classification have emerged since the dissolution of the Soviet Union, although its existence has been noted by some authors [7].

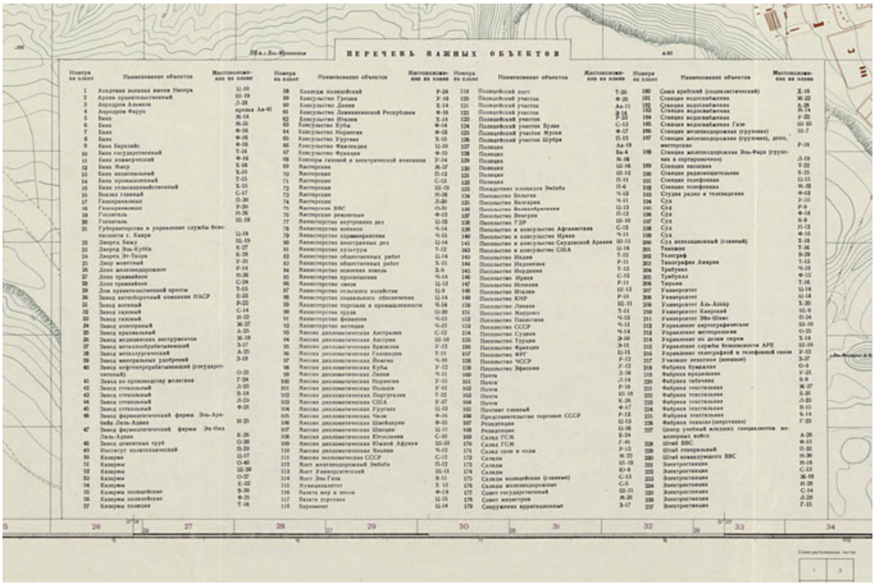


Fig. 2.13 Example of a list of important objects from the Soviet plan of Cairo, Egypt (1972, 1:10,000) (ICGC, RM.165391)

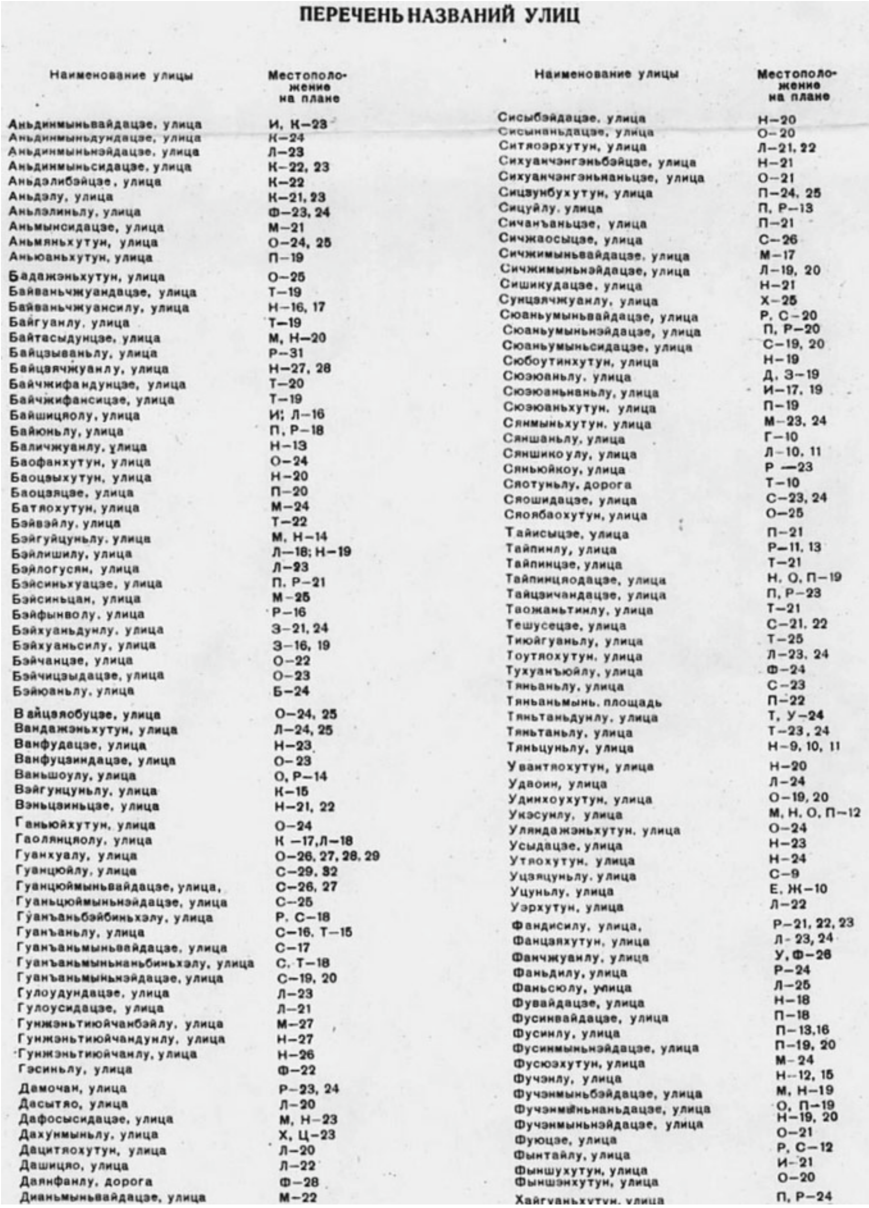
2.2.4 Lists of Street Names

On each plan, a list of street names is provided, including all streets which are labelled on the plan, regardless of their size. A general list is compiled for the whole plan, regardless of the number of sheets that it has ([6]: article 52). As on the list of important objects, a grid reference is provided for each street. If a street straddles two grid squares, the square in which the majority of the street name label is located is listed. For long streets which transcend several grid squares, two grid references are given—one for each end of the street (ibid.). The inclusion of grid references in the list allows for the differentiation of streets with the same name in different parts of a city. The list is compiled in alphabetical order and, unlike the list of important objects, no categorisations or subheadings are used. A small gap is included between the streets belonging to each letter of the alphabet and the first letter of the first street name for each letter is shown in a bold typeface (ibid.). In cities where Cyrillic is not the native alphabet, the transliterated street names are listed in Cyrillic alphabetical order, not the order in which the streets would be listed in the native alphabet (Fig. 2.14).

Street names which start with an ordinal number are listed separately after the alphabetical list. It was common practice in the Soviet Union to name streets after dates of significant historical events and, elsewhere, some cities with grid layouts (e.g. New York) use numbered street systems rather than proper nouns. If street names consist of an ordinal number followed by a name (e.g. 20th October Street), these streets are listed in alphabetical order according to the name. If, however, street names consist of an ordinal number followed by a common street designation (e.g. 51st Avenue), these are listed in numerical order (ibid.).

2.2.5 Schematic Metro Diagrams

A schematic diagram of metro lines around the city is included on some plans (Fig. 2.15). These diagrams show both current and proposed lines, stations (marked by a circle), transfer stations (marked by a larger circle) and railway depots. For context, main roads are also included and labelled, along with water courses and other major landmarks in the city. There is no fixed scale for metro diagrams. Instead, a scale is selected based on the extent of the metro system and the amount of available space on the plan ([6]: article 50). Metro lines and related labels are marked in black, distinguishable from roads and their labels which are marked with a brown outline. Proposed metro lines are indicated by a dashed, black line ([6]: Appendix 9). Hydrographic labels and outlines of water bodies are marked in dark blue, with a paler blue fill used for areas of water. The extent of the built up area is shown in pale yellow or brown ([6]: article 50). A basic legend is included with the diagram. Plans only include a single metro diagram, not one per sheet. If there is not sufficient space for the metro diagram on a sheet of the plan, it can be included in a separate booklet. In these cases, the diagram is printed entirely in black (ibid.).



ПЕРЕЧЕНЬ НАЗВАНИЙ УЛИЦ

Наименование улицы	Местоположение на плане
Аньдинмыньвайдацзе, улица	И, К−23
Аньдинмыньдундацзе, улица	К−24
Аньдинмыньнэйдацзе, улица	Л−23
Аньдинмыньсидацзе, улица	К−22, 23
Аньдэлибэйцзе, улица	К−22
Аньдэлу, улица	К−21, 23
Аньлэлиньлу, улица	Ф−23, 24
Аньмынсидацзе, улица	М−21
Аньмяньхутун, улица	О−24, 25
Аньюаньхутун, улица	П−19
Бадажэньхутун, улица	О−25
Байваньчжуандацзе, улица	Т−19
Байваньчжуансилу, улица	Н−16, 17
Байгуанлу, улица	Т−19
Байтасыдунцзе, улица	М, Н−20
Байцзываньлу, улица	Р−31
Байцзячжуанлу, улица	Н−27, 28
Байчжифандунцзе, улица	Т−20
Байчжифансицзе, улица	Т−19
Байшицяолу, улица	И; Л−16
Байюньлу, улица	П, Р−18
Баличжуанлу, улица	Н−13
Баофанхутун, улица	О−24
Баоцзыхутун, улица	Н−20
Баоцзяцзе, улица	П−20
Батяохутун, улица	М−24
Бэйвэйлу, улица	Т−22
Бэйгуйцуньлу, улица	М, Н−14
Бэйлишилу, улица	Л−18; Н−19
Бэйлогусян, улица	Л−23
Бэйсиньхуацзе, улица	П, Р−21
Бэйсиньцан, улица	М−25
Бэйфынволу, улица	Р−16
Бэйхуаньдунлу, улица	З−21, 24
Бэйхуаньсилу, улица	З−16, 19
Бэйчанцзе, улица	О−22
Бэйчицзыдацзе, улица	О−23
Бэйюаньлу, улица	Б−24
Вайцзяобуцзе, улица	О−24, 25
Вандажэньхутун, улица	Л−24, 25
Ванфудацзе, улица	Н−23
Ванфуцзиндацзе, улица	О−23
Ваньшоулу, улица	О, Р−14
Вэйгунцуньлу, улица	К−15
Вэньцзиньцзе, улица	Н−21, 22
Ганьюйхутун, улица	О−24
Гаолянцяолу, улица	К −17, Л−18
Гуанхуалу, улица	О−26, 27, 28, 29
Гуанцюйлу, улица	С−29, 32
Гуанцюймыньвайдацзе, улица,	С−26, 27
Гуаньцюймыньнэйдацзе, улица	С−25
Гуанъаньбэйбиньхэлу, улица	Р, С−18
Гуанъаньлу, улица	С−16, Т−15
Гуанъаньмыньвайдацзе, улица	С−17
Гуанъаньмыньнаньбиньхэлу, улица	С, Т−18
Гуанъаньмыньнэйдацзе, улица	С−19, 20
Гулоудундацзе, улица	Л−23
Гулоусидацзе, улица	Л−21
Гунжэньтиюйчанбэйлу, улица	М−27
Гунжэньтиюйчандунлу, улица	Н−27
Гунжэньтиюйчанлу, улица	Н−26
Гэсиньлу, улица	Ф−22
Дамочан, улица	Р−23, 24
Дасытяо, улица	Л−20
Дафосысидацзе, улица	М, Н−23
Дахунмыньлу, улица	Х, Ц−23
Дацитяохутун, улица	Л−20
Дашицяо, улица	Л−22
Даянфанлу, дорога	Ф−28
Дианьмыньвайдацзе, улица	М−22

Наименование улицы	Местоположение на плане
Сисыбэйдацзе, улица	Н−20
Сисыньнаньдацзе, улица	О−20
Ситяоэрхутун, улица	Л−21, 22
Сихуанчэнгэньбэйцзе, улица	Н−21
Сихуанчэнгэньнаньцзе, улица	О−21
Сицзунбухутун, улица	П−24, 25
Сицуйлу, улица	П, Р−13
Сичанъаньцзе, улица	П−21
Сичжаосыцзе, улица	С−26
Сичжимыньвайдацзе, улица	М−17
Сичжимыньнэйдацзе, улица	Л−19, 20
Сишикудацзе, улица	Н−21
Сунцзячжуанлу, улица	Х−25
Сюаньумыньвайдацзе, улица	Р, С−20
Сюаньумыньнэйдацзе, улица	П, Р−20
Сюаньумыньсидацзе, улица	С−19, 20
Сюбоутинхутун, улица	Н−19
Сюэюаньлу, улица	Д, З−19
Сюэюаньнаньлу, улица	И−17, 19
Сюэюаньхутун, улица	П−19
Сянмыньхутун, улица	М−23, 24
Сяншаньлу, улица	Г−10
Сяншикоулу, улица	Л−10, 11
Сяньюйкоу, улица	Р −23
Сяотуньлу, дорога	Т−10
Сяошидацзе, улица	С−23, 24
Сяоябаохутун, улица	О−25
Тайисыцзе, улица	П−21
Тайпинлу, улица	Р−11, 13
Тайпинцзе, улица	Т−21
Тайпинцяодацзе, улица	Н, О, П−19
Тайцзичандацзе, улица	П, Р−23
Таожаньтинлу, улица	Т−21
Тешусецзе, улица	С−21, 22
Тиюйгуаньлу, улица	Т−25
Тоутяохутун, улица	Л−23, 24
Тухуанъюйлу, улица	Ф−24
Тяньаньлу, улица	С−23
Тяньаньмынь, площадь	П−22
Тяньтаньдунлу, улица	Т, У−24
Тяньтаньлу, улица	Т−23, 24
Тяньцуньлу, улица	Н−9, 10, 11
Увантяохутун, улица	Н−20
Удаоин, улица	Л−24
Удинхоухутун, улица	О−19, 20
Укэсунлу, улица	М, Н, О, П−12
Улядажэньхутун, улица	О−24
Усыдацзе, улица	Н−23
Утяохутун, улица	Н−24
Уцзяцуньлу, улица	С−9
Уцуньлу, улица	Е, Ж−10
Уэрхутун, улица	Л−22
Фандисилу, улица,	Р−21, 22, 23
Фанцзяхутун, улица	Л−23, 24
Фанчжуанлу, улица	У, Ф−26
Фаньдилу, улица	Р−24
Фаньсюлу, улица	Л−25
Фувайдацзе, улица	Н−18
Фусинвайдацзе, улица	П−18
Фусинлу, улица	П−13, 16
Фусинмыньнэйдацзе, улица	П−19, 20
Фусюэхутун, улица	М−24
Фучэнлу, улица	Н−12, 15
Фучэнмыньбэйдацзе, улица	М, Н−19
Фучэнмыньнаньдацзе, улица	О, П−19
Фучэнмыньнэйдацзе, улица	Н−19, 20
Фуюцзе, улица	О−21
Фынтайлу, улица	Р, С−12
Фыншухутун, улица	И−21
Фыншэнхутун, улица	О−20
Хайгуаньхутун, улица	П, Р−24

Fig. 2.14 Extract of a list of streets from the Soviet plan of Peking (Beijing), China (1983, 1:25,000) (National Library of Australia, nla.obj-234057212)

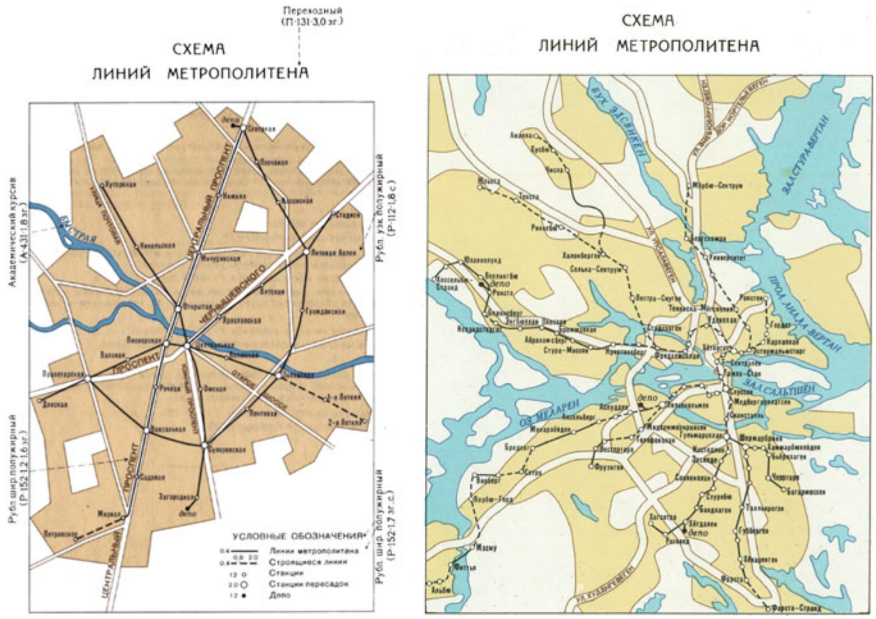


Fig. 2.15 Annotated example of a schematic metro diagram from the compilation manual for city plans (left) [6] and a schematic metro diagram from sheet 6 of the Soviet plan of Stockholm, Sweden (1986, 1:10,000) (right) (private collection)

2.2.6 Separate Booklets for the Spravka, Lists and Diagrams

For plans of larger cities, the *spravka*, the list of important objects and the list of street names can be presented in a separate booklet if including this information on the map sheets would 'enlarge the dimensions of the plan excessively' ([6]: article 9). Such booklets were required to have dimensions of 14.5 × 22.2 cm and feature a small-scale, schematic diagram of the city on the cover, showing the location of nearby settlements, roads, rivers, boundaries and water bodies ([6]: article 53). On plans for which a booklet has been issued, a note is placed in the right-hand margin stating that 'the *spravka*, list of street names and list of important objects is given in a separate booklet' (ibid.) (Fig. 2.16).

2.2.7 Topographic Insets

Despite being a separate series, it is clear that city plans were intended to be used in conjunction with Soviet topographic maps of the wider area. This is apparent from the inclusion of the relevant 1:100,000 IMW sheet reference under the title of each plan (Fig. 2.8). However, in instances where a plan was being produced of a city in

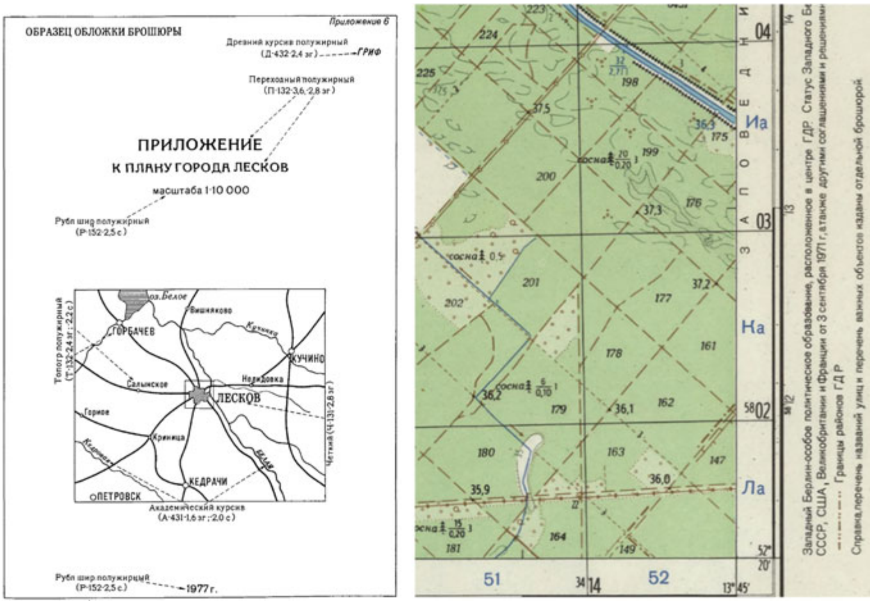


Fig. 2.16 Annotated example of a booklet cover for the fictional city of 'Leskov' from the compilation manual for city plans (left) [6] and a note in the margin of the Soviet plan of Berlin, East Germany (1983, 1:25,000) referring to the separate booklet (right) (National Library of Australia, nla.obj-234558452)

an area which was not covered by a Soviet topographic sheet at 1:200,000 or larger, a topographic extract was compiled at either 1:100,000 or 1:200,000 and placed on the plan as an inset ([6]: article 4). Such insets (see Fig. 2.17) were required to show an area at least 5–10 km in width around the edge of the city (ibid.). At least ten city plans have such a topographic inset.

2.2.8 Marginalia

Several pieces of information are included in the margins of all Soviet city plans. Although conventions regarding the layout of such information have developed slowly over time, the diagram published in the 1978 city plan compilation manual (Fig. 2.18) not only displays the conventions at this particular time, but also indicates the type of information included on Soviet city plans of all eras and the precision with which the format of each plan was stipulated. The marginalia of each sheet, based on its sheet number and the total number of sheets in the plan, was required to follow this layout framework, ensuring consistency between plans.

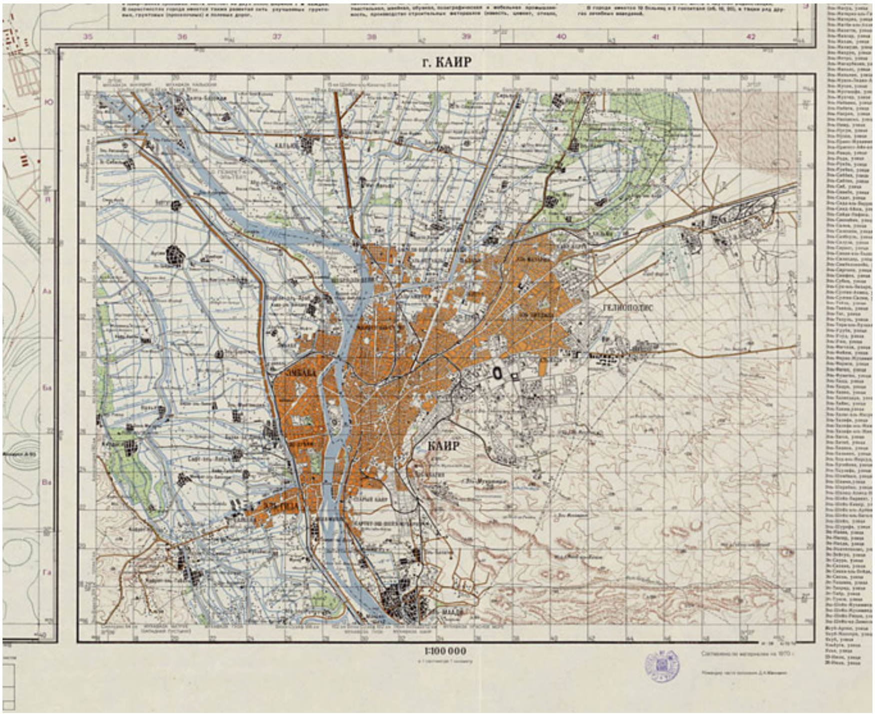


Fig. 2.17 A 1:100,000 topographic inset on the Soviet plan of Cairo, Egypt (1972, 1:10,000) (ICGC, RM.165391)

2.2.8.1 Country and Regional Information

Under the coordinate system label, in the top-left corner of the first sheet of each plan, a short label is given which indicates the political or administrative jurisdiction in which the city is located. Typically, this includes the name of the relevant country, in capitals, followed by the appropriate region or province in sentence case. Unlike other toponyms on the plans, Russian names are given where these exist, not transliterations of local names. Where the territory of a plan straddles an international border, both sets of relevant countries and regions are stated. In these cases, the country which covers the greater area of the plan is listed first (see Fig. 2.19). The label is omitted altogether on very early plans.

2.2.8.2 Edition Dates

The edition dates on city plans produced prior to 1967–69 are stated in a cut out in the frame of the plan, in the top-left corner of the first sheet. This label also includes a Russian ordinal number, indicating how many editions of a plan have been produced

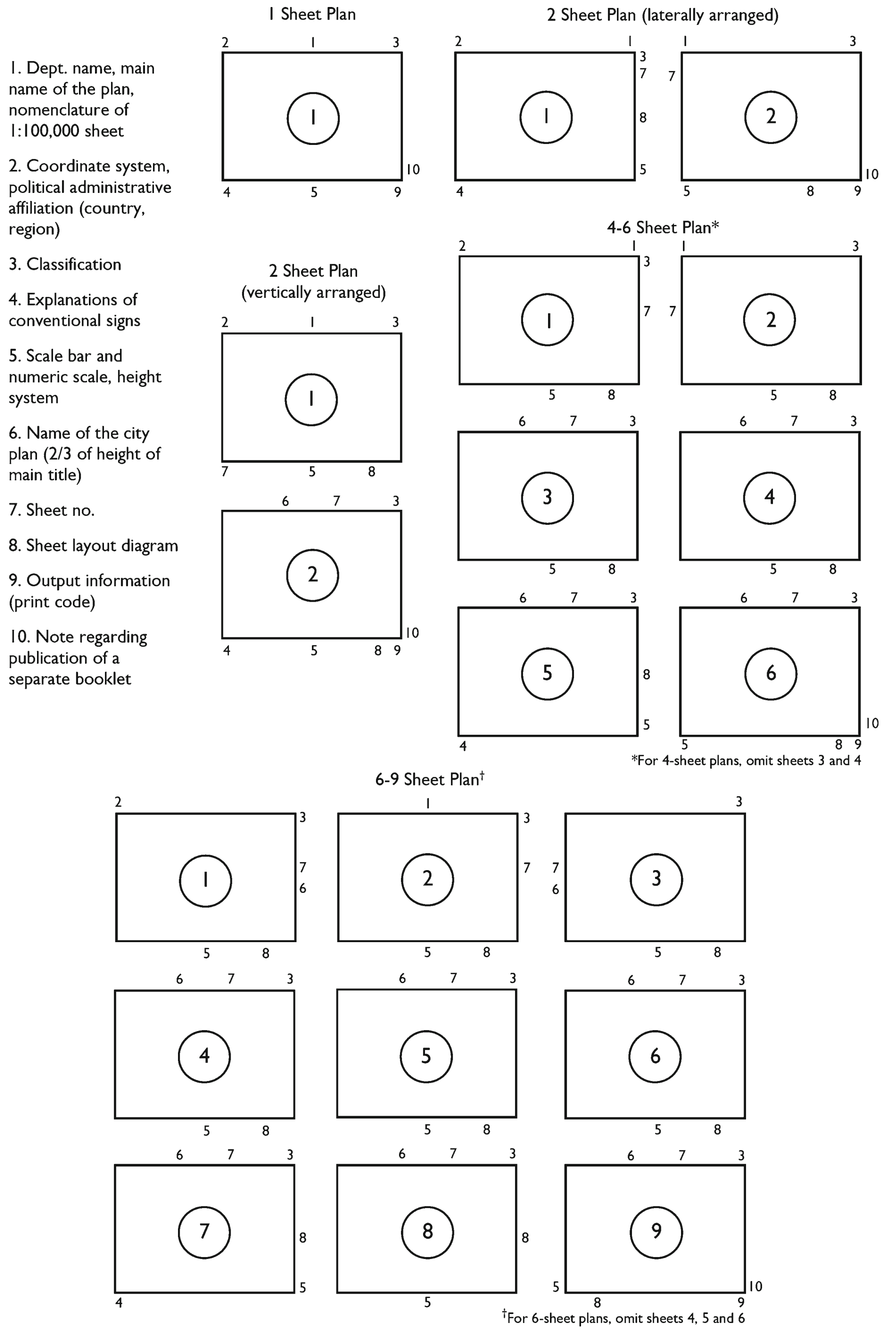


Fig. 2.18 A diagram translated and adapted from that presented in the compilation manual for city plans [6], indicating the content and positions of elements of marginalia on each sheet of a plan

Fig. 2.19 Country and regional information on the Soviet plan of Frankfurt an der Oder, East Germany (1983, 1:10,000). As part of the plan covers Polish territory, 'POLAND Zelenogorsk Voivodeship' is included (private collection)

in the past. After this time, the edition date is stated below the 1:100,000 sheet nomenclature on the first sheet of each plan (see Figs. 2.8, 2.9 and 2.10) and an ordinal number is not given.

2.2.8.3 Output Information (Print Codes)

Within the frame in the bottom-right corner of each sheet, 'output information' ([6]: article A4) is given regarding the printing and issue of the plan. The earliest plans began this information with the word Выпуск (*Vypusk*), meaning issue or output, but this practice was short-lived. The print code on city plans takes the same format as several other Soviet map series, and has five components.

The first is a Cyrillic letter denoting the series to which the map belongs (see Table 2.4). Generally, И denotes a city plan, although some early (1949–1962) plans use the code A. The meaning of the number which follows this is not fully clear, though could conceivably be a job number or similar reference, followed by the sheet number in multi-sheet plans. The following Roman numerals represent the month in which the plan was printed, followed by the last two digits of the relevant year. This year almost always corresponds to the year of the edition, as stated under the title. There are some early exceptions to this (pre-1965), which usually contain a note in the margin stating that the plan has been reprinted. The final Cyrillic letter in the print code refers to the factory in which a particular plan was produced (see Table 2.5) (Fig. 2.20).

Table 2.4 Map series codes found in the print codes of Soviet military maps. А and И are those found on city plans [4]

А	1:10,000 topographic maps, some 1:10,000 and 1:15,000 city plans (1949–1962)
И	City plans (all scales, 1944–1991)
Б	1:25,000 topographic maps
В	1:50,000 topographic maps
Г	1:100,000 topographic maps
Д	1:200,000 topographic maps
Е	1:500,000 topographic maps
Ж	1:1,000,000 topographic maps
З	1:2,000,000 and 1:4,000,000 aeronavigation maps

Table 2.5 Factory codes used on Soviet military city plans

Д	439th Military Cartographic Factory, Dunayev (Moscow) (1918–2009)
И	475th Military Cartographic Factory, Irkutsk (1936–2009)
Л	2nd and 444th Military Cartographic Factories, Leningrad (St Petersburg) (1944–2009)
Ср	108th Military Cartographic Factory (1941–1948), 33rd Military Cartographic Factory (1943–1993), Sverdlovsk (Ekaterinburg)
Срт	107th Military Cartographic Factory, Saratov (1941–2009)
Т	456th Military Cartographic Factory, Tashkent (1937–1992)
К	450th Military Cartographic Factory, Kiev (1946–1992)
Тб	453rd Military Cartographic Factory, Tbilisi (1936–1992)
Хб	488th Military Cartographic Factory, Khabarovsk (1933–2009)

Other military cartographic factories existed within the Soviet Union, but seemingly did not contribute to the production of the city plan series [4]

2.3 Mathematical and Geodetic Basis

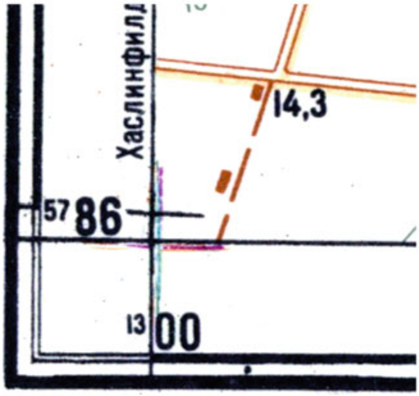
Soviet city plans use the conformal Gauss-Krüger projection, divided into 6° wide zones within the Krasovskiy 1940 ellipsoid ([6]: article 3). As a transverse Mercator projection, Gauss-Krüger preserves scale along the central meridian of each zone. The Gauss-Krüger projection is markedly similar to Universal Transverse Mercator (UTM), with the exception of the fact that it uses a scale factor of 1 to reduce scale error, whereas UTM uses a factor of 0.9996 (Bugayevskiy and Snyder, 1995). Since the Pulkovo 1942 datum was adopted by domestic Soviet cartography on 7th April 1946 [14], city plans, regardless of the location of the city, also adopted this datum and sheets typically include the label ‘Coordinate System 1942’ in the top-left corner. In areas outside the USSR, source materials frequently provided height data in the local system. Such data were used on Soviet city plans, but only after corrections had been made to convert the data to the Soviet system ([6]: article 6).

Fig. 2.20 Print code from the single-sheet Soviet plan of San Fernando, Spain (1975, 1:10,000). The code reads: И (city plan)—85 (job 85) VI (June) 75 (1975) Д (Dunayev factory) (ICGC, RM.165391)

The bottom-left corner of the map area of each plan shows information about the position of this point within its Gauss-Krüger zone. This information can be used to establish which 6° Gauss-Krüger zone has been used on a particular sheet. In the example in Fig. 2.21, the distance from this point to the equator is 5786 km (the value on the x axis) (a). The last three digits of the value on the y axis indicate the false easting; the distance to the false meridian of the relevant Gauss-Krüger zone, in this case 300 km (b). The remainder of the value on the y axis, in this case 1, should be added to 30 to find the zone number used on the sheet, in this case zone 31. If the remainder of the value on the y axis is 60, this should be treated as zero when adding it to 30 to find the zone number (or 1 for 61, 2 for 62 and so on) [9].

The frames of city plans show not only Gauss-Krüger coordinates, but small ticks indicating latitude and longitude. Many plans include small dots around the frame, which represent 10″ (second) segments, and alternate black and white shading around the frame, representing minute segments ([6]: article 33, e.g. Fig. 2.7). This is consistent with Soviet topographic maps at 1:25,000, 1:50,000 and 1:100,000 (General Staff, 1966).

The scale of individual plans was decided centrally, according to the political, administrative and economic importance of the city in question, in addition to its population and area ([6]: article 3). A rectangular grid is included on all city plans. At 1:10,000, grid squares are 5 × 5 cm (500 × 500 m on the ground) and at 1:25,000 grid squares are 4 × 4 cm (1 × 1 km on the ground) ([6]: article 5). With the exception



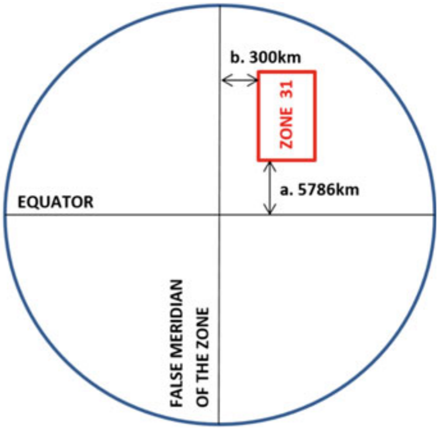


Fig. 2.21 The bottom-left corner of the map area of the plan of Cambridge, UK (1989, 1:10,000) showing information about the position of this point within its Gauss-Krüger zone (left) (private collection) and an illustrative diagram of zone calculation using the information from the Cambridge sheet (right)

of some very early plans, the edges of grid squares form the margins of each plan,grid squares are not partially shown ([6]: article 5).

2.4 Stylistic Development of the Series

The style of Soviet city plans developed somewhat throughout the duration of the series. Naturally, such changes will have been dictated by new editions of the compilation manual for city plans, as well as the later requirement of plans to be consistent with the conventional signs for topographic maps at 1:10,000 and 1:25,000—specifications which also changed on a fairly regular basis. Such changes, however, are difficult to define with precision as some plans possess some characteristics of one style and others of another. In addition, without closely examining every city plan that was produced, any outline of stylistic development can only be an indication of general trends, rather than an exhaustive tracing of minute changes and adaptions of style. It is, however, possible to gain a more thorough understanding of practices in the final years of the 1970s using the compilation manual for city plans [6]. Although this manual refers to earlier editions, only the 1978 edition has become available to date, meaning that observation of the plans themselves provides the only currently available source of information about plans produced at other times.

Nevertheless, it is possible to broadly group the known city plans into five phases, based on their style. The first four of these are relatively limited, both in terms of the number of plans which belong to them and the apparent duration of their utilisation. The fifth phase, which began in 1972 and continued until the dissolution of the USSR, incorporates the vast majority of Soviet city plans as its adoption corresponds with the aforementioned surge in production in the early 1970s. The fact that the 1978 compilation manual [6] makes brief reference to the previous edition of 1972 confirms that new regulations were indeed introduced in that year. Given that the post-1972 phase was significantly more lasting than its predecessors, the design specifications of the 1972 compilation manual possibly represent the most significant document for the subsequent standardisation of the series. However, none of the series' stylistic phases are, by any means, fully homogenous. Substantial variations in the available source materials and the methods used to compile the plan are likely explanations for smaller variations in the appearances of plans within the jurisdictions of single editions of regulations.

2.4.1 Phase 1

The earliest known city plan, of Sari, Iran (1944, 1:10,000) is fairly basic in its appearance, relative to later plans, largely because it is printed in only five colours. Trees, railways and edges of roads are shown in black, with rivers and lakes in blue. Green is used for vegetation and two shades of brown are used for the urban areas itself. The paler brown is also used to denote sand/gravel and contours. A significant area of the sheet is left white, which may perhaps give the impression of a desert despite much of the area being forested. The city itself is generalised into blocks, with only a small number of buildings being depicted individually (Fig. 2.22).

2.4.2 Phase 2

In the early 1950s, a small number of plans used a very distinctive six-colour scheme, with a striking shade of red used to depict buildings. Individual building footprints are shown; urban areas are not generalised into blocks. The majority of roads are white, although red is occasionally used for major roads. Red is also used to mark tramlines, while a pale green is used for vegetated areas. Blue denotes water, either finely hachured or as a solid fill. One class of notable building is distinguished, either by using a darker shade of red, or by using black hachuring over the standard shade. These buildings are numbered and correspond to an index of important objects. Also characteristic of this phase is the very wide spacing used for street name labels. On the plans in Figs. 2.23 and 2.24, red digits are used to number important objects, while black digits are used to number every block in the town or city. As no such numbering system exists in British, Austrian or Swiss mapping, this system was evidently devised by the Soviet cartographers.

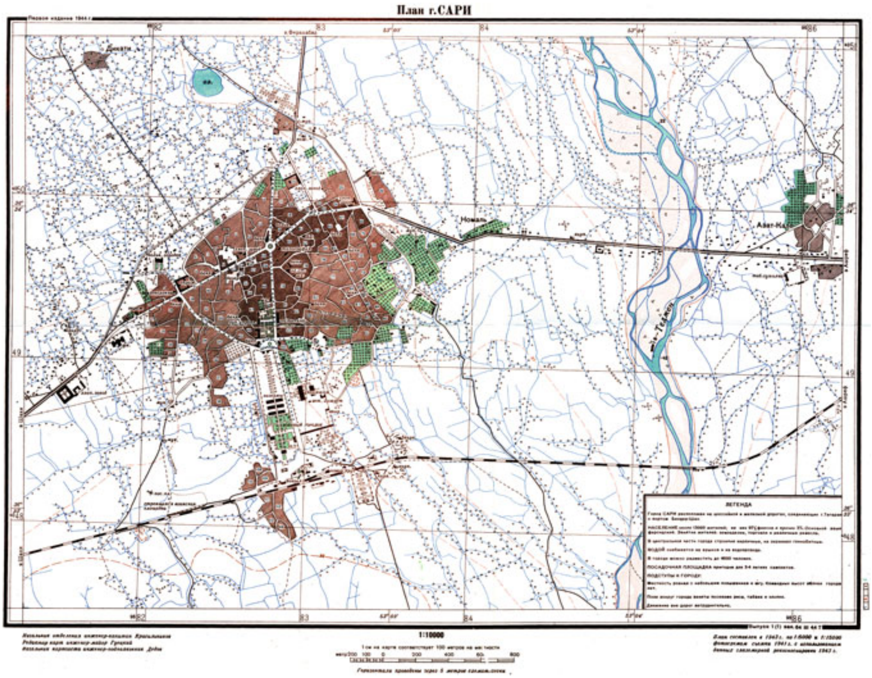


Fig. 2.22 The Soviet plan of Sari, Iran (1944, 1:10,000)—the earliest known Soviet military city plan separate from any topographic series (private collection)

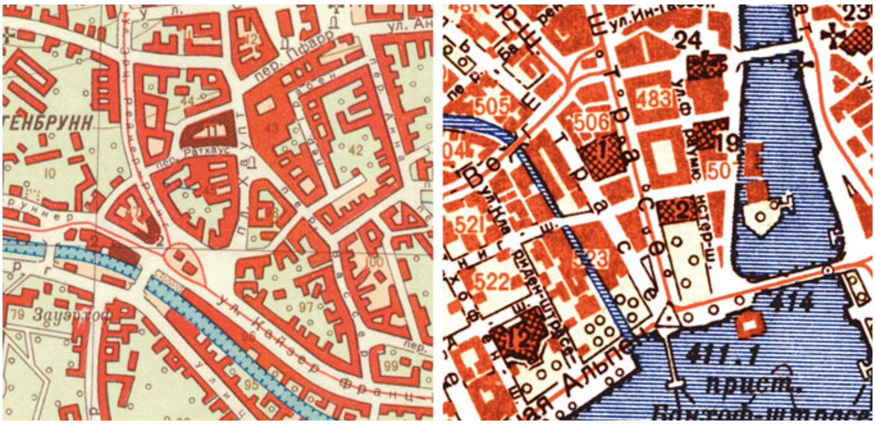


Fig. 2.23 Extract from the Soviet plans of Baden, Austria (1950, 1:10,000) (left) and Zürich, Switzerland (1952, 1:15,000) (right). Given the use of hachuring rather than graduated shades and lack of black building outlines on the plan of Zürich, it has a cruder appearance than the plan of Baden (private collection)

Fig. 2.24 Extract from the Soviet plan of Pembroke, UK (1950, 1:10,000) (private collection)

2.4.3 *Phase 3*

By the late 1950s, a style had been adopted that fused both of the previous styles and was more extensively used than both of them combined. Building footprints were either depicted individually or generalised into blocks, although the principal colour in either case was brown. The majority of roads remained in white regardless of classification and street names were spaced widely along the length of the street. Where a long street and short street name coincide, legibility can become more difficult. Pale orange was very occasionally used for some streets (see bottom-right corner of Fig. 2.25). Important buildings were once again numbered and highlighted on the map in a single class—either black or dark brown—and blue and green were once again used for water and vegetation respectively. Each block is numbered, although in a smaller font than the important object numbering (Fig. 2.26).

Phase 3 plans are reminiscent in appearance of plans used by Soviet forces during combat in the Battles of Berlin and Breslau at the end of the Second World War (see Fig. 2.27). Such plans are annotated with strategic information, including the numbering of important objects. The numbering of all blocks, the colours used and the spacing of street names are all elements that were revived by the city plan series some 15 years later. Unlike other Soviet city plans before or since, areas outside of the urban extent are printed in black and white. A variation for some Soviet cities in the late 1960s sees urban blocks shaded either orange or pale yellow; the former denoting areas with a predominance of fire-resistant buildings (see Fig. 2.28).

Fig. 2.25 Extract from the Soviet plan of Crewe, UK (1957, 1:10,000) (private collection)

Fig. 2.26 Extract from the Soviet plan of Budapest, Hungary (1962, 1:15,000) (ICGC, RM.165448)

2.4.4 Phase 4

One to two years prior to the publication of the 1972 compilation manual, a small number of plans were produced which were the first to be printed in ten colours. For the first time, this allowed important objects to be colour-coded, rather than simply grouped as a single class. All of the known plans which use this style were produced

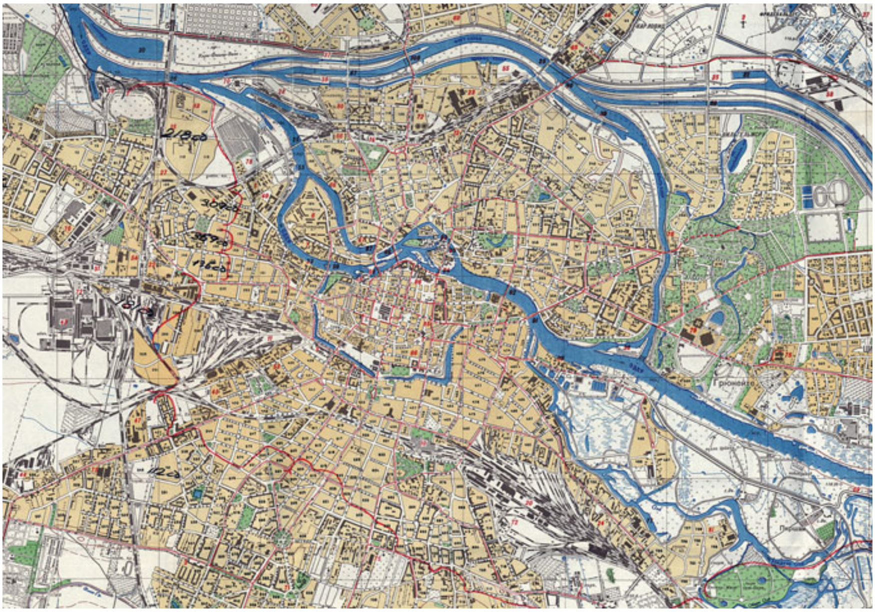


Fig. 2.27 Extract from an annotated Soviet combat plan of Breslau, Germany (now Wrocław, Poland) (1944, 1:15,000) (available at: http://igrek.amzp.pl)

Fig. 2.28 Extract from the Soviet plan of Almaty, Kazakhstan (1967, 1:25,000), distinguishing 'fire-resistant' blocks in orange (National Library of Australia, nla.obj-234565273)

Fig. 2.29 Extract from the Soviet plan of Rawalpindi, Pakistan (1972, 1:10,000); one of the first known plans printed in ten colours (National Library of Australia, nla.obj-234131211)

in 1971 or 1972 at the Tashkent military topographic factory. Besides the use of green and purple for important objects and black for annotations, the plans exclusively use pastel colours. Built up areas are displayed in either a pale beige or peach colour and streets are white, with the exception of orange major roads outside of the city. For the first time, expanded spacing is not used for street names; labels are instead repeated on longer streets, addressing earlier legibility issues (Fig. 2.29).

2.4.5 Phase 5

Phase 5 refers to city plans produced in 1972 or later and incorporates the vast majority of Soviet city plans (Fig. 2.30). Plans in this phase are printed in either eight or ten colours; those in the latter distinguishing important objects in three different classes. Plans of cities in the Soviet Union are printed in eight colours and do not highlight important objects. Civil city plans produced by GUGK also use this style of mapping, though these plans have some minor differences (see Sect. 2.6.1). The use of orange to denote major roads now extends into city centres and a pale yellow replaces the pastel brown in denoting the urban extent. A more comprehensive outline of the content of plans of this phase was given earlier in this chapter (Sect. 2.2).

Fig. 2.30 Extract from the Soviet plan of Addis Ababa, Ethiopia (1978, 1:10,000) (National Library of Australia, nla.obj-234551863)

2.4.6 Prague, Czechoslovakia (1980)

Plans produced after 1972 do exhibit some variation in style, though most broadly conform to the main conventions of the time. One plan which deviates significantly from these conventions is the plan of Prague, Czechoslovakia (1980, 1:10,000) which marks ordinary buildings in peach, reserving the usual brown for architecturally prominent buildings. The other building classifications are the same, although a much paler orange is used for the main roads. This colour combination ensures that classified buildings are even more prominent in the visual hierarchy of the map, although given that an original hard copy of the plan has not been seen during the course of this study, the extent to which scanning methods and digital manipulation have influenced this appearance is unknown. The plan of Prague is the only known plan in this style (Fig. 2.31).

It is clear that the later stylistic phases of the Soviet city military plan series, and their corresponding editions of *Conventional Signs*, accommodate much larger amounts of data than those produced between the 1940s and 1960s. The stylistic development of the series from the early 1970s may reflect the cartographic challenge of mapping the increasing amount of source data available, derived from satellite imagery after the launch of Zenit-4MT in 1971. It seems plausible that as the nature and scope of the available source data changed substantially, the structuring of this data into a broader and much more comprehensive symbology provided a practical cartographic solution. Concurrently, this explanation of the plans' stylistic development is congruent with the Soviet academic cartographic discourse of the 1970s and 1980s which placed increasing emphasis on map use and users (e.g. [13]). Soviet cartographic communication theories of this era may have necessitated a more

Fig. 2.31 Extract from the Soviet plan of Prague, Czechoslovakia (1980, 1:10,000) (ICGC, RM.165463)

capacious map design, rather than support placing more data on the map within the confines of existing symbologies.

2.5 Production Processes

2.5.1 Selection and Preparation of Source Materials

The source materials used to produce city plans varied by city, depending on what materials were available in a given area. The most important of these sources was a large-scale topographic base map or plan, known as the ‘basic cartographic material’. If no such material was available for a particular city, stereographic aerial photographs were used as the base material instead ([6]: article 27). Occasionally, a combination of these methods was used (ibid.). In addition to large-scale topographic maps, the following were used to provide the rich data which would appear on the city plans ([6]: article 28):

- Catalogues and lists of coordinates and geodetic points
- Sea navigation charts (to provide hydrographic information)
- Photo-plans, photo-diagrams and individual aerial photographs
- City plans (e.g. tourist maps or general plans)
- Literary/reference sources (economic or geographic descriptions of the city, directories, guide books, lists of street names and buildings, oblique images of the city or individual buildings and other diagrams)

Before using any of these sources, each one was assessed for accuracy and how up-to-date they were. The extent to which they should be used in the city plan was then recommended by the editor (ibid.). The marginalia of early plans includes a list of the major source materials used in the production of each plan. Although this practice became rare after the early 1960s, these early examples highlight that source materials often predated city plans by several decades, leading to some significantly outdated information appearing on some plans. Later plans also exhibit data which are seemingly in excess of 30 years old in some cases [5]. Naturally, these issues do not apply to cities within Warsaw Pact states where access to up-to-date source materials is likely to have been considerably easier (see Fig. 2.32).

Although satellite and aerial images could be used to update positional data elsewhere, especially after the launch of Zenit-4MT in 1971, non-spatial data, such as text and attributes, could not always be collected by such means and continued to rely on, sometimes outdated, cartographic sources (ibid.). However, where imagery was relied upon for up-to-date positional data, there was a risk of misinterpretation—[4] highlight numerous errors which seemingly result from such misreading.

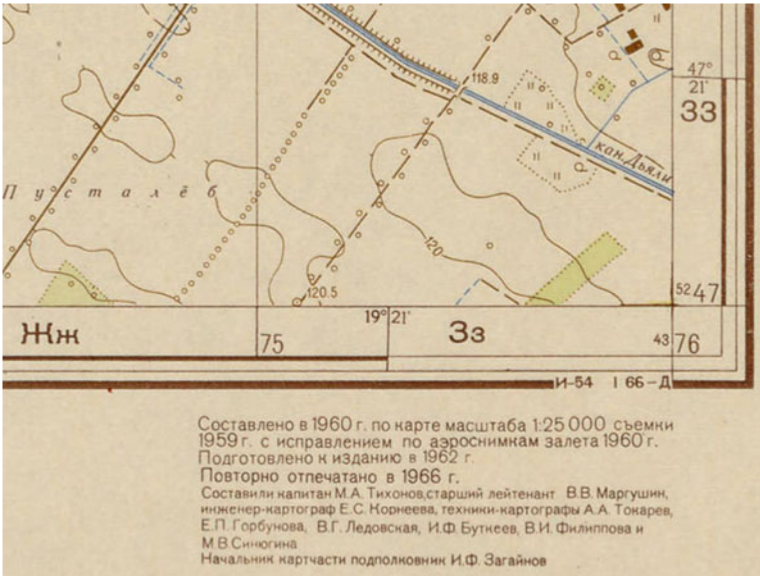


Fig. 2.32 Source materials listed on the final sheet of the Soviet plan of Budapest, Hungary (1962, 1:15,000). The text reads: 'Compiled in 1960 from 1:25,000 map, surveyed in 1959, corrected with aerial photographs, collected 1960. Prepared for issue in 1962. Re-printed in 1966'. This is followed by the names of various individuals involved in the production of the plan. (ICGC, RM.165452)

2.5.2 Compilation Methods

According to the compilation manual for city plans [6], the exact process by which a plan was compiled could be altered depending on the nature of a plan's content and its source materials. Depending on the type of base material being used (i.e. topographic or photographic base), the editor chose one of three methods of compiling the plan. Compilation on what was known as 'blue copy' took place if a plan was to have particularly rich content, or if its source materials were especially complex and would require generalisation. A 'brown copy', or sometimes 'black copy', was used if the plan would rely heavily on the basic cartographic material, and the additional sources would not add a significant amount of information ([6]: article 30). If the plan was to rely heavily on aerial images, its compilation could alternatively take place on a photo-plan of the city, supplemented by literary/reference sources which provided the descriptive data ([6]: articles 29–30). In this case, contours were plotted using a stereo-pair, as the plan could not rely on contours from an existing topographic map ([6]: article 30). Regardless of the method selected by the editor, compilation always took place at the final scale of the city plan ([6]: article 29). The basic cartographic materials therefore needed to be photo-mechanically enlarged or reduced to the correct scale, if necessary, at the beginning of the process ([6]: article 33).

When using a topographic base, rather than a photo-plan, compilation could either take place on a single transparent or opaque base, or on several matted transparencies (each one for a different element of the plan content). These transparencies could then be overlaid on a lightbox in order to bring the different elements together ([6]: article 31). Furthermore, compiling on multiple transparencies 'increases the productivity of labour' (ibid.), as several aspects of the content of the plan can be compiled simultaneously. Control points were selected on each of these layers so that they could be accurately aligned on completion ([6]: article 32). No transparent layer was permitted to contain more than one colour ([6]: article 40).

Although the order in which the compilation master copy was compiled could vary, as a rule, the following order was used ([6]: article 38):

1. The internal neat line/frame and the control points for alignment
2. The important (colour-coded) objects and their annotations
3. Hydrography
4. Railways and related structures
5. Main streets
6. Minor streets, blocks and other buildings
7. Structures along streets (e.g. tramlines, flyovers etc.)
8. Industrial, socio-cultural and agricultural objects
9. Cobbled/dirt roads
10. Relief
11. Boundaries and fences
12. Vegetation and soils
13. Sheet layout diagram
14. Other marginalia.

Labels could either be added after each individual element, or altogether at the end of the compilation ([6]: article 39). If there were a large number of labels to be added (including street name labels), these could be compiled on their own transparency. Only if labels were scarce could they be written directly on the master copy (ibid.). Other components of city plan sheets, including the *spravka* and lists of streets and important objects were compiled separately and added later (ibid.).

Compilation of city plans never took place directly on printing plates. Instead, the selection of content and the placement of labels took place on the basic cartographic material, in pencil, and this information was then engraved on the plate for printing after the whole plan had been compiled ([6]: article 31). Before this transfer took place, a rigorous checking process took place for each plan. The geodetic points shown on the basic cartographic materials were checked against any lists of coordinates that were available, in order to validate their positions on the map. The coordinates and the grid on the basic cartographic materials were then adjusted to conform to the Pulkovo 1942 coordinate system ([6]: article 32). For cities within the USSR, it is unlikely that this process would be required as it is likely that the basic cartographic materials already used the Pulkovo 1942 coordinate system. Any areas on the basic cartographic material which needed verification were marked on the copy and checked against photographs (ibid.). The layers could then be combined on a 'rigid base' and were required be accurately aligned to within 0.2 mm to be accepted for engraving ([6]: article 33). The combined transparencies for a plan were known as the 'compilation master copy', onto which the frame and marginalia could be added ([6]: article 37).

The final compilation master copy was required to adhere to several rules. Firstly, labels added to it must be full and clear in order that source materials which have already been consulted need not be revisited. Secondly, once all of the transparencies had been aligned, the compilation master copy was required to contain no two symbols closer than 0.2 mm (unless this was required by other regulations). Thirdly, the design quality of the compilation master copy was assessed to ensure that it was a suitable basis for the final copy of the plan.

2.5.3 Revision of City Plans

Revised city plans were produced either to reflect geographical changes in a city, to convert an old plan into a more recent coordinate system or to remake the plan using the latest conventional signs ([6]: article 54). Over 200 cities are known to have been mapped more than once as part of the city plan series.

Master copies were retained after the plan had been issued and were often the basis for future revised plans. Where only 20–25% of the plan content needed to be revised, corrections were made directly on the master copy ([6]: article 65). Where 25–40% of the plan required revision, copies of the original master copy were the basis for the revision ([6]: article 66). If over 40% of the plan content required revision, the option of compiling a completely new master copy was made available, if editing the existing master copy would be 'more laborious than compilation afresh' ([6]: article 67). If the mean planimetric discrepancy between the original plan and the latest cartographic materials was more than 0.7 mm, a new plan was produced from scratch ([6]: article 59).

Revised master copies used a colour coding system which made clear the changes to be made to the plan. Content to be removed was marked in red, content to remain was marked in dark brown and new content was marked in the colour that would be used for those features on original master copies ([6]: article 68).

2.5.4 Record Files

Alongside the compilation of each city plan, a record file was created and stored with the transparencies. Information regarding the source materials, layout and content of the plan were all accumulated in the record file for the appropriate plan ([6]: article 26). The most notable item in the record file was the 'editorial-technical instructions' for the plan, in which the editor outlined its requirements and characteristics, including guidance on the selection of important objects and the content of the *spravka*. Deviations from these instructions were also required to be recorded and explained (ibid.).

The mandatory contents of the record file for each plan included (ibid.):

- The editorial-technical instructions
- Sheet layout diagrams
- Source material information (and notes on the extents of its usage)
- Coordinates and diagrams of sheet extents
- A list of geodetic points
- Compilation and preparation information
- Lists of discrepancies in geographical names between source materials
- A quality assessment of the master copy.

After a city plan was issued, its record file was retained alongside its master copy for reference in the production of any future revisions. Unfortunately, no record files have emerged since the dissolution of the USSR and it remains unknown when the practice of compiling them began.

2.6 Related Series

2.6.1 Civil (GUGK) City Plans

In many ways, the city plans produced by GUGK for civil administration within the Soviet Union look markedly similar to the military plans produced by the General

Staff. The plans themselves share the stylistic appearance of phase 5 military plans but omit the *spravka* and lists of street names and important objects. They also use a slightly altered coordinate system (i.e. not Pulkovo 1942) and a locally-applied grid without Gauss-Krüger coordinates.

Perhaps the most notable difference between the civil and military plans is that the former are printed in eight, rather than ten, colours and therefore important structures are not marked and colour-coded as on the military plans, although locations of fire-resistant blocks are shown (Figs. 2.33, 2.34 and 2.28). GUGK never produced large-scale maps of territory outside the Soviet Union.

2.6.2 GUGK 1:2,000 and 1:5,000 Plans

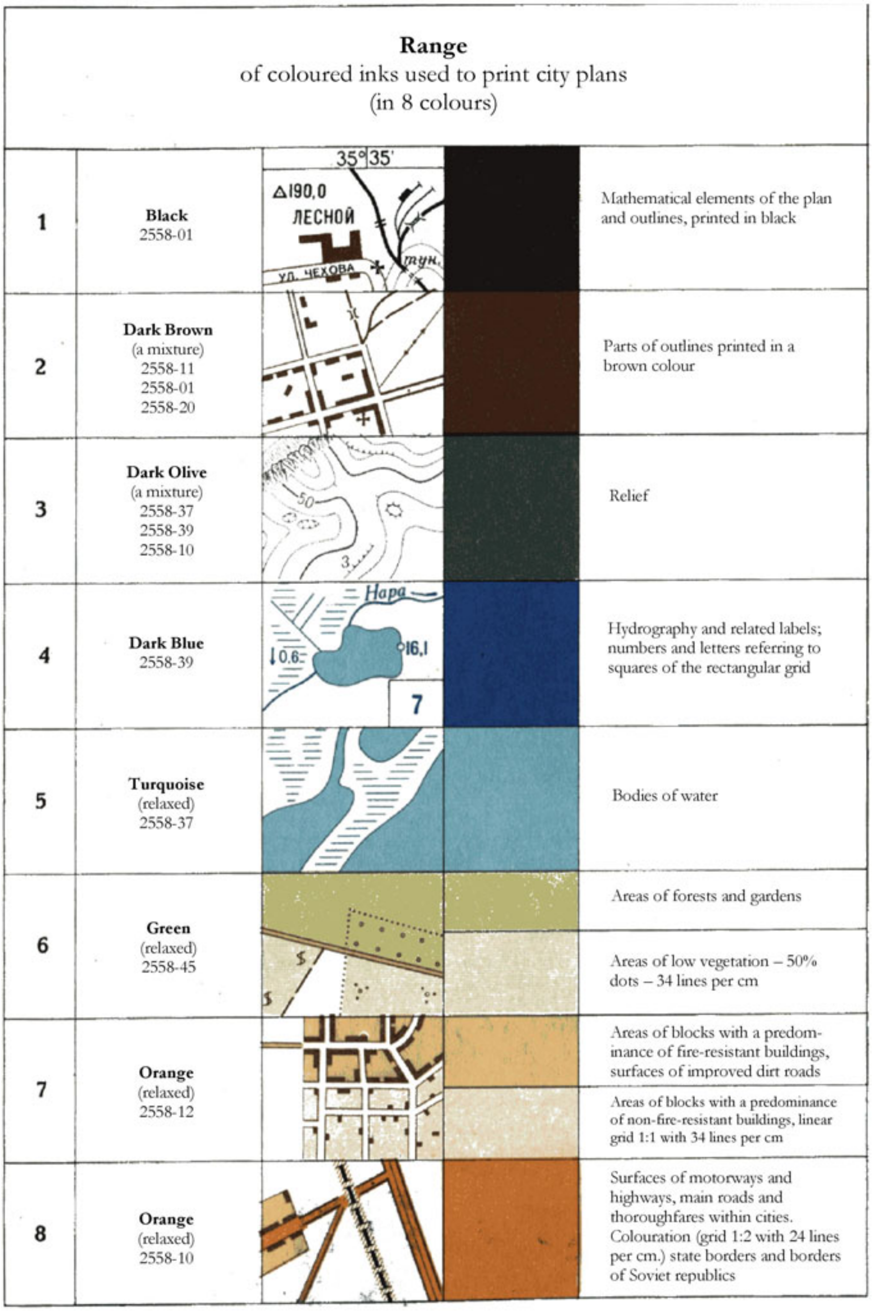
Some towns and cities in the Soviet Union were covered by a highly-detailed series of plans produced by GUGK at 1:2,000 and 1:5,000. These very large-scale plans are printed on small single-colour (brown) sheets covering the city and its immediate environs, though often stopping abruptly regardless of the location of the sheet lines (Fig. 2.35). The large scale and small sheet size means that even modest-sized towns can require 10–20 sheets. The detail on these maps exceeds that on other Soviet map series, incorporating utilities networks, individual trees and outbuildings as well as dense contours. The maps use a locally-applied grid but were classified secret.

2.6.3 Plan Schema

A *plan schema* is a simplified map of a town or city within the Soviet Union, produced at scales ranging from 1:5,000 to 1:25,000. They are highly generalised and omit the detailed information and annotations of the aforementioned series. The classification of the series is lower than that of other Soviet city plans and are marked 'for official use' in the top-right corner. Although a typical *plan schema* does include a small legend and a street index, it does not have a *spravka* and uses a locally-applied grid without coordinates. The only known maps in the *plan schema* series are of towns and cities in Latvia and Estonia. Unlike the military city plans, these plans have not appeared in collections around the world since the dissolution of the USSR and remain accessible to the public only via collections within these countries.

2.6.4 Sister Series in Other Warsaw Pact States

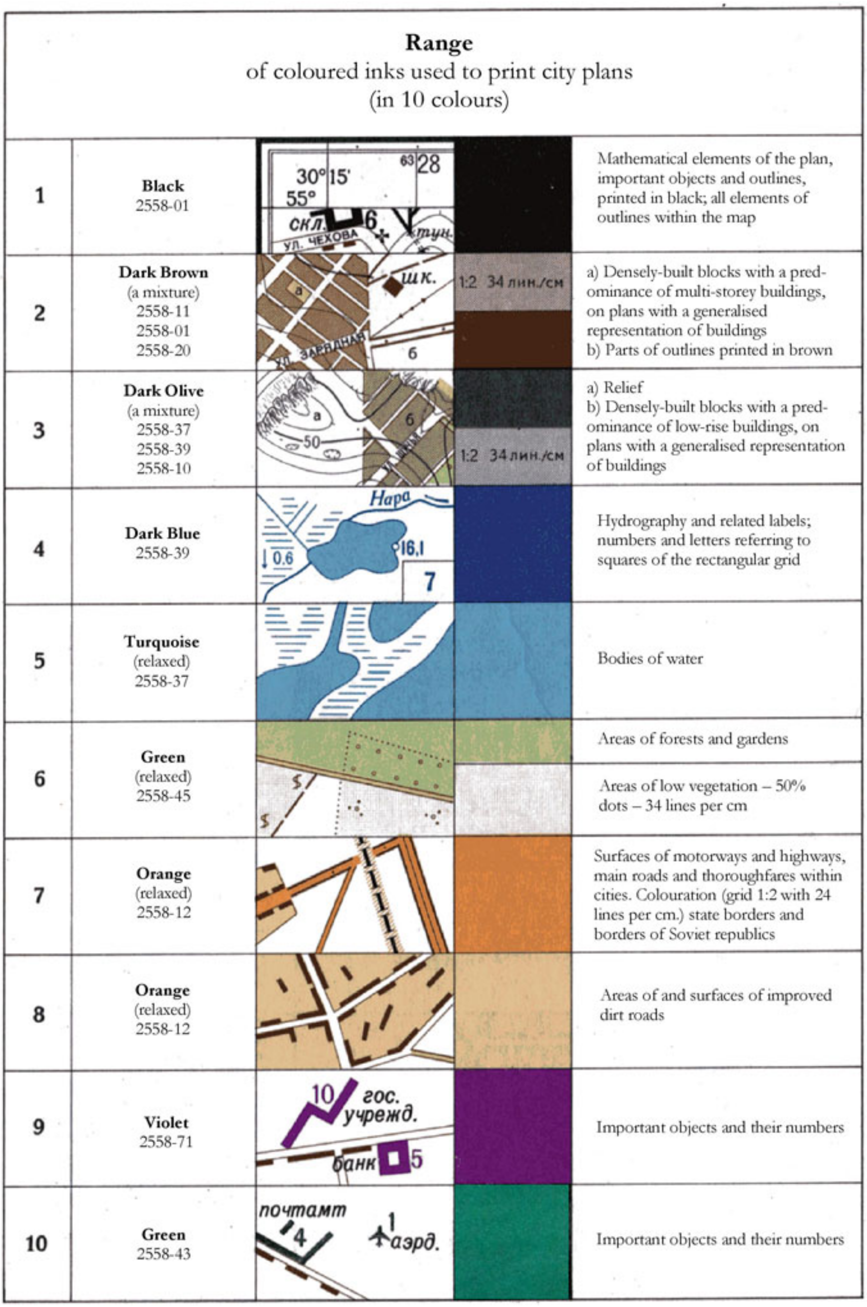
The close military cooperation between Warsaw Pact member states did not exclude military-cartographic endeavours. The Polish military adopted the Gauss-Krüger



Range
of coloured inks used to print city plans
(in 8 colours)

1	**Black** 2558-01	Mathematical elements of the plan and outlines, printed in black
2	**Dark Brown** (a mixture) 2558-11 2558-01 2558-20	Parts of outlines printed in a brown colour
3	**Dark Olive** (a mixture) 2558-37 2558-39 2558-10	Relief
4	**Dark Blue** 2558-39	Hydrography and related labels; numbers and letters referring to squares of the rectangular grid
5	**Turquoise** (relaxed) 2558-37	Bodies of water
6	**Green** (relaxed) 2558-45	Areas of forests and gardens
		Areas of low vegetation – 50% dots – 34 lines per cm
7	**Orange** (relaxed) 2558-12	Areas of blocks with a predominance of fire-resistant buildings, surfaces of improved dirt roads
		Areas of blocks with a predominance of non-fire-resistant buildings, linear grid 1:1 with 34 lines per cm
8	**Orange** (relaxed) 2558-10	Surfaces of motorways and highways, main roads and thoroughfares within cities. Colouration (grid 1:2 with 24 lines per cm.) state borders and borders of Soviet republics

Fig. 2.33 Range of colours used on Soviet city plans printed in eight colours with ink specifications and details of the relevant elements on the plan for each colour. Translated and adapted from the compilation manual for city plans [6]



Range
of coloured inks used to print city plans
(in 10 colours)

1	**Black** 2558-01	Mathematical elements of the plan, important objects and outlines, printed in black; all elements of outlines within the map
2	**Dark Brown** (a mixture) 2558-11 2558-01 2558-20	a) Densely-built blocks with a predominance of multi-storey buildings, on plans with a generalised representation of buildings b) Parts of outlines printed in brown
3	**Dark Olive** (a mixture) 2558-37 2558-39 2558-10	a) Relief b) Densely-built blocks with a predominance of low-rise buildings, on plans with a generalised representation of buildings
4	**Dark Blue** 2558-39	Hydrography and related labels; numbers and letters referring to squares of the rectangular grid
5	**Turquoise** (relaxed) 2558-37	Bodies of water
6	**Green** (relaxed) 2558-45	Areas of forests and gardens Areas of low vegetation – 50% dots – 34 lines per cm
7	**Orange** (relaxed) 2558-12	Surfaces of motorways and highways, main roads and thoroughfares within cities. Colouration (grid 1:2 with 24 lines per cm.) state borders and borders of Soviet republics
8	**Orange** (relaxed) 2558-12	Areas of and surfaces of improved dirt roads
9	**Violet** 2558-71	Important objects and their numbers
10	**Green** 2558-43	Important objects and their numbers

Fig. 2.34 Range of colours used on Soviet city plans printed in ten colours with ink specifications and details of the relevant elements on the plan for each colour. Translated and adapted from the compilation manual for city plans [6]

Fig. 2.35 Extract from a GUGK plan of Tartu, Estonia (1984, 1:5,000) (National Archives of Estonia, EAA.2072.9.866)

projection and the Soviet Pulkovo 1942 datum for its topographic output from 1953 [1]. Moreover, from 1950 until 1990, Hungarian military maps used Soviet nomenclature, a variant on the Gauss- Krüger projection and Soviet topographic symbology [15]. During this period, the Hungarian military produced topographic maps of Northern Yugoslavia, Austria and contiguous parts of neighbouring countries (notably Switzerland, Southern Germany and Northern Italy) at 1:50,000, 1:100,000 and 1:200,000. Mirroring the Soviet system, Hungary also produced 63 plans of foreign cities between 1956 and 1988, covering a similar geographical area to its topographic output. This city plan series differed from its larger Soviet counterpart in three notable respects. Firstly, the maps use the Hungarian language in Roman script, rather than Russian (this also applies to Hungarian topographic maps). Secondly, many Hungarian city plans are at 1:10,000 and 1:15,000, the latter being a relatively rare scale in Soviet cartography. Only one Hungarian city plan, Leoben, Austria (1966), is known to use the common Soviet scale of 1:25,000. As a result, the Soviet symbology was not applied rigidly. Thirdly, some of the Hungarian city plans feature photographs of notable landmarks and buildings (Fig. 2.36), alongside the familiar street index and reference text (or *tájékoztató*) [15].

By outlining details of the scope and nature of Soviet military mapping of cities, it is envisaged that its future uses will not be confined to historical studies of Cold War history or historical cartography, but that Soviet city plans might be used in new contexts and applied to previously unimagined tasks. In order to conceptualise these

Fig. 2.36 A photograph of the Town Hall and the church of St Peter am Perlach accompanies a Hungarian plan of Augsburg, Germany (1966, 1:10,000) (Photograph: Alexander J. Kent)

future applications, it is necessary to take a much broader look at Soviet mapping; considering its ontology and an epistemological framework within cartography in which these maps may be handled. Using the work of Brian Harley as a starting point for this consideration, Chapter Three discusses these issues in order to construct a new paradigm that helps to bridge the conceptual gap between past and future applications of Soviet military city plans.

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Chapter 3
Towards an Ontogenetic Approach to Soviet Military City Plans: A Post-Representational Epistemology

> City plans are intended for the detailed study of cities and their approaches, for orientation, and for the production of accurate measurements and assessments in the planning and the execution of measures significant for the national economy and for defence. (Article 1, Manual for Cartography and Cartographic Reproduction Works: Part 4—Compilation and Preparation for Printing of City Plans; General Staff [21])

Throughout much of the twentieth century, the dominant paradigm in cartography incorporated themes of objectivity, science and the communication of a message to a map reader in the most effective and efficient way possible. A growing post-war concern for the needs of map users and the unimpeded communication of cartographic information was advocated most notably by Robinson [35] and Koláčný [30]. Drawing on principles of cognitive science, cartographic communication models supported the need for an effective 'cartographic language' to be employed when designing maps—a language intelligible to the map reader with the primary purpose being to 'get across a concept or relationship' [35: 13]. The development and adoption of cartographic communication models was not a process which took place exclusively outside of the USSR. The work of the Soviet academic cartographer, Konstantin Alekseevich Salishchev, challenged the early-twentieth-century notion that cartography exclusively incorporated elements of cartographic production and advocated a broader definition of the subject which included all users of maps in addition. While Salishchev's [38: 85] own definition of cartography maintains a representational stance which sees cartographic symbols as means of representing aspects of reality, Salishchev's definition extends beyond those of his Soviet contemporaries in that it incorporates entities beyond geographical maps to spatial models more broadly. However, Salishchev also criticised North American cartographic communication models for placing too much emphasis on the map itself, rather than its geographical content [31: 294]. However, the above quote from the opening article in the 1978 manual for the compilation of Soviet military city plans supports the notion that Robinson's view was adopted, or at least expressed, by the General Staff as it undertook its unprecedentedly comprehensive global city mapping programme. Soviet cartographers were instructed to portray locations 'reliably and accurately' while being 'clear and legible' [21: article 2]. In the eyes of the Soviet cartographer,

M. Davis, *A Cartographic Analysis of Soviet Military City Plans*, Springer Theses,
https://doi.org/10.1007/978-3-030-84017-4_3

there existed a 'true' landscape, ready to be represented as rigorously and precisely as possible, using the foremost technology of the time. Reference to 'detailed study' and 'accurate measurements and assessments' suggests an objective and scientific approach. While this may have been done with a specific purpose in mind for the maps, today, in the absence of this original purpose, the maps continue to find new life in very different contexts and applications. This chapter traces the major paradigm shifts which have taken place in cartography since the time of the Soviet mapping programme and, drawing notably on the work of the French post-structuralist Jacques Derrida, attempts to reframe Soviet maps in a post-representational epistemology which explains the endurance of the maps in contemporary applications while considering the nature of mapping from a broader, conceptual perspective.

3.1 Fundamentals of Harleian Deconstruction

3.1.1 Background

While it has long been recognised that maps of a more thematic nature are able to be used as persuasive tools (e.g. Ager [1]; Tyner [39]) and express something of the culture that produced them [2], the first attempt to move away from a 'map as truth' approach to topographic maps did not materialise until the mid-1980s when Wood and Fels [42] made the first tentative steps towards linking cartography with semiotics. Identifying maps as simultaneously a series of signs and a singular sign as a whole, Wood and Fels facilitated a vision of cartography, not as an endeavour towards *the* optimal map in the communication of a particular message, but as a connotation-imbued text, unavoidably immersed in its social, cultural and political contexts. This conception paved the way for Brian Harley's seminal 1989 publication 'Deconstructing the map' [26] (updated in 1992 [27]), which was the first to theorise the notion of maps as social constructions. Believing that cartographers adopted a 'map as truth' stance in order to remain credible, Harley surmised 'it is better for us to begin from the premise that cartography is seldom what cartographers say it is' [26: 1]. Harley's paradigm, subsequently styled 'critical cartography', contested the view that an objective and accurate representation of a geographical space could be achieved, arguing that how a map represents a space is influenced by the social and political contexts of its production. Harley's argument is divided into three sections: 'The Rules of Cartography', 'Deconstruction and the Cartographic Text' and 'Maps and the Exercise of Power'. Before engaging fully with Harley's assertions, it is necessary to refer the writings in which these concepts are rooted.

The first and third sections owe much to Michel Foucault; in particular, his well-known expositions of the relations between knowledge and power. The second is underpinned, at least nominally, by the work of Jacques Derrida, the originator of the post-structuralist movement of deconstruction more than 20 years prior to Harley's inaugural application of the concept to cartography. Reference should also be made to the interpretations of Foucault and Derrida by Rouse [36] and Norris [32] respectively, which are adopted and cited by Harley. While deconstruction does not lend itself to being adequately summarised, the opening section of this chapter interprets some key elements of Foucault's and Derrida's writings from some of the major texts of each in relation to these arguments, interspersed by summaries of Harley's stance on each in the context of cartography.

3.1.2 Fundamentals of Knowledge

Rouse [36: 2] defines knowledge as an 'accurate representation whose accuracy is recognized and justified by the knower.' Foucault is well known for his linking of the concepts of knowledge and power, although Rouse highlights that these two concepts remain independent and distinct of one another, despite these linkages. Recognising that science is the 'most successful means' we have of representing the world and how it operates (ibid.: 3), Rouse begins his discussion of knowledge by outlining the major criticisms of science-centric empiricist philosophy. Firstly, he notes that scientists make observations selectively, influenced and governed by their theoretical and practical interests. Secondly, he stresses the complexity of scientific observation, along with the fact that it depends on numerous prior determinations and pre-existing assumptions that certain 'facts' are indisputably true. Thirdly, related to the second criticism, Rouse states that theory cannot be directly compared with observations; we must describe observations in some way first, before comparing our theories with these descriptions. In summary, these criticisms together mean that the world and its processes operate independently of any representations of them, leading to the inherent possibility that our representations may depict the world inaccurately (ibid.: 3).

3.1.3 'The Rules of Cartography'

Harley's [26] first argument is that cartography is governed by a system of rules. The basis for this is Foucault's establishment of discourse as the primary unit of analysis. The concepts of rules and discourse are linked by the claim that where there are rules which govern the making and assessing of statements, there is discourse. Rather than claiming that such rules are universal, Harley emphasises their society-specific nature. Within European cartography since the seventeenth century, two groups of rules are identified, technical rules governing map production and the rules relating to the cultural context of a map's production. The former includes the perceived objectivity of Western maps, which leads to the denigration of maps of the past, or those produced using more primitive or anachronistic technologies. The latter incorporates matters such as ethnocentricity (e.g. placing Europe at the centre of a world map, or orientating maps towards particular religious sites) and rules of social order (i.e. social hierarchies are reflected in the map's visual hierarchy, with more powerful features given more prominence). Harley's principal argument here is that maps not only reflect and reinforce these social conditions, but are instrumental in defining them.

3.2 Foundations of Deconstruction

3.2.1 Spotting the Différance

Derrida challenges the traditional philosophical, or metaphysical, idea that the formation or origin of a concept, or 'logos', is independent of language which, according to this 'logocentric' concept is merely a means of expressing a logos. Derrida's position is that language and concepts are intrinsically interdependent; each being vital to the construction of the other [18]. In elucidating this, Derrida deconstructs this premise of metaphysics by dismantling the traditional methods by which philosophers have organised the origins of concepts or ideas and how these have been construed as having a pure and original meaning independent of their expression through language (ibid.; Norris [32: 19]). Essentially, Derrida's work can be read as an argument that the concept of a 'logos' is a metaphor referred to by metaphysicists in order to express abstract concepts. However, this argument in itself is problematic in the sense that, as Derrida [14: 6] asks, 'how can we make this discernible, except by metaphor?'.

Central to Derrida's concept of deconstruction is his neographism, *différance*. This 'assemblage' is designed to encapsulate both the concept of 'differing', in the sense of possessing characteristics which vary from that of another, and 'deferring', the temporal and conceptual spacing which dislocates one thing from another [13: 278]. *Différance* in the Derridean sense advocates a movement away from the structuralist conception that the identity of all things is either intrinsic or relational, or some combination of the two. In this paradigm, an intrinsic view of identity may be one which relies on particular distinguishing features. Were something not to possess such features, it would cease to maintain its identity [23: 60]. Indeed, the very concept of existence is dependent on the maintenance of an identity, which allows something to be both extant and recognised. However, the maintenance of such an identity often transcends that which is in question, incorporating external factors too, namely the positioning of something within a wider structure, relative to others (ibid.: 61).

Derrida's writings take this relational concept further than can be contained by this neat, structuralist framework, endorsed notably by Ferdinand Mongin de Saussure (ibid.: 63). He challenges the pre-existing philosophical elucidation that signs (explained by Derrida using the example of language, but applicable to any form of sign which signifies some 'other') can be distinguished through either sensibility (i.e. directly via the human senses) or intelligibility (i.e. via information presented directly to the mind) [13: 281]. Both of these concepts hang on the premise that the information necessary to discriminate the identities of signs is fully in the present—available in some way directly from the sign itself. Using the analogy of audible speech, Derrida rejects this premise on both counts. If speech is to be meaningfully understood, he argues, the receiver must be able to discriminate between different signs, or different units of the sound, according to a given language. Such difference between signs is not an audible sound in itself and therefore cannot be sensed—discrediting the idea that the distinguishing of signs can take place via sensibility [23: 58]. Derrida affirms that this distinction does not take place via understanding either, as no information is being presented to the mind, in the present, which allows such a distinction of signs to be made (ibid.: 59).

It is this inability to distinguish signs fully in the present which leads Derrida to introduce the concept of deferral; 'to put off until "later" what is presently denied' [13: 278]. The differences which give signs their identities are not inherent in them or, as Derrida asserts, 'they have not fallen from the sky ready made' (ibid.: 286). Therefore, *différance* expresses the movement which takes place as referral is made between different signs; a movement through which differences find their distinctions (ibid.: 287). These signs, according to the structuralist conception of presence, are fundamentally not present [12: 166] and can therefore be termed historical:

> …we shall designate by the term différance the movement by which language, or any code, any system of reference in general, becomes 'historically' constituted as a fabric of differences. [13: 287]

The major consequence of accepting *différance*, as defined here by Derrida, is that a 'system of reference' in itself is not an adequate means of explaining the identification of signs, as it is the movement of deferral which gives them meaning, not the code itself. Codes and languages are themselves governed by rules and conventions, which in turn must also be subject to *différance* if they are to hold meaning, and so on ad infinitum. This unending, paradoxical loop makes impossible the establishment of a definitive genesis of meaning (or 'logos'), as the movement—*différance*—which is defining identities is a continuous phenomenon [23: 64]. It also leads us to conclude that the structuralist logic of meaning being extant in the present—within a text—no longer prevails (ibid.: 68). The unending nature of this movement also discredits any notion that any kind of finite polysemia or multiplicity of meaning is at play. The contexts and spaces across which a sign can be deferred are countless, rather than fixed and finite (ibid.: 26). In order to fully deconstruct a sign, we need to distinguish and separate the signifier (be it graphical or audible) from its signifying concept and referent [3, 12].

3.2.2 Absolute Absence

Just as *différance* challenges the notion of the meaning of signs inhabiting the present, it also challenges the classical philosophical conception of the term 'writing', which relies on the assumption that such a text is used when communication is necessary to a recipient (or recipients) who is distant, but still present in the sense that they are being communicated with [23: 69]. Derrida attempts to push the boundaries of this concept by asking whether it extends to the absolute absence of either the author or intended receiver of the writing—i.e. if either, or both, were to die. Derrida argues that a fundamental characteristic of writing is its ability to function beyond the death of (or in the total absence of) its author or intended receiver. It must be iterable, or able to be stated again, more than once and independent of the sender or receiver (ibid.: 70):

> For a writing to be a writing it must continue to 'act' and to be readable even when what is called the author of the writing no longer answers for what he has written. [15: 8]

Therefore, if we accept iterability as a fundamental element of 'writing' (or, more broadly, the expression of any sign), all 'writing', in this broad Derridean sense, can only incorporate that which can do without the presence of the author, just as a reader of anything 'written' can read that which the author could write in the absence of the intended reader [23: 71]. Derrida [16] illustrates this using the analogy of a postcard, which can be read and understood by someone other than the writer or intended receiver, while still being inherently linked to its producer, meaning and receiver—despite all three being absent [5]. Together with *différance*, this conception that iterability is fundamental to all 'writing' forms a central element of Derrida's effort to challenge the structuralist (or metaphysical) construal of 'presence' in relation to any form of sign [23: 77].

3.3 'Deconstruction and the Cartographic Text'

Harley begins his discussion of deconstruction by advocating the treating of maps as texts, particularly against a backdrop of treating maps as objective reflections of a reality. Rather than a technical process of communication, Harley's premise is one which recognises 'the narrative qualities of cartographic representation' [26: 8]. Not only does this discredit the neutrality of maps by focussing on their inherently constructed nature, it does so by using the Derridean concept of metaphor. Harley's first illustration of metaphor in maps serves to illustrate to role of the 'margins' of the text; that which has not been historically considered part of the map itself but rather an addendum to the main cartographic component. The example given is that of decorative art and cartouches in seventeenth and eighteenth century European maps which, although not part of the cartographic element per se, reveal much about the culture from which the text originated.

Harley proceeds beyond the margins of the map to suggest that the map itself—namely the employment of a visual hierarchy and the selection of important elements for inclusion in a state highway map—makes similar revelations which renders the communication of the map to its reader more complex than a simple depiction of a reality. He clarifies 'I am not suggesting these elements hinder the traveller from getting from point A to B, but that there is *a second text* within the map' with additional functions such as an instrument of sovereignty or a constructor of a mythical geography of a place (ibid.: 9, emphasis added). It is the existence of this second text which introduces Harley's first example of a cartographic metaphor. Harley argues that 'a cartographer' would argue that these secondary functions can only exist because of their difference from 'the ultimate scientific map' from which the map in question derives (ibid.: 10). Harley argues that, through this, science has become a metaphor for an authority to which maps refer, just as a European renaissance map may use a coat of arms as a metaphor for its royal authority. Although rhetoric may be a technique most associated with clearly partisan maps, such as advertisement or propaganda maps, Harley adopts a broader definition of the term, incorporating all subjective elements of map production. On this basis, he argues for the universality of rhetoric in maps, contending that:

> The steps in making a map – selection, omission, simplification, classification, the creation on hierarchies, and "symbolization" – are all inherently rhetorical. In their intentions as much as their applications they signify subjective human purposes rather than reciprocating the workings of some "fundamental law of cartographic generalization". [26: 11]

Far from being an inconsequential detail of map production, Harley maintains that this universality of rhetoric and subjectivity can be manipulated by cartographers to communicate the most desirable metaphor to the map reader—perhaps his most fundamental claim in 'Deconstructing the Map'.

3.3.1 Power and Governmentality

Rouse [36] elucidates three principal relations between knowledge and power. The first comprises the notion that knowledge can be applied in order to achieve power. More specifically, knowledge of how things operate affords the bearer of the knowledge opportunities to manipulate and control those not in possession of such knowledge. The second relation is that power can be used to prevent the acquisition of knowledge by others, or to distort the knowledge that is acquired. False knowledge or beliefs may be promulgated by the power-bearer and given credibility, while simultaneously discrediting or suppressing true beliefs, or knowledge (ibid.: 13). The third relation is approached more cautiously by Rouse, who suggests that it could be treated as part of the first relation. However, rather than using knowledge to exercise or achieve power, the third relation indicates scope for knowledge to be used as a means of liberation from oppressive power. Accurate knowledge may be used as a tool with which to identify the distortions and augmentations of any false knowledge, which has been used to propagate power (ibid.: 13).

In Foucault's writings, the art of government, or 'governmentality', is an important vehicle for expressing these manifestations of power and knowledge, operating in the same way as knowledge and power can be utilised between individuals. Foucault [20: 207] surmises that governing a state essentially entails 'exercising toward its inhabitants, and the wealth and behaviour of each and all, a form of surveillance and control as attentive as that of the head of a family over his household and goods.' In this summary, surveillance appears to be synonymous with power, a synonym which leads Foucault to write at length about juridical power. Seeing systems of crime and punishment as important to the ways in which particular societies define 'subjectivity, forms of knowledge, and, consequently, relations between man and truth' [19: 4], Foucault discusses penal systems at length within his writings on power.

3.4 'Maps and the Exercise of Power'

In Harley's reading of knowledge-power relations, maps are clearly seen as an instrument of power, particularly state-produced maps, which 'extend and reinforce the legal statuses, territorial imperative, and values stemming from the exercise of political power' [26: 12]. However, rather than viewing maps as part of a simple binary model of 'domination and subversion', Harley distinguishes between two types of power possessed by maps—internal and external power (ibid.: 12). This stance represents a development of Harley's [24] chapter 'Maps, Knowledge and Power', in which he first links maps to power and highlights their compatibility with Foucault's conception of surveillance. It was also in this chapter that Harley first referred to a 'deeper' or 'symbolic' level within a map, beyond its literal meaning, which contains the rhetorical and persuasive—and powerful—components of the map.

External power is that which is exerted on or by cartography. Maps tend to be produced to meet the needs of a particular patron or cause. Moreover, some maps are specifically tasked with defining or maintaining elements of state power, which are external to the map, such as boundaries, commerce or the control of population. Harley sees this external power as representative of Foucault's juridical power, as it facilitates a degree of surveillance and control.

Conversely, internal power is that which is inherent in the map itself, in the same way that any other form of text can hold power. Harley describes a process by which the world is 'catalogued' through generalisation, classification, abstraction and the other processes which are definitive of mapping. Such power is therefore held by cartographers themselves [40: 192]. Furthermore, he advocates that 'to catalogue the world is to appropriate it, so that all these technical processes represent acts of control over its image which extend beyond the professed use of cartography' [24: 13]. Citing several examples, Harley uses this premise to indicate that maps represent knowledge with power as they shape and alter people's perception of real landscapes, through their context, inclusions and exclusions. Rarely is this more the case than when the map in question assumes a stance of objectivity or neutrality. 'Where it seems to be neutral it is the sly "rhetoric of neutrality" that is trying to persuade us' (ibid.: 14).

3.4.1 Politicising the Map

In elucidating the fundamental theses of the Harleian paradigm, interspersed with notable standpoints of Jacques Derrida and Michel Foucault, several issues have become clear. Firstly, despite describing the ideas in 'Deconstructing the map' as 'ow[ing] most to writings by Foucault and Derrida' [26: 2], Harley directly cites the work of neither in his 1989 essay, instead relying solely on secondary texts (e.g. Crampton [9]; Norris [32]). Harley does cite a translator's preface to Derrida's 'Of Grammatology' but stops short of scrutinising the work itself. This is less the case with regard to the work of Foucault, as Harley more overtly embraces power-knowledge discourses, particularly in 'Maps and the Exercise of Power'.

The 1992 revision illuminates Harley's interpretation of deconstruction a little more. 'Of Grammatology' itself is cited but only as a source of 'the notion of deconstruction' [27: 232]. Although this notion undoubtedly finds its roots in the work of Derrida, beyond embracing the general essence of the term, Harley does not mention or allude to logos, *différance*, absolute absence or any other specific element of Derridean deconstruction. Harley does describe using 'a deconstructionist tactic to break the assumed link between reality and representation which has dominated cartographic thinking' (ibid.: 232); a statement which characterises Harley's effort to depart from the communication-centric 'map as truth' paradigm. He also acknowledges that the ideas of Foucault and Derrida are not always congruent, describing his approach as 'deliberately eclectic' (ibid.: 232). Harley also attributes the idea of the textuality and rhetorical nature of maps to Derrida, while vocalising disagreement with an uncited Derridean view that 'nothing lies outside the text' (ibid.: 233). This statement itself is a misinterpretation, addressed by Derrida in 1988:

> The phrase which for some has become a sort of slogan, in general so badly understood, of deconstruction ("there is nothing outside the text" [it n'y a pas de hors-texte]), means nothing else: there is nothing outside context. In this form, which says exactly the same thing, the formula would doubtless have been less shocking… To the extent to which it – by virtue of its discourse, its socio-institutional situation, its language, the historical inscription of its gestures, etc. – is itself rooted in a given context (but, as always, in one that is differentiated and mobile), it does not renounce (it neither can nor ought do so) the "values" that are dominant in this context (for example, that of truth, etc.). [17: 136–137]

It seems, therefore, that Harley's notion of maps being constructed within a socio-cultural context has more in common with Derrida than he perhaps realised. This misunderstanding has arisen due to Derrida's view of these contexts and values as so fundamental to text (as in, the signifier) that he saw it as an integral part of the term 'text', using the word in reference to this broader meaning. Rundstrom [37] avoided such terminological confusion by using the term 'artefact' to describe the physical map, rather than 'text', framing this within the context of both the map production process and cultural and political setting. Nonetheless, other elements of Harley's work, which are presented as originating from Derrida's ideas, diverge from the latter on some fundamental grounds. Harley refers to deconstruction as aiming at 'as many meanings as possible' and as 'a search for alternative meanings' (1992: 239). These statements suggest a misunderstanding of *différance* by suggesting a finite and quantifiable number of possible meanings, which a text (map) can in some way possess; rather than an ongoing deferral of meaning which reaches no fixed logos, or point of origin. An acceptance of cartographic polysemia by Harley by definition indicates a tacit acceptance that these multiple but fixed meanings are present on the map itself—rofoundly opposing the Derridean assertion that meaning does not belong to either sensibility or intelligibility and therefore cannot be present in the text [13: 281].

Crampton [9] notes Harley's general lack of engagement with primary texts and promotes a two-fold development of the paradigm in response. Firstly, Crampton contrasts Harley's conception of knowledge-power with Foucault's before discussing issues of power in cartography with more direct linkages to the work of the latter. Secondly, he endorses the examination of the field of 'geographic visualisation' (GVis) (which facilitates more interactivity and data exploration than a traditional map) as an effective and more contemporary means of moving away from the 'map as truth' communication model, which strives toward an optimal, single and static map. In the first of these developments, Crampton challenges the notion of a unitary 'author' of a map and that power can be divided into a binary, external and internal, system. He also notes Harley's seemingly negative view of power and surveillance and, supported by Foucault, highlights the possibility of resisting power. After addressing these issues with direct reference to Foucault, Crampton necessitates the need to move beyond Harley if the conception of maps as social constructions is to be fully explored. The fact that Crampton proceeds to undertake this by formulating a 'Harleian research agenda' (ibid.: 242) indicates his general support of the notion of 'maps as social constructions'. However, despite addressing some of Harley's discrepancies with the writings of Foucault, Crampton gives no such treatment to any of the issues relating to Derridean deconstruction. Furthermore, Crampton appears to directly support Harley's contradiction of Derridean *différance* by advocating a polysemic interpretation of maps:

> By contrast to the communication model which identifies a single optimal map… in a Harleian agenda, polysemy and multiplicity are preferred. [9: 244]

The subsequent discussion of GVis simply serves to highlight how the new spatial technologies of the time increased the multiplicity of meanings which could be extracted from a map by increasing user interactivity and abandoning the static nature of traditional maps in favour of 'data exploration' (ibid.: 245). While the emergence of digital technologies has undoubtedly transformed the nature and scope of cartographic texts, this technological development does nothing to escape from the notion that possible meanings of maps are not only fixed (albeit numerous) but present in the map or visualisation itself.

3.5 Beyond the Landscape

Perhaps the most thorough critique of Harley is found in 'Images of Power' by Belyea [3]. Belyea notes that Harley's engagement with Foucault and Derrida is 'derivative and highly selective' (ibid.: 1) before using some untranslated excerpts from both in order to identify several conflicts between them and Harleian deconstruction. Some of these conflicts are fundamental enough for Belyea to argue that Harley's stance has not moved on from the 'maps as images of the world' epistemology which predates his work, but rather that he simply adds a social-political dimension to this traditional position.

Belyea begins by challenging Harley's concept of a 'symbolic' level in maps, arguing that this cannot constitute deconstruction, given that the role of a symbol is to refer to 'something else' outside of the text; an issue which also applies to Casti's [7] support of maps as a means of iconizing the landscape. Belyea also contests Harley's distinction between internal and external power, for which she finds no justification in the work of either Foucault or Derrida. Whereas Harley's two-fold approach theorises means by which cartography can utilise power, Foucault's argument, as Belyea perceives it, is that power is an inherent and inseparable element of any discourse, including cartographic discourse, rendering Harley's interpretation inaccurate [3: 3]. Finally, Belyea recognises that Harley does little to elucidate what he sees as vital to Derridean deconstruction, beyond references to identifying the 'rhetorical' elements in maps (as opposed to 'scientific' elements). If signs do not point to the referent but instead refer to other signs, any language or system of signifiers does not directly represent pure thought or nature but functions by 'establishing and adjusting purely arbitrary relationships within each system' (ibid.: 4). In adopting this position, Belyea supports the concept of *différance*, albeit without using its name.

Although Casti [7] supports Harley's view that the meaning of a map is not entirely self-contained, she departs from Harley in arguing that cartographic semiosis cannot be separated from the semiotic study of the landscape represented by the map. Based on this premise, Casti envisages maps as an agent at work between territory and society—with social actions on territory being shaped by the representation on the map. This moves away from the Harleian tendency to clearly distinguish between map and landscape, in an effort to move away from a 'map as mirror of reality' mentality. However, Casti does not support the notion of maps as a simple signifier of landscape but acknowledges a 'second-level' semiosis, through which codes other than the landscape are referenced, such as the map itself and socio-cultural and political agendas, especially through iconization and the use of toponyms. Nevertheless, even at this secondary level, Casti's approach fails to evade an inherent linking of the map and the landscape, even if this is to a lesser degree than as a 'mirror of reality', causing friction with the work of Derrida. However, Casti does note the ability of a map to self-reference in order to be recognised as a map and, through this, it is able to communicate messages beyond those which were specifically envisioned by the cartographer (ibid.: 10). Casti's work therefore opens up new possibilities for cartographic epistemology; namely that a map may refer to entities other than the landscape (including itself), albeit while acting as an agent connected with reality in order to facilitate work in the world.

Contrastingly, Belyea [3] contends that Harley subscribes to the concept of signs referring directly to nature (or, more specifically, maps mirroring reality)—the very notion which Harley set out to escape from. In supporting this claim, Belyea cites the example of Harley's paper on 'Silences and Secrecy' in early modern European cartography [25], in which he notes that European maps of North America 'remain silent about the true America' (ibid.: 70), indicating that the socio-political agenda of European settlers prevented the production of an accurate and 'true' map. Although Harley was among the first to consider this non-scientific agenda in cartography, Belyea uses this example to claim that the 'map as mirror of reality' concept remains intact beneath the façade of a new approach. Harley's work appears to be built upon the premise that maps are rhetorical and culturally immersed representations of the world. However, as Belyea [3: 4] points out, if signs merely point to other signs, as Derrida suggests, in what sense is a map a representation at all?

3.6 Escaping an Ontology of Maps: Towards Post-Representational Cartography

All of the epistemological models of cartography discussed so far in this chapter have dealt purely with ontic knowledge; that which falls within an assumed knowledge of how a map operates, rather than questioning the operation of maps in itself. Beneath all of the agendas and qualities attributed to cartography by the above authors is a tacit acceptance of the notion that maps can accurately depict the landscape [35], albeit that this depiction can reveal ideology and rhetoric [9, 26] and perhaps refer to itself in addition to reality [7]. Crampton [10] argues that the way in which maps are viewed can reach a much more fundamental and conceptual level than this, dealing not with existing maps and their use, but asking ontological questions about the very being of maps in themselves. To this end, he echoes Belyea [4] in supporting a non-progressivist history of cartography in which modern maps are not viewed as inherently superior to earlier maps because they more accurately mirror the world but rather that they are simply different. Moreover, Crampton [10] notes that the work that a map does in the world evolves over time and space, the context of a map's interpretation being of similar importance to that of its creation.

Pickles [34] makes similar observations and also supports a shift in focus from what maps *are* to what they *do*. In making this claim, Pickles refers to maps as 'inscriptions'—not static representations but instead items which code the world, shape our understanding of it and allow us to carry out work in the world. Some of these arguments echo those of Casti [7] but with less emphasis on the semiotic functions of maps, which fit more comfortably into a conception of maps as representations. Pickles [34] uses this 'map as inscription' approach as a means of abandoning the long-established ontic approach to cartography:

> All texts are… embedded within chains of signification: meaning is dialogic, polyphonic and multivocal – open to, and demanding of us, a process of ceaseless contextualization and recontextualization. Intertextuality, in this sense, cannot be fused with positivist or more broadly empiricist epistemologies, but requires a thoroughly different understanding of epistemology – a rejection of the univocity of texts (and images), of representation as a mirror of nature, and of metaphysics of presence (and the foundational claims of positivism) to ground itself unproblematically in the given real world or the immediacy of observation. [34: 174]

Here, Pickles sees the importance of incorporating context of observation into the reading of maps; recognising maps as producers of the world and our understanding of it, rather than mirrors of it [34: 146]. However, despite the efforts of Crampton [10] and Pickles [34] to establish a post-representational cartographic discourse, Kitchin and Dodge [28] argue that even these two authors fail to escape the ontic limits of traditional cartography and still view maps as representations of space. In justifying this, they elucidate that it is possible for maps to be 'multivocal' and influential in the world and our understandings of it while still being a stable representation of spatial patterns. In this sense, Kitchin and Dodge [28] argue that Crampton [10] and Pickles [34] add yet more complexity to ontologically stable cartographic discourse but fall short of breaking free from it.

In response, Kitchin and Dodge [28] support an ontogenetic view of maps, maps as a process of continual development and maturing. Although this process naturally begins with various processes which bring a map into being (including technical, social and political components), this ontogenetic stance sees this merely as the starting point for a map, where more traditional perspectives see it as the map's 'completion'. Beyond the production of the map, Kitchin and Dodge [28] endorse Pickles' [34] emphasis on recontextualization and argue that maps are 'remade every time they are engaged with' [28: 335]. In contrast to both Crampton and Pickles, this approach sees 'maps as practices' rather than static representations that happen to be at work in the world. Consequently, a truly post-representational epistemology sees continual engagement with maps in new temporal and spatial contexts as a fundamental element of the map itself—without this continual engagement, and remaking of the map each time in its new context, the map is 'simply coloured ink on a page' (ibid.: 335). Only when the concept of 'mapping' is read to incorporate continual engagement and re-engagement of this 'ink on a page' in new contexts for new purposes can the ontological security of a map be finally discarded. Mapping is therefore a process which is never complete—it is always emerging and becoming, never reaching an end point at which it becomes static.

Kitchin and Dodge [28] proceed to argue that this newly-conceived notion of 'mapping' encompasses processes of 'transduction'. Each time a map is re-engaged with, previous engagements can be drawn upon. A reading of a map need not take place in total ignorance of all past readings of a map, but these may rather be used as a starting point for further modulation or development of the map. This concept fits naturally into traditional notions of 'map-making', in which particular types of features may be added in sequence, each one in relation to the previous one. Kitchin and Dodge [28] see this process continuing into the traditional realm of 'map use', which, in the post-representational sense, is a continuation of the mapping process. Work done with the map in the world builds upon work that has been done in the past. In this way, transduction allows the map to mutate and facilitates its 're-making' in new contexts. As a result, the binaries which have long defined cartography—map maker/map user and subject/object—are no longer operative in the same way [11, 22].

3.6.1 Illustrating Maps as Practices

In a later summary of this new paradigm, Kitchin et al. [29] explain that as well as doing work in the world, maps may also be worked upon by the world, both during and after the practices that initially brought them into being. Such work may include vectorising, scanning, generalising, the use of a map for the compilation of another, or even the simple folding or rolling of a paper map. These practices have no place in a conventional view of a map representing the world, yet they each influence the ways in which a map is engaged with in new contexts and can therefore be considered 'mapping' in this broader sense. In illustrating this, Kitchin et al. [29] refer to earlier work by Corner [8] which began to undermine the 'maps as representations' ontology by separating maps from territory and, in doing so, removing the need for one to precede the other. Indeed, given that man-made environments, such as cities, are designed and constructed using maps and plans, either as a complete new town (see Fig. 3.1) or site by site, reality in these situations can be more accurately viewed as representations of the map (Corner [8] in Kitchin et al. [29]). This, Kitchin et al. [29: 18] argue, highlights how 'maps and territories are co-constructed'.

Del Casino and Hanna [11] moved beyond Corner's illustration of the physical production of a place to explain how visitors to a town can contribute to its production in more abstract senses, as their use of a tourist map shapes and influences their actions and interactions with the town. Despite still referring to maps as representations, Del Casino and Hanna's illustration highlights how the work of the tourist map is never complete. As tourists continue to engage with the map, they contribute to the nature of the town and contribute to the nature of the map. As a result of this process, the distinction between the author and the reader of the map becomes blurred.

> What we want to suggest is that representations are not simply visual objects ripe for deconstruction. Representations, maps included, are tactile, olfactory, sensed objects/subjects mediated by the multiplicity of knowledges we bring to and take from them through our everyday interactions and representational and discursive practices. [11: 37]

Applying Kitchin and Dodge's [28] post-representational approach to this analogy, a tourist map only becomes a map when it is engaged with as such (read, recognised and interpreted). Crucially, Kitchin et al. [29: 21] highlight that it is these practices, which have been 'learned and constantly reaffirmed', which have given

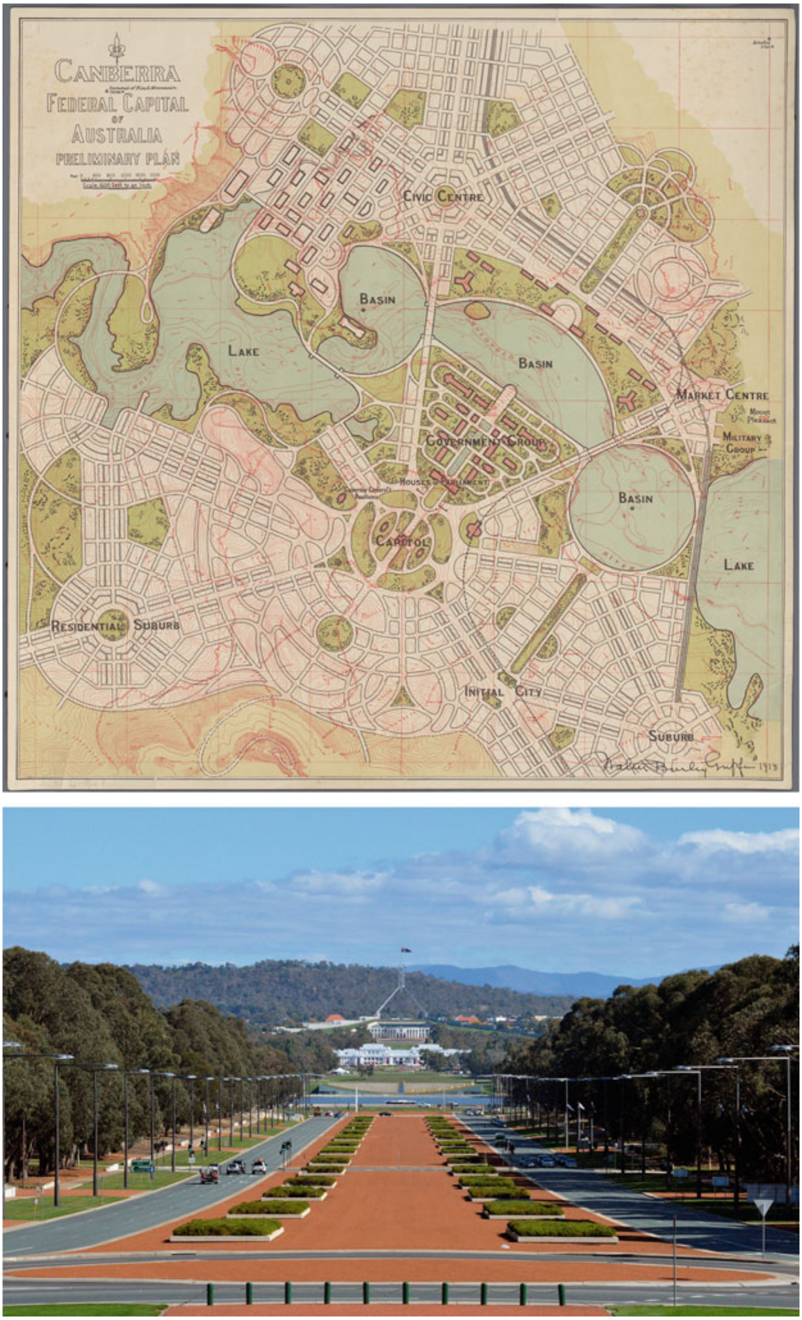

Fig. 3.1 Which is the representation? Walter Burley Griffin's (1913) competition-winning design for the layout of Parliament House and Capitol Hill, Canberra, Australia (top) (National Library of Australia, nla.obj-230041959) and a view of Old Parliament House, Canberra, Australia completed in 1927—pictured in 2017 (bottom)

maps their long-standing perceived status as representations. In other words, the coloured ink on the page only becomes a map when an individual brings their own knowledge of how to engage with it and implements these practices accordingly. Because this takes place at the level of the individual, the knowledge and ability to apply various map-related skills will vary each time the map is engaged with and applied in the world by different people, affirming the conclusion that the map cannot possibly be a static representation which operates independently of the map viewer.

3.6.2 Deconstructing the Ontogenetic Map: Revisiting Derrida

After departing from an ontologically secure conception of mapping (i.e. one which remained within a 'map as representation' framework) in favour of a post-representational view, it is argued here that there remains scope to further scrutinise the nature of maps by drawing on the work of Jacques Derrida in relation to the metaphysics of presence. While Harley's problematic application of Derridean deconstruction has already been recounted, two particular components of Derrida's work, which have not previously been applied directly to cartography, can aid our understanding of maps as ontogenetic processes, rather than the rhetorical representations described by Harley. The following section summarises these components, illustrating them in the context of the Soviet military city plan programme.

Although the concept of *différance* has not been directly cited in the exploratory literature on post-representational cartography, the two concepts appear to be mutually compatible in several respects. Firstly, the two agree that, as meaning is not extant in the present (neither by sensibility or intelligibility; Derrida [13: 281]), the map has no meaning in itself. Just as a Derridean construal of the meaning of any language would contend that a system of signs is merely arbitrary graphics or sounds until an interpreter attributes meaning to them, Kitchin and Dodge [28] similarly dismiss a 'map' as ink on a page, until such a time as it is engaged with as a map (by being read and interpreted etc.). Working from this premise that the map has no meaning present to itself, but yet it has proven an invaluable tool for communication and interpretation throughout the history of civilisation, we are led to conclude that any meaning which can be gleaned 'from the map' is rather deferred to the interpreter of the map. The interpreter of a map is forced to 'put off until "later" what is presently denied' [13: 278] in order to distinguish a sign from another which is in some way different. The map reader brings to the map their culturally prescribed knowledge of how to interpret and understand a map, their knowledge of any conventional signs used on the map as well as their broader knowledge of the features of the place which the map purports to represent. It is through this final element of knowledge that a map interpreter links the map to a reality—a reality to which the map itself is not inherently linked. Similarly, a map interpreter's knowledge of the conventional signs on a map is akin to a reader of literature's familiarity with the language in which a particular text is written; although a map is no more required to use all symbols in a symbology than a text is required to use all words in a dictionary.

On a Soviet plan of a foreign city, this deferral of meaning takes place regardless of the toponyms on the map. An individual attempting to interpret such a plan with no knowledge of the Cyrillic alphabet or Soviet conventional signs may yet glean meaning from the map by bringing to it their culturally ingrained understanding of what a map 'should look like'. They may, for instance, recognise blue areas as water or green as an area of vegetation, as dictated by cartographic convention. They may recognise bold orange lines as major roads, not because they have learnt that the Soviet conventional sign for a major road is orange, but because they have learned to interpret a linear feature, prominent in the map's visual hierarchy, as a road—with greater visual prominence reserved for those of greater importance. The interpreter imbues each component on the map with meaning as they explore and move through the 'fabric of differences' between each conventional sign [13: 287].

The notion that meaning is attained by moving through such a fabric jars against the concept of a legend, which purports to define the meaning of signs found on the map. However, as Glendinning [23] explains, codes and languages (we can view a legend as a code for interpreting a cartographic language) are themselves governed by conventions and, once again, have no meaning in the present, legends also rely on the deferral of meaning to an interpreter. The legend therefore enriches the fabric through which a map interpreter defers and explores the meaning of the map, but does not ascribe a univocal meaning to a sign, any more than a dictionary definition of a word depends on the reader deferring understanding of the defined word to an understanding of each of the words used in the definition.

It should be stressed that *différance* in the context of the map, just as in Derrida's expositions on more conventional languages, does not reach a logos or defined origin of meaning. Whereas a representational view of cartography sees reality (the landscape) as the logos of a map's meaning, this stance is problematised when we consider how a map can be interpreted and understood by an individual with no knowledge of the place which the map purports to represent. Once again, Derrida aids our understanding of this phenomenon. If the reader is not deferring the meaning of the map to reality, nor is meaning present in the map itself, the reader must be assuming meaning from their own 'historically constituted' [13: 287] weave of experience of cartographic language and its culturally endorsed linkages to generic features in reality. This distinction of a specific feature in a real location and a map interpreter's generic (or experiential) understanding of a certain feature type is important in undertaking a deconstruction of a map; not in the Harleian sense of identifying rhetoric, but by perceiving the difference between signifiers (e.g. a conventional sign for a tower), signifying concepts (e.g. a tower) and the referent (e.g. a specific tower in a specific location in reality) [3, 12]. Far from being merely polysemic (as suggested by Harley [26] and Crampton [9]), or limited to a discrete selection, the meanings with which map interpreters grapple in relation to all three of these components are infinite in number. Different individuals in different temporal, spatial and cultural contexts will defer the meaning of all three elements across potentially very distinctive 'fabric[s] of differences', leading to an infinite number of possible directions in which this movement can take place, which will certainly not arrive at a single logos. Just as the map is remade each time it is engaged with and 'recontextualised' [28, 34], so the meaning that an individual may attribute to a map will be different in different contexts. More generally, the concept of assigning meaning to a map through movement is harmonious with the post-representational notion of a map as a practice, rather than an object. As we conceptually visualise a map in an ontogenetic sense, continually emerging and maturing over time, with each 'recontextualisation' transducing previous engagements with the same map, so too can we imagine an individual's fabric of differences, across which meanings are deferred, being enriched by each encounter they have with mappings and related concepts. In this way, *différance* helps us to understand Kitchin and Dodge's [28] description of transduction as an important process in the mapping and continual remapping which takes place after a map has been brought into being.

Beyond *différance*, Derrida's concept of absolute absence also helps us to ask ontological questions of the map. The concept rests on the basis that writing, in order for it to be considered as such, must still be capable of functioning in the 'absolute absence' of the author or the intended receiver on the map. By absolute absence, we can read the death or total eradication of either party. Understanding the map as a form of writing, and applying this concept accordingly, the concept of simple communication between a cartographer and map reader is undermined. Rather than functioning as a means of information transfer between two parties, the map, for it to be considered as such, must be capable of functioning (i.e. be interpretable) on its own—'even when what is called the author of the [map] no longer answers for what he has written' [15: 8]. In the case of the Soviet programme, this concept can be clearly seen in operation. The author of the maps, the Soviet Union, has been defunct (or 'absolutely absent') since 26th December 1991 when it ceased to exist as an entity. The maps therefore have no author who answers for them, nor can the maps' author ever return to being extant in the same way again. Returning to the quote which began this chapter, summarising the intended function of the maps, we can also conclude that the intended user or recipient of the map is also 'absolutely absent' as, in the absence of the Soviet Union, there can be no 'execution of measures significant for the national economy and for defence' in the way intended here [21]. Similar concepts have been alluded to in a cartographic context in the past, although without specific reference to Derrida. Vujakovic et al. [41], for example, defines 'feral maps' as those which are no longer the controlled entity originally envisaged but function more wildly and uncontrollably in the world.

Nevertheless, it cannot be stated that Soviet mapping is today rendered uninterpretable or without possible purpose, as the continued interest in the maps affirms. Consequently, the iterability of Soviet maps—their capacity to be stated and interpreted again in the absence of their author and intended receiver—has been unequivocally proven. Viewing Soviet maps ontogenetically, we see them not as historical relics which no longer have a function, or as a fixed point in the narrative presented in Chap. 1, but rather as mappings which continue to be remade and recontextualised in settings which would have been unimaginable to their authors. The majority of the cities mapped as part of the Soviet city plan series have never been administered by a communist regime and therefore most of the maps have never been used for the purpose intended by their authors. It is precisely the inherent iterability of the maps—the capability of them to be remade in new contexts to solve new problems—which explains their enduring appeal, usefulness and applicability to new scenarios in a way that an ontologically secure, representational epistemology cannot.

A model of maps as processually emergent appears to dismantle the binaries which have long defined traditional cartography, as described by Del Casino and Hanna [11] and Gerlach [22]. Nonetheless, the above lacing of Derridean deconstruction with post-representational cartography may initially appear problematic insofar as it still depends on such binaries in order to be explained coherently (e.g. references to map readers and interpreters, as opposed to map authors and creators). However, the stubborn endurance of binaries here can perhaps be explained by their necessity within a cartographic discourse which remains predominantly sited within an ontologically secure construal of the map. Indeed, binaries are the classic structuralist means of establishing the particular conceptions of meaning (what is, and what conversely is not) which *différance* exists to disassemble. As Derrida moves beyond the 'strict and problematic opposition of speech and language' [14: 7], cartographers may move beyond the similarly problematic opposition of map-making and map use, given that the boundary between these activities has been blurred by the acknowledgement of all interactions with maps as 'mapping'. As we abolish the notion of a finite multiplicity of meanings which can be understood by interpreting a map, we also abolish the finite binaries which unjustifiably limit the roles which can be played by various actors who are involved in 'mapping', in the processual sense. Perhaps future discourses in cartography will establish an intelligible means of conveying ontogenetic deconstruction without resorting to using the language of its representational predecessors.

3.7 A Pseudo-Representational Framework

Broadly, this fusion of Derridean deconstruction and post-representational thought leads us to several theoretical implications for the discipline of cartography. Firstly, it affords us an understanding of how maps can be useful in new contexts and times and for new purposes. This perhaps also accounts for the endurance of the field of historical cartography, which continually revisits maps which, by definition, were brought into being in a distant temporal context but can be re-engaged with using new methods, technologies and insights from new perspectives to serve new purposes. Re-engagement with Soviet maps in new contexts and the absence of their author demonstrates this.

The framework also allows us to understand a vital characteristic of the map; that it can allow an interpreter to understand something of the nature and spatial layout of a real-world location, independent of any existing knowledge or experience of that place. This allows, for example, a tourist to familiarise themselves with a city before visiting it, or stakeholders to visualise a new development before it has been brought into existence. In light of this, we must be careful not to overstate the severance of the link between the map and the reality it purports to represent. This linkage may not be direct in the sense implied by cartographic communication models (or in the metaphor of a map as a mirror) as a real location cannot be present to a map. Nevertheless, the enduring usefulness of maps throughout history serves to demonstrate that a map-reality linkage must exist in some form, if only in the sense that the map allows an interpreter, by referring them to their existing knowledge of signifying concepts, to attain a representative knowledge of a particular space. Therefore, although we may consider a map to be non-representational, the successful functioning of a map must still depend on the map interpreter associating their knowledge of particular signifying concepts with the location with which a map is nominally connected. In this sense, it is not the map which is a representation, but the interpreter's knowledge of a signifying concept which represents a location; the role of the map is to forge the mental connection between signifying concept and referent in reality.

Consequently, the concept of accuracy, which cannot refer to the consistency of a map and a place in a post-representational framework, can more correctly be considered the focus with which cartographic language leads an interpreter to explore the meaning of the signifying concept intended by the map's creator. A topographic map, which nominally aims to be objective, may wish to focus the interpreter's deferral of meaning through a very specific 'fabric of differences' by using a large symbology, with each symbol referring to a very narrow signifying concept. The inherent ability of maps to persuade and to act rhetorically rests on their ability to lead the interpreter's deferral of meaning in a particular direction, desired (or not) by the map's creator.

As a result of understanding the operation of maps in this way, we are led to a practical implication for cartography with regard to map design. The map designer has at their disposal an infinite array of colours, shapes, lines, symbols and other graphical variables, as set out by Bertin [6]. The optimal choice of each of these is that which leads the reader to the 'fabric of differences', within their existing knowledge, which is most closely linked to the signifying concept intended by the designer. In this way, map design enables the cartographer to communicate particular themes.

Post-representation undoubtedly marks a fundamental shift in cartographic theory, although whether its practical implications are as momentous for the discipline is questionable. Maps are enduringly useful in all of their applications because of their perceived link to reality. Even if the direct representational link between map and reality can be severed by new cartographic theory, it is unlikely that this will alter the working practices of cartographers or the actions of map users in any way. To the map user, it matters not if they are referring to a 'mirror of reality' or are deferring meaning to existing knowledge; if the map fulfils the purpose for which the user engaged with it, it has met its objectives. Regardless of whether the map holds meaning present to itself, if map users perceive that they are gleaning useful information 'from the map,' they will continue to engage with it in the same way. Whether this process is called 'map reading' or a continuation of the 'mapping' process is inconsequential for most, if not all, map users.

Although the concepts of absolute absence and re-mapping in new contexts serve to explain the enduring usefulness of Soviet mapping long after the demise of its author and intended application, this usefulness still relies on an understanding of the correspondence between the maps and the locations they purport to represent. Although legends and directories of conventional signs should themselves be considered texts which have no meaning present to themselves (and are therefore also subject to *différance*), they nevertheless aid the illusion of maps representing reality. Legends, in any form, explicitly link symbols to signifying concepts, which in turn are purported to link to a real-world referent when they are placed on a map (despite still referring the user to their existing knowledge of the signifying concept to draw meaning from this). Therefore, in essence, it is the perceived link between map and reality, which accounts for the functionality of the map, rendering the presence of an actual link, or lack thereof, unimportant—a pseudo-representational link is enough. In the use of maps for practical purposes, outside of epistemological discussions, a representational viewpoint is not problematic, although the addition of 'pseudo' to this stance clarifies that this 'representation' is not genuine but rather a façade for the deferral of the meaning of the map's signs to its interpreter, or re-maker. The practical focus of the early advocates of cartographic communication models in the mid-twentieth century perhaps explains the overlooking of this theoretical point at that time. As observed by Pacione [33: 6], 'in terms of real-world problems, post-modern thought would condemn us to inaction while we reflect on the nature of the issue.' Accepting the concept of a pseudo-representational link between maps and landscapes allows the avoidance of this pitfall by providing a framework that can explain the endurance of Soviet maps in the twenty-first century, while retaining the possibility of constructing a methodology for analysing map symbologies which has an applied aspect. Chapter 4 aims to develop such a methodology, which can not only shed further light on the Soviet military city plan series, but also inform elements of future mapping praxes.

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Chapter 4
Developing an Approach to Analysing Soviet City Plans

In tracing the development of Russian cartography from its beginnings to its twentieth-century zenith, Chap. 1 concluded that three major themes have long characterised Russian and Soviet cartography: strong state control, a history of censorship and an appetite for precision. The first two of these factors are largely responsible for the distinct lack of academic work featuring the cartography of the Soviet era to date. Chapter 2 identified the manifestation of these themes in the more specific context of Soviet military city plans by collating information regarding their scope and production. It also revealed the continuing drive for comprehensiveness, both in terms of the amount of topographic content which appears to have been included on the plans and in the geographic coverage of the series.

Departing from this historical focus, Chap. 3 explored the development of paradigms in cartography, concluding that a fusion of a post-representational view of maps (e.g. Kitchin and Dodge [13]) and themes from the post-structuralist work of Jacques Derrida on the deconstruction of texts allows us to view maps as a process, holding different meanings to different readers in different contexts. In the context of Soviet maps, this framework explains the re-use and re-interpretation of the maps in modern contexts, despite the absence of both the maps' author (the USSR) and their intended function. The maps achieve this by deferring their meaning, not directly to the landscape in a representational sense, but through the reader's own 'fabric of differences' within their own temporal context. Nevertheless, it was concluded that, despite this theoretical severance of the link between the map and reality, map readers will continue to read maps as direct representations of places. It is the task of the cartographer to design the map in such a way that it leads the reader's interpretation in the desired direction; appearing to function as a representation by 'endowing [symbols] with geographical meaning' [22: 316], although, in reality, deferring the construction of meaning to the reader. In this sense, although elements of map symbology would traditionally be seen as tools of representation, they remain vital in the position adopted here. As Chap. 3 concluded, we may term this position 'pseudo-representation', as this process manifests itself in an almost identical way to

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established representational conceptions of the functioning of maps, with the addition of ‘pseudo’ denoting that this representation is not genuine but merely acting as a façade for the deferral of meaning to the interpreters of maps (or, more accurately, those engaged in their re-making).

All of these issues combine to make Soviet city plans unique among cartographic products. Produced in secrecy for use by a very small, culturally homogenous group, the maps are now found scattered across the globe, being re-contextualised and re-used for new purposes. In addition, the maps appear to use a highly-detailed and comprehensive symbology, in keeping with the aforementioned tendency for precision wherever possible. This makes the city plans unique in that, whereas other state-produced large-scale topographic maps would tend to only incorporate locations within the jurisdiction of the producing state, the Soviet plans extend far beyond this, necessitating a symbology which can adequately depict a broad variety of natural and built environments whilst satisfying the requirement of comprehensiveness. In a century when maps are more readily accessed via the internet, the global coverage and fine detail which distinguished Soviet maps in the twentieth century have, to an extent, become a basic expectation of map users in the twenty-first. The need for the current generation of digital maps to employ a symbology which can transcend all boundaries and be applied globally remains today; mirroring the Soviet effort during the Cold War. Understanding more about the scope and utilisation of the symbology of Soviet city plans, beyond providing historical insight, has scope to inform modern endeavours to the same end. With this as the principal aim of this research, we are led towards specific objectives which will enable this to take place.

4.1 Research Objectives

It is necessary to fully understand the scope of the Soviet city plan symbology before it becomes possible to apply aspects of it to modern online maps. However, as the implementation of this symbology in a variety of environments has also been identified as important, this applied factor must also be incorporated in these objectives. Once data have been collected regarding the scope of the Soviet city plan symbology and its implementation across the globe, a comparison of these with an online map will identify differences and, potentially, examples of where one map outperforms the other in terms of utilising a symbology which is suitably comprehensive for accommodating varied environments around the globe.

OpenStreetMap (OSM) is an open-source online map platform which allows users to both freely use and freely contribute to its ever-expanding geospatial dataset. Since being founded in 2004 in the United Kingdom as a response to the high cost of Ordnance Survey data, its coverage has now spread globally and there are now over two million registered OSM users [21]. OSM has been selected as a suitable platform for this comparison, due to its sharing of several characteristics of Soviet city plans. Firstly, it aims to map the whole world at a variety of scales, regardless of socio-cultural, political and physical boundaries (ibid.). Secondly, the crowd-sourced nature of OSM data collection means that it shares a tendency for more data to be included on the map wherever it is available. In addition, OSM data are open data (free of cost and usage restrictions) causing it to be widely used as base data for other websites and applications. This enables OSM data to be used well beyond its original context, in a similar way to Soviet city plans today.

To achieve the overall aim of the research, its principal objectives are:

- **To examine the extent to which the symbology of Soviet military city plans was successfully implemented across a variety of socio-cultural and physical environments across the globe.**
- **To explore the extent to which the symbology of Soviet military city plans can inform and supplement the global, standardised symbology of *OpenStreetMap*(OSM); successfully transcending socio-cultural, political and physical boundaries.**

The fulfilment of these objectives will involve the construction of a comprehensive record of the symbology of Soviet military city plans according to the relevant specifications and technical manuals. As the extent of the application of the Soviet symbology is an integral component of these objectives, the sole use of symbology specifications would be inappropriate, as these largely present symbols out of the context of a map. Therefore, a sample of city plans will be systematically analysed to identify the extent to which the maps employ this decontextualised specification or deviate from it. By carefully selecting the sample to include a range of socio-cultural, political and physical environments it will also be possible to identify differences in the application of the symbology to maps of locations within these varied environments, thus addressing the first objective. As the use of symbology is the focus here, rather than assessing the accuracy of depictions of local geography, only graphical symbols will be included. Annotations and descriptive text undoubtedly add detailed information to Soviet city plans, and could be the focus of a separate study, but are less important to current internet applications which tend to not use static text labels, but rather annotations which match the language, search history and preferences of individual users.

A similar analysis of OSM in the same locations and at the nearest available scales will highlight differences between the Soviet and OSM symbologies in different environments, thus addressing the second objective. It is beyond the scope of this study to incorporate all 1,899 known city plans in this analysis, nor will all of these plans be accessible in the course of this research, hence the need to create an indicative sample. Within the sample, the number of instances of each symbol being used will not be recorded, but rather whether that particular symbol has been used or not. While undertaking the former would reveal more about the geography of each location included in the analysis, this is beyond the objectives of this study which, again, is concerned with map symbology, not location-specific geography.

4.2 Previous Methodologies

4.2.1 Overview

Detailed analyses of topographic symbologies have rarely been undertaken in the past, given the breadth and quantity of content included in such maps. Whereas publications such as *World Mapping Today* [18, 19], *Maps and Survey* [2] and a pair of publications by Larsgaard [14, 15] give an overview of the scope of various topographic series without addressing any specific aspects of symbology, Olson and Whitmarsh [16] and the series of papers instigated by Forrest et al. [6] focussed their analyses on particular feature types. The most similar existing methodology to that required in this study is that of Kent [10], developed and carried out by Kent and Vujakovic [11], which, although primarily concerned with identifying stylistic diversity, involved the classification of 2,388 graphical symbols from 20 state topographic symbologies using a three-tier typology. Contrastingly, Ory et al. [17] scrutinised stylistic issues within the context of a single state topographic symbology (France), identifying the extent to which users were able to identify the symbology from various graphical components. Other texts have foregone this symbology-wide or multiple-symbology breadth in the interest of a more longitudinal approach and the examination of particular elements of a symbology in depth. *Mapping the Windmill* [1], for example, focusses solely on the evolving depiction of windmills on Ordnance Survey maps of Great Britain, and the socio-historical factors acting as stimuli to such change. With an objective of this study being to establish the extent to which a standardised symbology has been applied to varied environments across the world, a balance of these two general approaches is required.

There is not scope in this study to examine the culturally-imbued development of each symbol in the Soviet specification. Conversely, a general summary of the Soviet specification would be too coarse, if the nature of the application of this symbology is to be understood in anything more than anecdotal terms. This study is also distinctive from its predecessors, with the exception of Ory et al. [17], in the sense that it is primarily concerned with a single topographic map series, produced by a single organisation rather than several. Nevertheless, elements of methodologies used in existing studies incorporating several topographic series, typically those of different National Mapping Organisations (NMOs), provide useful starting points in developing a methodology.

4.2.2 Methods of Analysing the Symbologies of Topographic Maps

Olson and Whitmarsh's *Foreign Maps* (1944) is the earliest example of a detailed analysis of topographic maps and aimed to 'fill a long-felt prewar cartographic void' [16: xi]. Despite the book's title, 'Maps of the United States' is the only chapter devoted to the mapping of a single country (the authors were both based at the University of Chicago), although it deals mainly with coverage and the mathematical bases of the maps, rather than symbology. Chapter 2 features sections addressing 'the principal problems in interpreting foreign maps', including 'Sign and Symbols' as one of five areas for concern. It advises the reader to construct a table, incorporating the troublesome foreign symbols in one column and English language descriptions of these in another (ibid.: 23). It is envisaged that all of this information will come from the map itself, making no use of any supporting documents. This means that the interpretation necessary before writing a description of each symbol relies on the reader's recognition of cartographic conventions, stemming from 'man's tendency to solve similar problems by similar means' (ibid.: 23). Olson and Whitmarsh recognise the limitations of this approach, particularly in the case of symbols which 'must stand for features which do not have a wide distribution or which, in some instances, are restricted to a particular country' (ibid.: 24). Chapter 7 of their book is dedicated solely to 'Signs and Symbols' and features seven tables, each dealing with a particular category of feature:

- Railroads
- Roads
- Cities, towns and villages
- Water features
- Small objects
- Boundaries
- Lakes, marshes and forest

Each table includes between three and fourteen specific objects, with a monochrome graphic provided for twelve countries (Argentina, Britain, Czechoslovakia, Denmark, Finland, France, Germany, Italy, the Netherlands, Russia, India and Sweden). Details of any colours that would be used are described in the accompanying notes. Although the chapter recognises a geographical variance in the symbols used by each country, this is explained purely by the notion that symbols are 'a function of the land itself' (ibid.: 146); a firmly representational stance which does not indicate a recognition of cultural influence on map content and design; although this stance is undoubtedly a product of its culture in itself.

A more thorough survey of state topographic mapping during the Second World War can be found in *Maps and Survey* (1952) [2]. Commissioned by the British War Office, *Maps and Survey* was intended to function as a record of information acquired during the war and as an aid to recognising features on the topographic maps of various state organisations. Although classified 'restricted' when produced, the publication was declassified in 1972. The approach it adopts is more systematic than that of *Foreign Maps*, with several chapters dealing exclusively with one or two countries. In each of these, a detailed account is given of the history of mapping operations in these areas, with a particular focus on wartime activities, the coverage, mathematical bases and source materials of the maps, as well as the resources available in the course of their production. Content varies by country, depending on the information available, but is richly supported by sketch maps, fold-out charts showing the organisational structures of mapping organisations and several colour plates of map extracts.

In its comprehensive outlook, *Maps and Survey* is similar in style to the much later civilian publication *World Mapping Today* [18, 19], which includes similar information, covering more countries but in less detail. Despite the vastness of both of these volumes, neither contains an analysis of symbology.

A similarly ambitious overview of topographic mapping around the world was undertaken by Mary Larsgaard in two volumes, one dealing with *Topographic Mapping of the Americas, Australia and New Zealand* (1984) [14] and the other with *Topographic Mapping of Africa, Antarctica, and Eurasia* (1993) [15]. However, Larsgaard states that these volumes are 'not intended to be a detailed study of available topographic mapping, but rather a survey of the history of the mapping of countries with an area of 4,000 miles square or larger' [15: xix] and thus deviate from the type of methodology required by this study.

Far from providing a global overview of mapping or symbologies, Ory et al. [17] focus their empirical work solely on the topographic style of Institut National de l'Information Géographique et Forestière (IGN), the NMO of France, albeit by nature of a comparison with maps from four other NMOs (Switzerland, Catalonia, Luxembourg and New Zealand). Firstly, 410 users (mainly 'French expert[s] in cartography', ibid.: 197) were presented with six topographic maps including a 1:25,000 IGN map and a 1:50,000 IGN map, the latter covering Italian territory. Users were asked to identify the two IGN maps among the maps of other NMOs, two of which covered French territory. 91% correctly identified the 1:25,000 IGN map, while only 16% correctly identified both the 1:25,000 and 1:50,000 IGN maps. Choosing from a pre-defined list of five map elements, 80% of participants considered the 'graphic appearance of the depicted features' as the most important criterion for identifying the maps, followed by the level of generalisation (47%) and toponymy (33%). Finally, a selection of 1:25,000 IGN symbols assigned to six classes was displayed in isolation from the map on a white background, similar to a legend (Fig. 4.1), and map users were asked to identify those which were most easily identifiable as deriving from an IGN map. The most common response was the representation of relief (62%), followed by the symbolisation of built-up areas (48%) and road networks (47%),

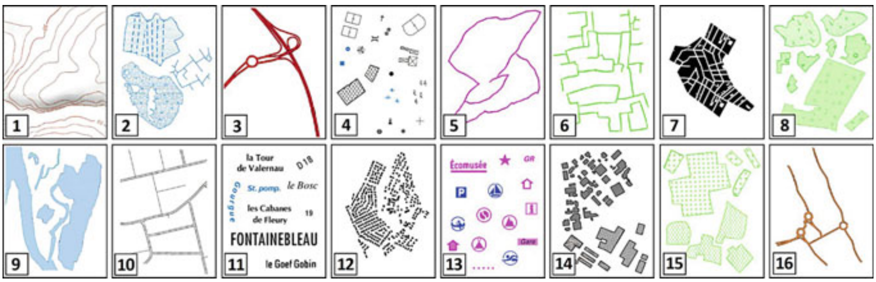

Fig. 4.1 Elements of the 1:25,000 IGN-France symbology in isolation, from Ory et al. [17]

with Ory et al. consequently considering these three feature types as the most important to the identification of topographic style. Vegetation Cover, Hydrography and Tourist Information were the other three classes.

Although the style of topographic maps is not the focus of this study, an element of the work of Ory et al. [17] which will be useful is the classification of symbols according to feature type. In the context of the Soviet symbology, as in the IGN symbology, this allows broader trends to be identified across the symbology, which may not be as readily discernible at the level of the individual symbol. However, as the application of symbology in different natural and built environments is important here, it is necessary for an analysis of the use of symbols in the context of the maps on which they appear to be an important element of this methodology. In addition, Kent and Vujakovic [11: 183] note other elements of map style which cannot be incorporated in a classification of symbology out of context, such as 'white space', visual hierarchy and lettering; all of which may have influenced the choices made by users in the first test by Ory et al. [17], but were overlooked in the second. Although the initial user-testing of Ory et al. [17] took place using entire map sheets, users were later required to explain their choices using a series of symbols removed from their context, and thus only part of the study simulated realistic map use.

Map symbols are designed to be a part of their respective symbologies which are, in turn, designed to be employed on a map. It is possible that the process of assigning meaning to symbols by a map reader may be enhanced by their context of application, likewise as understanding a sentence part-way through a novel may be enhanced by reading those which preceded it. The deferral of a meaning of a map symbol to the map interpreter's own understanding may be influenced by their simultaneous or immediately preceding interpretations of other symbols on the same map, as well as past readings of other maps; as supported by Kitchin and Dodge's [13] notion of transduction in the event of a map being re-engaged with and Derrida's assertion that a meaning is '"historically" constituted as a fabric of differences' [5: 287]. An acceptance that factors beyond isolated map symbols are influential on any construal of their meaning, and therefore perceived level of importance, is alluded to by Ory et al. [17: 198] by their decision to 'request mainly French [participants] in order to manage a certain level of knowledge and experience of the IGN-France maps', but the chosen methodology did not allow such previous encounters with IGN maps to manifest themselves fully. Although, in this study, the separation of the Soviet symbology into discrete symbols is necessary for empirical analyses, the resulting explanatory tables of symbols should be viewed merely as an aid to interpreting the maps, rather than a text to be analysed in itself, in *lieu* of the maps. Although understanding the holistic style of Soviet maps is not an aim here, retaining the mapped context of symbols as far as possible in this methodology remains important to the theoretical stance which has been adopted.

A methodology which does retain the mapped context of symbols is adopted in Bignell's *Mapping the Windmill* [1], which analyses the mapping of a particular feature (windmills) by a particular organisation (Ordnance Survey) in a particular location (England). Issues such as differences between scales and editions, geographical variations and a strong grounding in relevant cultural and industrial histories are all incorporated, supported by substantive quantitative data and graphical examples (Fig. 4.2). Bignell also identifies differences in the application of symbols on different sheets of different areas; an approach which may be useful here given the objective of identifying different applications of a symbology in different environments. Attempting to carry out such detailed research into each symbol across a whole symbology (especially one as large as the Soviet symbology) is impractical, yet the concept of analysing symbols in the context of the map has merit. The application of the Soviet symbology across the globe introduces further complexities, the research objectives of this study necessitating a broader approach.

Bignell's [1] approach goes beyond that which is required by the objectives of this study in that it records the locations and number of instances of a symbol on map sheets, as well as variations between editions (Fig. 4.2). Given that an entire symbology will be incorporated here, rather than a single symbol, it is more practical to simply record whether each symbol is present on a particular sheet at all. This will still facilitate an understanding of which elements of the symbology are used in various environments, although not the extent to which symbols have been used on each map. Forgoing the depth of Bignell's data on the application of a single symbol will allow more breadth in that it will be more feasible to include more city plans in the study.

A methodology incorporating the entire symbology of the Soviet military city plans does not, however, remove the possibility of highlighting any notable patterns of use of a particular symbol or group of symbols. Observations of this nature were made by Forrest, Pearson and Collier in their series of papers dealing with 'The Representation of Topographic Information' [3, 4, 6, 7] which, after an introductory paper, addressed 'Vegetation and Rural Land Use', 'The Coastal Environment' and 'The Depiction of Relief' respectively. Further papers dealing with other features were planned but have not yet come to fruition. Approaching topographic symbologies from the perspective of particular feature types allowed comparisons to be made between maps from different producers at different scales, while not giving an overall impression of any particular map or map series.

Where the 'Representation of Topographic Information' series of papers aimed to highlight national differences in representation, Piket [20] resolved to eliminate them. Basing his approach on five types of feature (or 'range classes')—built-up areas, roads, ground cover, orography and hydrography, Piket compared the legends of 1:25,000 maps from five European countries (Belgium, the Netherlands, West Germany and Denmark [together], Italy and Switzerland). Unfortunately, the resulting symbol counts are not given in Piket's account of his work but, rather, a table is presented including a series of stars which give an indication of the relative emphasis on each range class in each country. No quantitative reasoning for the numbers of stars is provided, resulting in a purely illustrative impression. Piket's method also does not consider any possible discrepancies between map legends and the map itself. A map legend may not be a comprehensive record of all symbols used (or possibly used) on a map, but may rather focus on a selection (e.g. commonly used symbols, or particularly obscure symbols). Some 35 years later, a similar approach

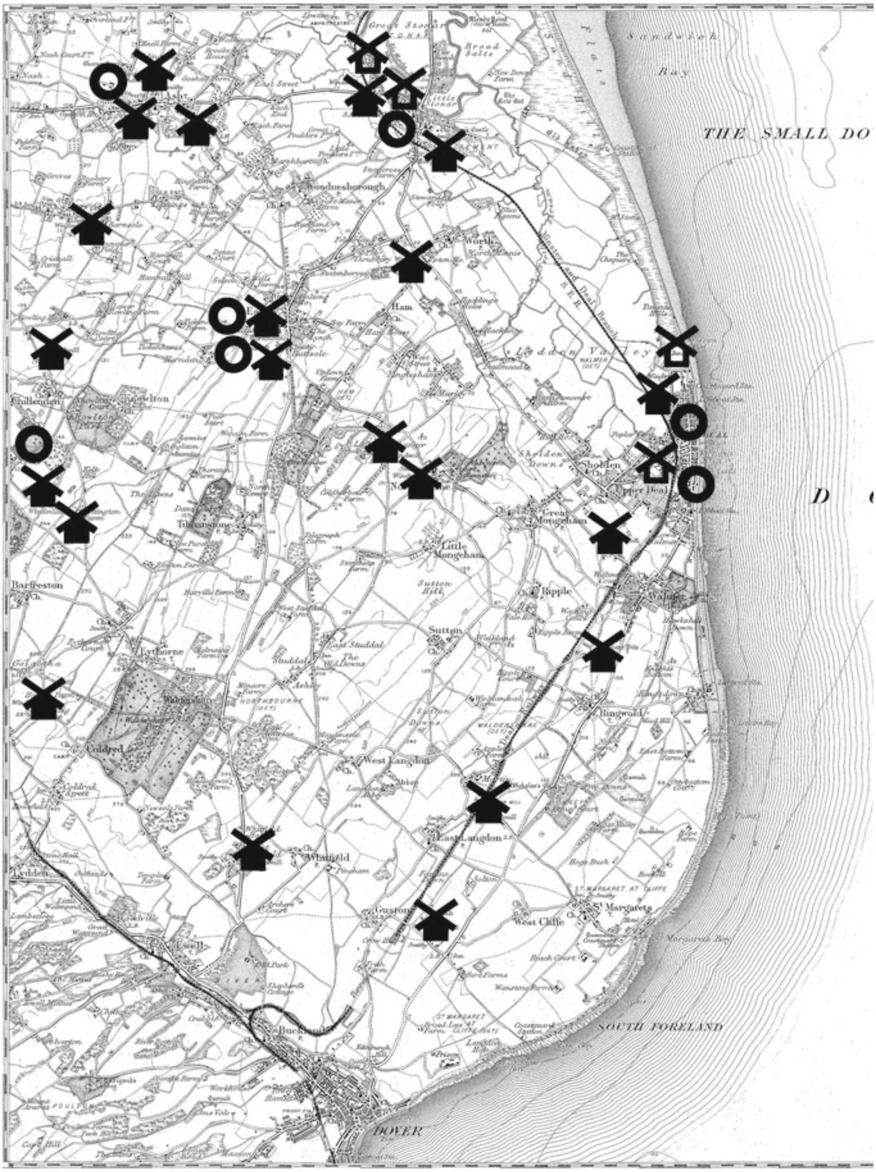

Fig. 4.2 An extract of Ordnance Survey Revised New Series Sheet 290 (Dover) annotated to indicate the locations of windmills and their inclusion in this and other Ordnance Survey series covering the same area (Bill Bignell, *Mapping the Windmill*, Charles Close Society, reproduced with permission from the author and publisher [1])

was taken by Hopfstock [8: 9] in the context of the Infrastructure for Spatial Information in Europe (INSPIRE) programme, with a view to creating a 'harmonised' European symbol set. Hopfstock quantified the motorway symbols of 24 organisations (half commercial, half NMOs) at scales between 1:160,000 and 1:250,000, although her analysis did not address similar issues arising from the sole use of legends and specifications.

An approach involving drawing conclusions about the symbology of a map based on its legend, as adopted by all of the examples cited thus far save Bignell [1], is problematic for this study. As it has been identified that achieving the research objectives will include understanding how the Soviet symbology has been implemented in different environments, it is important that data are collected regarding the symbols in their context, i.e. on the map. However, if using maps themselves as the only source of information on the symbology of an entire series, comprehensiveness can only be guaranteed by analysing all maps in the series. Given the scope of the Soviet city plan series, that is not possible here meaning that a comprehensive record of the symbology out of its context (i.e. in a production manual) will also need to be consulted in order to assess the scope of the symbology in its entirety.

Piket [20] saw national differences between topographic map symbologies as an issue to be overcome through international cooperation, with an ICA Commission being suggested as a platform for such a dialogue. Although Piket [20: 270] recognised that the content of topographic maps tended to follow a 'national norm', his analysis remains within a representational framework which sees maps as a function of the landscape. Contrastingly, Kent [10] saw the differences in symbologies of state topographic maps as something to be analysed in order to identify the broader cartographic styles to which these symbologies contribute and the national traits shared by countries whose maps share stylistic characteristics, or 'supranational styles'. Kent's methodology is the only approach of those encountered here which uses a 'map as language' viewpoint as the premise of a critical analysis of topographic symbology, although it stops short of accepting a fully post-structuralist paradigm in its acceptance that a map's meaning may be constructed by cartographic language; suggesting that meaning is inherent to language [12: 29]. Although aspects of Piket's [20] work are developed, especially the classification and quantification of symbols by feature type, Kent's [10: 151] acknowledgement of an 'open interpretation of the meaning of symbols wherein connotations are not fixed', echoes Derrida's substitute of a fixed *logos* with *différance* and permits a consideration of topographic symbology which extends beyond functions of the landscape. This interpretation was not adopted in that methodology, seemingly due to the impracticalities of doing so [10: 151].

The pseudo-representational stance adopted here, and outlined in the previous chapter, acknowledges the practical limitations of fully accepting a Derridean view of language in the context of maps, while retaining the insight it can give into the map interpretation process; thus reaching a workable compromise. Importantly, however, Kent [10: 151] also recognises that,

> Any attempt to compare styles by replicating symbol specifications for the creation of maps of a landscape (hypothetical or otherwise) is insufficient for any rigorous examination of the differences in topographic maps.

This implicitly recognises the transduction which can take place between different mappings experienced by an individual map interpreter, which the interpretation of a specification in isolation would not fully emulate. The methodology required here differs from that of Kent [10] in its requirement to incorporate maps of specific locations, in order to highlight geographical variance in the application of the Soviet symbology. In contrast, Kent [10: 152] was concerned with 'the wider landscape' and stylistic trends within symbologies as a whole. Nonetheless, the methodology of this study can incorporate a similar analysis of a classified symbology together with characteristics of the locations which have been mapped. This will facilitate the identification of variations within the Soviet symbology at two scales, whereas Kent's similar analysis was concerned with comparing and differentiating 20 different symbologies at the same scale [11: 189]. Helpfully, in the results of Kent's [10] proposed methodology, Kent and Vujakovic [11] divide their classification of discrete symbols into three levels. This allows both the analysis of general trends across the dataset at the broadest level, in addition to more detailed expositions of patterns within particular feature classes. This also allows the prominence of particular feature classes within the symbology (in terms of symbol count) to be revealed and, in the current study, the technique will be a useful means of highlighting geographical variations. Whereas Piket [20] stopped short of providing data at the level of the individual symbol, the provision of individual symbol counts by Kent and Vujakovic [11] allows precise comparisons between different symbologies and will likewise facilitate comparisons between different geographical applications of a single symbology.

Kent [9: 147] opted not to compile an 'exhaustive description of topographic symbols in use' stating that this would be a 'gargantuan task'. However, given that the focus of this study is only one symbology, rather than the symbologies of multiple NMOs (as in Olson and Whitmarsh [16]; Piket [20], the series initiated by Forrest et al. [6], and in Kent and Vujakovic [11]), it is perhaps more feasible here than in previous analyses of topographic maps. It may also be more useful, given that this information has never been provided in a single volume before, or at all in the English language, and would therefore provide a valuable guide to modern interpreters of these maps. Using aspects of these previous methodologies as a starting point, the following chapter explains the methodology that will be adopted by this study in order to meet its research objectives.

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Chapter 5
The Methodology

The methodology can be divided broadly into three parts. The first two deal with the requirements of addressing the first research objective, including the issues regarding the translation of source materials, classification methods and the construction and sourcing of a sample of maps. The third part deals with the second research objective. It is necessary to divide the first objective into two elements, due to the different methodological challenges posed by compiling a record of symbology out of its context and analysing it within the context of the map.

5.1 Compiling a Comprehensive Record of the Symbology of Soviet Military City Plans

5.1.1 Selection and Translation of Source Material

The first task required to achieve the research objectives is the compilation of a comprehensive record of the symbology of Soviet military city plans, as no such record exists in English. Even in the Russian language, the symbology of the series is derived from three separate documents which need to be sourced, translated and amalgamated in order to complete this segment of the research. It is intended that the resulting document will not only facilitate the achievement of the remainder of the above research objectives but that it will, in itself, provide a useful guide for those interpreting these maps. It will also provide a full record of the comprehensiveness of the series for the first time, thus providing a more complete picture of this aspect of Soviet and twentieth century history. As explained in Chap. 2, the three documents needed for this task are the *Conventional Signs for Topographic Maps of the USSR* (covering scales between 1:25,000 and 1:1,000,000), *Conventional Signs for Topographic Maps at 1:10,000* and a small supplement appended to the compilation manual for city plans [5: article 11].

M. Davis, *A Cartographic Analysis of Soviet Military City Plans*, Springer Theses,
https://doi.org/10.1007/978-3-030-84017-4_5

As the majority of known Soviet city plans were produced between 1970 and 1990 (due to a surge in production between 1970 and 1973, coinciding with the launch of Zenit-4MT), the symbology studied here will be that in effect in the early 1970s. Accordingly, the 1966, 1968 and 1978 editions of these three texts respectively are used here [4–6]. Original hard copies of both *Conventional Signs* books were sourced via online second-hand booksellers, while a copy of the 1978 city plan compilation manual is the only edition of this document available. Both editions of *Conventional Signs* were translated using an online translation tool and the *Oxford Essential Russian Dictionary* [15] where required. The translation was completed using the same method as both editions of *Conventional Signs*. After translation, these three texts were compiled into a single table which represents a snapshot of the complete Soviet city plan symbology in the early 1970s, albeit out of the context of the map.

5.1.2 Symbol Separation and Classification

Classification is the arrangement of data into 'taxonomic groups according to their observed similarities' [14] or, more specifically, the structuring of source data in order to reduce the complexity of information by eliminating unnecessary detail, thus facilitating appropriate visualisation and effective graphic communication [1: 134]. However, in the context of map symbologies, Kent [8: 157] highlights that a perfect classification is unlikely to be found, as there are often several methods of classifying the same data. Nonetheless, a classification of symbols which is workable in the context of this study is vital to the research objectives, as groupings of symbols by type will form a key element of the analysis of the symbology of Soviet city plans. Identifying classes with more symbols available may reveal something of the priorities of the map series. As Kent [8: 159] summarises, 'the more symbols used to describe a type of feature, the more significance that feature has, both on the map itself and to [the society which produced it].' In addition, the extent to which symbols appear on different maps may reveal discrepancies in the source data available for different locations, in addition to variations in social and physical landscapes.

More broadly, an analysis based on classes will also make key themes more apparent than one solely at the level of individual symbols. Additionally, as a reference resource, the data collected in the course of the analysis will be more easily interpreted by users if organised logically into feature classes. In constructing a card sorting method for map symbols, Roth et al. [16: 89] made similar observations:

> Organizing map symbols into broader categories improves the memorability of symbols by imposing a grouping rule, better delineates key themes within the map when the symbols are designed to reflect their higher-level category, and structures map legends for improved symbol reference.

The first major obstacle to be overcome in the creation of such a classification is the division of the symbology into discrete symbols in order that they might be homogenously quantified, as the method adopted by Roth et al. [16] relied on the presence of a set of discrete items (i.e. cards) as a starting point. Many symbols appear in the *Conventional Signs* books as discrete symbols and thus can be included in the new compilation in their original state. Others symbols, however are presented in groups, or as an annotated fictitious map (Fig. 5.1), in order to demonstrate their intended application in relation to other symbols. A similar issue encountered by Kent and Vujakovic [9: 182] led to their division of such 'clusters' into discrete symbols. Similarly, elements of the Soviet symbology presented in this way need to be separated in order to be included in this analysis, in order to avoid misleading symbol counts. In the Soviet specifications, the identification of discrete symbols within clusters or map extracts is typically aided by the inclusion of annotations (see Fig. 5.1). While some symbols can easily be separated into discrete units, others are dependent on context and their relationship with other symbols. In some cases, this means that a feature may be classified in more than one category. A level crossing, for example, is no more a feature of a railway than it is a feature of a road and could therefore be justifiably included in either of these categories, depending on the point of view of the user. In such instances, the category chosen is that which relates most closely to the category in which the feature appears in the relevant edition of *Conventional Signs.*

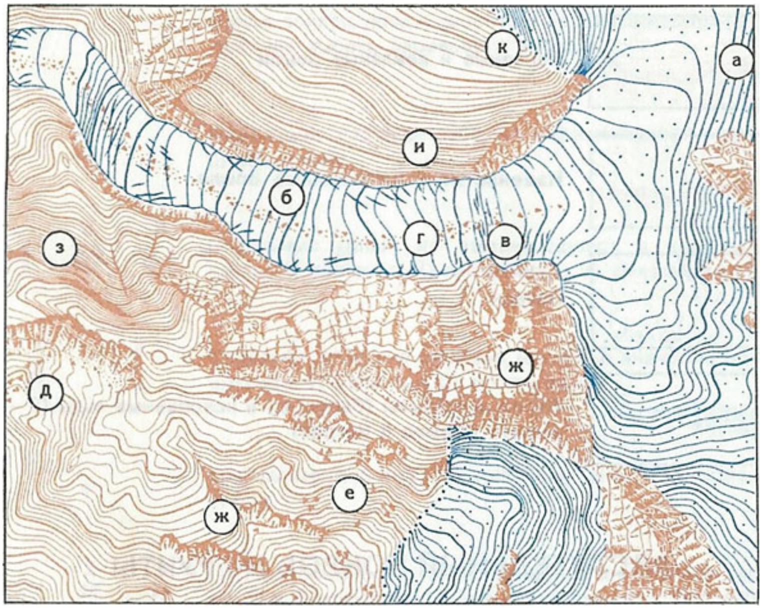

Fig. 5.1 A sample map from *Conventional Signs for Topographic Maps of the USSR* (General Staff [4]; no scale provided) demonstrating the depiction of various elements of relief as a 'cluster'. Many of the annotated features are not included elsewhere in the specification as discrete symbols (private collection)

As previously stated, dividing the classification of symbols into multiple levels, similar to the three levels adopted by Kent and Vujakovic [9: 183] (Fig. 5.2), will enable both the identification of general trends across the symbology, as well as patterns within more precisely defined groups of features. Whereas Kent and Vujakovic [9: 183] differentiated between Land Cover (Level I), General Land Use (Level II) and Specific Features (Level III), broad distinctions between 'natural' and 'human' landscape are less relevant here given the focus on a single symbology. Rather, the two-level system in this analysis (Fig. 5.3) is more akin to a twofold division of Kent and Vujakovic's [9] Level III typology into 13 and 35 classes respectively. This detailed level of analysis reflects the objective of identifying geographical variations in the mapping of specific features within the same map series, whereas Kent and Vujakovic's broader classes reflect their need to make broader distinctions between different symbologies. In addition, this method is similar to Kent and Vujakovic's in that each class, at both levels, is mutually exclusive.

Broadly, the classification of symbols adopted here is based on the classification of symbols in the editions of *Conventional Signs* used. However, as the categorisations of conventional signs at 1:25,000 and 1:10,000 differ from one another, a degree of compromise is required. Table 5.2 shows the First-Level classification used in both editions of *Conventional Signs* and the new classification devised for the purposes of this exercise. The most major change relates to the division of a markedly broad category used by both Soviet documents. Both texts incorporate a significant part of their symbology under the broad heading 'Industrial, agricultural and socio-cultural objects' (Промышленные, сельскохозяйственные и социально-культурные объекты), which includes an eclectic mixture of features, including a wooden windmill, a slagheap, an apiary, a bus stop and a mass grave. It was considered that this

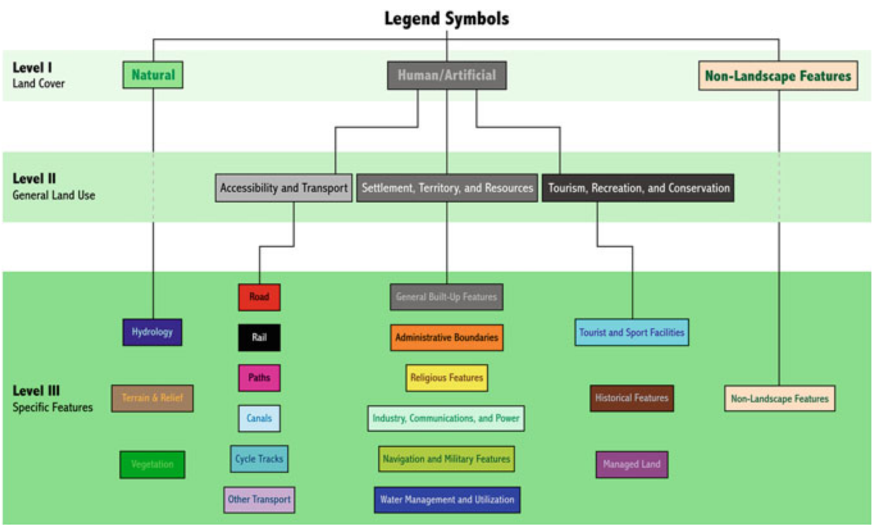

Fig. 5.2 The three-level classification adopted by Kent and Vujakovic [9]

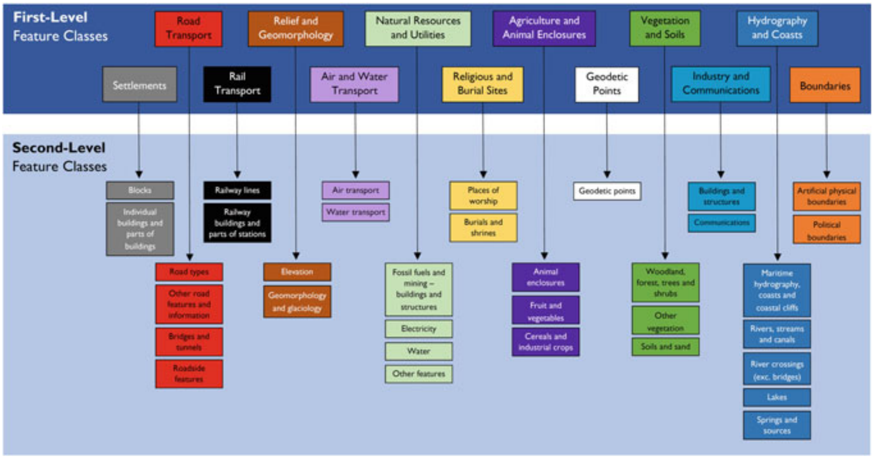

Fig. 5.3 The two-tier classification of feature classes used in the typology of Soviet military city plans

large category would be more usefully divided into five more specific categories (Table 5.1), facilitating more meaningful results. Across the symbology, several symbols were moved into other categories deemed more appropriate (the bus stop, for example, was moved to 'Road Transport'). Other categories were simply given names which more accurately describe their content. These issues are similar to those encountered by Roth et al. [16] who, on analysing the ANSI INCITS 415-2006 symbol standard, discovered overlaps between categories, categories missing altogether and individual symbols which had been misclassified, thus requiring the classification to be refined.

Within each of the new First-Level classes are a series of Second-Level classes which will enable a finer level of analysis and detection of any variance within the First-Level classes. Given the large quantity of symbols involved, these additional divisions will also aid navigation in the new record of symbology. The names and indicative scope of each of these Second-Level classes are presented in Table 5.2. The classification outlined in Table 5.2 does not include labels or any feature marked only by text. Although there is undoubtedly scope for a full analysis of these features and annotations in their own right, they have been excluded from this analysis as graphical symbology is the focus of the study (see Sect. 4.1).

5.1.3 Further Issues in Compiling a Comprehensive Symbology

Further complications arise in the case of graphically identical (or very similar) symbols which appear in both editions of *Conventional Signs*, but with slightly

Table 5.1 The First-Level classes used in both editions of *Conventional Signs* [4, 6] and the new classes devised for this study

***Conventional Signs for Topographic Maps of the USSR*(1966)** 'Conventional signs for maps at 1:25,000, 1:50,000 and 1:100,000' section	***Conventional Signs for Topographic Maps at 1:10,000*(1968)**	**New classes**
Settlements	*Settlements*	**Settlements**
Transport networks	*Highways, dirt roads and trails*	**Road transport**
	Railways and their facilities	**Rail transport**
Industrial, agricultural and socio-cultural objects	*Industrial, agricultural and socio-cultural objects*	**Air and water transport**
		Industry and communications
		Natural resources and utilities
		Religious and burial sites
		Agriculture and animal enclosures
Borders	*Borders and fences*	**Boundaries**
Geodetic points	*Geodetic points*	**Geodetic points**
Hydrography	*Hydrography*	**Hydrography and coasts**
Relief	*Relief*	**Relief and geomorphology**
Vegetation and soils	*Vegetation and soils*	**Vegetation and soils**

different descriptions. For example, a 'rocky outcrop' symbol at 1:25,000 is more specifically a 'large rocky outcrop' at 1:10,000. It is not possible to identify which meaning is intended when such a symbol is used on a map by its scale alone, as some symbols which only appear in the 1:25,000 specification appear on 1:10,000 maps and vice versa. In these cases, these symbols have been recorded separately each with its own description, despite their graphical likeness.

In a smaller number of cases, the reverse issue is manifested. Some phenomena are described identically in the two editions of *Conventional Signs*, but minor graphical differences exist between the two. These differences are often very slight and unlikely to reflect different real-world features and have thus been considered the same symbol in this study. An example of this is the 'palm tree' symbol, the trunk and leaves of which exhibit slightly different angles between the two scales (Fig. 5.4). The extent to which these differences are applied to maps at different scales will not be assessed here, as this will not contribute to the research objectives. Discrepancies in the sizes of symbols between the two documents will also not be considered here, as this may simply be a by-product of the different formatting of the books.

Table 5.2 The First-Level classes with Second-Level divisions and examples of features included in each class

First-Level classes	Second-Level classes	Examples of features included
1.0 Settlements	1.1 Blocks	Fire-resistant blocks, destroyed blocks, planned blocks
	1.2 Individual buildings and parts of buildings	Administrative, industrial or military buildings, ruins, yurts, tents, gazebos, cellars
2.0 Road transport	2.1 Road types	Motorways, highways, dirt roads, footpaths, roads under construction
	2.2 Other road features and information	Level crossings, steep section, road surface boundaries
	2.3 Bridges and tunnels	Road tunnels, metal bridges, wooden bridges, multi-level bridges, footbridges
	2.4 Roadside features	Embankments, cuttings, road signs, bus stops
3.0 Rail transport	3.1 Railway lines	Railways by number of tracks, electrification status, narrow gauge lines, monorails, funiculars
	3.2 Railway buildings and parts of stations	Stations, metro stations, parts of stations, depots
	3.3 Other railway features	Signals, dead ends, embankments, cuttings, lights, tunnels
4.0 Air and water transport	4.1 Air transport	Aerodromes, landing sites
	4.2 Water transport	Ferries, moorings, jetties, piers, buoys, lighthouses, breakwaters, groynes
5.0 Natural resources and utilities	5.1 Fossil fuels and mining—buildings and structures	Oil wells, coal mines, gas tanks, fuel stations, shafts, pipelines
	5.2 Electricity	Power stations, sub-stations, power lines, wind turbines
	5.3 Water	Aqueducts, water pipelines, wells, pumps
	5.4 Other features	Slag heaps, foresters' house
6.0 Religious and burial sites	6.1 Places of worship	Churches, mosques, Buddhist monasteries
	6.2 Burials and shrines	Cemeteries, graves, monuments, burial mounds

(continued)

Table 5.2 (continued)

First-Level classes	Second-Level classes	Examples of features included
7.0 Agriculture and animal enclosures	7.1 Animal enclosures	Paddocks, apiaries
	7.2 Fruit and vegetables	Orchards, vineyards, greenhouses
	7.3 Cereals and industrial crops	Rice fields, arable land
8.0 Boundaries	8.1 Artificial physical boundaries	Fences and walls
	8.2 Political boundaries	International, sub-national and local administrative boundaries
9.0 Geodetic points		Geodetic points, levelling marks astronomical points
10.0 Hydrography and coasts	10.1 Maritime hydrography, coasts and coastal cliffs	Coastal cliffs, mudflats, beaches, underwater stones, tidal directions, reefs
	10.2 Rivers, streams and canals	Rivers, canals, ditches, dykes, sluices, quays, waterfalls
	10.3 River crossings (exc. bridges)	Fords, river boats/ferries
	10.4 Lakes	Lakes, ponds, reservoirs, water holes
	10.5 Springs and sources	Springs, geysers, water fountains
11.0 Relief and geomorphology	11.1 Elevation	Contours, supporting contours
	11.2 Geomorphology and glaciology	Ravines, cliffs, craters, mounds, pits, caves, glaciers, firn fields, ice, snow
12.0 Vegetation and soils	12.1 Woodland, forest, trees and shrubs	Deciduous trees, coniferous trees, palm trees, clearings, scrub, bushes
	12.2 Other vegetation	Meadows, mosses, lichens, lawns and grasses, canes, reeds
	12.3 Soils and sand	Marshes, waterlogged ground, soil, sand, clay, gravel
13.0 Industry and communications (excluding natural resources)	13.1 Buildings and structures	Factory chimneys, towers, mills
	13.2 Communications	Radio and TV masts, broadcasting stations, telephone lines and exchanges

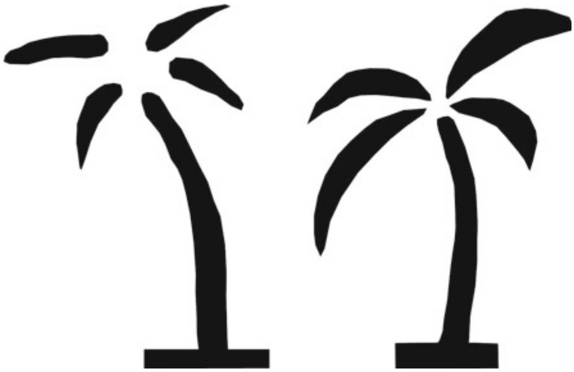

Fig. 5.4 Graphical differences between the 'palm tree' symbols in the 1968 1:10,000 (left) and 1966 1:25,000 (right) editions of *Conventional Signs* (derived from GUGK [6] and General Staff [4], redrawn and enlarged)

5.2 Designing an Analysis of Symbology in Context

5.2.1 Constructing a Sample of City Plans

The selection of city plans to be included in the study was designed to include as broad a range of cities as possible, within the confines of those mapped as part of the city plan series, as well as being approximately representative of the series as a whole, according to the information in Table 2.1. As the objectives of this study are concerned with the application of symbology in different socio-cultural and physical environments, ensuring that a diverse selection of locations is included must be the main priority of the sample, based on metrics which can be used to distinguish cities on these bases. In order to identify cities subject to diverse environmental conditions, the locations of the cities included in the city plan series were assigned to a Köppen-Geiger climate class, using a GIS overlay based on data compiled by Kottek et al. [10] (Fig. 5.5). This overlay was used to ensure that at least one city from each level one Köppen-Geiger climate class was included in the sample, in turn ensuring the inclusion of a range of physical environments.

In order to include the socio-cultural element of the first research objective, a measure of social diversity was incorporated by assigning a 2016 Human Development Index (HDI) value to each city plan. These data are only available at nation-state level, based on current political boundaries. Therefore, in cases in which a city is currently located in a different country than the one in which it was located at the time of the production of the relevant Soviet plan, the HDI value for the modern country has been used. In the construction of the sample, it was ensued that at least one city was included from a country with a HDI value in each decile between 0.4 (low human development) and 0.9 (very high human development). In order to increase the number of HDI values represented, no more than one plan was included from any one country. This also removes the need to differentiate the human development of multiple cities within a single country, as standardised data which could be used for this purpose across the globe is not available. The use of nation-state-level human development data to differentiate cities is not problematic in this analysis, as a precise and detailed measure of development is not required in order to meet its objective of broadly differentiating a small number of cities across the globe. If the symbology of a larger sample, or the whole series, of Soviet city plans were to be analysed in relation to human development, it may be necessary to investigate options for the compilation of more precise, sub-national metrics for this purpose. In such a situation, it should be considered that city-level data would also be aggregated and generalised to an extent, therefore overlooking diversity at larger, sub-city scales. Ivanov and Peleah [7: 6] highlight the potential benefits of geographically disaggregating HDI data but also identify elements of the index's constituent data which are unavailable at various sub-national scales. In any case, the balance between data precision and fitness for purpose must be struck in accordance with the requirements of the analysis being undertaken.

As the development of cities is not the focus of this analysis and the sample of cities incorporated is small, HDI data are not unduly coarse in this context. Conversely, its international standardisation renders it appropriate for a global analysis such as this.

In addition to these considerations, as far as possible, a range of population sizes were included. Given the restrictive effect of the above conditions, the consideration of population could not have a rigorous quantitative basis but instead has been applied approximately. Given that the available population data are subject to local methods of boundary delineation, were compiled considerably more recently than Soviet city plans and, in some parts of the world, are solely based on estimates, any consideration of population in these circumstances can only be approximate. Given the evolving

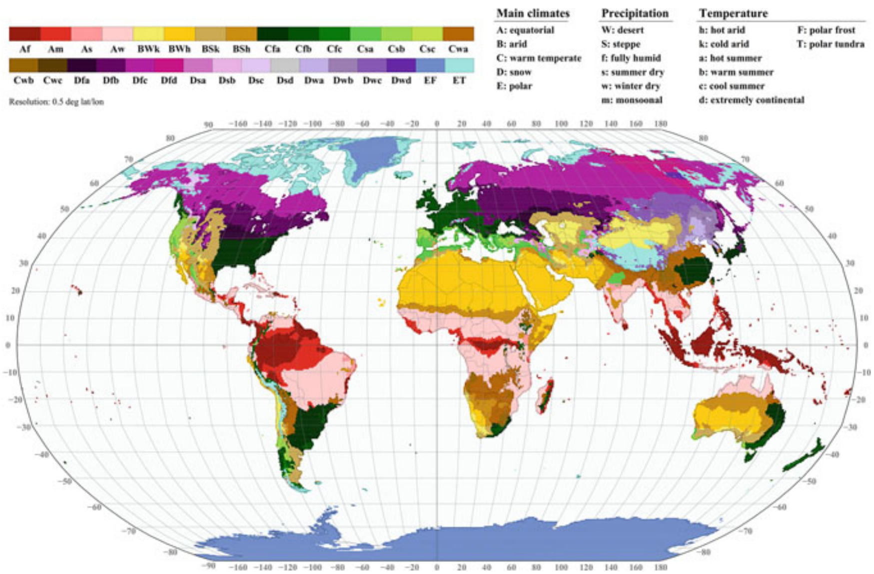

Fig. 5.5 Updated Köppen-Geiger Climate Classification used in the sample selection, adapted from Kottek et al. [10]

styles of Soviet city plans outlined in Chap. 2, it is natural to consider that the application of symbology may also evolve over time. It was therefore considered necessary to ensure a temporal spread within the sample. Specifically, this resulted in the stipulation that at least one plan be included from each rolling three-year period between the introduction of the new compilation manual for city plans in 1972 and the dissolution of the USSR in 1991. This period represents the peak of city plan production, as understood in Fig. 2.4. City plans are here identified based on their edition date, rather than any compilation or printing dates, given the issues associated with identifying plans based on the latter [2, 3].

Another consideration is the number of plans to be included. Given the labour-intensive nature of compiling a comprehensive record of symbols used on topographic maps, the practicalities of undertaking this confine the study to a relatively small number of city plans. Of the 1,899 city plans known to exist, 19 were selected for inclusion; 1% of the total. The nature of the 19 plans selected proportionately reflects the characteristics of the entire series. Of the 1,899 city plans, 1,545 (85%) are at 1:10,000, dictating that 15 plans in the sample should be at this scale. Likewise, there are 324 known plans at 1:25,000, dictating a 17% share of the sample – rounded to the remaining four plans. In addition, all known documents dealing with large-scale Soviet symbologies expressly address 1:25,000 and 1:10,000 maps, making the compilation of comprehensive records of symbology at other scales problematic. It is also acknowledged that further stipulations could have been made with regard to the proportion of plans with a particular number of sheets at each scale. However, these additional conditions would have made the construction of a sample virtually impossible, once all of the other considerations have been made.

It should also be noted that the above conditions for the selection of city plans could not be applied to all 1,899 known city plans, but were instead restricted to those available in the course of this research (i.e. held in accessible institutions). This presents the issue that collections in Europe and North America (which constitute the majority of holdings of Soviet city plans) have a tendency to focus, with some exceptions, the geographic coverage of their collections on these areas. Nonetheless, it was possible to satisfy all of the above-outlined conditions despite this trend, resulting in the final sample in Table 5.3 (Fig. 5.6).

5.2.2 Obtaining the Map Sample

Of the 19 city plans in the sample, ten were already held in digital form by Canterbury Christ Church University and were analysed on-screen (Cairo, Freetown, Port-au-Prince, Frankfurt-am-Main, Gloucester, Tromsø, Boulogne-Sur-Mer, Miami, Halifax/Dartmouth and Canberra). In addition, the plans of Damascus and Sidon are available in the online collections of the National Library of Australia, while the plans of La Paz and Zaragoza are available in the online collections of the Cartographic and Geological Institute of Catalonia. Consequently, these four plans were also analysed on-screen using these repositories. The remaining plans in the sample

Table 5.3 The sample of 1:10,000 and 1:25,000 Soviet military city plans analysed in this study (ordered by scale then population)

Plan title	Edition	Scale	No. of sheets	Primary country covered	Population	HDI (2016) and rank (of 188)	Climate
Cairo	1972	1:10,000	4	Egypt	7,772,000	0.691 (111)	BWh
Damascus	1987	1:10,000	2	Syria	1,711,000	0.536 (149)	BSk
Amritsar	1979	1:10,000	1	India	1,133,000	0.624 (131)	Cwa
La Paz	1977	1:10,000	1	Bolivia	789,585	0.674 (118)	ET
Freetown	1984	1:10,000	1	Sierra Leone	772,873	0.420 (179)	Am
Liaoyang	1974	1:10,000	1	China	728,492	0.738 (90)	Dwa
Port-au-Prince	1983	1:10,000	1	Haiti	704,776	0.493 (163)	Aw
Frankfurt am Main	1983	1:10,000	4	Germany (West)	691,518	0.926 (4)	Cfb
Zaragoza	1990	1:10,000	1	Spain	679,624	0.884 (27)	BSk
Namangan	1976	1:10,000	2	Uzbekistan (USSR)	391,297	0.701 (105)	BSk
Gloucester	1989	1:10,000	2	United Kingdom	123,205	0.909 (16)	Cfb
Sidon	1983	1:10,000	1	Lebanon	80,000	0.763 (76)	Csa
Tromsø	1975	1:10,000	1	Norway	71,590	0.949 (1)	Dfc
Boulogne-sur-Mer	1981	1:10,000 ara>	1	France	43,310	0.897 (21)	Cfb
Topar	1980	1:10,000	1	Kazakhstan (USSR)	9,314	0.794 (56)	Dfb
Johannesburg	1972	1:25,000	2	South Africa	752,349	0.666 (119)	Cwb
Miami	1984	1:25,000	2	United States of America	417,650	0.920 (=10)	Am
Halifax/Dartmouth	1974	1:25,000	1	Canada	390,096	0.920 (=10)	Dfb

(continued)

Table 5.3 (continued)

Plan title	Edition	Scale	No. of sheets	Primary country covered	Population	HDI (2016) and rank (of 188)	Climate
Canberra	1981	1:25,000	1	Australia	358,222	0.939 (2)	Cfb

Fig. 5.6 The sample of Soviet military city plans analysed in this study

are not held by Canterbury Christ Church University, nor are they known to be available via any online collection. As a result, hard-copy plans of Amritsar, Namangan and Topar were analysed in the Maps Reading Room of the British Library, London (UK) and plans of Liaoyang and Johannesburg were analysed in the Geography and Map Division of the Library of Congress, Washington, D.C. (USA). The collection of some data on-screen and others from paper maps is not expected to influence the results of the exercise in any way as the only differences between these two methods are those relating to colour, resolution and the scale at which the map is displayed. As these differences are likely to be slight and only the symbols in use on each map are being counted, such discrepancies will be inconsequential.

5.2.3 Data Collection Process

Beginning at the top-left corner of each plan, each grid square was inspected and each element of the symbology used was marked on a hardcopy sheet of the entire symbology at both 1:10,000 and 1:25,000. An analogue method using pencil and paper was used in order to meet the requirements of the reading rooms in which some of the data collection took place. Although the same restrictions did not apply when data were collected from online maps, the same method was used for consistency. Once a symbol had been marked on the sheet for a particular plan once, it was ignored if used again subsequently on the same plan. In the event of a symbol appearing on a map but not on the symbology list, a description was noted separately along with any additional information from the legend, if available. In cases where an identical symbol appears in the specifications for both scales, the version marked was that which corresponded with the scale of the plan. Where a symbol only appears in the specification at one scale, it was marked, if present, regardless of the scale of the plan under scrutiny. The process accelerated throughout the analysis of each plan, as repeated symbols became more common. The data on the symbology sheets were subsequently transferred to a spreadsheet prior to analysis.

5.3 Comparison with *OpenStreetMap*

The second research objective necessitates a comparison of the Soviet military city plan symbology and the symbology of *OpenStreetMap* (OSM) in order to highlight elements of one which may inform the other. The comparison of the Soviet city plan symbology with the OSM symbology will be undertaken separately, after the collection of data from the Soviet city plans has taken place. This will enable the comparison of OSM data with the Soviet city plan with the highest total symbol count. This has been done in order that the largest possible proportion of the Soviet symbology may be included in this part of the analysis, while still being based on map symbols in context, rather than legends and specifications alone. To this end, an area of OSM data is required which corresponds to the geographical extent of the Soviet plan of Frankfurt am Main, Germany (1983, 1:10,000). The symbology of these data can then be directly classified using the feature classes in Fig. 5.3 and directly compared with the Soviet symbology data for Frankfurt am Main. The full OSM and Soviet symbol specifications can also be compared.

There are several technical discrepancies between OSM and a Soviet city plan which should be considered during this process. Firstly, as Soviet city plans are static, printed maps, the comparison will need to take place with only one zoom level of OSM data, of a total of 19 available zoom levels (Table 5.4).

As no OSM zoom level is equivalent to 1:10,000 (or 1:25,000), zoom level 16 will be used in this comparison (approximately 1:8,000) as the closest available scale to the plan of Frankfurt am Main (Fig. 5.7). As a result, direct comparisons of symbol counts are likely to be less useful than a more holistic comparison of the relative proportions of the symbology in each First and Second-Level feature class, due to the resulting discrepancy in generalisation. OSM also offers several ‘tile layers’ which display OSM data according to different style sheets. Although users can create custom style sheets, there are four ‘featured tile layers’ which are available in

Table 5.4 Comparison of *OpenStreetMap* (OSM) zoom levels with approximate scale and global tile count [11]

Zoom level	Approximate scale	Total number of tiles
0	1:500,000,000	1
1	1:250,000,000	4
2	1:150,000,000	16
3	1:70,000,000	64
4	1:35,000,000	256
5	1:15,000,000	1,024
6	1:10,000,000	4,096
7	1:4,000,000	16,384
8	1:2,000,000	65,536
9	1:1,000,000	262,144
10	1:500,000	1,048,576
11	1:250,000	4,194,304
12	1:150,000	16,777,216
13	1:70,000	67,108,864
14	1:35,000	268,435,456
15	1:15,000	1,073,741,824
16	1:8,000	4,294,967,296
17	1:4,000	17,179,869,184
18	1:2,000	68,719,476,736
19	1:1,000	274,877,906,944

the main OSM interface: Standard, Cycle Map, Transport Map and Humanitarian. The Humanitarian layer is intended to be used in emergency situations, such as in the aftermath of a natural disaster, and uses pale colours to facilitate printing annotation in the field, while maintaining legibility [12]. It also highlights features which may be particularly useful in such situations, such as wells, pumps, fire hydrants, light sources and public buildings (ibid.). As the Soviet city plan series has no explicit thematic focus, mapping data according to availability rather than any particular theme, the Standard tile layer will be used in this analysis as it is similar in this respect.

The OSM symbology data collection will take place online using the standard OSM interface. Symbology will be recorded manually, similar to the data collection from the Soviet city plans. The Soviet plan of Frankfurt am Main will be to hand during this process, for the identification of the sheet extent. As the tile servers of OSM are not open source, as OSM data are [13], a live, online version of OSM will be used. Consequently, the data collection will be carried out on the same day, to minimise the effect of updates during the process, which take place within a few minutes of user edits. As data for only one city will be collected, this is a feasible timescale. A further complication is that the classification devised for the Soviet city plan symbology is not adequate for application to the OSM standard layer. To

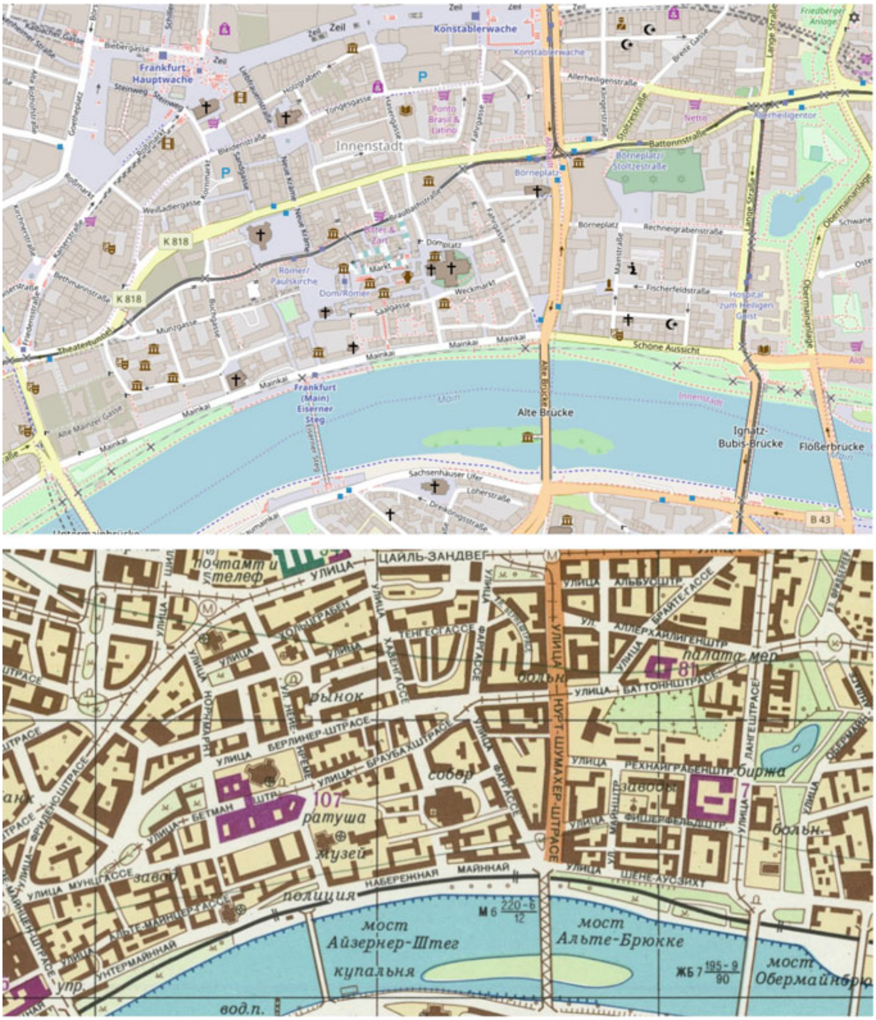

Fig. 5.7 Central part of Frankfurt am Main, Germany on OSM zoom level 16 (approximately 1:8,000) using the Standard tile layer (22nd January 2018) (top) (© OpenStreetMap contributors) and the Soviet plan of Frankfurt am Main (1983, 1:10,000) (bottom) (private collection)

this end, two additional First-Level feature classes will be added to this part of the study; 'Retail and Restaurants' and 'Leisure, Tourism and Public Services'. Within the Soviet city plan symbology, there are no symbols which would be better placed in either of these new classes than the class in which they have already been placed. Although a limited selection of public buildings are marked on the city plans, this is generally done by labelling rather than the use of a specific graphical symbol. As a result, the Soviet symbology data have not been reclassified for this part of the analysis. Beyond these two new classes, the OSM symbology is classified according to the 13 classes used for the Soviet symbology. Given the discrepancies in scale and age between the Soviet city plans and OSM, the finer level of analysis provided by the Second-Level feature classes is unsuitable for this part of the analysis. Chapter 6 outlines the results of the data collection processes explained in this chapter, dealing with the Soviet city plans and OSM in turn.

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Chapter 6
Analysing the Symbology of Soviet Military City Plans

This chapter comprises a summary of the results from the analysis of the symbology of the Soviet military city plan series according to specification documents and the same symbology in the context of a 1% sample of the plans, as previously explained. The latter concludes with an analysis of the relationship between symbology and the characteristics of cities which were previously used to construct, as far as possible, a balanced and representative sample of the series. These two components are addressed in turn and, together, aim to address the first research objective, regarding the implementation of the Soviet city plan symbology across a variety of socio-cultural and physical environments. Naturally, as it would be expected that the nature of the symbology applied to plans at 1:10,000 and 1:25,000 may differ, these scales are frequently separated in the following presentation of data, although overall trends will be nonetheless apparent.

6.1 Analysing a Comprehensive Record of the Symbology of Soviet Military City Plans, 1966–1978

The first phase of the analysis focussed on the specification documents which coincide with the period of peak city plan production in the early 1970s. The 1968 edition of *Conventional Signs for Topographic Maps of the USSR* (at 1:10,000) [3] contains a total of 562 symbols, 58 of which are annotations, leaving 504 graphical symbols. The section of the 1966 edition of *Conventional Signs for Topographic Maps of the USSR* [1] relevant to maps at 1:25,000 contains 382 symbols, 25 of which are annotations, leaving 357 graphical symbols. The supplementary table of symbols included in the 1978 edition of the compilation manual for city plans [2], which lists symbols for use on city plans but not any other topographic map, includes eight symbols for plans at 1:10,000, eight symbols for plans at 1:25,000 and 28 symbols which may be used

M. Davis, *A Cartographic Analysis of Soviet Military City Plans*, Springer Theses,
https://doi.org/10.1007/978-3-030-84017-4_6

at either scale. None of the scale-specific symbols are annotations, although five non-scale-specific symbols are annotations, reducing the included number of such symbols to 23. Therefore, a total of 39 symbols from the supplementary table has been included. Consequently, the symbology of Soviet military city plans, based on these three sources, constitutes 988 symbols, in terms of total gross symbol count. Of these, 88 are annotations, leaving precisely 900 graphical symbols; 535 which may be used on maps at 1:10,000 and 388 which may be used on maps at 1:25,000. As both of these counts include the 23 non-scale-specific symbols from the 1978 edition of the compilation manual for city plans, they total 923, despite the existence of only 900 discrete graphical symbols. However, some of these symbols are graphically identical, or graphically similar but with an identical description in their respective source specifications. In these cases, symbols which appear in more than one of the three specifications listed above have been considered the same symbol for the purposes of this study. Where graphically identical or similar symbols have different descriptions in different specifications, they have been considered different symbols. Using these criteria, 254 symbols from the 1968 edition of *Conventional Signs for Topographic Maps of the USSR* (at 1:10,000) are considered identical to symbols included in the 1966 edition of *Conventional Signs for Topographic Maps of the USSR* (section dealing with 1:25,000 maps), excluding annotations [1, 3]. Such repetition is considered here as an endorsement of the possibility of using these symbols at either scale.

In addition, nine of the scale-specific symbols and three of the non-scale-specific symbols in the 1978 edition of the compilation manual for city plans [2] are also included in the 1968 edition of *Conventional Signs for Topographic Maps of the USSR* (at 1:10,000) [3], excluding annotations, with eight of these 12 symbols also appearing in in the 1966 edition of *Conventional Signs for Topographic Maps of the USSR* (section dealing with 1:25,000 maps) [1]. In addition one non-scale-specific symbol and two scale-specific symbols in the 1978 edition of the compilation manual for city plans are also included in the 1966 edition of *Conventional Signs for Topographic Maps of the USSR* (section dealing with 1:25,000 maps) but not the 1968 edition of *Conventional Signs for Topographic Maps of the USSR* (at 1:10,000). Some of the repeated scale-specific symbols from the *compilation manual for city plans* are repeated in the edition of *Conventional Signs* which does not correspond with the scale specified in the compilation manual. In addition, two of the scale-specific symbols in the compilation manual for city plans are considered identical in this study. As a result, the symbology of Soviet military city plans, based on these three sources, is considered in this study to comprise a net total of 630 graphical symbols. Of these 630 symbols, 104 are presented in the source specifications, or their relevant parts, in a manner which indicates that they are solely for use on maps at 1:25,000; likewise 252 solely for use on maps at 1:10,000 and 274 suitable for use on maps at either scale. In the following analysis, only graphical symbols are referred to, unless stated otherwise.

6.1.1 Symbology by First-Level Feature Class

Figure 6.1 shows the number of symbols in each First-Level feature class by scale and gives an insight into the relative prominence of each class within the Soviet symbology as a whole. The data displayed in Fig. 6.1 include the 23 non-scale-specific symbols from the 1978 edition of the compilation manual for city plans in the values for both 1:10,000 and 1:25,000, given that these symbols may be used at either scale. Additionally, in instances where an identical or similar symbol is included in more than one specification, or part thereof, dealing with different scales, the symbol has been included in the counts for both scales.

The rank order of the classes is similar at both scales, although not identical. The class with the highest number of symbols in the 1:10,000 symbology is 'Hydrography and Coasts' (84 symbols) followed closely by 'Vegetation and Soils' (80 symbols). In the 1:25,000 symbology, this order is reversed with 62 and 66 symbols in these classes respectively. Similarly, 'Religious and Burial Sites' and 'Industry and Communications' are also reversed, due to the lack of distinction between the construction materials of places of worship at 1:25,000. At both scales, 'Road Transport' is the largest of the three transport classes and is the third largest class overall at both scales. 'Agriculture and Animal Enclosures' and 'Boundaries' are the smallest two classes at both scales, both including 17 and 11 symbols at 1:10,000 and 1:25,000 respectively. As would be expected, symbol counts at 1:10,000 are higher in each class than at 1:25,000, due to increased generalisation at the latter, smaller scale.

6.1.1.1 Settlements

At both scales, there are more symbols for individual building footprints and specific types of building than aggregated blocks. Moreover, a large number of symbols in both of these Second-Level classes is included in the supplementary table of symbols included in the 1978 edition of the compilation manual for city plans, with those from the two editions of *Conventional Signs* being of more relevance to the topographic map series. Due to increased generalisation at 1:25,000, the number of symbols for 'Blocks' is higher at this scale than at 1:10,000, whereas the reverse is true for individual buildings. The pale orange and yellow buildings included in the 1968 edition of *Conventional Signs* for 1:10,000 maps rarely feature on city plans. Instead, the brown building footprints, along with the purple, blue and black classified buildings, which are an important stylistic characteristic of the city plan series, are all derived from the compilation manual for city plans. Despite this, these symbols are frequently included in the small legend in the margin of city plans, as they are unique to this series. Several other symbols relating to individual structures, such as ruins, yards and yurts derive from *Conventional Signs* (Fig. 6.2).

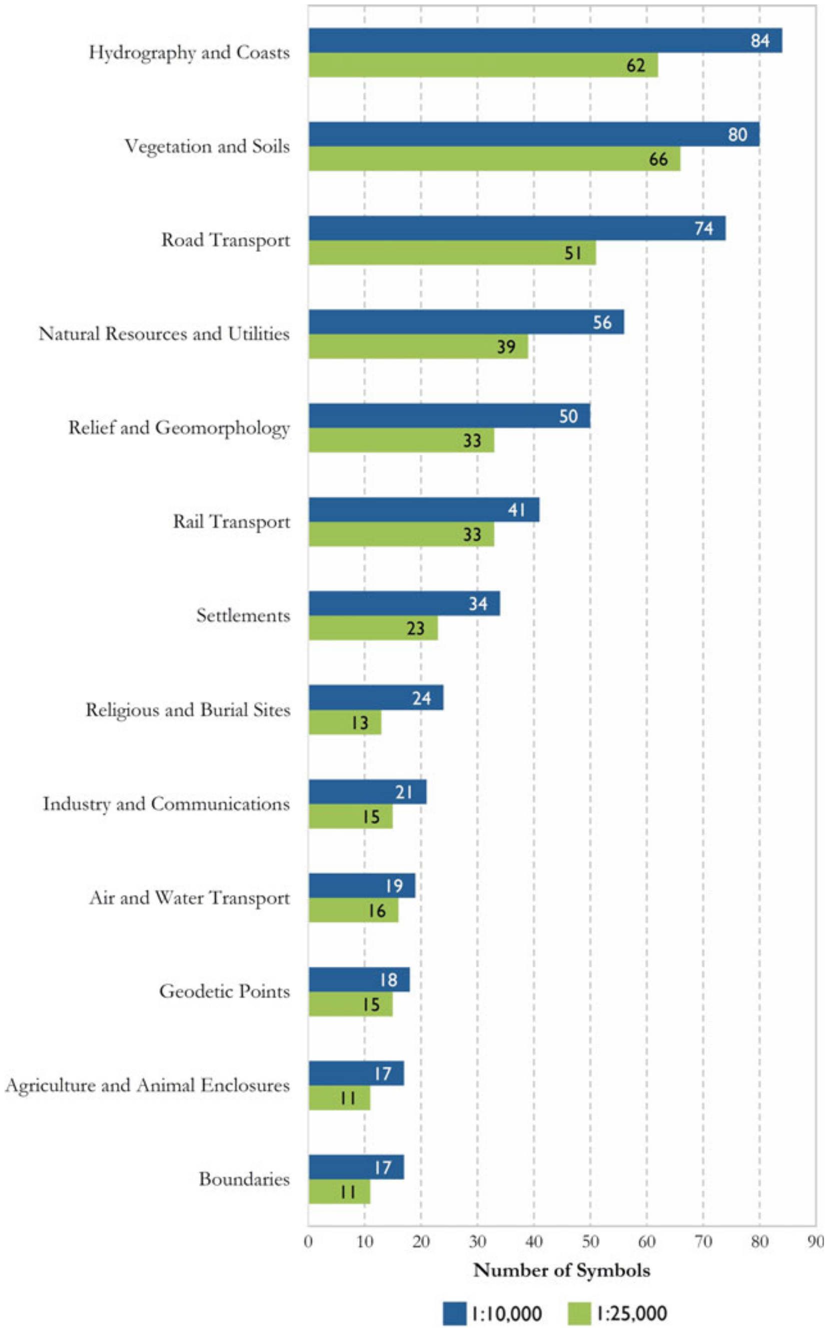

Fig. 6.1 Symbol counts for first-level feature classes, by scale (ordered by 1:10,000 rank)

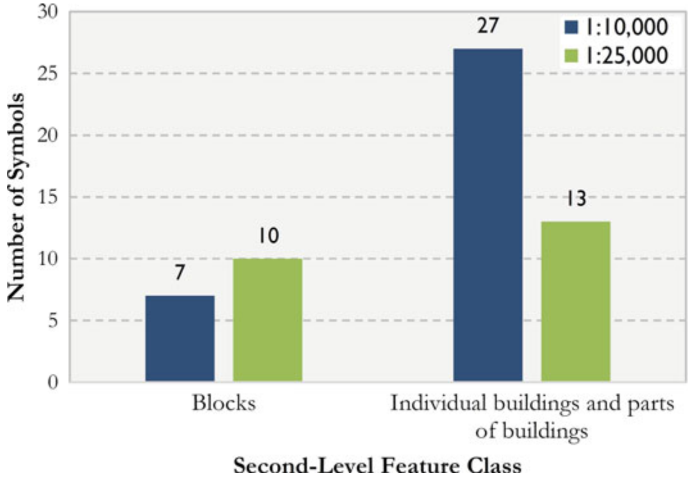

Fig. 6.2 Symbol counts for second-level feature classes within ‘settlements’, by scale

6.1.1.2 Road Transport

A total of 34 types of road are included in the ‘Road Types’ Second-Level class, ranging from the highly distinctive orange motorways and highways to more obscure road types such as ‘Causeways exposed at low tide or roads along river beds’ or a ‘Trail on eaves/ledges over a ravine’. Naturally, more road types are included in *Conventional Signs* at 1:10,000 than 1:25,000, although many are repeated in both. None derive from the compilation manual for city plans, indicating that this element of symbology is identical in both the city plan and topographic series. The ‘Other road features and information’ class includes six symbols which are repeated in both editions of *Conventional Signs*. ‘Bridges and Tunnels’ is a sizeable class at both scales, though many of the symbols at 1:10,000 stipulate particular lengths of bridges and therefore cannot be considered identical to the similar symbols at 1:25,000 which carry a more general description. Most symbols in the ‘Roadside features’ class appear in *Conventional Signs* at both scales, with cuttings and embankments also appearing in the compilation manual for city plans (Fig. 6.3).

6.1.1.3 Rail Transport

Railway lines are depicted similarly at both scales, with the number of tracks depicted intuitively by the relevant number of lines across the track, with an additional perpendicular line signalling an electrified line. Whereas, at 1:25,000, distinction between ‘Railway buildings and parts of stations’ extends only to ordinary, narrow gauge and metro stations and depots, a wider selection is included at 1:10,000, including smaller booths and patrol huts. At both scales, the ‘Other railway features’ class, including

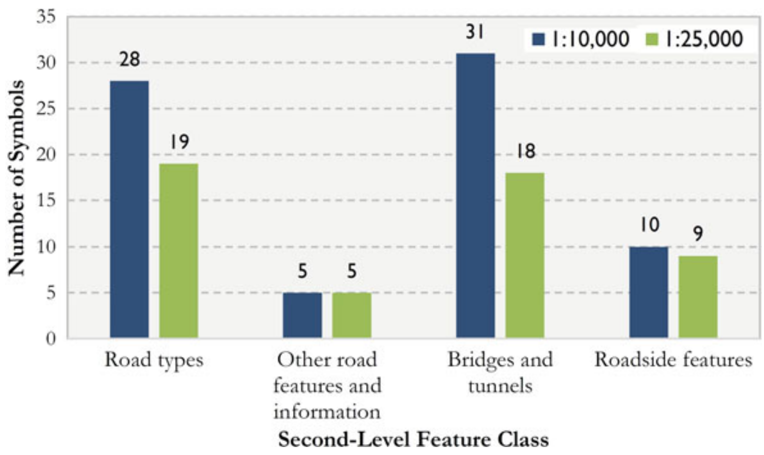

Fig. 6.3 Symbol counts for second-level feature classes within 'road transport', by scale

Fig. 6.4 Symbol counts for second-level feature classes within 'rail transport', by scale

signals, cuttings embankments and dead ends, includes more symbols than either of the other classes (Fig. 6.4).

6.1.1.4 Air and Water Transport

At both scales, sites suitable for landing aircraft are marked identically, with distinction being made between whether the site is an aerodrome or less formal landing site, but not whether it is on land or water (although the context of the symbol on the map

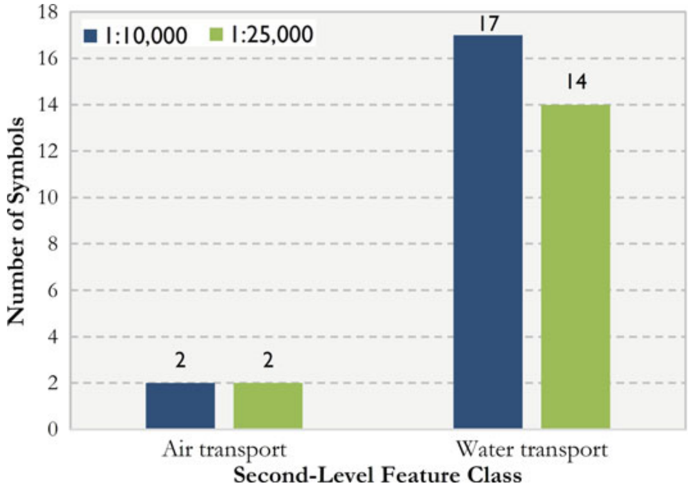

Fig. 6.5 Symbol counts for second-level feature classes within ‘air and water transport’, by scale

would make this clear). Interestingly, there is no symbol at either scale for a helipad. ‘Water transport’ is dealt with much more comprehensively at both scales, with the 1:10,000 symbology frequently facilitating ‘to scale’ and ‘not to scale’ options for the same feature. Other symbols are also given more detailed treatment at 1:10,000. For example, a single symbol for a ‘Light ship or floating light’ at 1:25,000 (for nautical navigation) is distinguished at 1:10,000 by whether it possesses one or two lights, with a generic symbol available for cases in which this level of detail is unavailable (Fig. 6.5).

6.1.1.5 Natural Resources and Utilities

By a significant margin, the largest Second-Level feature class in this category is ‘Fossil fuels and mining—buildings and structures’, with 34 symbols at 1:10,000 and 19 at 1:25,000. Once again, distinction is made at 1:10,000 between ‘to scale’ and ‘not to scale’ symbols. At the larger scale, the placement of some symbols on the map is stipulated in greater detail. For example, a symbol denoting a mine at 1:25,000 should be more specifically placed at the entrance to the mine at 1:10,000. Although the symbologies at both scales differentiate between operational and non-operational mining sites, an additional distinction is made at 1:10,000 between the ‘main lift’ and ‘auxiliary lifts’. There is little difference between the specific types of natural resources referred to; oil, gas, salt and peat are all referred to by name in the symbologies at both scales, although there is further reference to ‘mineral mining’ at 1:10,000. ‘Water’ and ‘Electricity’ follow fossil fuels and mining, with little difference in symbol counts between the scales. Although the construction material of power line supports is denoted at both scales, the 1:10,000 symbology additionally

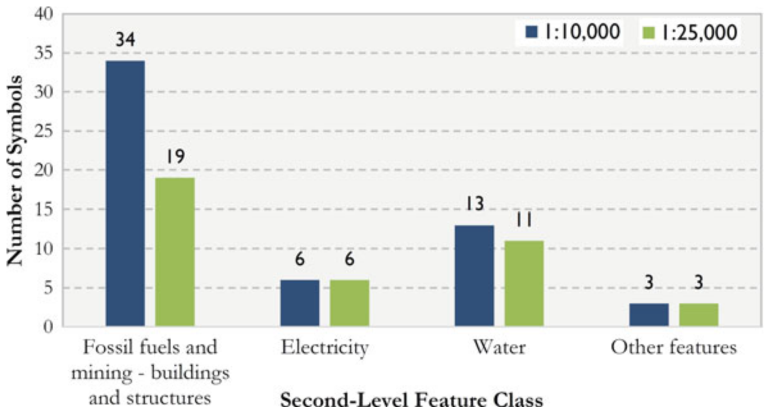

Fig. 6.6 Symbol counts for second-level feature classes within 'natural resources and utilities', by scale

distinguishes power lines which are at least 14 m high. The 'Water' Second-Level feature class includes several, lesser-known features; namely an 'Artesian well', 'Sakia' and 'Kariz' (Fig. 6.6).

6.1.1.6 Religious and Burial Sites

The places of worship in the symbologies relate to Christianity, Islam and Buddhism, reflecting the three major world religions with a significant presence within the sphere of influence of the Soviet Union. A variety of 'Burials and shrines' are also included, with individual graves and monuments included at 1:10,000 (Fig. 6.7).

6.1.1.7 Agriculture and Animal Enclosures

As pasture is generally left blank on Soviet maps, a much smaller number of symbols is allocated to livestock (paddocks and apiaries) than to crops. The divide between the 'Fruit and vegetables' and 'Cereals and industrial crops' Second-Level feature classes is almost even. A fill for generic 'Arable land' is given at 1:10,000 but not 1:25,000, whereas the reverse might have been expected (Fig. 6.8).

6.1.1.8 Boundaries

Five of the six symbols for 'Artificial physical boundaries' at 1:10,000 are incorporated in the single symbol 'Stone/brick wall or metal fence' at 1:25,000. Conversely, a more comprehensive approach is taken at both scales with regard to political or administrative boundaries, the only features not included at 1:25,000 being

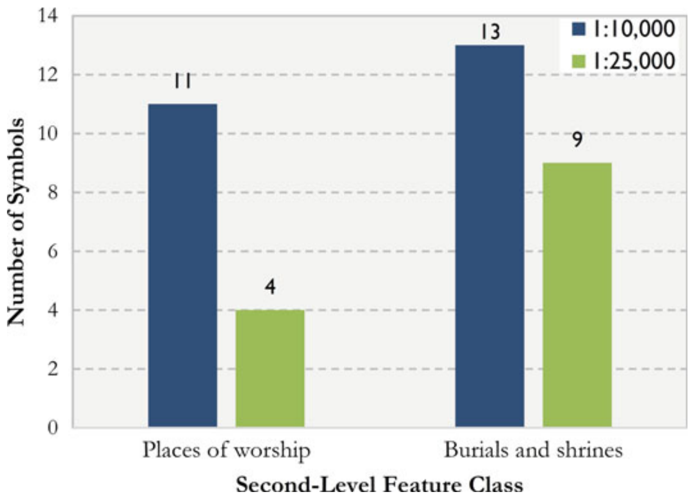

Fig. 6.7 Symbol counts for second-level feature classes within 'religious and burial sites', by scale

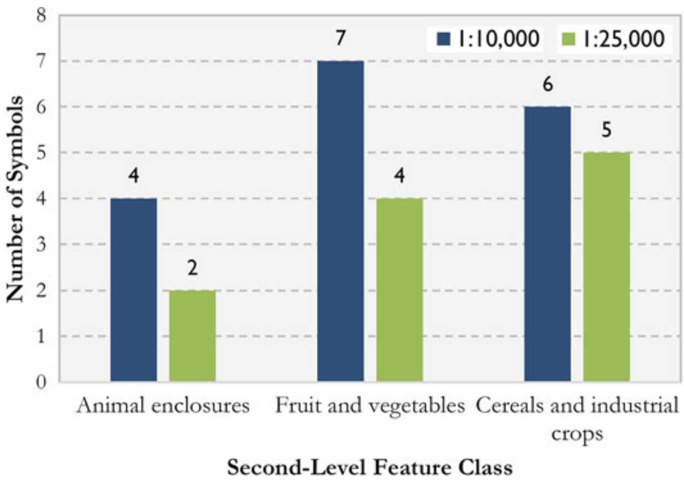

Fig. 6.8 Symbol counts for second-level feature classes within 'agriculture and animal enclosures', by scale

'Boundary marker of value as a landmark' and 'City limits'. The inclusion of 'Border of polar possessions of the USSR' in the compilation manual for city plans is surprising, given the lack of cities in these areas, but may be a politically important inclusion (Fig. 6.9).

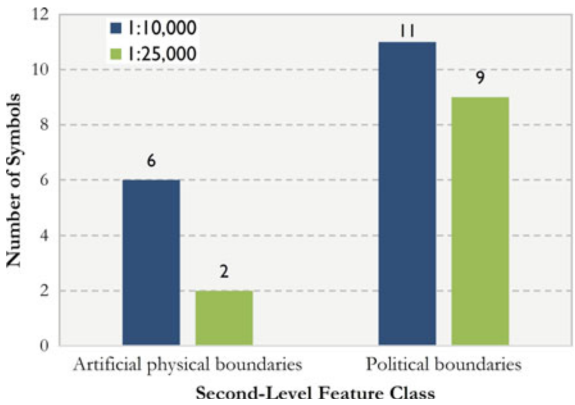

Fig. 6.9 Symbol counts for second-level feature classes within ‘boundaries’, by scale

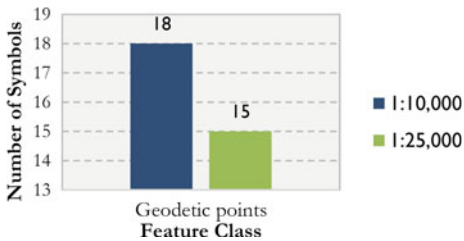

Fig. 6.10 Symbol counts for the first-level feature class ‘geodetic points’, by scale

6.1.1.9 Geodetic Points

Given the importance of geodetic points on maps at any scale, it is unsurprising that there is little variation in symbol counts between scales. *Conventional Signs* at 1:10,000 gives a small number of examples of geodetic points on various features, which are not provided in *Conventional Signs* at 1:25,000 symbology. However, many of the examples in the 1:10,000 edition are repeated (or elaborated on) in the compilation manual for city plans; endorsing the importance of geodetic points to this series (Fig. 6.10).

6.1.1.10 Hydrography and Coasts

In addition to being the largest First-Level feature class, ‘Hydrography and Coasts’ also exhibits broad consistency between the two scales, with few features being included at one scale but not the other, but with additional detail sometimes included at 1:10,000. The majority of features fall within the ‘Maritime hydrography, coasts and coastal cliffs’ and ‘Rivers, streams and canals’ Second-Level feature classes, with higher symbol counts in the latter. ‘Rivers, streams and canals’ also exhibits greater discrepancy between the scales, with stipulation of the widths of rivers and canals at 1:10,000 largely accounting for this. The symbol ‘Irrigation canal/ditch

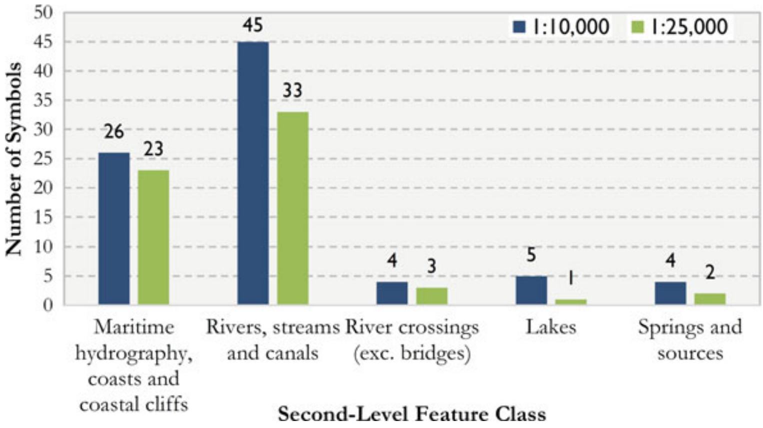

Fig. 6.11 Symbol counts for second-level feature classes within 'hydrography and coasts', by scale

in reinforced concrete trays on supports' is unusually included in the compilation manual for city plans but neither edition of *Conventional Signs*. The three smaller Second-Level feature classes are characterised by the distinction between mechanical and non-mechanical ferries (in 'River crossings [exc. bridges]'), the inclusion of only one, generic symbol for a lake at 1:25,000 (in 'Lakes') and the separation of types of springs at 1:10,000 (in 'Springs and sources') (Fig. 6.11).

6.1.1.11 Relief and Geomorphology

Across all Soviet topographic map series, elevation is indicated by contour lines. This fact is evidenced by the simplicity of the 'Elevation' Second-Level feature class, which straightforwardly includes contours and their direction indicators at 1:25,000 and introduces a limited hierarchy for contours at 1:10,000. 'Geomorphology and glaciology' is far more extensive, incorporating elements of cliffs and ravines, volcanic, karst and glacial areas (Fig. 6.12).

6.1.1.12 Vegetation and Soils

Over half of the symbols in 'Vegetation and Soils' fall within the 'Woodland, forest, trees and shrubs' Second-Level feature class. The greater detail within this class at 1:10,000 is largely explained by a more thorough treatment of clearings, as well as the inclusion of 'Individual bushes' and small 'Subshrub vegetation (sagebrush, eurotia, sarzasan etc.)'. In 'Other vegetation', two types of lawn are included in the compilation manual for city plans, given the ubiquity of lawns within most cities. The conventional signs for 'Soils and sand' are virtually identical at both scales, although some descriptions of features are subtly different (Fig. 6.13).

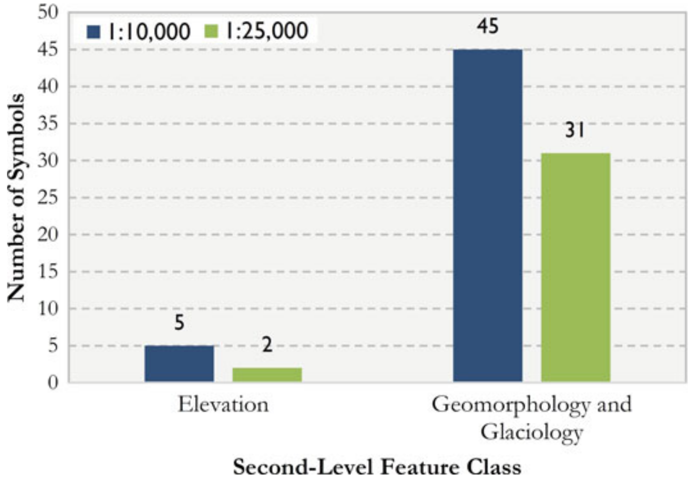

Fig. 6.12 Symbol counts for second-level feature classes within 'relief and geomorphology', by scale

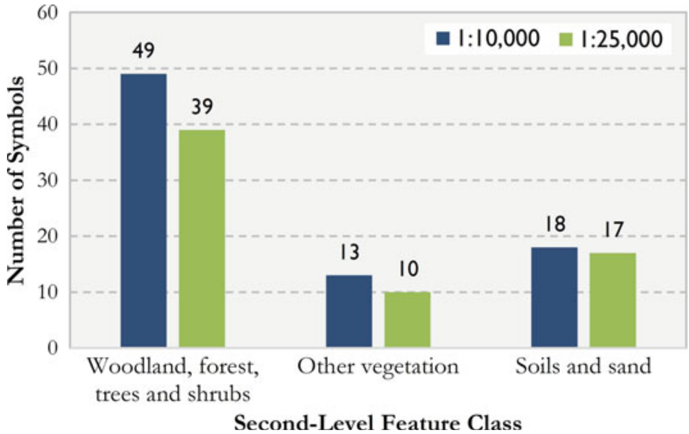

Fig. 6.13 Symbol counts for second-level feature classes within 'vegetation and soils', by scale

6.1.1.13 Industry and Communications (Excluding Natural Resources)

The 'Buildings and structures' and 'Communications' Second-Level feature classes are very similar in content at both scales, with the small number of differences arising from issues directly regarding the scale of features, or subtle differences in descriptions (Fig. 6.14).

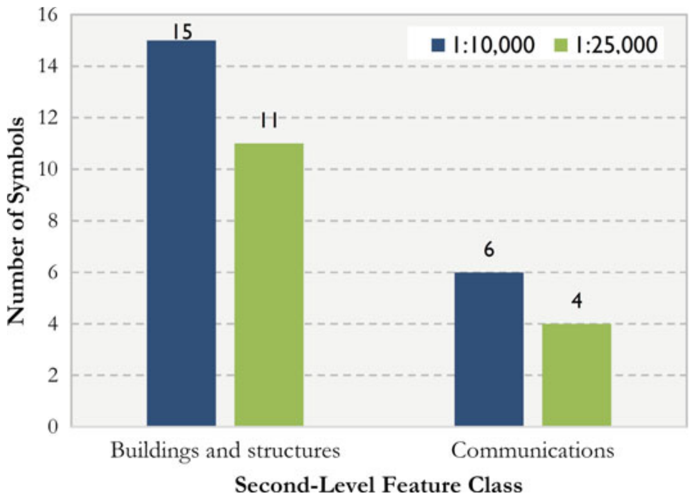

Fig. 6.14 Symbol counts for second-level feature classes within ‘industry and communications (excluding natural resources)’, by scale

6.2 Analysing the Symbology of Soviet Military City Plans in Context

Comparing the total numbers of different graphical symbols used in each of the 19 city plans in the sample will, firstly, highlight the plans which exhibit a greater richness of ‘fabric of difference’ through which the reader may assign meaning to elements of the map. It also provides, in the broadest sense, an indication of the variance in the application of the Soviet military city plan symbology to the maps for which they were intended. As a result, this will provide an initial insight into data that will contribute to the consideration of the research objective of examining ‘the extent to which the symbology of Soviet military city plans was successfully implemented across a variety of socio-cultural and physical environments across the globe.’ The second step towards identifying variance in symbology application around the globe is to consider in more detail the focus afforded to different feature classes on different city plans and how this variance corresponds with the characteristics of the mapped cities.

6.2.1 Trends Across the Sample

Of a total of 630 graphical symbols in the Soviet city plan specification as a whole, 302 (47.9%) are used at least once in this sample. Of the 378 symbols suitable for use at 1:25,000, 158 (41.8%) are used across the sample and of the 526 suitable for use at 1:10,000, 274 (52.1%) are used. Some 130 symbols are used on plans at both scales.

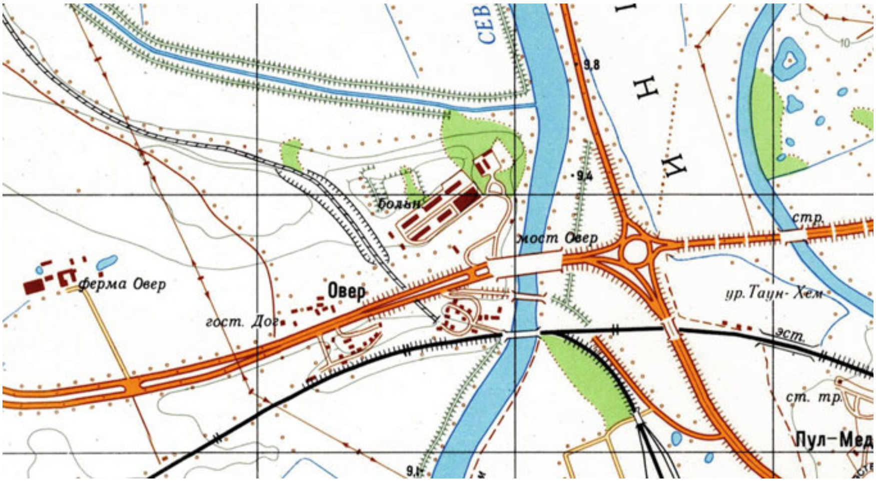

Fig. 6.15 Extract from the city plan of Gloucester, UK (1989, 1:10,000) showing the five symbols common to all 19 plans in the sample used in this study. Note that the road on the right is an 'improved motorway' (dotted); the 'highway' symbol is used on the roundabout (private collection)

Furthermore, only five symbols (0.79%) appear on all 19 plans in this sample and are shown in Fig. 6.15. Two of these, 'General fire-resistant building' and 'Highway', constitute the distinctive dark brown polygons and orange roads which contribute to the distinctive aesthetic of the plans. The 'Contour slope direction indicator' is also found on all of the plans, despite the absence of the standard contour on the plan of Miami in favour of 'supporting' (dashed) contours. One of the smallest symbols in the symbology, 'Individual tree with no value as reference point', also appears on all plans, along with the dotted 'Outline of vegetation and soil' which is typically used to separate vegetation from 'blank' space.

However, the analysis of this sample has also revealed that the symbology of city plans is not limited to that which is recorded in the specifications which are expressly for the particular scale of the plan. In this sample, a total of 62 symbols appear on plans at 1:10,000 which only appear in specifications for 1:25,000 maps. Of these, 37 only appear on 1:10,000 plans and not on 1:25,000 plans. Likewise, 28 symbols are used on plans at 1:25,000 which only appear in specifications for 1:10,000 maps. Of these, two only appear on 1:25,000 plans and not on 1:10,000 plans. Much greater is the number of symbols in the specifications which do not appear on any of the 19 plans in this sample, which totals 328 (52.1%). Many of these may have been designed for larger scale topographic maps, rather than city plans, as these share the same editions of *Conventional Signs*; for example, many of the numerous means of denoting the density and fire-resistance of buildings are far more commonly seen on 1:10,000 maps from the topographic series. Also numerous in this selection of unused symbols are over 20 types of bridge, many of which stipulate very specific conditions for their use, such as 'Triple-spanned stone, concrete and reinforced concrete bridge – over 13 m – to scale' and 'Footbridge with steps, wooden, 3–13 m length'. Other features are more feasible, but simply did not appear on any of the plans, such as 'Electrified triple track' (railway), 'Oil pumping station', 'Waterfall' and 'Hydroelectric dam'. Several features which are not marked on any plan in this sample are confined to particular geographical locations and thus may have been included had plans of different locations been selected, such as 'Geyser', 'Border of polar possessions of the USSR', 'Sakia (water lifting device)' (or Persian wheel) and 'Kariz' (an underground water channel in Arabic-speaking areas).

6.2.2 Total Symbology by City Plan

The numbers of different graphical symbols used in each of the 19 city plans in the sample are shown in Fig. 6.16. For each city plan, the larger datum refers to the number of different symbols on the plan which are included in the specifications already discussed, herein referred to as 'specification symbols'. For each city plan, the smaller datum refers to 'additional symbols'; those which are included on the plan but do not appear in the specifications. Such additional symbols include variants on those in the specifications and those which are explained in the margin of the relevant plan. The range in specification symbol counts for the 1:10,000 plans is 126 (Frankfurt am Main) to 56 (La Paz) (Fig. 6.17) and at 1:25,000 is 105 (Halifax/Dartmouth) to 71 (Canberra) (Fig. 6.18). These numbers are striking in that they represent a very small portion of the entire symbology at both scales. Despite including the largest number of symbols of the 1:10,000 plans in this sample, the plan of Frankfurt am Main incorporates only 23.6% of the total graphical symbology at 1:10,000 (535 symbols). Likewise, the plan of Halifax/Dartmouth incorporates only 27.1% of the total graphical symbology at 1:25,000 (388 symbols). The plans of La Paz and Canberra utilise 10.5% and 18.3% of their respective symbologies.

No plan uses more than ten additional symbols (Frankfurt am Main and Cairo) which deviate from the specifications. In total, 38 different additional symbols are used across the 19-plan sample and are listed in Table 6.1, the most common being a yellow fill denoting an urban area (used on 18 plans), a generic bridge (used on 18 plans) and generic vegetation (used on 17 plans). The plan without the yellow urban fill is Miami, which instead uses a more detailed selection of (additional) fills denoting building density and height in different parts of the city. The plans of Tromsø, Canberra and Topar use only five additional symbols each. In many cases, additional symbols have been used where those in the specifications are too specific for the data available in a particular location. Many are therefore more generic variants on specification symbols and may be interpreted without the aid of legend. Others simply combine elements of two or more specification symbols, or alter the variables; for example, a 'Quadruple electrified railway', where only single, double and triple-track railways are included in the specifications. Where additional symbols have been explained in a legend on the plan itself, a translation of this text has been included in Table 6.1. Examples of additional symbols from the sample are shown in Fig. 6.19.

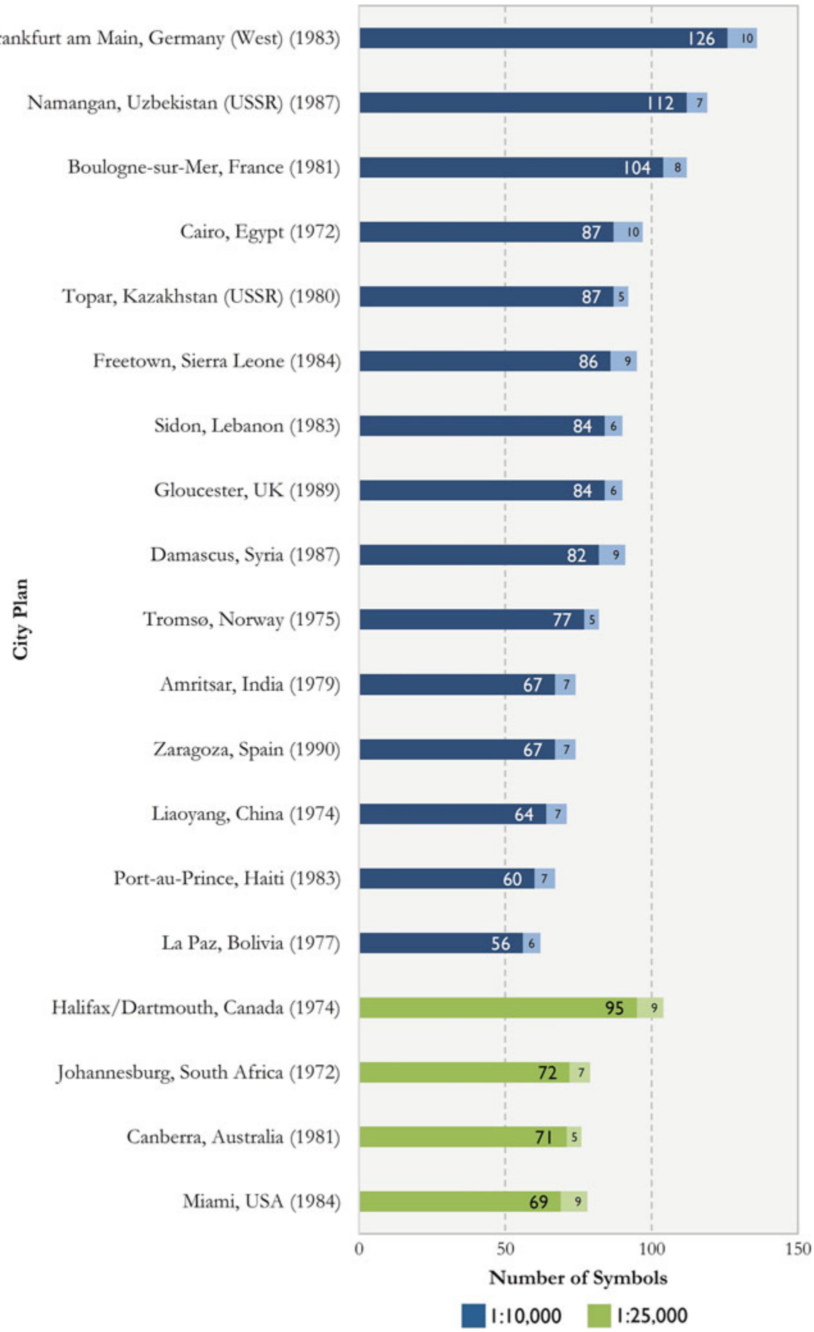

Fig. 6.16 Specification and additional symbol counts for city plans (ordered by specification symbol count rank, by scale)

Fig. 6.17 Extracts from the city plans of Frankfurt am Main, Germany (West) (1983, 1:10,000) (left) (private collection) and La Paz, Bolivia (1977, 1:10,000) (right) (ICGC, RM.165446) which utilise the greatest and fewest number of different symbols in the 1:10,000 sample respectively

Fig. 6.18 Extracts from the city plans of Halifax/Dartmouth, Canada (1974, 1:25,000) (left) and Miami, USA (1984, 1:25,000) (right) which utilise the greatest and fewest number of different symbols in the 1:25,000 sample respectively (private collection)

Table 6.1 Descriptions of additional symbols which are used on city plans in the sample, but do not appear in the specifications

Generic symbols	Other variants on specification symbols			Non-specification symbols	
General vegetation	Isobath direction indicator	Projected road	Stream passing under road/rail	Urban area (yellow fill)	River width arrow
General Church (cross within footprint)	River width markers	Lighthouse—geodetic point (black)	*Reinforced embankment (with dots)*	Densely built blocks in urban areas (brown hachures on yellow)	Fire-resistant urban area (darker yellow fill)
General mosque (crescent within footprint)	*Coastal sand with rocks*	*Pipeline with alternate filled and unfilled dots*	*Sparse forest on pale green fill*	*Densely built low-rise buildings (green hachure)*	*Reservoir section separator*
General bridge	*Quadruple electrified railway*	*Variant on city limits boundary*	*Sand with clusters (dunes?)*	*Sparsely built urban area (yellow fill)*	*Underwater cable*
General impassable marsh	*Sandy reef*	*Haphazard quarters of the city*	*Passable waterlogged ground*	*Unknown (unlabelled circle with central dot)*	*Densely built high-rise buildings (brown hachure on yellow)*
General passable marsh	*Sluice gate in impassable dam*	*Monument—geodetic point (black)*	*Stone church—geodetic point (black)*	*White building with cross over entire footprint*	*Densely built blocks in rural areas (brown hachures on white)*
General railway line				*Unknown (brown line with perpendicular ticks)*	

Descriptions of symbols only used on one plan in the sample are italicised

Fig. 6.19 Examples of additional symbols from the sample (clockwise from top-left): Isobath direction indicator (Boulogne-Sur-Mer), General vegetation (Cairo), General impassable marsh (Freetown), River width arrow (Frankfurt am Main), General bridge (Gloucester), Densely built low-rise buildings (green hachure) (Miami) (private collection)

6.2.3 Analysis of First and Second-Level Feature Classes

Figure 6.20 shows the total number of specification symbols used at least once in the 19-plan sample in each First-Level feature class, separated by scale and ordered by 1:10,000, then 1:25,000 rank. At both scales, the rank order of the First-Level feature classes differs from the order obtained by totalling the symbol counts deriving solely from the specifications (see Fig. 6.1). Notably, 'Rail Transport' is the sixth-largest class at 1:10,000 in the specifications, but is the third-largest class in the sample (26 symbols), surpassing the symbol counts of 'Natural Resources and Utilities' (22) and 'Relief and Geomorphology' (21). Despite a slightly higher symbol count in the specifications, 'Religious and Burial Sites' is the equal of 'Industry and Communications' (14 symbols) in the sample at 1:10,000 but remains the smaller class at 1:25,000. At both scales, 'Agriculture and Animal Enclosures' and 'Boundaries' have equal symbol counts in the specifications. This remains the case in the 1:10,000 sample, although the latter surpasses the former by one at 1:25,000.

Generally, more variation can be seen at 1:25,000 in the sample than in the specifications where, with one exception, the 1:25,000 rank mirrored the 1:10,000 rank. For example, 'Vegetation and Soils' is the largest First-Level feature class in the 1:25,000 specification, but only the third-largest in the sample. Similarly, 'Settlements' becomes a smaller class than 'Industry and Communications' in the sample and 'Air and Water Transport', which has a similar symbol count to 'Geodetic Points'

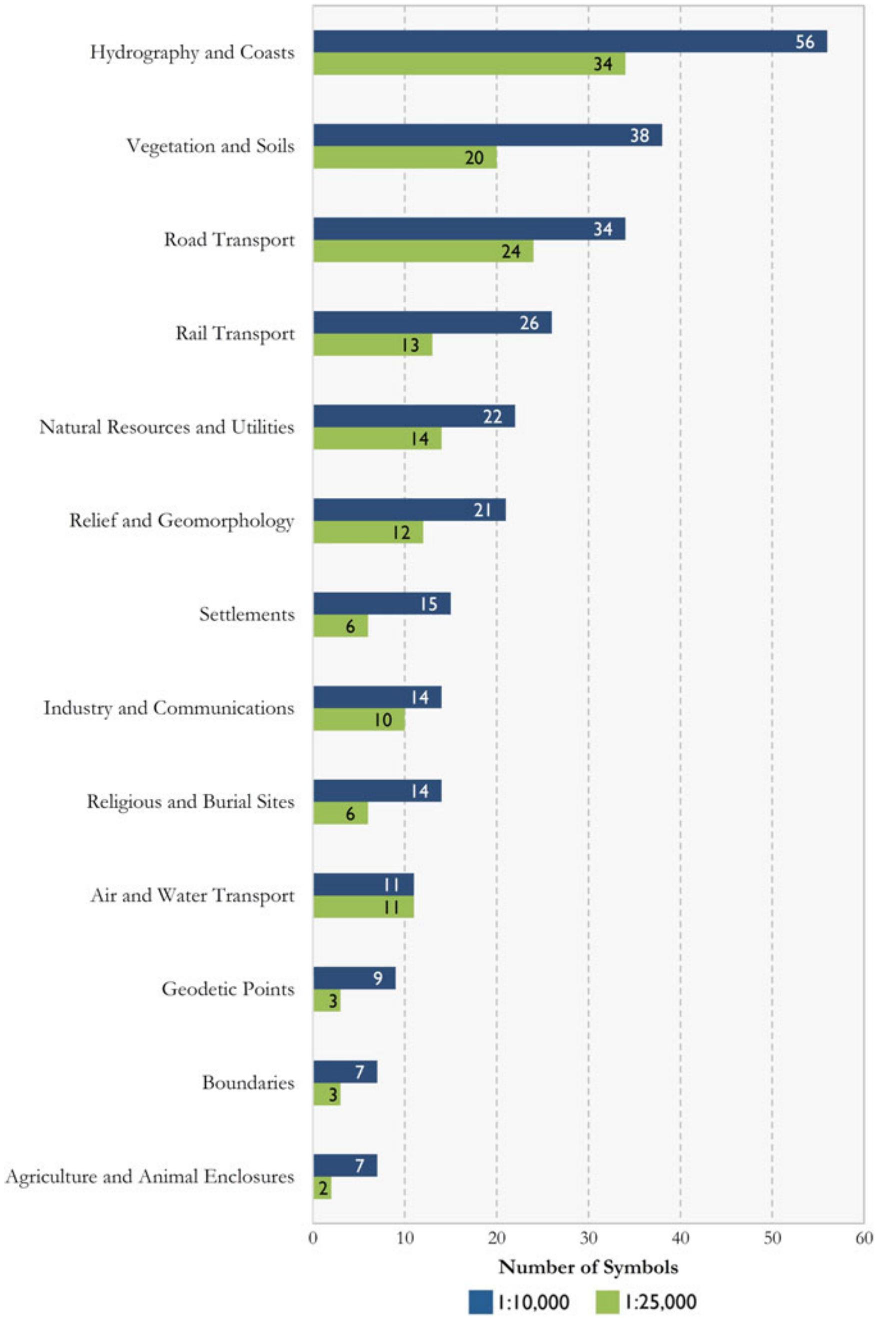

Fig. 6.20 Counts of specification symbols used at least once in the 19-plan sample, by first-level feature class and scale (ordered by 1:10,000 rank then 1:25,000 rank)

in the 1:25,000 specification, is larger by a more significant margin in the sample, equalling its 1:10,000 count. A clearer sense of how these symbol counts compare with the total symbol counts from the specifications can be gained from Fig. 6.21 which shows the specification symbol counts from across the sample (Fig. 6.20) divided by the total symbol counts from the specifications by First-Level feature class (Fig. 6.1), separated by scale and displayed as percentages.

Figures 6.22 and 6.23 show star plots which compare the relative proportions of the First-Level feature classes within the symbology of each city plan. These refer to specification symbols only, as additional symbols have been examined separately. It should be noted that the prominence of any particular feature class in these charts does not necessarily dictate that such features will be visually prominent on the map, as multiple uses of the same symbol are not considered in this analysis. For example, 'Settlements' is not the largest element of any of the star plots in Figs. 6.22 and 6.23, as the number of different symbols utilised from this feature class is typically low, relative to some others. Nonetheless, the same means of representing a building may be repeated hundreds of times across a single plan and thus be visually prominent. As this study is concerned primarily with the application of symbology, rather than issues of aesthetics and design, this is not problematic (Fig. 6.24).

The First-Level class with the highest degree of variance is 'Hydrography and Coasts', with a standard deviation of 5.22 across the sample. This variation is to be expected, given that seven of the 19 cities in the sample are coastal. Although symbols in this class may also be used in the context of inland water bodies, naturally, the coastal cities feature a larger portion of the symbology in this feature class; the largest being Freetown (26 symbols; located on a peninsula on the Atlantic coast) and the smallest being La Paz (six symbols; located over 300 km from the Pacific Ocean). Consequently, 14 of the 26 'Hydrography and Coasts' symbols on the plan of Freetown are in the 'Maritime hydrography, coasts and coastal cliffs' Second-Level class, whereas the six symbols on the plan of La Paz are all in the 'Rivers, streams and canals' and 'Lakes' Second-Level classes (four and two respectively). Although the plan of Gloucester, UK includes more symbols in this First-Level class (9) than the plan of La Paz, the class accounts for an 11% share of the total symbol count on both plans.

Perhaps more surprising is that 'Road Transport' is the First-Level feature class with the second-highest standard deviation across the sample (4.00), despite the more universal nature of the features it includes. Once again, the plan of La Paz utilises the fewest symbols (five symbols, 9%) and Frankfurt am Main the greatest (19 symbols, 15%) with the majority of these (10) within the 'Road types' Second-Level feature class. The plan of Frankfurt am Main also exhibits the joint-largest number of symbols in the 'Bridges and tunnels' Second-Level class (with Gloucester), largely due to the unusually high number of types of footbridges it includes. Despite the plan of Frankfurt am Main exhibiting the greatest number of symbols in this First-Level feature class, 'Road Transport' proportionately occupies a greater share of the symbology of five other city plans in the sample, with the plans of Gloucester, Zaragoza and Canberra exhibiting the highest proportion (21%).

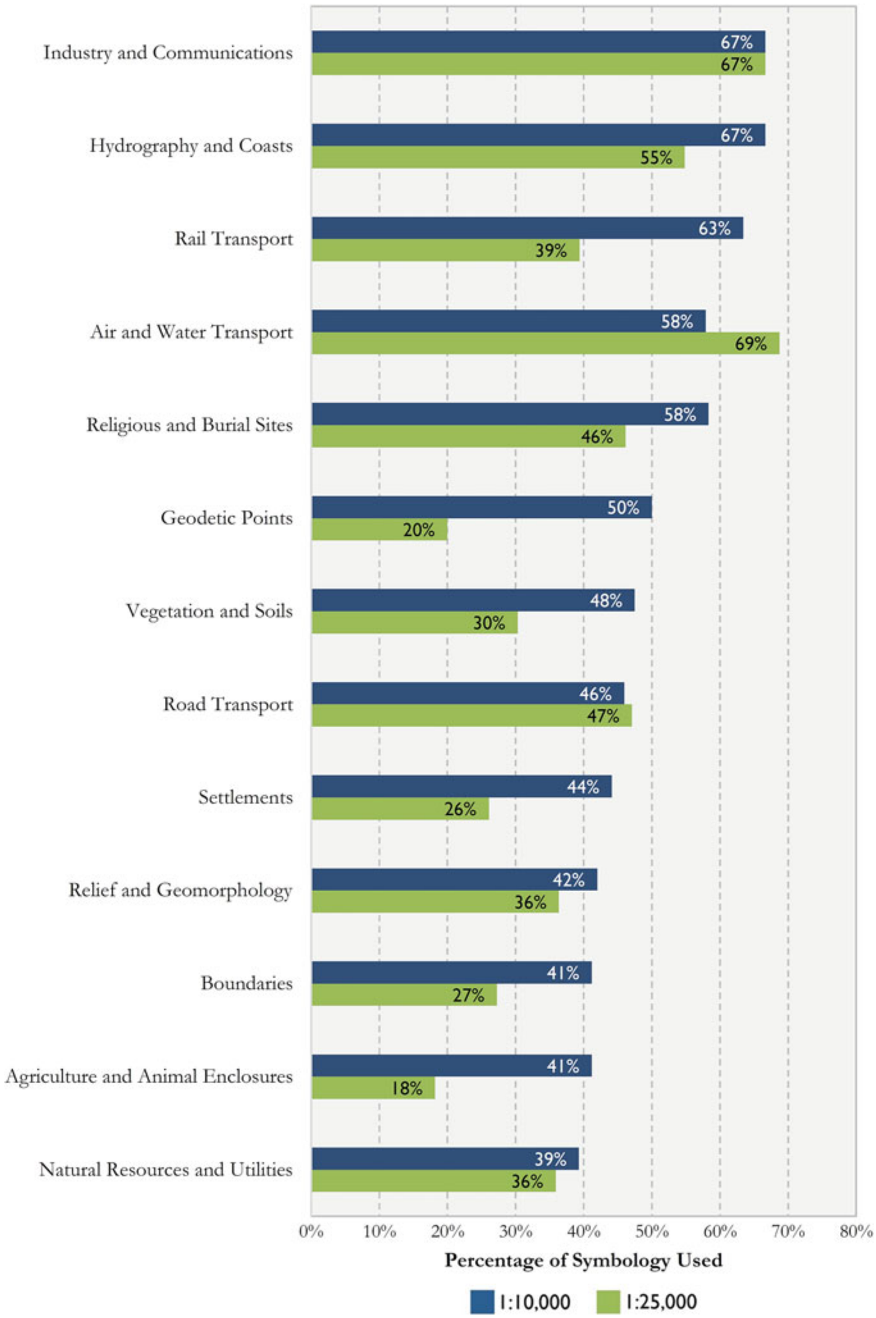

Fig. 6.21 Percentage of the specification symbols used at least once in the 19-plan sample, by first-level feature class and scale (ordered by 1:10,000 rank then 1:25,000 rank)

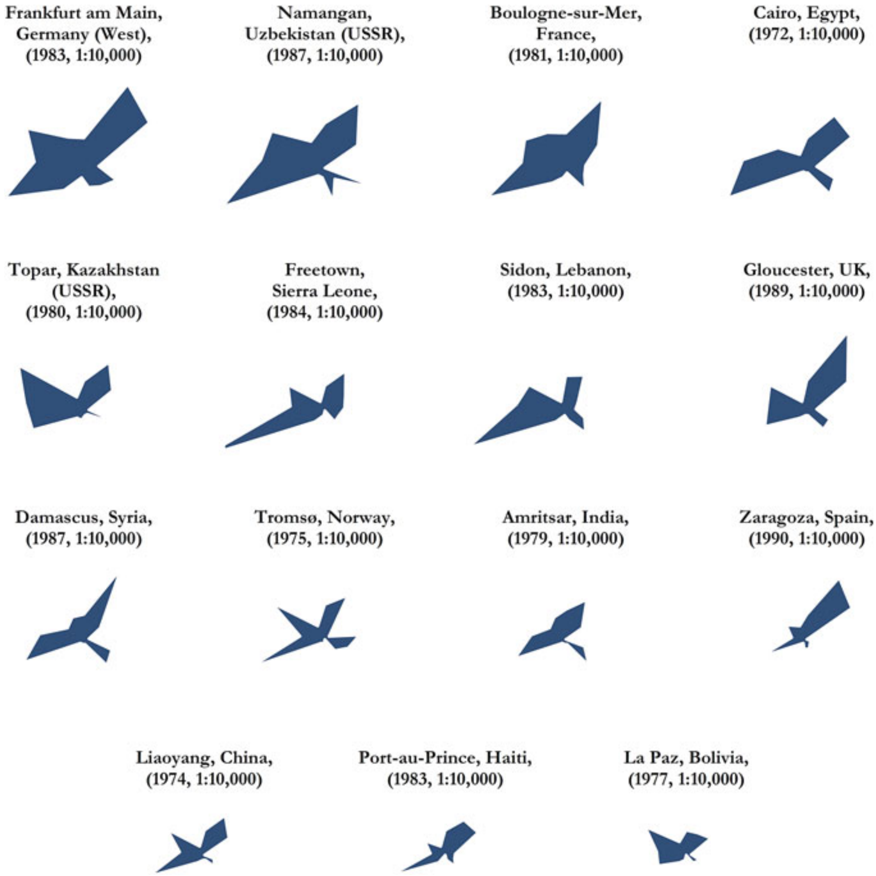

Fig. 6.22 Star plots indicating 1:10,000 city plan symbologies by first-level feature classes, plotted on identical axes (the surface area of each plot reflects the total symbology size)

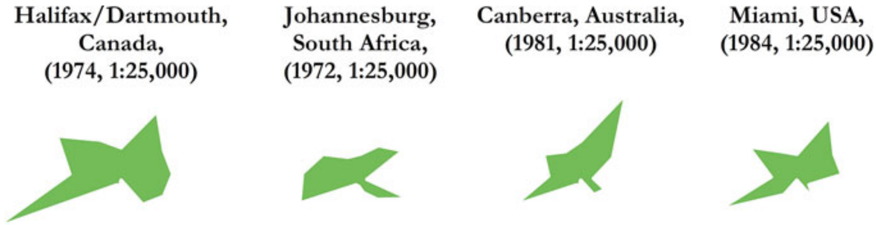

Fig. 6.23 Star plots indicating 1:25,000 city plan symbologies by first-level feature classes, plotted on identical axes (the surface area of each plot reflects the total symbology size)

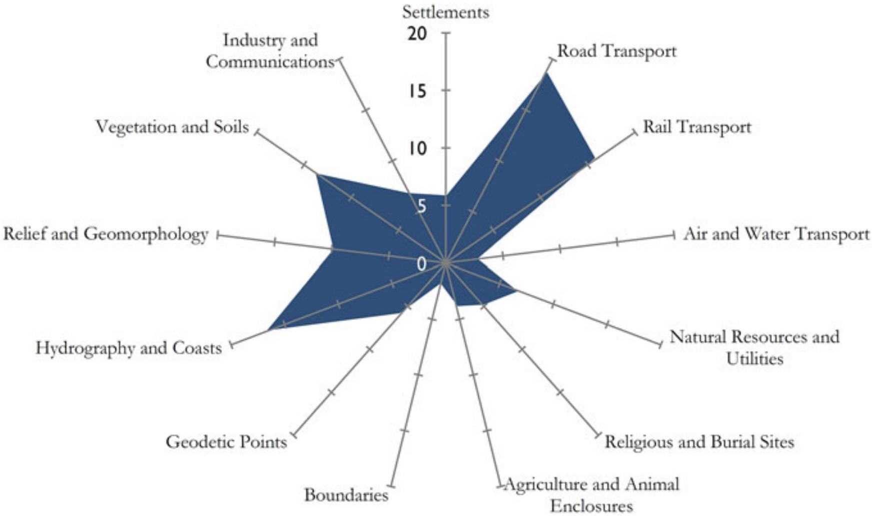

Fig. 6.24 Star plot indicating the symbology of the Soviet plan of Frankfurt-am-Main (1983, 1:10,000) by First-Level feature classes (the ordering of the axes reflects that used in Figs. 6.22 and 6.23)

The standard deviation of the ‘Vegetation and Soils’ and ‘Rail Transport’ First-Level classes are similar (3.42 and 3.36 respectively), although the highest symbol counts for each are found on different plans. The highest number of symbols in the former class is on the plan of Topar (16 symbols, 18%), possibly reflecting both the ability of the map-makers to freely access detailed surveys of the area and the fact that the urban extent of Topar is small, meaning that a larger proportion of the area covered by the plan is rural. For example, the plan of Topar includes the joint largest symbol count in the ‘Woodland, forest, trees and shrubs’ Second-Level feature class (nine, with Frankfurt am Main). ‘Vegetation and Soils’ also accounts for an 18% share of the symbology of the plan of La Paz, albeit with fewer symbols (10). Although the plan of Frankfurt am Main includes the highest symbol count in the ‘Rail Transport’ First-Level class (16 symbols, 13%), the class occupies a greater share of the symbology of the plan of Zaragoza (11 symbols, 16%). These two plans, along with those of Cairo and Johannesburg, have symbol counts among the highest in the ‘Railway lines’ Second-Level feature class, as these four plans exclusively incorporate both electrified and non-electrified lines. Although the plan of Gloucester is the equal of those of Zaragoza and Johannesburg in this respect, this is due to the presence of ‘Railways on trestles’ and a ‘Bed of [a] dismantled line’, rather than electrified lines. However, the high ‘Rail Transport’ symbol count on the plan of Frankfurt am Main is also promoted by the ‘Other railway features’ Second-Level feature class (six symbols), in which it is the only plan to include detailed footprints of station platforms and the ‘Point where metro line emerges at surface’ symbol.

Once again, the two plans of Soviet cities in this sample have symbol counts among the highest in the 'Relief and Geomorphology' First-Level feature class (standard deviation, 3.11); Namangan with 13 symbols (12%) and Topar with 12 symbols (14%). The symbol count of the former is matched only by the plan of Cairo (13 symbols) and both are exceeded by the same plan with regard to percentage share (15%). At the opposite end of the spectrum, the plans of Zaragoza and Port-au-Prince include only three symbols each in this class (4% and 5% respectively). However, the prominence of the plans of Soviet cities at the First-Level disguise broad consistency across the sample in the 'Elevation' Second-Level class, which itself has a standard deviation of only 0.79. Being solely comprised of contours and related markings, plans are typically only distinguished from one another in the 'Elevation' class by whether or not they incorporate 'additional' or 'supporting' contours. A much higher level of variance can be seen in the 'Geomorphology and Glaciology' Second-Level class (standard deviation, 2.65), in which the chasm between Namangan and Topar (10 symbols and eight symbols) and Zaragoza and Port-au-Prince (one symbol and zero symbols) can be more clearly discerned. The plan of Namangan provides the sample's only example of 'Gullies along dry ravines and valleys, less than 1 m deep', as well as both to-scale and not-to-scale delineations of pits and mounds (along with Topar, Cairo and Frankfurt am Main). Similarly, the plan of Topar is unique in its inclusion of a 'Cluster of stones', while the plan of Sidon is solitary in depicting the 'Entrance to [a] cave or grotto', despite falling short of the Soviet cities' symbol counts.

Far less Second-Level variance can be seen in the four classes within the 'Natural Resources and Utilities' First-Level feature class (standard deviation, 2.66). Although the highest symbol counts are again found on the plans of Namangan (12 symbols, 11%) and Topar (nine symbols, 10%), the highest percentage share is shared by the plan of Johannesburg (eight symbols, 11%). The plan of Namangan can be most clearly distinguished from the rest of the sample in the 'Water' Second-Level class (five symbols), in which the plans of Tromsø, Liaoyang, Zaragoza, La Paz, Port-au-Prince and Miami are united in their symbol count of zero, while eight other plans share a count of one (a 'Well', in seven cases). Three of the First-Level feature classes include plans with symbol counts of zero. Of these, 'Air and Water Transport' (standard deviation, 2.48) displays the greatest variance, with the plans of Halifax/Dartmouth (eight symbols, 8%) Tromsø (seven symbols, 9%) and Miami (seven symbols, 10%) clearly dominant in terms of symbol count due to the status of each of these cities as a major regional port, thus swelling symbol counts in the 'Water transport' Second-Level class. Unusually, the plans of the two Soviet cities have symbol counts among the lowest in this First-Level class, with a jetty on the shore of Sherubaynurinskoe (lake), outside Topar, preventing only one of them from recording a count of zero.

'Religious and Burial Sites' and 'Industry and Communications' have remarkably similar levels of variance (Standard deviation, 1.91 and 1.93 respectively). While the cemeteries and monuments of the 'Burials and Shrines' Second-Level feature class are broadly universal, with differences in symbols counts generally being dictated by whether such sites are shown to-scale or not-to-scale and whether or not they incorporate trees, more variation can be seen in the 'Places of worship' Second-Level feature class. In some cases, these variations are consistent with the status of religion in each city. For example, the plan of Damascus, a city which is divided into both Islamic and Christian quarters, has the highest symbol count in this class (five) and reflects the presence of both religions, as well as the construction materials used in many religious buildings. Conversely, Amritsar (three symbols) is a global hub of both Sikh and Hindu populations, although sites important to both of these religions are marked on the plan using the symbol 'Buddhist monastery, temple or pagoda – not to scale', as the Soviet specification does not expressly name either religion (see Fig. 6.25). The use of church and mosque symbols elsewhere on the plan perhaps gives a misleading impression of a region in which Christians and Muslims account for less than 3% of the population (Census Organisation of India, 2011). In light of the state atheism policies of the Soviet Union, both Namangan and Topar have symbol counts of zero in the 'Places of worship' Second-Level feature class, along with (more surprisingly) Zaragoza. Boulogne-Sur-Mer records the highest number and proportion of symbols in the 'Industry and Communications' First-Level class (eight symbols, 8%), with a notable concentration around the port. Conversely, the plans of Freetown, Liaoyang, Sidon, Port-au-Prince and Gloucester only incorporate two symbols in this class, occupying 2–3% of their symbologies.

The remainder of the First-Level feature classes are characterised by very low levels of variation across the sample (standard deviation 1.70 or less). 'Settlements' consists of means of representing buildings which are, naturally, features universal to all cities. The main differentiation factor is between Soviet and non-Soviet cities. While plans of cities within the USSR do not include the triple-class

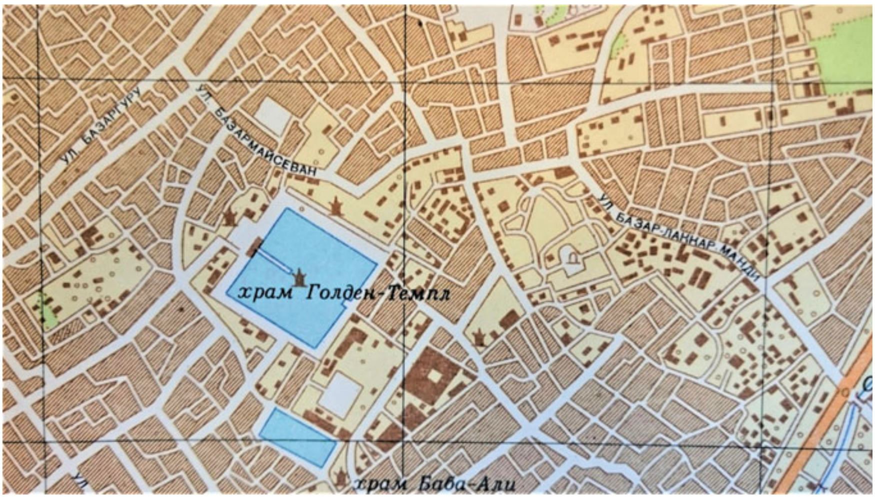

Fig. 6.25 Extract from the city plan of Amritsar, India (1979, 1:10,000) showing the (Sikh) golden temple marked using the symbol 'Buddhist monastery, temple or pagoda—not to scale' (©British Library Board, X.7241)

colour coding system for buildings (administration, military/communications and industrial) common to all other plans in this sample, the plans of Namangan and Topar are the only examples which distinguish non-fire-resistant from fire-resistant buildings. This is despite the dark brown polygon ‘General fire-resistant building’ functioning as the universally-used standard symbol for a non-classified building, even without its non-fire-resistant counterpart. ‘Settlements’ accounts for a 5–9% share of the city plan symbologies. Plans at the upper end of this range are typically those which incorporate planned construction, destroyed buildings and ‘lightweight’ constructions. Namangan stands out in the ‘Agriculture and Animal Enclosures’ First-Level class (seven symbols, 6%) from the next largest symbol count on the plan of Frankfurt am Main (four symbols, 3%); the result of a near-full complement of orchards, vineyards, greenhouses and industrial crops. Across the sample, a ‘Paddock for cattle – not to scale’ on the plan of Johannesburg is the only example of a symbol in the ‘Animal enclosures’ Second-Level feature class. ‘Boundaries’ and ‘Geodetic Points’ are by far the smallest First-Level classes. While various walls and fences appear on most plans, only three in this sample include any ‘Political boundaries’ (Freetown, Halifax/Dartmouth and Canberra), with none of these examples being state borders. The plan of Frankfurt am Main includes the greatest number of ‘Geodetic Points’ (six symbols, 5%) solely due to its placement of some points on churches and other buildings, which are listed as distinct symbols in the 1978 compilation manual for city plans.

6.2.4 Analysis of Symbology and Characteristics of Cities

Statistical analyses of the above-described characteristics of the symbology of the city plan sample and the characteristics of the cities selected for inclusion have yielded little strong evidence of unequivocal linkages. The strongest link identified is between the specification symbol counts of the city plan sample at 1:10,000 and the current HDI of the countries in which the cities are currently located, which produces a weak positive correlation of 0.341 (Fig. 6.26). Removing the two Soviet cities from this analysis, given the different production circumstances of these plans, produces a slightly stronger correlation of 0.394, although there are greater outliers than these cities. The corresponding figure for the 1:25,000 plans is 0.229. It is accepted that the extent to which this metric is representative of global trends in Soviet city plan symbology is questionable for several reasons. Firstly, HDI data are only available at the national level and therefore mask differences between cities within the same country. Secondly, the city plans included in this study span some 18 years between 1972 and 1990, yet the HDI data used are the most recent available (2016) as no metric exists for this period which is the equal of current HDI in terms of both global standardisation and breadth of measures of development included. This also introduces both the possibility that some cities are today located in a different country than that in which they were located at the time of the production of the corresponding city plan, and that changes in the level of development may have taken place in the

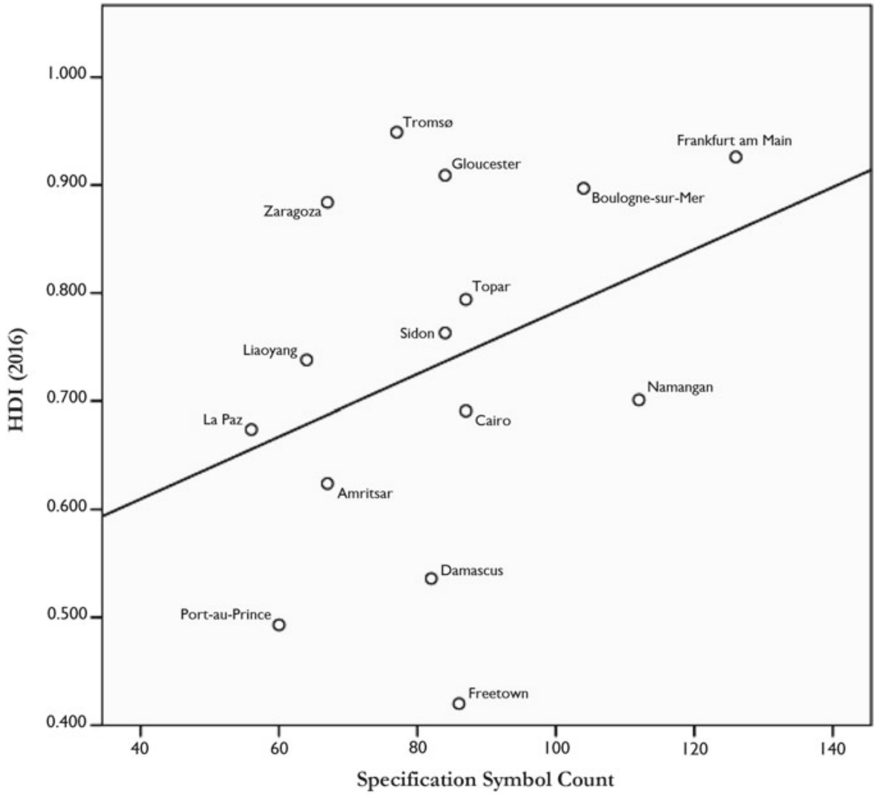

Fig. 6.26 Scatter plot showing the relationship between specification symbol counts of the 1:10,000 sample and HDI values from 2016

subsequent 26–44 years. However, given the presence of a weak correlation despite these limitations, a stronger correlation may be obtainable if these limitations were to be overcome, and if the sample was enlarged to incorporate a greater proportion of the city plan series.

The correlation between the specification symbol counts and population is weaker than that with HDI; with virtually no correlation at 1:10,000 (− 0.009) and a very weak negative correlation at 1:25,000 (− 0.260). However, issues with the age of the data also exist with this metric, exacerbated by the fact that there is no global, standardised source of population data at the city level. Secondly, vast differences between the definitions of city limits in different locations add further inconsistency, with some city population statistics including the wider region in which the city is located and others including little more than the city centre. These issues are currently insurmountable and thus more accurate correlation data are unlikely to be obtainable. In terms of climate, the major trend appears to be a higher mean symbol count for plans of cities within temperate climates (Fig. 6.27). Given the small sample

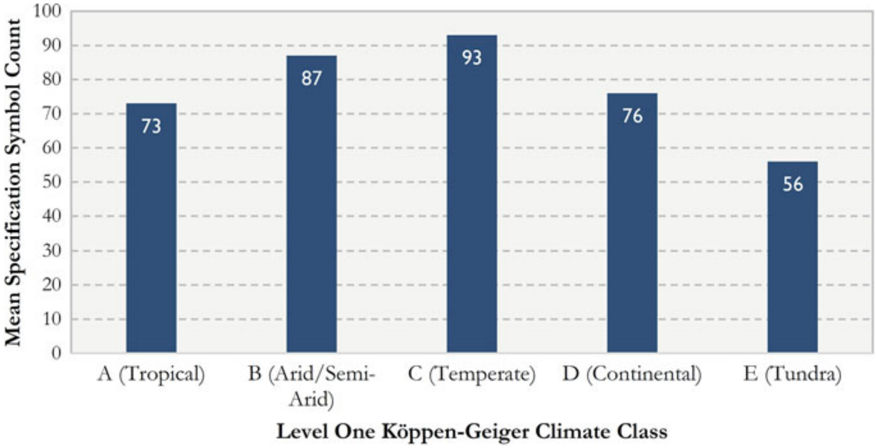

Fig. 6.27 Mean specification symbol counts on plans at 1:10,000 by level-one Köppen-Geiger climate class

size, this conclusion should be treated cautiously. There are also insufficient data to meaningfully analyse variations in Köppen-Geiger climate class at the second or third level, or at all at 1:25,000. Although class E (Tundra) scores lowest with a symbol count of 56, it should be noted that this derives solely from the plan of La Paz, which is the only city within this climatic region to be included in the entire city plan series.

6.3 Comparison of Soviet and *OpenStreetMap* Symbologies

An analysis of the OSM Standard Layer symbology reveals a lower total symbol count than the Soviet symbologies, albeit with a greater emphasis on human features and a far more limited symbology for natural environments. The symbol count for the OSM specification totals 281, whereas the Soviet city plan symbology totals 378 at 1:25,000 and 526 at 1:10,000, including symbols which may be used at either scale. When comparing these figures, it should be remembered that the OSM symbology referred to here is intended to be applied to maps between 1:500,000,000 and 1:1,000, whereas the Soviet specifications deal with each scale separately. In terms of First-Level feature classes, the two additional feature classes introduced in this part of the study are the largest in terms of total symbol count, with 'Retail and Restaurants' (64) the largest and 'Leisure, Tourism and Public Services' (54) the second largest (Fig. 6.28). These classes include features such as 'café', 'ice cream shop', 'library' and 'theatre', none of which appear in the Soviet specifications as graphical symbols. The largest OSM First-Level feature class which is also used by the Soviet city plans is 'Road Transport' (48), which is also a large feature class in the Soviet specifications, although not the largest. The OSM symbology includes

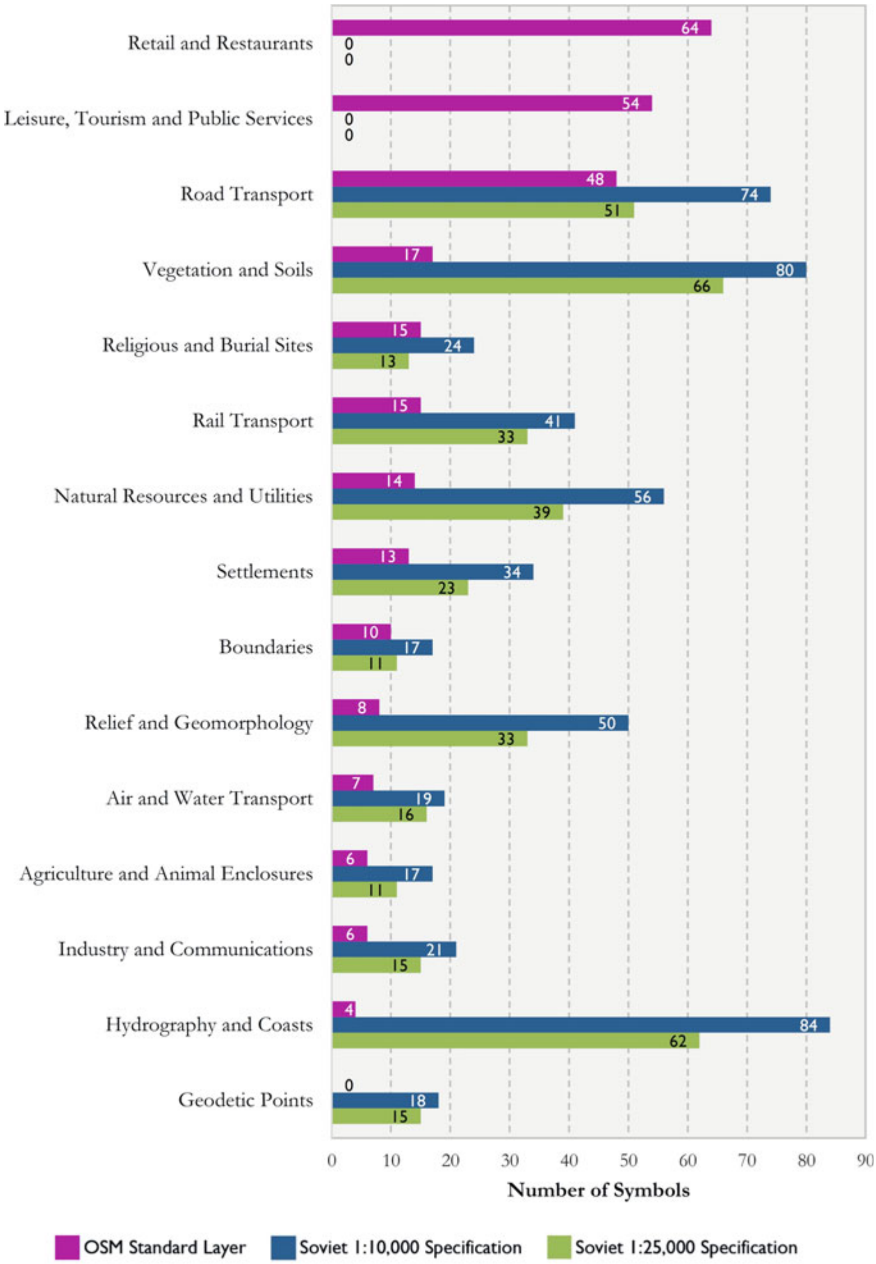

Fig. 6.28 Specification symbol counts for first-level feature classes (ordered by OSM rank)

symbols such as ‘car park’, ‘bicycle parking’ and ‘taxi rank’, which are absent from the Soviet symbology. This symbol count is similar to that from the Soviet 1:25,000 specification (51). These three feature classes comprise the majority (59%) of the OSM Standard Layer symbology.

The next largest feature class in the OSM symbology, ‘Vegetation and Soils’ (17), has a significantly smaller symbol count than ‘Road Transport’, despite this being one of the largest feature classes in the Soviet symbology. Furthermore, all of the other feature classes are significantly smaller in the OSM symbology than its Soviet equivalents. Among the most striking of these differences is ‘Natural Resources and Utilities’ (14), a symbol count which is a quarter of the size of the same feature class in the Soviet 1:10,000 symbology, ‘Relief and Geomorphology’ (8) and ‘Hydrography and Coasts’ (4). In addition, the OSM symbology includes no geodetic points.

6.3.1 Mapping Frankfurt am Main

Some major differences are evident between the OSM legend symbology and that which has been applied to Frankfurt am Main at 1:8,000, although the bias towards human features which characterised the specification also broadly manifests itself on the map. Despite being considerably smaller in the specifications, the OSM ‘Road Transport’ symbol count applied to Frankfurt am Main (35) is larger than the equivalent symbol count from the Soviet plan of the city (19), in addition to being the largest OSM feature class for the city. Although there is little difference in the number of road classes used, the inclusion of smaller features such as ‘gate’, ‘ford’ and ‘bollard’, as well as additional information such as ‘one way arrow’, contribute to this higher symbol count. Of the 54 ‘Leisure, Tourism and Public Services’ symbols in the specification, 20 are included on the OSM of Frankfurt am Main, retaining its position as the second largest OSM feature class (Figs. 6.29, 6.30 and 6.31).

Although the ‘Vegetation and Soils’ feature class is much larger in the Soviet specifications than the OSM specification, the symbol counts applied to Frankfurt am Main are much more comparable, as the majority of Soviet vegetation symbols were unused on the 1983 plan of the city. Several of the OSM feature classes have higher symbol counts than the Soviet plan, namely ‘Religious and Burial Sites’ (10), ‘Settlements’ (8), ‘Boundaries’ (5), ‘Agriculture and Animal Enclosures’ (5) and ‘Retail and Restaurants’ (3). Although ‘Retail and Restaurants’ is the largest OSM feature class in the specification (64), the identification of only three of these symbols in this analysis indicates that use of the vast majority of this is confined to larger scales. However, as in the specifications, ‘Relief and Geomorphology’, ‘Hydrography and Coasts’, ‘Industry and Communications’ and ‘Geodetic Points’ are far more richly presented on the Soviet plan than OSM, despite the slightly smaller scale of the former.

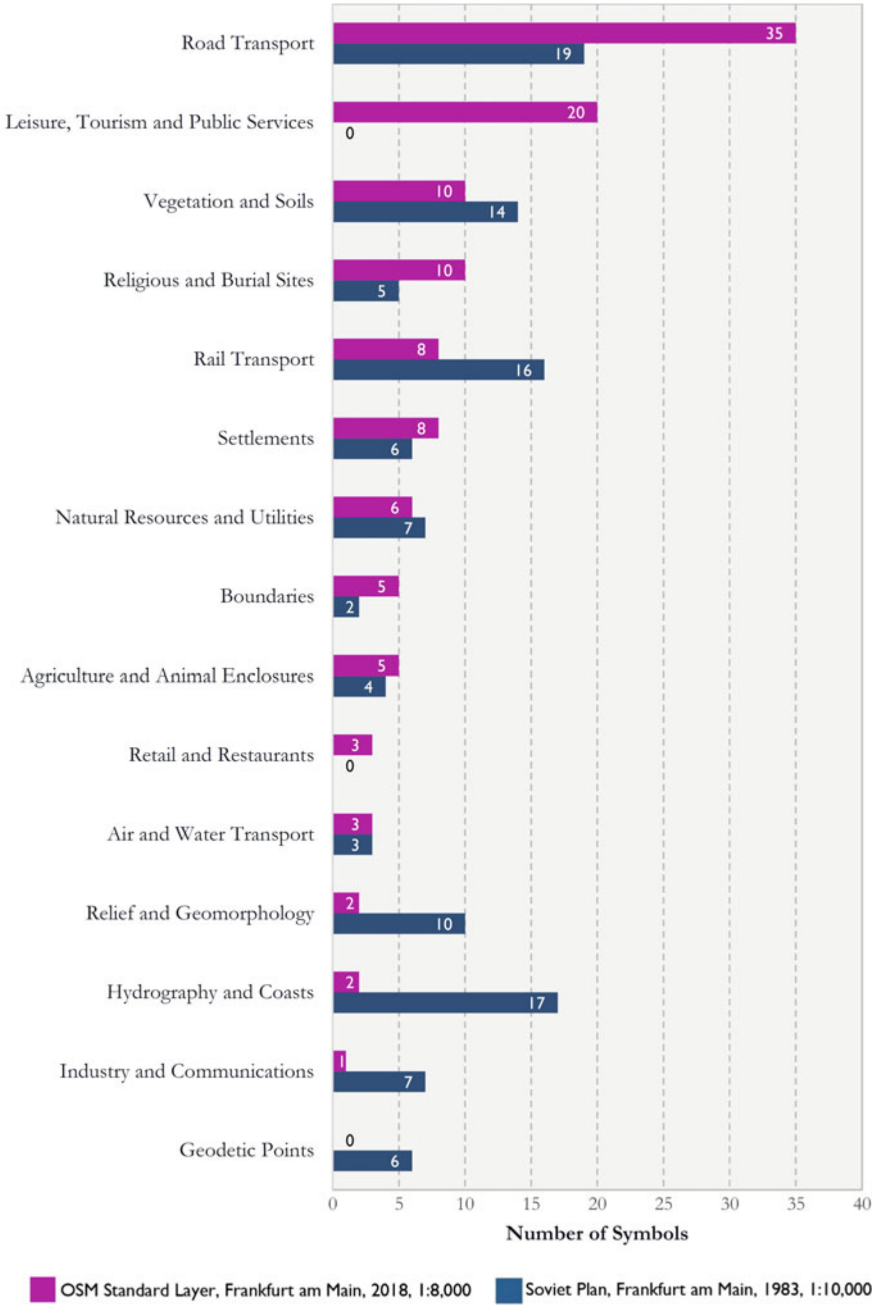

Fig. 6.29 Counts of specification symbols used at least once on the Soviet plan of Frankfurt am Main (1983, 1:10,000) and the equivalent area on OSM at 1:8,000 by first-level feature class (ordered by OSM rank)

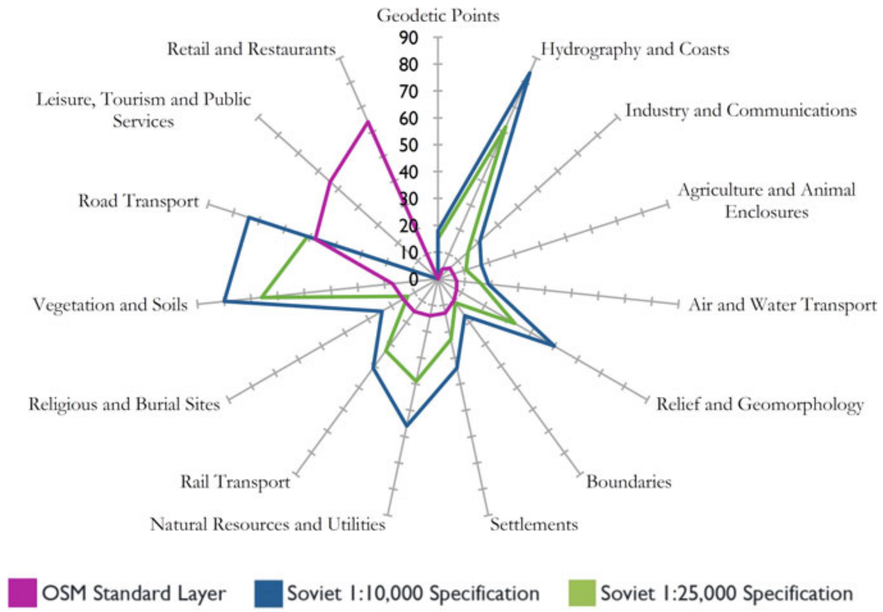

Fig. 6.30 Star plot indicating specification symbol counts for first-level feature classes

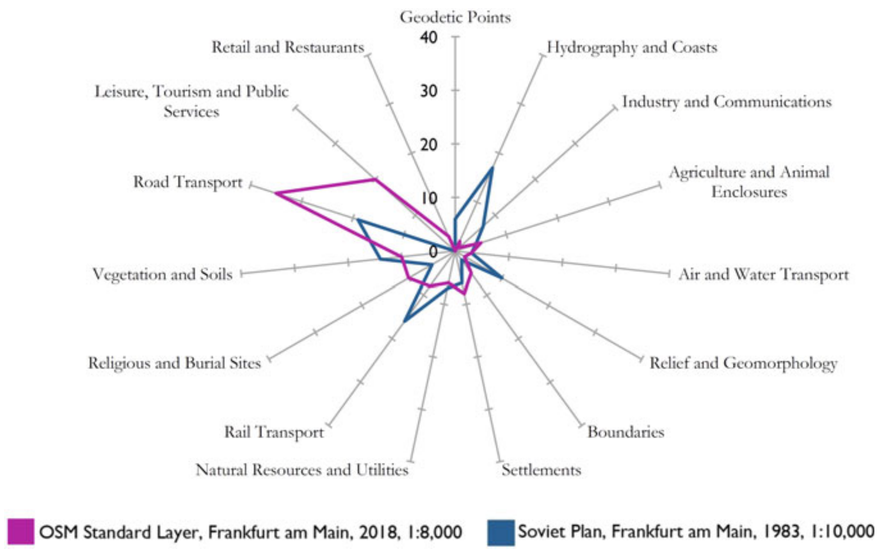

Fig. 6.31 Star plot indicating counts of specification symbols used at least once on the Soviet plan of Frankfurt am Main (1983, 1:10,000) and the equivalent area on OSM at 1:8,000 by first-level feature class

It is possible to summarise the major findings presented in this chapter as follows:

- The specifications dictating the symbology of Soviet city plans include 252 graphical symbols solely for use at 1:10,000, 104 solely for use at 1:25,000 and 274 for use at either scale; totalling 630 graphical symbols across the symbology as a whole.
- In the specifications, ‘Hydrography and Coasts’ is the largest First-Level feature class at 1:10,000 by symbol count (84) but ‘Vegetation and Soils’ is the largest at 1:25,000 (66).
- ‘Hydrography and Coasts’ is the largest First-Level feature class at both scales in the city plan sample although, relative to the specification symbology, a higher proportion of the ‘Industry and Communications’ symbology is used at 1:25,000 (equal at 1:10,000).
- Of the 630 graphical symbols available in the specifications, 302 (47.9%) are used at least once in the 19-plan sample analysed here, leaving 328 (52.1%) unused.
- Only five symbols (0.79%) are common to all 19 plans in the sample.
- Frankfurt am Main and La Paz exhibit the highest and lowest symbol counts respectively at 1:10,000; Halifax/Dartmouth and Miami likewise at 1:25,000.
- Symbols which only appear in the specification for maps at a particular scale are not confined to use only at that scale.
- Additional symbols are widely used across the sample, commonly to denote features which are more generic than those in the specifications. Completely new symbols are far less common than variants on those in the specifications.
- There is a weak positive correlation (0.341) between the total specification symbol count of the sample’s 1:10,000 plans and the HDI value of the relevant modern country.
- The mean total specification symbology for plans at 1:10,000 is highest for cities in temperate climates (93).
- ‘Retail and Restaurants’ (64) and ‘Leisure, Tourism and Public Services’ (54) are the largest feature classes in the OSM symbology specification, despite neither of these feature classes appearing in the Soviet city plan symbology.
- On comparable maps of Frankfurt am Main, ‘Road Transport’ is the largest feature class for both OSM and the 1983 Soviet plan.
- In both the specifications and the maps of Frankfurt am Main, the OSM symbology incorporates many more symbols for human features, while the Soviet symbology is far larger with regard to natural features.

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Chapter 7
Discussion

The results outlined in Chap. 6 highlight the size of the symbology available for use on Soviet military city plans and the uneven application of this symbology within the sample of 19 cities incorporated in this analysis. This core finding highlights the contrasting results which may be obtained by analysing symbology specification data and data on the maps themselves. However, in addition to endorsing the methodological contrast between analysing symbols in and out of context, as discussed in Chap. 4, this result also highlights the challenge presented by the aim of producing consistent topographic mapping of the globe at a large scale. With this objective, the Soviet military city plan series undoubtedly became one of the most ambitious mapping projects of the twentieth century yet the fact that, with a similarly ambitious 630-symbol symbology at its disposal, a common core of only five symbols is used on all of the maps in the sample (general building, highway, contour direction indicator, outline of vegetation and individual tree), plainly highlights the challenges it faced in meeting this aim. This chapter discusses the evidence of these challenges highlighted by the empirical analysis of the Soviet city plan symbology, exploring what it allows us to understand about the Soviet mapping programme more generally, in addition to the implications of this on current global mapping initiatives. A broader view is then taken on the relevance of Soviet maps in current and future applications, with use of the maps in the context of humanitarian crises identified as a significant opportunity for future investigation.

7.1 Understanding Soviet Military Mapping

The preparatory work for the symbology analyses included the compilation of a list of over 2,000 known Soviet city plans and their locations within cartographic collections around the globe, in addition to the partial translation of a compilation manual for the series. The resulting documents provided a substantial source of the information presented in Chap. 2 and, together, give a broad insight into the scope

M. Davis, *A Cartographic Analysis of Soviet Military City Plans*, Springer Theses,
https://doi.org/10.1007/978-3-030-84017-4_7

and aim of the Soviet military city plan series in addition to the extent to which the series was successfully extended to cities in over 130 countries. Understanding the component parts of a city plan, such as its marginalia, the format of the *spravka* and other associated elements, such as schematic metro diagrams, street indexes and metadata, are invaluable in the interpretation of the maps and in the gathering of useful information from them. This is especially valuable to non-Russian-speakers embarking on this process. More immediately, the dissemination of this information [5, 6] aims to facilitate more accurate and consistent cataloguing and recording of the maps in libraries and archives which, in turn, allows them to be accessed more easily.

Chapter 1 concluded that state control, censorship and a drive towards accuracy and precision have long-characterised cartography in Russia. Although Chapter Two identified that the Soviet military city plan series continued to exhibit this state control and censorship, the results outlined in Chap. 6 indicate that comprehensiveness was also a key aim. With the symbology specifications including 630 symbols, it is clear that, regardless of the extent of implementation of this symbology on the maps themselves, the series was intended to be precise and comprehensive, with seemingly minor characteristics of features accommodated. Additionally, in presenting a translation of extracts of the 1978 compilation manual for city plans for the first time, new insights have been gained into the production processes involved during the creation of the series, including the keeping of record files, the composition of the *spravka* as well as the general stylistic evolution of the series. While previous studies of Soviet city plans provided valuable background information which became the starting point of this study (e.g. [2–4, 11]), the systematic analysis of symbology data undertaken here provides substantial empirical evidence of the relative importance afforded to various feature types as well as, more generally, the richness of the symbology.

In this context, the results of the symbology analyses serve, firstly, as a means of developing our understanding of the Soviet military mapping programme itself. Although the observation that Soviet military city plans are rich in topographic detail has been made previously [2, 3, 11], the sourcing and translation of symbol specifications for the first time allows this observation to be more informed and precisely stated. Knowledge of the exact scope of the symbology, in addition to the manner in which it is divided between feature classes, enables potential future users of the maps to assess their suitability for particular purposes, based on this fuller understanding of the map's content. Particular findings include the fact that 'Hydrography and Coasts' is the largest First-Level feature class at both 1:10,000 (84 symbols) and 1:25,000 (62 symbols) (see Fig. 6.1), which may be unexpected in a primarily urban map series, and that the inclusion of other natural features, such as 'Vegetation and Soils' (80 and 66 symbols) and 'Relief and Geomorphology' (50 and 33 symbols) is also comprehensively facilitated at both city plan scales. Since the pre-Petrine era, hydrological features (particularly rivers) have been attributed much importance on Russian maps, at first as a framework for maintaining positional accuracy in relation to other features [23] and latterly as an important transport network across the Russian Empire and the Soviet Union. It is clear that Soviet military city plans continued to assign importance to these features, with rivers emerging as the largest Second-Level feature class within 'Hydrography and Coasts', with 45 1:10,000 symbols and 33 1:25,000 symbols (see Fig. 6.11).

7.2 Mapping Diverse Environments

The first research objective was directed towards assessing the extent to which the Soviet city plan symbology had been implemented in a selection of varied socio-cultural and physical environments across the globe. As identified in Chap. 6, a weak positive correlation exists between symbol counts at 1:10,000 and HDI, in the sample used, implying that plans of cities in less industrialised countries exhibit a smaller number of symbols than plans of cities in countries with a higher level of development. This trend could, at least in part, be explained by a smaller variety of features in such cities. For example, a plan of a more industrialised city, with advanced transport and communications infrastructure, includes a larger number of symbols in order to accommodate this level of development.

Conversely, a less industrialised city may possess a very low symbol count in feature classes relating to industry. However, the issue of source material may also be influential in this trend too as, generally, countries with a higher level of development are perhaps more likely to have been the subject of detailed survey and information-gathering exercises in the recent past, thus providing a larger amount of secondary data to inform the processes outlined in Chap. 2. Although colonial powers frequently conducted detailed mapping exercises of their territories, many of these would have become independent states before the zenith of the Soviet mapping programme and thus this source of information would have been increasingly outdated. For example, Sierra Leone gained independence from the United Kingdom in 1961. According to Larsgaard [14: 43], the country was better mapped than many other former colonies at the time of their independence, yet it was not until 1980 that maps of the whole country at 1:50,000 (the largest available scale) had been published. In contrast, IGN had completed 1:25,000 mapping covering France by 1979 and had begun work on larger-scale projects [14: 131]. The findings of this study also reveal that the mean total specification symbology for plans at 1:10,000 is higher for cities in temperate climates than in other climatic zones, highlighting a further factor which may influence the symbology used. Although this broad tendency for higher symbol counts to be recorded in more industrialised countries with temperate climates exists, the correlations involved are weak and do not incorporate other factors which may affect symbol counts. The plans of Namangan and Topar, for example, may have higher symbol counts due to the relative ease of access to information regarding Soviet domestic territory. It should also be considered that the sample analysed here represents only 1% of the Soviet city plan series and that enlarging this sample may yield more accurate results.

Notwithstanding this, the findings of Chap. 6 reveal a considerable variance in the extent of the application of symbology on different city plans and display a clear disconnect between the comprehensiveness of the symbology specifications and the rather less comprehensive symbology which tends to appear on the plans. Although the precise reasons for this variance could be explored in subsequent research, the practice of including information on the plans wherever it was available seems to have been prioritised over consistently applying the specification symbology to all city plans and is a significant and original finding of this research. Although the city plan series may have aimed to be a fully standardised venture, these findings are indicative of a less homogenous series. The extent to which the symbology has been applied differs across the different urban environments included in the analysis but the symbology used, in itself, is unquestionably the same, with the exception of a small number of 'additional' symbols, which are discussed in Chap. 6 (see Table 6.1). It is therefore not the symbology itself which is unable to be applied to a variety of socio-cultural and physical environments, but the availability of consistent base data, without which the symbology cannot be applied consistently. This naturally leads us towards reconsidering the sources of information used in the compilation of each plan during the process outlined in Chap. 2.

7.2.1 Investigating Source Materials of Soviet Military City Plans

As previously mentioned, the variation in the application of the Soviet symbology to cities around may be due, at least in part, to a variation in the quantity and comprehensiveness of source materials used during the compilation process. Chapter 2 outlined this process in detail, highlighting that either an existing map or satellite imagery could be used as the 'basic cartographic material', with a preference for the former. This base map was then supplemented by information from a myriad of other sources. Table 7.1 summarises the availability of source material for each of the 19 plans in the sample analysed in Chap. 6, in addition to the specification symbol counts for each plan.

As explained in Chap. 5, the sample of plans was designed to reflect the peak of the series, after 1971, and as such all of the plans analysed were produced at a time in which satellite data from Zenit-4MT (1971–1982) and/or Zenit-8 (1984–1994) are likely to have been available [1]. The variation in symbology application identified in Chap. 6 is therefore unlikely to be the result of a lack of satellite imagery, a factor which may have limited the source data available for plans compiled before 1971. The availability of potential source mapping at various scales at the time each plan was produced has been based on information from [14, 20, 21].

Most NMOs tend to use similar scales for their larger-scale topographic maps and, as a result, the largest scale of topographic mapping available in most countries is either 1:50,000 or 1:25,000 (or a similar scale, e.g. 1:20,000). Although no particular scales are mentioned in the Soviet compilation manual for city plans, it seems likely that maps at these scales would be too generalised to function as a base map for a plan

Table 7.1 Summary table of potential source materials available at the time of compilation for each Soviet city plan in the sample analysed in Chap. 6 (ordered by scale then year)

City, Country	Edition year	Scale of Soviet plan	Specification symbols	Zenit-4MT imagery	Zenit-8 imagery	NMO topographic mapping—1:50,000	NMO topographic mapping—1:25,000 or larger	NMO or commercial street plans
Cairo, Egypt	1972	1:10,000	87	✓		✓	✓	✓
Liaoyang, China	1974	1:10,000	64	✓		✓	✓	
Tromsø, Norway	1975	1:10,000	77	✓		✓		✓
Namangan, Uzbekistan (USSR)	1976	1:10,000	112	✓		✓	✓	
La Paz, Bolivia	1977	1:10,000	56	✓		✓		✓
Amritsar, India	1979	1:10,000	67	✓		✓	✓	
Topar, Kazakhstan (USSR)	1980	1:10,000	87	✓		✓	✓	
Boulogne-sur-Mer, France	1981	1:10,000	104	✓		✓	✓	✓
Port-au-Prince, Haiti	1983	1:10,000	60	✓		✓		✓
Sidon, Lebanon	1983	1:10,000	84	✓		✓	✓	✓
Frankfurt am Main, Germany	1983	1:10,000	126	✓		✓		✓
Freetown, Sierra Leone	1984	1:10,000	86	✓	✓	✓		✓
Damascus, Syria	1987	1:10,000	82	✓	✓	✓	✓	✓
Gloucester, UK	1989	1:10,000	84	✓	✓	✓	✓	✓
Zaragoza, Spain	1990	1:10,000	67	✓	✓	✓	✓	✓

(continued)

Table 7.1 (continued)

City, Country	Edition year	Scale of Soviet plan	Specification symbols	Zenit-4MT imagery	Zenit-8 imagery	NMO topographic mapping—1:50,000	NMO topographic mapping—1:25,000 or larger	NMO or commercial street plans
Johannesburg, South Africa	1972	1:25,000	72	✓		✓		✓
Halifax/Dartmouth, Canada	1974	1:25,000	95	✓		✓	✓	✓
Canberra, Australia	1981	1:25,000	71	✓		✓		✓
Miami, USA	1984	1:25,000	69	✓	✓	✓	✓	✓

at 1:10,000. It is therefore plausible that existing large-scale city plans would be used as the ‘basic cartographic material’ where these were available, and satellite imagery where they were not. Smaller-scale topographic maps may then have provided a useful source of supplementary data. Typically, extant large-scale city plans at the time each Soviet plan was produced were far more limited in detail and symbology than the resulting Soviet plan, indicating the use of the base map as a starting point for the compilation of more detailed information from a myriad of other sources.

For example, at the time that the 1987, 1:10,000 plan of Damascus, Syria was compiled, only a small number of plans of the city had previously been published. A 1:10,000 plan produced by the Syrian Information Office for Tourists in 1954 (Fig. 7.1) is indicative of the type of cartographic material which may have functioned as the base material for the Soviet plan. Oriented to the North West, with no graticule, the 1954 plan clearly shows the city at an earlier stage in its development, with buildings much more generalised than on the Soviet plan, despite the common scale. Although projected development is indicated on the 1954 plan, the newer parts of the city on the Soviet plan extend beyond its predecessor and include more descriptive labels. The classification of roads also differs significantly between the maps. The lack of more recent plans of Damascus together with the up-to-date information on the Soviet plan perhaps point towards a satellite base in this instance. Parry and Perkins [20] refer to an expedition of Soviet geologists to Syria in the late 1950s,

Fig. 7.1 The Qassaa district of Damascus, Syria (left) on the Syrian Information Office for Tourists plan (1954, 1:10,000) (©British Library Board, 53.a.82) and (right) the Soviet plan of Damascus (1987, 1:10,000) (National Library of Australia, nla.obj-234529475). The extracts show a similar extent but are oriented differently

potentially providing a source of information not available in any cartographic or documentary material (Fig. 7.1).

Although discrepancies in detail may be expected between a tourist map and a military plan, it should be noted that extant indigenous military plans rarely incorporated the level of detail found on Soviet plans. Figure 7.2 highlights this with a 1:12,500 plan of Tromsø produced by the British War Office in 1944. The extent of the plan is very similar to the Soviet plan of Tromsø, produced in 1975, affording the possibility that it was photo-mechanically enlarged and used as the base map. A military plan would also have provided information not visible on satellite imagery, such as underwater cables, although relief (contour interval and placement) and hydrographic information have clearly been sourced from elsewhere.

Tracing the source mapping which has potentially been used in the production of another map is more straightforward in locations where few maps of an appropriate scale had been produced previously. At the time of the compilation of the 1:10,000 Soviet plan of La Paz, Bolivia (1977), the largest-scale plan available was a 1:11,000

Fig. 7.2 A strait between Tromsøya island, Norway, and the mainland (left) on a British War Office plan (1944, 1:12,500) (©British Library Board, 35,055.(2.)) and (right) the Soviet plan of Tromsø (1975, 1:10,000) (private collection)

plan produced by cartographic firm La Papelera on behalf of the local authorities in 1972 (Fig. 7.3). If any map were to be used as the base map for the Soviet plan, it is likely that it would this one; with the extents of the plans not invalidating this. However, once again, the lower level of generalisation on the Soviet plan, most clearly with regard to building footprints, illustrates the use of satellite imagery, at least as a supplementary source of information.

In each of these examples, the level of detail and the consequent scope of the symbology used is far greater on the Soviet plan than on the plan indicative of the cartographic material available to be used as a base map. In the context of the analysis conducted in Chap. 6, this indicates that the size of the symbology used on each Soviet plan is unlikely to be a direct consequence of the 'basic cartographic material' selected during the production process outlined in Chap. 2. In addition, discrepancies in symbol counts in this sample are unlikely to be due to a lack of satellite imagery, as all of the plans included were produced after the launch of Zenit-4MT in 1971. We may therefore reason that the most influential factor in the symbol count of a Soviet plan, and its resulting level of topographic detail, is the nature and availability of the secondary, supplementary sources; including sea charts, guide books, directories and topographic maps—rather than the primary base map. The slight trend towards higher symbol counts in more developed, temperate countries, according to HDI data (Fig. 6.26), may simply reflect a larger amount of available supplementary information sources in these locations. As the sources of data used in the city plans have not been the direct focus of this thesis, more detailed research in this area may further increase understanding of the plans and facilitate the explanation of the differing symbol counts presented in Chap. 6.

7.3 Implications for *OpenStreetMap*

The comparison of the Soviet and OSM symbologies highlights the total lack of symbols relating to retail, leisure and tourism on Soviet city plans and the relative lack of symbols on the natural environment on OSM. Therefore, at the most basic level of interpretation, the main means by which these two mapping projects could inform one another would be the expansion of their respective symbologies in order to fill these gaps, thereby increasing the comprehensiveness of both. Clearly, however, the differing foci of these two symbologies is a result of the very different intended context of use of each map, despite the projects' similarities in other respects. The different formats of the maps must also be considered when discussing the implications of the analysis. Original Soviet plans are paper-based products and are therefore physically static, although they may be annotated, overprinted or scanned. The 1978 compilation manual [9: article 2] supports this with the statement that city plans should 'have the capacity, and a graphical and colour design, which may allow more information to be put on the plans, or imprinted on them', although such additions are scarce on known examples of the plans. Conversely, OSM is an inherently more dynamic, digital platform which actively encourages users to alter the map by viewing

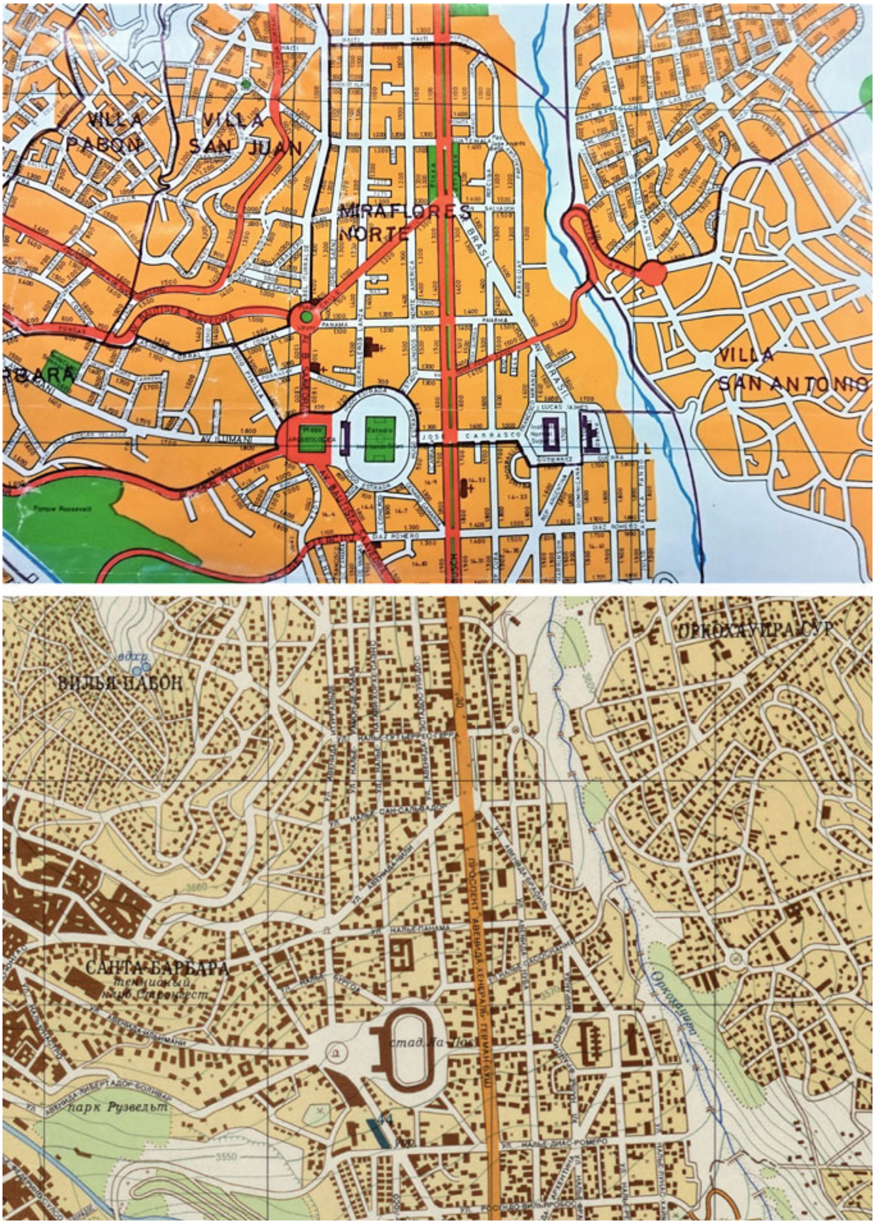

Fig. 7.3 Area around the Estadio Hernando Siles, La Paz, Bolivia: **a** *Plano official de la ciudad de La Paz* (1972, 1:11,000) (©British Library Board, 86,390.(3.)). **b** Soviet plan of La Paz (1977, 1:10,000) (ICGC, RM.165446)

different layers or by editing the map's content. Soviet plans are therefore more likely to have been viewed by their makers as repositories of geographic knowledge, onto which data were added wherever available at the time of compilation. Although OSM performs a similar function as a repository of knowledge, the more fluid nature of the product and its medium means that this repository is continually growing, rather than a 'finished' product. OSM does not set a defined end point for the compilation of information for a particular area, the process is continuous, implying a continual increase in comprehensiveness. Because of this continual growth, it is feasible to perceive scope for the expansion of the OSM symbology, more than that of Soviet city plans, even if the fact that the latter are no longer produced is overlooked.

However, the adoption of a pseudo-representational framework, building on the post-representational position of Kitchin and Dodge [12], adds complexity to this seemingly straightforward differentiation of the nature of Soviet city plans and OSM by its assertion that maps, regardless of the extent of their digital interactivity, are 'remade' each time they are engaged with as the construction of their meaning is deferred to their interpreter and context of interpretation. Through this lens, Soviet maps are just as dynamic as OSM, as an interpreter would bring meaning to them both (via *différance*; [8]) in an identical way. This framework also removes the problematic nature, within a more traditional, progressivist position, of a historical map 'informing' a more modern map, as suggested by the second research objective, as both are continually subject to re-mapping (or being 're-made'; [12]) during each re-contextualisation and thus the relative date of their original compilation becomes largely irrelevant (although knowledge of this context may affect interpretations of the map). Although the transfer of symbols used in one symbology to another may be a narrow application of the results of this analysis, this study more broadly reveals the parallels between the Soviet mapping programme and OSM, in terms of their global ambitions and functions as repositories of knowledge. Both initiatives highlight the possibilities of mapping the world to a standardised specification, even at very large scales, irrespective of socio-cultural, political and physical boundaries with, once again, data availability posing greater problems than the scope of the symbology itself. OSM's open source nature, and its four million map-makers, overcome this issue in a way unimaginable to the relatively small group of Soviet cartographers.

7.4 Context-Specific Challenges of a Global Symbology

Chapter 4, in examining previous analyses of topographic symbologies, highlighted studies which had used the map itself as the basis of their analysis and others which depended on legends or specifications for a complete view of those symbologies. By examining both, this study has been able to identify the differences in the respective findings. Crucially, this approach also renders this analysis compatible with the pseudo-representational position reached in Chap. 3, by not treating symbols on the map and in legends as the same, despite their graphical similarity and identical classification in both parts of the analysis, in order to facilitate meaningful quantitative comparisons. While a legend, which provides descriptions of each graphical element, assumes that each symbol points to a fixed concept or type of feature, the Derridean concept of *différance* allows us to consider the symbol's context (in a legend or map) as vital to the map user's mental construction of meaning. Of course, the surroundings of a symbol on a map, or the description or classification of a symbol in a legend, are all subject to *différance* as well, making this process complex and infinite. In relation to the core findings of this study, this framework allows the view that Soviet symbology specifications and Soviet city plans are distinct texts which, while undoubtedly connected, are able to be interpreted, and interpreted differently, in isolation from one another. This disconnect goes some way towards explaining the variations seen in Chap. 6 between specification symbol counts and those used in the 19-plan sample. If both constituted means of rationalising real landscapes across the globe, as a representational view of maps would advocate, logically these differences would be less evident.

Whereas 'Industry and Communications' is the ninth largest First-Level feature class in the 1:10,000 specification, the fact that the sample of city plans uses the joint-highest proportion of these symbols reflects the plans' intended function of facilitating the 'execution of measures significant for the national economy and for defence' [9: 1]. Correspondingly, classes which are more distant from the accomplishment of this purpose are less prevalent on the maps. A map series is no more required to use all symbols in a symbology than a text is required to use all words in a dictionary. The symbology specifications can, however, conceivably be used to gain an understanding of the Soviet ideal for the series, while the maps indicate the extent to which this ideal was achieved. The differences between the Soviet symbols in the specifications and on the city plans are likely to be reflective of the practical limitations encountered by the Soviet cartographers during the production of the series.

The compilation manual for city plans, discussed in Chap. 2, is clear that secondary cartographic materials and other secondary sources played an important role in the production of the city plans, with large quantities of information extracted, frequently placed in the requisite record file and subsequently included on the appropriate city plan. Therefore, the notion that city plan content will vary, according to the quality and quantity of secondary information available, is supported by the differences in Chap. 6 seen between different city plans of the same scale, but of contrasting locations; geographically, socio-culturally and environmentally. Illustrating this, one of the most surprising findings of Chap. 6 is the identification of only five symbols common to all 19 city plans in the sample. With a vast, 630-symbol symbology available, the size of this basic core of common symbols seems disproportionately small and may be viewed as a falling-short of the ideal topographic series alluded to by the symbology specifications. Furthermore, a small majority of symbols in the Soviet specifications (52.1%) are unused in the city plan sample analysed here. In these ways, practical limitations caused by the relatively poor availability of adequate source materials for some areas appear to have manifested themselves on the maps.

In essence, the 'ideal' symbology needed to have been reassessed and significantly reduced in order to be usable in the context of a real map series.

Supporting this notion is the significant number of 'additional symbols' highlighted by the analysis of the city plan sample. Although these symbols add to the total symbol counts, they should in no way be considered as increasing the symbology's comprehensiveness in order to express more detail on the plans than the unaltered specification symbology would facilitate; rather, the opposite is the case. Chapter 6 finds that a majority of these additional symbols are generic alternatives to symbols in the specifications which would have required the acquisition of more detailed information about particular features than that which was available. It is in this way that the 'saxaul', 'bamboo thickets' and 'palm groves' in the 'ideal' symbology give way on the map to a green fill simply denoting vegetation. Likewise, lifting and sliding metal bridges and pontoon bridges on floating rafts are far less common than a generic bridge. The possibility of creating ever-increasing subsets of symbologies gives way to the practicality of mapping at such a level of detail, particularly when source mapping adopts a more generic symbolisation of features (as discussed earlier in this chapter) and recognising the minute, identifying features of, for example, vegetation, is not possible using the satellite imagery available at the time. Conceptually, vastly comprehensive topographic symbologies are possible. In practice, applying this comprehensiveness to real landscapes around the globe would have required an even larger input of resources than that of the most ambitious mapping programme of the twentieth century.

7.5 The Enduring Versatility of Soviet Mapping

Chapter 3 concluded that, despite the dissolution of the Soviet Union and the consequent redundancy of the original purpose of its vast map output, the maps may still be encountered and re-engaged with in new contexts in order to serve new purposes, far removed from their initial *raison d'etre*. As highlighted by Chap. 6, the symbology of Soviet city plans from the satellite era is hugely complex and comprehensive and, particularly with regard to physical geography, can incorporate more topographic detail than the equivalent *OpenStreetMap* (OSM) layer. This is well-illustrated by the revelation that 84 graphical symbols relating to 'Hydrography and Coasts' are available for use on 1:10,000 Soviet military city plans, whereas only four appear in the Standard Layer OSM symbology. The equivalent figures for 'Relief and Geomorphology' (50 and 8) and 'Vegetation and Soils' (80 and 17) also support this conclusion. These results would suggest that future contexts in which Soviet cartography may be useful may include any application which requires a large amount of topographic detail, especially detail regarding natural features. Evidence of this already exists in the limited range of applications of Soviet map data which have already taken place, although few of these utilise the full extent of the comprehensive symbology of the maps and consequently there remains scope for a greater number of applications including those which require much more wide-ranging topographic data.

Just as the current dissemination of Soviet cartography around the world was not foreseeable in the maps' original context, it is not possible to foresee all of the possible future applications of the maps. Rather, this section focusses on an application of Soviet maps which has received little attention—use of detailed topographic data in humanitarian response situations—and suggests that Soviet maps, including city plans, could find new uses in such settings. Geographical data are vital in several stages of the response to a humanitarian crisis, such as a natural disaster; for example, assessing damage to infrastructure, locating victims, distributing aid and transporting medical personnel. Such data, in order for them to be of practical use, must be of an appropriately large scale and contain sufficient topographic detail to convey the complexity of the local geography during a humanitarian event or in its aftermath. Where such incidents take place in less industrialised areas, existing maps, such as those produced by NMOs or tourism agencies, often fail to include the necessary data for these activities to be carried out effectively. Kent [10] highlights a lack of such information and mapping in the aftermath of the 7.0 magnitude earthquake in Haiti in January 2010, but gives an account of the Global Earth Observation Catastrophe Assessment Network (GEO-CAN) initiative by *ImageCat*, which coordinated 600 expert volunteers in the assessment of building damage from specially-released high resolution satellite imagery, divided into grid squares.

The reliance of this process on remote sensing data means that this data can be collected by volunteers around the world, regardless of their remoteness from the location of the disaster, provided that they have an internet connection. In total, 90,000 destroyed or heavily-damaged buildings were identified, with this information subsequently used to create damage maps. However, Kent [10: 43] notes that while satellite imagery provides a useful source of land cover data, it does not provide an interpretation of the landscape or any land or building use information which can be provided on a map. Concurrently, *Google*, *DigitalGlobe* and *GeoEye* released high resolution satellite imagery within 24 hours of the earthquake. This enabled volunteers in the OSM community to remotely digitise affected areas of the country, notably Port-au-Prince, and quickly populate the previously sparse OSM coverage of the country. These data were then supplemented by GPS traces recorded by volunteers on the ground in Haiti [28: 19]. Subsequently, the usefulness of up-to-date topographic maps in humanitarian applications has become well-recognised and has led to the establishment of several non-governmental initiatives, such as *MapAction*, *Missing Maps* and the *Humanitarian OpenStreetMap Team* (HOT). Each of these initiatives coordinates volunteers in the execution of various remote tasks which contribute to the compilation of data on OSM. According to Albuquerque et al. [7: 3], these crowdsourced tasks vary in complexity from simple classification, through to digitisation and more advanced conflation tasks, although the process more generally could benefit from greater automation of creating and assigning tasks to volunteers. Addressing some of the data quality risks associated with using data from non-specialist volunteers, *MapAction* solely uses expert volunteers and provides additional training. While crowdsourced data collection is a vital part of the humanitarian map-making process, effective visualisation and symbology is also key; a particular challenge given the dynamic nature of the areas in question [18: 1243].

OSM incorporates a 'humanitarian' map style, developed by the HOT, which displays OSM mapping in pale colours, facilitating printing and annotation in the field.

7.5.1 Applying Soviet Map Data in Humanitarian Contexts

The potential use of Soviet maps in humanitarian contexts is two-fold. In some parts of the world, such as those with less indigenous mapping (see Sect. 7.2.1), the data included on Soviet maps remains among the best available sources of topographic data, even several decades after their compilation. In addition, Soviet maps often provide a much more comprehensive impression of terrain and land use than other global maps available online (see Figs. 7.6, 7.7 and 7.8), as the analysis presented in Chap. 6 highlighted in relation to OSM. The recent use of Soviet elevation data for military purposes in Iraq and Afghanistan, and their use elsewhere for resource management [4, 26, 27] exemplifies this continuing relevance (see Chap. 1 and Table 7.2). In light of this, Soviet maps may provide a useful supplementary source of data in the compilation of topographic or reference maps of affected areas, in addition to the sources already being used by humanitarian mapping agencies. For example, while *MapAction* uses global Digital Elevation Models (DEMs) such as ASTER and the 90 m DEM provided by the Consortium for Spatial Information [17], the use of Soviet data, including those already digitised (see Fig. 7.4) as a supplementary source of information may provide additional interpretation of the characteristics of smaller terrain features which may be helpful in the field. Similarly, in identifying land use, *MapAction*'s core sources includes uninterpreted Moderate Resolution Imaging Spectroradiometer (MODIS) and European Space Agency *GlobCover* land cover data, in addition to OSM (ibid.). The clear classification of buildings on Soviet city plans, in addition to these sources, may provide an insight into the functions of different parts of the city (i.e. residential areas, industrial plants, transport hubs etc.). *MapAction*'s use of free *Natural Earth* data at 1:10,000,000, 1:50,000,000 and 1:110,000,000 may also be usefully supplemented by Soviet mapping at much larger scales, including city plans. The annotations included on Soviet maps should also not be overlooked. Assessments of transport infrastructure or logistics planning may benefit from information such as, for example, bridge loading capacities, tunnel height clearances and river flow directions (see Fig. 7.5). Where overview maps are required, showing the basic layout and features of an entire region or country, Soviet topographic maps at smaller scales may be a useful data source. Whereas the Soviet city plan series only covers urban areas and their surroundings, Soviet topographic coverage extends into rural areas worldwide and potential provides useful coverage of less accessible areas (Fig. 7.8). While it is acknowledged that Soviet maps by no means include all of the data necessary to respond to a humanitarian crisis, adding this resource to the range of sources already available may be useful in some cases. In this process, consideration must be given to the compilation date of the relevant Soviet map and whether this may reduce its usefulness in particular contexts, as some data will become outdated more quickly than others. With this in mind, in many cases

Soviet data may best be used for additional guidance, rather than accepted as a definitive data source for a particular area. Soviet data are likely to be of the most use in the examination of features which by their nature evolve at a slower pace than others (for example, hydrology and relief rather than infrastructure and urban extents).

Secondly, the design and presentation of data on Soviet maps could, in some respects be used as a model for the visualisation of data on humanitarian crisis maps. While the strong colours used on Soviet city plans are not ideally suited to extensive field annotation, the plans do exemplify the possibility of displaying large quantities of detailed data in a static, paper format; mirroring a common medium of crisis maps. The extensive use of variants of graphical symbols to denote variants of geographical features avoids the need for widespread textual annotations. While this is advantageous in multi-lingual environments, it also increases the space on

Table 7.2 A summary of previous applications of Soviet map data, although there remains scope for even greater use of the maps within each category

Type of application	Nature of activity	Examples of previous use
Military	• Strategic planning and management of conflict areas using detailed topographic data	• UN use of Soviet mapping of terrain in Afghanistan and Iraq [4: 134–137]
Resources management	• Identification of historical natural or human features, or current features where more recent data are unavailable	• Identification of artesian wells in Armenia [4: 135] • USGS [27] use of Soviet geological maps to identify gold, copper, mercury and iron deposits in Afghanistan
Environmental impact assessment (EIA)	• Vectorisation of Soviet map data to enable its use as an additional source in a GIS alongside modern data	• Lee [15] use of digitised Soviet contour data to create high resolution digital elevation models (DEMs) • LandInfo [13] vectorisation of Soviet road and contour data for commercial sale (see Fig. 7.4)
Archaeology	• Identification of geomorphological or human features which are scarcely recorded elsewhere	• Rondelli et al. [24] and Mantellini [16] use of Soviet topographic maps to identify sites of archaeological interest in Uzbekistan
Historical study	• Addition of Soviet maps to other historical sources in historical accounts of particular locations	• Moore [19] use of Soviet topographic maps and city plans in a historical study of the River Clyde • Times Books [25] use of a Soviet plan of London to contribute to a historical narrative of the city

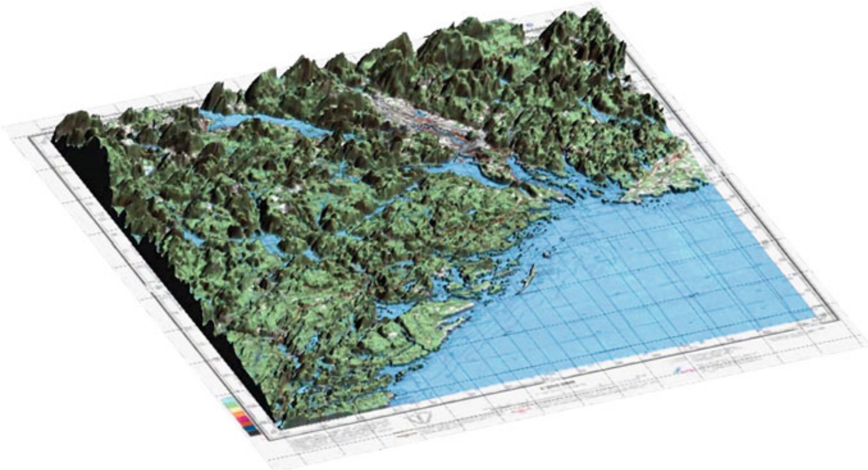

Fig. 7.4 A 1:200,000 Soviet topographic sheet draped over a Digital Elevation Model (DEM) of Norway, derived from Soviet contour data from the same sheet (©LAND INFO Worldwide Mapping LLC, www.landinfo.com)

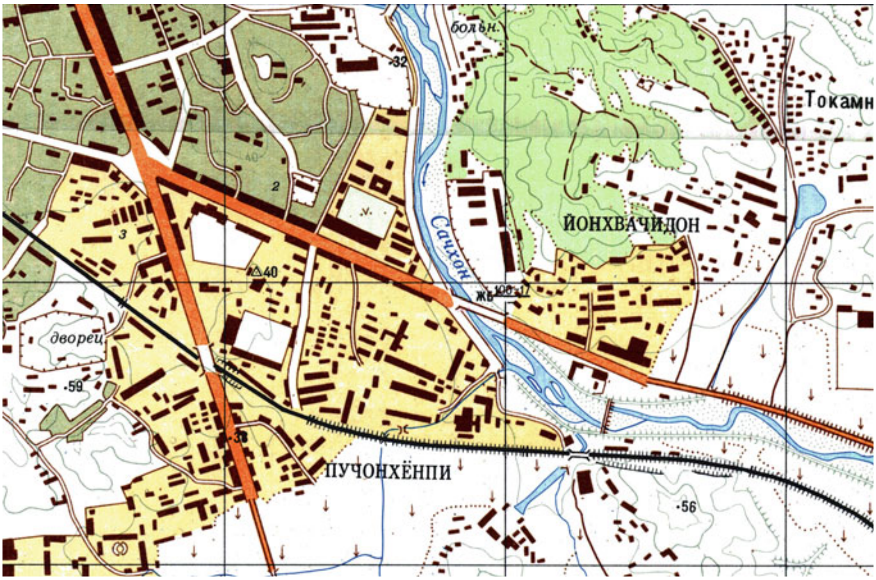

Fig. 7.5 Information of potential value appearing as annotations on the Soviet plan of Kaesong, North Korea (1980, 1:10,000), including the flow direction of the river and the construction material and width clearance of the road bridge (private collection)

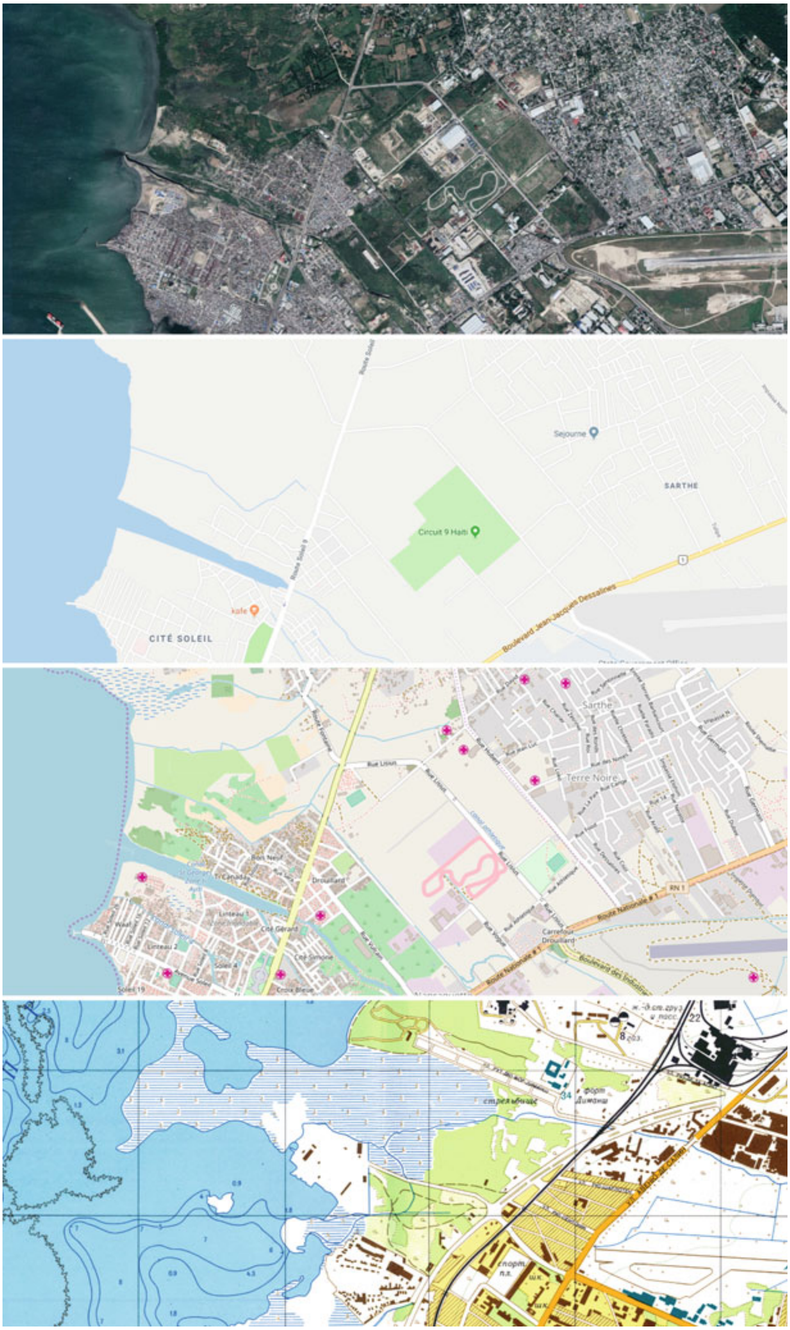

Fig. 7.6 A comparable area of northern Port-au-Prince, Haiti on (top to bottom) satellite imagery (©2018 CNES/Airbus, Maxar Technologies), *Google Maps* (©2018 Google), *OpenStreetMap* standard layer (©2018 OpenStreetMap contributors) and the Soviet plan of Port-au-Prince, Haiti (1983, 1:10,000) (private collection)

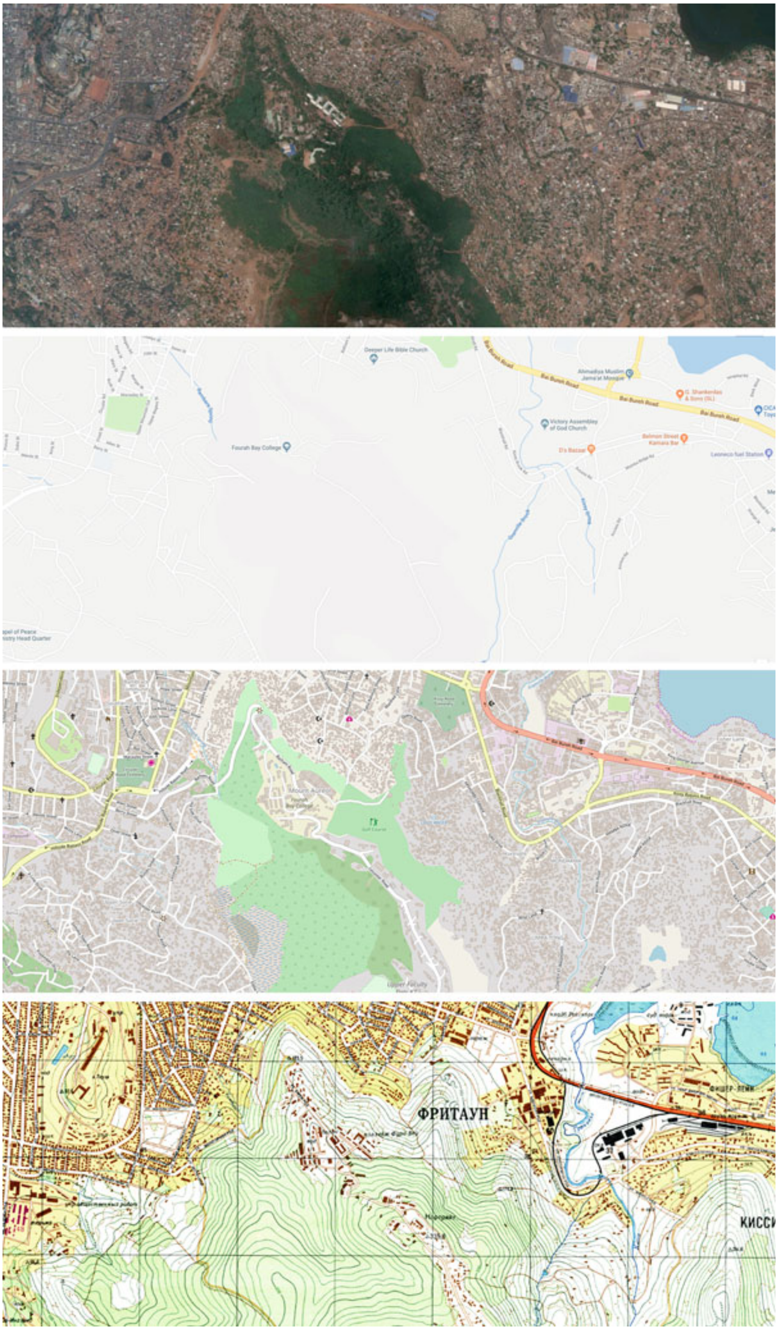

Fig. 7.7 A comparable area of Freetown, Sierra Leone on (top to bottom) satellite imagery (©2018 CNES/Airbus, Maxar Technologies), *Google Maps* (©2018 Google), *OpenStreetMap* standard layer (©2018 OpenStreetMap contributors) and the Soviet plan of Freetown, Sierra Leone (1984, 1:10,000) (private collection)

Fig. 7.8 A comparable area of northern Algeria on (top to bottom) satellite imagery (©2018 TerraMetrics), *Google Maps* (©2018 Google), *OpenStreetMap* standard layer (©2018 OpenStreetMap contributors) and Soviet topographic sheet J-32-XXV (1986, 1:200,000) (courtesy Petro Vlasenko)

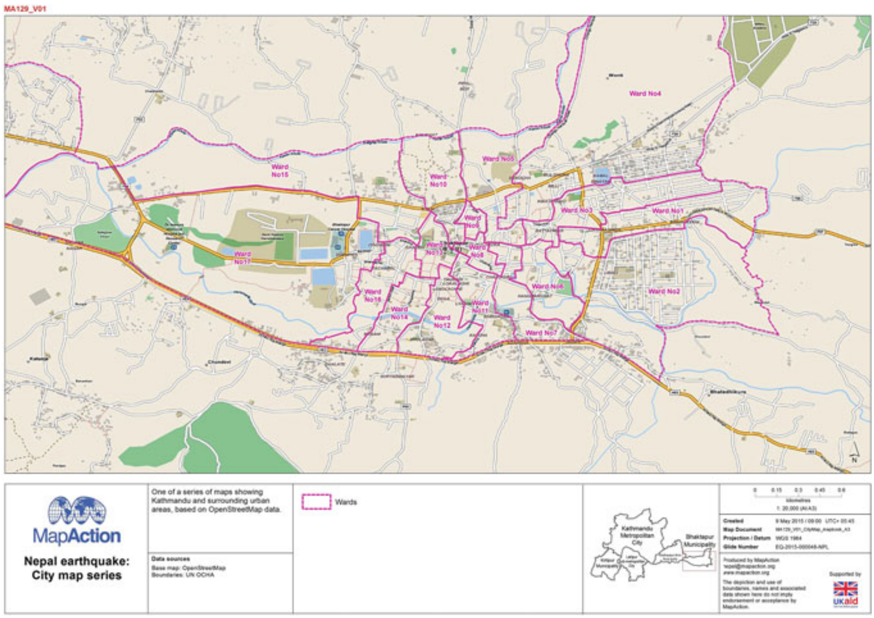

Fig. 7.9 *MapAction* plan of Kathmandu, Nepal (2015, 1:20,000) created from *OpenStreetMap* data in the aftermath of an earthquake (courtesy MapAction, base map ©2015 OpenStreetMap contributors)

the map available for annotation. Text which is used more frequently on Soviet city plans, such as toponymic labels and numerical annotations (e.g. bridge width and carrying capacity), are likely to be of more use in the field. In addition to field annotations, *MapAction* commonly adds thematic layers on top of an *OpenStreetMap* humanitarian style base map, such as information pertinent to the humanitarian event itself, or other useful information, such as the ward boundaries in Fig. 7.9.

While Soviet city plans were designed to incorporate sufficient empty space to add additional information at a later stage [9: article 2], such as the addition of tactical annotations on Soviet plans during the Second World War (see Figs. 1.4 and 2.27), the topographic base map would need to be reduced or supressed to a greater extent in instances where a large amount of thematic data is required. Nonetheless, the design and comprehensive symbology of Soviet city plans would be best suited to topographic reference maps and highlight that a paper map can be sufficient for this purpose. Where the communication of large amounts of data is paramount, a Soviet-style model may facilitate this more effectively than some existing crisis mapping models, as a comparison of *MapAction* and Soviet plans of Kathmandu, Nepal demonstrates (see Figs. 7.9 and 7.10). In practical terms, this may be achieved by incorporating Soviet mapping as a layer in online portals used during relief efforts, such as the *ImageCat Virtual Disaster Viewer*.

Fig. 7.10 Extract from the Soviet plan of Kathmandu, Nepal (1979, 1:10,000) (private collection)

7.5.2 Accessibility of Soviet Mapping for Humanitarian Applications

Any application of Soviet city plans is dependent upon access to the maps. Payne et al. [22] highlight that the use of VGI in humanitarian contexts is only possible due to the availability of easy-to-use online and mobile tools for sharing and creating data. Numerous public and university libraries around the world have acquired stocks of Soviet city plans since they became commercially available in 1993, although only two provide high resolution raster images of the maps via an online portal (Institut Cartogràfic i Geològic de Catalunya and National Library of Australia) and there is currently no free-to-use online portal offering Soviet-derived vectorised data. Table 7.3 represents the largest holdings globally, excluding private collections and those within the Russian Federation. For the purposes of this list, no distinction is made between original sheets, facsimiles or public or private digital image files, as these distinctions are infrequently made in library catalogues. This information is based on information retrieved from online library catalogues (where available) or personal correspondence with representatives from 71 institutions between September 2014 and June 2015 and may not be exhaustive. Holdings of Soviet city plans could be identified in 40 of these institutions.

Despite the institutions listed in Table 7.3 acquiring variably-sized collections of the maps, a poor understanding of the maps' *raison d'être* and organisational context, in addition to the difficulties inherent in deciphering information given on the sheets due to the language and alphabet barrier for some cataloguers, can hinder access for

Table 7.3 Summary of global public holdings of Soviet city plans, indicating the number of plans and sheets held by each institution

Institution	Country	Plans	Sheets
Library of Congress	USA	838	1,375
University of Chicago	USA	441	789
Latvijas Nacionālā bibliotēka (National Library)	Latvia	259	455
Harvard University	USA	230	402
Canterbury Christ Church University	UK	210	444
Cornell University	USA	140	242
British Library	UK	131	266
University of Cambridge	UK	124	244
University of Georgia	USA	105	209
National Library of Australia	Australia	105	205
Institut Cartogràfic i Geològic de Catalunya (ICGC)	Spain	63	138
University of California (Berkeley)	USA	59	143
Universiteit Utrecht	the Netherlands	35	83
University of Utah	USA	34	58
University of Oxford (Bodleian Library)	UK	30	57
UCLA Research Library	USA	28	33
University of Texas	USA	24	43
Zentralbibliothek Zürich	Switzerland	18	44
University of California (Davis)	USA	14	43
Stanford University (Earth Sciences Library)	USA	14	28
University of Manchester	UK	11	27
Library and Archives Canada	Canada	9	19
Kungliga biblioteket (National Library)	Sweden	8	13
Maa-amet Eesti (Estonian Land Board)	Estonia	7	19
University of Melbourne	Australia	7	15
ETH Zürich	Switzerland	6	14
National Library of Scotland	UK	6	11
National Library of Wales	UK	6	10
University of Liverpool	UK	5	11
New York Public Library	USA	4	11
University of Michigan	USA	3	14
University of Oregon	USA	3	9
University of Portsmouth	UK	3	8
Trinity College Dublin	Ireland	3	6
Danish Royal Library	Denmark	3	5

(continued)

Table 7.3 (continued)

Institution	Country	Plans	Sheets
Alexander Turnbull Library	New Zealand	3	5
Penn State University	USA	2	5
Kansalliskirjasto (National Library)	Finland	1	6
University of Toronto	Canada	1	1
Eesti Rahvusraamatukogu (National Library)	Estonia	1	1

As some city plans span multiple sheets, the quantity of sheets is greater

potential users. The extent of holdings in an institution is often hard to establish via online library catalogues due to inter-institutional differences in approaches and policies regarding transliteration, the use of Cyrillic characters, dating the plans, and the name of the publisher assigned to the maps. Further impeding access to accurate information about holdings is the inconsistent treatment that exists within library catalogues with regard to all of these elements. Such inter- and intra-institutional discrepancies in cataloguing also hamper many union catalogues, which sometimes include several records for the same plan due to their inconsistent cataloguing. Davis and Kent [5, 6] provide a full account of the nature of common issues when cataloguing Soviet maps and potential methods of adopting a consistent approach. However, increasing usage of Soviet city plans in humanitarian settings is unlikely without its incorporation in online portals, such as existing services (for example, the *ImageCat Virtual Disaster Viewer*) or new portal, such as those described by Payne et al. [22].

In summary, it has been contended that the detailed and systematic analysis of the Soviet city plan symbology summarised in Chap. 6, together with the information regarding the scope of the project outlined in Chap. 2, provides a useful starting point for future applications of the maps by promoting a fuller understanding of their precise nature and content, in addition to the variations which exist across the globe; a key aim of the research. However, dissimilarities between the Soviet symbol specifications and Soviet maps have also been identified, with the latter proving considerably less comprehensive (47.9% of specification symbols are used in the sample of maps) reinforcing the importance of distinguishing analyses of these separate texts in any analysis of topographic symbologies. This finding also highlights the difficulty of applying a standardised symbology across the globe without a consistent availability of base data, with Table 7.1 indicating the inconsistency of source material available across the map sample, which may partially help to explain the significant differences in the size of the symbology used on each plan (see Fig. 6.16). However, the comparative analysis of Soviet and *OpenStreetMap* (OSM) symbologies has served to emphasise the areas in which the two may supplement one another in contemporary applications, with humanitarian crisis mapping identified as a potential field in which Soviet mapping may prove valuable. Soviet data regarding natural features has been considered of particular potential value while, on a broader level, the convergence of Soviet maps and OSM as standardised repositories of available knowledge of the globe renders the former a useful precedent for the communication of large amounts of topographic data. Notwithstanding this, accessibility issues must be addressed if the potential value of Soviet mapping is to be fully realised.

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Chapter 8
Conclusion

As initially outlined in the Introduction, the overall aim of this thesis is threefold; firstly, to comprehensively set out the scope of the Soviet military city plan series in detail; secondly, to frame the series within an epistemological context within cartography, and; thirdly, to understand the nature and application of its symbology through an empirical analysis, helping to facilitate future applications of the maps. These components serve to evidence the enduring relevance and value of the maps in current and future mapping initiatives. More specifically, this aim was to be explored by conducting an analysis based on addressing two principal objectives:

- **To examine the extent to which the symbology of Soviet military city plans was successfully implemented across a variety of socio-cultural and physical environments across the globe.**
- **To explore the extent to which the symbology of Soviet military city plans can inform and supplement the global, standardised symbology of OpenStreetMap (OSM); successfully transcending socio-cultural, political and physical boundaries.**

This final chapter summarises the work that has been carried out to this end and outlines the major findings which have consequently emerged. It then sets out potential directions in which future research may proceed, using these findings as the point of departure.

8.1 An Outline of the Research

Chapter 1 traced the history of cartography in Russia and, in doing so, identified three historical traits which were inherited by the Soviet mapping programme; state control, censorship of public information and a continual drive towards producing more accurate and precise geographical data. These characteristics remained apparent in Chap. 2 which concentrated its focus on the Soviet military city plan series. The

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compilation of a list of the plans which are known to exist and have been acquired by libraries and research institutions across the globe provided an initial insight into the scope and coverage of the series, as well as highlighting key production trends; in particular the substantial growth in production after the launch of Zenit-4MT in 1971—the USSR's first of two satellites designed to provide data for military cartography. It is hoped that the detailed explanations of the content and layout of city plan sheets will serve as a practical aid to future users of these maps [2, 3]. An original translation of material from the 1978 compilation manual for city plans provided the basis for an outline of the maps' production process, shedding light on their originally intended purpose and the potential nature of the source materials used.

Chapter 3 used Brian Harley's landmark paper, 'Deconstructing the Map' [6], as a springboard for discussing the potential of the post-structuralist deconstruction tactics of Jacques Derrida to challenge the way in which we view maps as texts which hold meaning. The conclusions drawn hold much in common with the post-representational paradigm adopted by Kitchin and Dodge [9] in that maps are 're-made' each time they are engaged with and therefore cannot refer directly to the landscape which they purport to represent. However, heeding the warning of Pacione [10: 6] that 'in terms of real-world problems, postmodern thought would condemn us to inaction while we reflect on the nature of the issue', Chap. 3 concluded that a total severance of the map-reality link would be unhelpful in practical contexts, given the enduring perception of this link by map users. A 'pseudo-representational' stance was therefore adopted, with Soviet city plans providing an ideal illustration of how Derrida's concepts of *différance* [4] and absolute absence [5] allow maps to be re-contextualised and reused for new practical purposes, despite the total dissolution of their original purpose and author.

Based on this epistemology, Chaps. 4 and 5 construct a methodology which re-contextualises the uniquely extensive symbology of Soviet military city plans in order that it may inform modern cartographic practices. Given the series' success in implementing a standardised symbology across diverse socio-cultural and physical environments, exploring the extent of this application in more detail was the focus given to the research objectives, which progressed from a solely historical focus in order to highlight potential parallels between the Soviet mapping programme and *OpenStreetMap* (OSM) which, despite its very different function, mode of production and medium of dissemination, is similar in terms of its aspiration for global coverage and completeness.

Building on a small number of previous methodologies for analysing topographic symbologies, notably [1, 7, 11], Chap. 6 presents the Soviet city plan symbology, according to *Conventional Signs* specifications in a typology which is then compared with the actual application of the symbology on 19 geographically-diverse city plans. The analysis highlights the uneven and inconsistent application of symbology across the sample, in addition to a slight tendency for plans of temperate cities in highly-developed countries (according to HDI data) to exhibit a greater proportion of the symbology (0.341 positive correlation between HDI and 1:10,000 symbology). In total, 630 graphical symbols were identified across the symbology, with 252 for use at 1:10,000 only, 104 for use at 1:25,000 only and 274 for use at either scale. At both scales, natural features comprised the largest elements of the symbology, with ‘Hydrography and Coasts’ emerging as the largest First-Level feature class at 1:10,000 (84 symbols) and ‘Vegetation and Soils’ the largest at 1:25,000 (66 symbols). However, the analysis also revealed key differences between the relative prominence of particular feature classes in the symbology specifications and in the sample of maps itself. For example, while ‘Hydrography and Coasts’ is the largest First-Level feature class in the 1:25,000 specification, ‘Industry and Communications’ is the larger in the sample of 1:25,000 plans included in the analysis. The use of only 47.9% of the total symbols in the specifications on the 19 plans analysed suggests that, while the plans are undoubtedly rich in topographic detail, their symbology was designed with an even greater degree of comprehensiveness in mind; only five symbols (0.79%) are used on every plan in the sample, highlighting the importance of distinguishing methodologies which analyse either specifications or maps. The comparison of the symbology with OSM, both in the context of specification documents and in their coverage of Frankfurt am Main, Germany, highlighted the Soviet plans’ unparalleled inclusion of relief (50 1:10,000 Soviet specification symbols to eight OSM symbols) and hydrographic data (84 1:10,000 Soviet specification symbols to four OSM symbols), whereas the largest OSM specification feature classes concern service sector facilities—‘Retail and Restaurants’ (64 symbols) and ‘Leisure, Tourism and Public Services’ (54 symbols)—reflecting the diverse purposes of the maps.

In order to more holistically assess what the empirical results of Chap. 6 allow us to understand about Soviet military city plans, Chap. 7 juxtaposed map extracts from the sample against examples of maps which may have been used as the base map for compiling the plans (during the process outlined in Chap. 2). The significantly smaller symbology employed on these pre-existing maps, together with the likelihood that Zenit-4MT imagery was available during the production of all of the plans in the sample, led to the conclusion that the secondary, supplementary materials available for each city are likely to most significantly influence the extent of the symbology used on the final city plan. The supposition that such materials would have been more plentiful for developed cities provides an explanation for the trends regarding symbol counts, HDI and climate identified in Chap. 6; a slight tendency for higher symbol counts in more-developed cities (correlation of 0.341) and temperate climates. Chapter 7 also uses the detailed analysis presented in Chap. 6, particularly the commonalities and differences between the Soviet and OSM symbologies, as a basis for suggesting potential applications of Soviet mapping as a supplementary resource. In the particular context of humanitarian crisis mapping, it was firstly suggested that Soviet city plans and topographic maps have potential to be used as an additional source of topographic data, especially in parts of the world where few alternative sources of topographic data are available. The maps may be a particularly useful source of data on natural features, as these features represent the largest proportion of the symbology. Secondly, the maps have potential to be used as a model for presenting large amounts of topographic data in a static paper format. In crisis response situations, paper maps are often favoured due to their continued usability in areas without electricity or internet connections and their ease of annotation with field data and notes. An adapted Soviet city plan symbology may provide a useful balance between including comprehensive topographic data while able to be presented in this format.

Overall, these findings support the notion that the Soviet military city plan series was a remarkably extensive project, both in terms of geographic coverage and symbology. Nonetheless, it has become apparent that the series' symbology, as found in various editions of *Conventional Signs*, is incompletely and inconsistently applied to the plans, and therefore represents an ideal which was not fully achievable using the source data which was most often available. Notwithstanding this, this research has shed light on the scope of these maps' content and symbology which, facilitated by its epistemological discourse, have potential to be applied to countless future applications; some of which have been considered here.

8.2 Directions of Future Research

Given the theoretical stance adopted by this study, it would be counter-intuitive to highlight a finite selection of potential avenues of future research. Rather, this section gives examples building on the work carried out here, recognising that, as the maps continue to be re-contextualised, new applications will emerge. The historical narrative presented in Chap. 1 focuses on cartographic endeavours throughout Russian and Soviet history. It should not be overlooked that the cartographic history of the world's largest country may illumine broader historical and political discussions, which have yet to recognise the unprecedented nature of Russia's cartographic efforts and the scale of the resources required to bring these to fruition. Within the more specific context of Soviet military city plans, it is recognised that this study focusses largely on those maps which were produced at the zenith of the Soviet global mapping programme, in the age of satellite imagery. A broader analysis incorporating a wider temporal range may reveal more about the evolution of the programme over time and, from a more technological perspective, the more specific impacts of the advent of satellite imagery on cartographic practices during the second half of the twentieth century. A broader temporal context would also pave the way for further analyses of symbology, although it may also be possible to focus research on a particular symbol or group of symbols, akin to the work of Bignell [1], in order to trace the development and socio-cultural influences on the portrayal of particular features. While the present study has been primarily concerned with the content and scope of the maps, a more acute focus on design, both at the level of the individual symbol and the application of design principles across the maps as a whole, may yield interesting insights into the cultural influences on such aesthetic judgements, as Kent and Vujakovic [8] explored in the context of smaller-scale European topographic maps. Methodologically, this study's distinction between an analysis of documentary symbology and symbology as presented in the context of a map would be usefully considered in future detailed analyses of cartographic symbology.

8.3 Concluding Remarks: Access and Application

In addition to these avenues of research, Soviet military city plans remain valuable—along with the vast quantities of other Soviet maps, undiscussed in this study—as a source of topographic data in their own right. In many cases, the plans still represent some of the most detailed data available for some geographical locations but, in any case, are a rich resource of data for use in historical geography or archaeological settings. With only a few exceptions, the maps remain a resource which is yet to be utilised in this way. Use of the maps as a model for legibly visualising large quantities of topographic data, particularly in contexts in which static paper maps are the most suitable format, is also an avenue in which there is scope for further exploration. However, application of Soviet maps, such as these, will remain scarce if accessibility to the maps does not improve [2, 3]. A lack of understanding of the maps' metadata, common cataloguing errors and the distribution of the maps across institutions around the globe, mostly in analogue formats, are barriers which must be overcome if the maps are to be used in the ways suggested here.

With its global, multi-scale coverage, detailed symbology and ability to be easily updated, OSM in some ways exemplifies many of the traits which were deemed desirable by the General Staff of the Soviet Union as it embarked on its unprecedented global mapping programme. Exhibiting the themes of Russian cartography identified in Chap. 1—centralised state control, censorship and increasing precision and accuracy—the Soviet mapping of the world differs from OSM on two of these counts, although if online VGI technologies had been available to the Soviet Union during the Cold War, there may have been merit in it pursuing this model. While Chap. 6 highlighted feature classes in which one symbology provides more detail than the other, the digital medium and open source nature of OSM makes it far more accessible to a myriad of uses, while VGI data has far more currency than some of the sources used by Soviet cartographers, which sometimes predated the maps by several decades—in some ways rendering OSM the 'ideal' Soviet map. In the twenty-first century, when the technological limitations and motivations for centralised control and censorship no longer exist, perhaps a fusion of OSM and Soviet mapping may yet yield an ideal standardised map of the world, some 130 years after Albrecht Penck first envisaged the idea of creating one. It is hoped that this initial analysis of Soviet military city plans goes some way towards providing the information and stimuli necessary to facilitate the fulfilment of their untapped potential.

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Glossary

Absolute absence A term used by the post-structuralist Jacques Derrida to refer to the notion that a text continues to function when its author is no longer present in any way.

Absolutism A form of government in which an individual monarch (or tsar) has overall, unrestricted control.

Chief Administration of Geodesy and Cartography (Главное управление геодезии и картографии) ***or*** **GUGK** Soviet organisation responsible for domestic survey and the production of maps for non-military functions.

Conformal projection A type of map projection which preserves angles.

Deconstruction A name for the discourse regarding the relationship between a signifier and its meaning.

Différance A term used by the post-structuralist Jacques Derrida to refer to the differing and deferral which separates a word from its meanings.

Equal area projection A type of map projection which preserves the relative sizes of areas.

Gauss-Krüger projection A conformal projection used on many Soviet military maps, including city plans. It is similar to Universal Transverse Mercator (UTM) in all respects other than its scale factor of 1, rather than 0.9996.

General Staff (Генеральный штаб) The branch of the Soviet armed forces which oversees its management and administration.

GUGK See *Chief Administration of Geodesy and Cartography.*

Harleian Referring to the work or ideas of the British cartographer Brian Harley (1932–1991).

International Map of the World (IMW) A project instigated by Albrecht Penck in 1891 to create a 1:1,000,000 topographic map of the entire land area of Earth.

Krasovskiy 1940 ellipsoid A coordinate system developed and used by the Soviet Union.

Military Topographic Directorate (Военное топографическое управление) ***or*** **VTU** Division of the Soviet General Staff responsible for the production of military maps.

M. Davis, *A Cartographic Analysis of Soviet Military City Plans*, Springer Theses,
https://doi.org/10.1007/978-3-030-84017-4

Muscovy The state which preceded tsarist Russia. Also known as the Grand Duchy of Moscow.

National Mapping Organisation (NMO) A state body responsible for creating official maps of a particular country.

Ontogenetic Developing from a point of origin.

Ontology A field of study concerned with the nature of something's being or existence, especially when this is fixed, or real.

Ontic knowledge Knowledge about a real or visible entity, as opposed to knowledge regarding the nature of its being.

OpenStreetMap (OSM) An open source online map of the world founded in 2004.

Petrine Referring to the reign of Peter the Great, tsar of Russia between 1682 and 1725.

Post-representational cartography A school of thought which considers maps to be more than simple reflections of the landscape they purport to represent.

Pseudo-representational cartography A term used to recognise the complex, non-representational relationships between people, symbols and landscapes while also acknowledging a practical need to preserve a de facto link between the landscape and the map in order for cartography to function.

Representation The idea that a sign is connected to something else and takes its place within a particular context (e.g. a map).

SK-42 See *Krasovskiy 1940 ellipsoid*.

Soviet Union *or* Union of Soviet Socialist Republics (USSR) A centralised federation of republics which existed as a unified sovereign state between 1922 and 1991.

***Spravka*(справка)** A reference text accompanying Soviet military city plans which describes aspects of the mapped city.

Symbology The sum of the graphical devices used to denote features on a map, or series of maps.

Transduction A process discussed by Kitchin and Dodge (2007) which allows encounters with maps to inform and influence future encounters.

VTU See *Military Topographic Directorate*.

Warsaw Pact A defence treaty between the Soviet Union and its close allies, signed in 1955.

Zenit A series of reconnaissance satellites launched by the Soviet Union in 1961 and decommissioned in 1994.