

Nowak, Tadeusz

Studies of the history of military technologu in Poland

Kwartalnik Historii Nauki i Techniki 25/4, 721-730

1980

Artykuł umieszczony jest w kolekcji cyfrowej Bazhum, gromadzącej zawartość polskich czasopism humanistycznych i społecznych tworzonej przez Muzeum Historii Polski w ramach prac podejmowanych na rzecz zapewnienia otwartego, powszechnego i trwałego dostępu do polskiego dorobku naukowego i kulturalnego.

Artykuł został zdigitalizowany i opracowany do udostępnienia w internecie ze środków specjalnych MNiSW dzięki Wydziałowi Historycznemu Uniwersytetu Warszawskiego.

Tekst jest udostępniony do wykorzystania w ramach dozwolonego użytku.



Tadeusz Marian Nowak
(Warsaw)

STUDIES OF THE HISTORY OF MILITARY TECHNOLOGY IN POLAND

Studies of the military technology occupy a special place among those of the history of technology. This is due to the fact that military technology covers many areas which correspond to various fields of "civilian" technology. And yet it remains a separate sphere because of its purpose and its specific development which is usually closely supported by the State authority.

So the history of military technology is a branch of the history of technology and at the same time it is also part of military science. That is why the history of military technology is closely connected with other sections of history. These connections are a reflection of those, of a feedback character, which exist between the development of military technology and the phenomena taking place in other spheres of life.

The military technology of the past used to be linked to such branches of technology as: geodesy and cartography, land and water engineering, architecture and town-planning, technical mechanics and machine construction, mining, metallurgy, founding of metals, and technical chemistry. It was also closely linked to the economic and social history of the country, as well as to mathematical, natural and technical sciences, and even to the history of art. Finally, the history of military technology, being part of military history, is there by directly connected with other parts of that history and first of all with the history of wars and the art of war, both concerned with the methods of warfare.

All these links can be taken account of only in wide-ranging complex studies; the fact is however that the individual works written so far have been discussing only some of them.

A programme of complex studies includes following requirements: 1) in dealing with particular subjects, especially with the whole history of Polish military technology, it is necessary to do it against the background of the European military technology at the given period; this is essential in view of the intensity with which elements of this kind of technology penetrate from one country to another; 2) it is also necessary to show the conditions prevailing in a country in which military technology was developing at the given time; these were determined, on the one hand, by the military and political situation of the country, and, on the other, by the country's

possibilities resulting from its social, economic and political relationships and circumstances; to be more specific, what mattered was the supply of rawmaterials, the existence and equipment of factories, the existence of craftsmen and the degree of their skill, and in later periods the state of science necessary for the production in various branches of military technology; 3) then there is the necessity of presenting the military technology of the past as a development of material means for warfare, of the knowledge of their production and then of their handling; so a historical description of these means should include the data on: a) the technology of their construction, as well as on their constructors, b) on the technology of their production with the description of their direct producers and production workshops; c) on the technology of their application or use, while also showing the people who used them.

In order to give a picture of the development of Polish military technology in the past a scheme has been drawn including the following **periods** and subperiods:

Period I — from the first mentions about the Polish State and its warriors in the second half of the 10th century to the loss of independence by Poland in 1795.

Subperiod I — from the middle of the 10th c. to the early 12th c. — includes the appearance and evolution of armements consisting of a spear, sword, axe, bow and the first heavy throwing machines, of a helmet, flexible cuirass and a shield; castles were built and continuous fortifications, both of timber and earth.

Subperiod II — from the early 12th c. to the middle of the 14th c. — includes the appearance and wide use of hand-arbalasts; the development of two kinds of heavy throwing machines: big arbalasts and machines with counter weight; beginnings of stone fortifications.

Subperiod III — from the middle of the 14th c. to the middle of the 15th c. — includes the appearance and evolution of stiff armour plates; appearance and initial evolution of fire artillery and hand fire-arms; development of stone or brick castles and of medieval type towns; development of military engineering (boat-bridges, earth siege works); building of a navy (that of the city of Gdańsk and Elbląg).

Subperiod IV — from the middle of the 15th c. to the middle of the 16th c. — includes a complete replacement in infantry of arbalasts by fire-arms, development of fortress, siege and field artillery; emergence and evolution of bastion forms in the fortification of towns and castles and in field fortifications (in the building of artillery positions).

Subperiod V — from the middle of the 16th c. to 1632 — includes the gradual disappearance of protective armour; the armement of artillery with long-barrel cannons of the culverin type; the emergence and evolution of bastion fortifications, mainly of the Italian type; development of military engineering in transport (mostly bridges on poles) and in siege operations; emergence and evolution of land-surveying and military cartography; building of ships for the navy; beginnings of the military technological literature.

Subperiod VI — from 1632 to 1763 — includes; complete disappearance of protective armour; uniformity of cannon calibres; armement of artillery with medium-long-barrel cannons of the cortana type; muskets as the typical fire-arms of infantry; development of rocket technology; building of new arsenals; emergence and development of the Dutch type bastion fortifications; improvement of the engineering methods of conducting sieges; the first pontoon park; development of military cartography, the first military cartographical atlas; efflorescence of the military technological literature (A. dell'Aqua, A. Freytag, K. Siemienowicz, J. Naronowicz-Naroński).

Subperiod VII — from 1764 to 1795 — includes: the rearmement of artillery, production of field cannons, howitzers and hand fire-arms of a new type; formation of an army engineering corps and its intensive activities in the improvement of field fortifications, of bridge-building, land-surveying, and military cartography; emergence of technical military schooling; development of military technological literature (J. Jakubowski, J. Bakałowicz).

Period II — from the loss of independence by Poland in 1795 to its recovery in 1918.

Subperiod I — from 1795 to 1814 — covers the times of Polish Legions and of the Duchy of Warsaw — prevalence in the Polish army of foreign equipment, mainly the French and Prussian one; achievements in military fortification and engineering; military technological literature, translated mostly from French.

Subperiod II — from 1814 to 1831 — covers the time of the Polish Kingdom and the November Uprising — prevalence in the Polish army of foreign equipment, mainly the Russian one; experiences in the field of artillery technology; organization of rocket troops, works on engineering and cartography, development of military technological education at the secondary and higher levels; development of military technological literature, translated from Russian and the original Polish one (J. Bem, I. Prądyński).

Subperiod III — from 1832 to 1863 — covers the time of exiles after the November Uprising, their service in foreign armies, as well as their participation in the struggles of the Springtide of Nations both at home and abroad, then the January Uprising; technological problems discussed in the emigré military literature; achievements of the military cartography; technological methods in use during the national uprisings of 1848—1849 and 1863—1864.

Subperiod IV — from 1864 to 1918 covers the time of massive emigration after the fall of the January Uprising and the service of Poles in foreign armies, as well as in Polish troops during the first world war; technological problems in the military literature; foreign equipment in Polish troops during the years 1914—1918.

The sources a historian of military technology makes use of can be divided into the objects of material culture, iconographical and cartographical documents, and written documents. Of special importance are among these the objects of material culture made up practically of two categories of sources: immovable objects — (in the field) — in the shape of ancient fortifi-

cations and other military structures, and movable objects, usually kept at museums, such as armements, and military equipment.

The initial work in the description and utilization of objects of material culture consists in cataloguing them which is done, as regards military objects in the field, partly while taking stock of monuments of art, especially of architecture. In this respect the publications to be taken into account are: *The Catalogue of Art Monuments in Poland (Katalog zabytków sztuki w Polsce)* Issued successively for particular areas of the country by the Section of Art Monuments Inventory in the Institute of Art at the Polish Academy of Science, and *A List of Monuments of Architecture (Spis zabytków architektury i budownictwa. Warsaw 1964)*, issued by the Centre of Monuments Documentation at the Museum Board in the Ministry of Culture and Art). Some production workshops, working in the past for the army, can find themselves on the list of industrial objects, published successively by the Institute for the History of Material Culture at the Polish Academy of Sciences under the title *The Catalogue of Monuments of Industrial Architecture in Poland (Katalog zabytków architektury i budownictwa przemysłowego w Polsce)*. Of special value are the catalogues of defence structures, contained in books discussing particular subjects of the history of fortifications, among others such books as: B. Guerquin: *The Silesian Castles (Zamki śląskie. Warsaw 1957)*, and by the same *The Castles in Poland (Zamki w Polsce. Warsaw 1974)*, J. Widawski: *Town Walls in the Polish State till the early 15th c. (Miejskie mury obronne w państwie polskim do początku XV w. Warsaw 1973)*, and A. Gruszecki: *Bastion Castles in Little Poland (Bastionowe zamki w Małopolsce. Warsaw 1962)*.

Movable objects of material military technology are kept first of all in the Museum of the Polish Army in Warsaw, in the Navy Museum in Gdynia, Museum of Air Force in Cracow, and in 26 regional museums having sections of military collections, among which the leading one is the Czartoryski Museum in Cracow, as well as in 9 archaeological museums and 30 archaeological section in various regional collections. The inventories of these collections have not been so far published in their entirety, but usually as a list of selected objects making up the standing exhibitions or the periodical ones, sometimes also as catalogues of objects belonging to a particular historical period. Rather an exception are, the scientifically most valuable publications of collections on a single theme. An example of such a publication is: M. Grodzicka: *The Ancient Bronze Cannons in Polish Collections (Zabytkowe dzieła spiżowe w zbiorach polskich)* ("Studia i Materiały do Historii Wojskowości" — "Studies and Materials to the History of Army" — quoted further on as SMHW Vol. VI part 2). The problems of collecting, preserving and describing military objects in museums have been discussed in a publication, issued by the Museum of the Polish Army in Warsaw, entitled: *Military Museums (Muzealnictwo Wojskowe. Vol. I—II. Warsaw 1959 and 1964)*.

Iconographical sources to the history of military technology are widely dispersed. Mostly easily available are those which constitute illustrations in printed or manuscript treatises on military technology. Less-known are the iconographical materials kept by themselves in collections of illustrations in

libraries or museums, and the least-known are those buried in archives, attached through their subjects or provenience to archival sections. We have no inventory of iconographical monuments concerning the military technology in Poland; some help in searching for them is provided by the thematical catalogues published so far, e.g. *The Catalogue of Measured Architectural Monuments* (*Katalog pomiarów zabytków architektury i budownictwa*. Warsaw 1967), or by those of particular collections, e.g. *The Catalogue of Drawings in the Collection of Illustrations at the Warsaw University Library* (*Katalog rysunków z gabinetu rycin Biblioteki Uniwersyteckiej w Warszawie*. Part I—II Warsaw 1967 and 1969). Some iconographical material on the history of military technology can also be found in special monothematic publications, e.g. in T. M. Nowak's *The Drawings of Cannons Captured by the Swedes in Poland in the 17th and early 18th centuries* (*Rysunki dział zdobytych przez Szwedów w Polsce w XVII i na początku XVIII w.* SMHW Vol. XX).

It is maps and plans, made for military purposes or containing land elements as part of military technology, which are cartographical sources to the history of military technology. There is no complete inventory of these sources available, yet major maps and some plans are discussed in some books on the history of cartography, among others in K. Buczek's *The History of Polish Cartography from the 15th to 18th cc* (*Dzieje kartografii polskiej od XV do XVIII w.* Warsaw 1963), and especially in B. Olaszewicz's book on the history of military cartography, *The Polish Military Cartography* (*Polska kartografia wojskowa*. Warsaw 1921). In making a detailed search for this material one can make use of the existing catalogues and guides to the cartographical collections, such as *The Central Catalogue of Cartographical Collections in Poland* (*Centralny katalog zbiorów kartograficznych w Polsce*. Book I—IV. Warsaw 1961—1968); *The Cartographical Collections in People's Poland* (*Zbiory kartograficzne w Polskiej Rzeczypospolitej Ludowej*. Warsaw 1972).

In the study of the history of military technology very helpful are written sources, two groups of which are especially important: archival sources and military literature. The first group comprises, in its earlier part, all sorts of inventories of equipment and bills for its production, as well as bills for the construction of military installations, and in its later part — technological documentation relating to these objects. In trying to get to these materials one can avail oneself of the searches relating to the history of the Polish army that have been carried out for many years by the Institute of Military History in archives and collections of manuscripts in libraries. Not many of these sources have been published so far. Some of the inventories and bills have appeared in print as annexes to works on the history of military technology, others in specialist journals, especially in "Studia i Materiały do Historii Wojskowości" ("Studies and Materials to the History of Army").

The other group consists of early military writings, the most important among them being treatises and text-books on artillery, fortifications, engineering, and military cartography, and, as regards the later period — the whole military technological literature, published in books and in articles, as well as military rules and regulations. Polish printed writings on the

military technology, published to 1920 inclusive, and indeed most of them, have been mentioned in the book by K. Daszkiewicz and J. Gąsiorowski: *Polish Military Bibliography (Polska bibliografia wojskowa. Part I. Vol. I—II. Warsaw 1921—1923)*. But the early Polish military technological literature which has been preserved only in manuscripts has not got so far its complete bibliography. Part of it has been dealt with in the works by T. M. Nowak: *A Review of Polish Literature on the Artillery till the Middle of the 17th c. (Przegląd polskiego piśmiennictwa z dziedziny artylerii do połowy XVII w. SMHW Vol. IV)* and *A Review of Polish Literature on Fortifications and Engineering in the 16th — 18th cc (Przegląd polskiego piśmiennictwa z dziedziny fortyfikacji i inżynierii wojskowej w XVI—XVIII w. SMHW Vol. XI. Part II)*.

In the post-war period some important texts of the early Polish literature in this field have been published, and some more are already prepared for publication. Among the former have been issued, based on the manuscripts: the first extensive treatise on artillery written in Polish in c. 1630 by Andrzej dell'Aqua (Wrocław 1969), and the first extensive treatise on fortifications, equally written in Polish in 1659, by Józef Naronowicz-Naroński (Warsaw 1957). Kazimierz Siemienowicz's texts of his book on artillery dating from 1650, have been translated into Polish and published with comments (Warsaw 1963), as has been also Józef Bem's book of 1819 on rockets (Warsaw 1953). Also an anthology of Polish military technological writings of the period from the 16th c. to 1764 has been issued under the title *Source Material to the History of Polish Military Art (Wypisy źródłowe do historii polskiej sztuki wojennej. Book VIII B. Warsaw 1961)*. Among the manuscripts prepared for printing are: the Polish translation by Maciej Strubicz, of 1561, of a treatise by Albrecht Hohenzollern, the Prussian prince, written in 1553 at the request of the king of Poland, Sigismund August, and containing many data on war technology; Józef Naronowicz-Naroński's work on geodesy and cartography, written in 1659 for Polish military engineers; Gen. Ignacy Prądzyński's work on field fortifications, written in 1825, as well as other books.

While speaking about the works on the history of Polish military technology in the two afore-mentioned periods, covering altogether the time-span from the 10th c. to 1918, it must be stated that the Polish historiography does not possess a work which would embrace the whole of this problem, while the existing literature on this subject can be split into four parts: history of armements with a special emphasis put on the history of artillery and rocket technology, history of military engineering and within it especially that of fortifications, history of military cartography, and history of the navy.

The earlier works, trying to cover the whole history of Polish armements and written by W. Dziewanowski: *An Outline of the History of Armements in Poland (Zarys dziejów uzbrojenia w Polsce. Warsaw 1935)*, by B. Gębarzewski: *Armements and the Types of Arms (Uzbrojenie i rodzaje broni in T. Korzon: The History of Wars and Army in Poland (Dzieje wojen i wojskowości w Polsce. Vol. III. Lwów 1923)* have been largely replaced by a new book by Z. Żygulski: *Arms in Ancient Poland Against the Background of Europe's and Middle East's Armements (Broń w dawnej Polsce na tle uzbroje-*

nia Europy i Bliskiego Wschodu. Warsaw 1975), and by a series of works on particular kinds of Polish arms, works including those by A. Nadolski on side-arms (Wrocław 1974), S. Kobielski on fire-arms (Wrocław 1975), and by J. Werner on bows and arbalests (Wrocław 1974).

The earliest periods of the history of armements in Polish territories are dealt with in a book by W. Wojciechowski (Warsaw 1973). Polish arms in the Middle Ages are discussed in the work by A. Nadolski: *Studies of the Polish Armements in the 10th, 11th, 12th cc* (*Studia nad uzbrojeniem polskim X, XI, XII wieku*. Łódź 1954), based mainly on archaeological relics, and in books by Z. Kajzer and Z. Wawrzonowska (based on iconographical documents). As for a later period, a work by A. Zahorski on the armements of Polish troops during the Kościuszko uprising in 1794 must be noted. Many contributions to the history of armements have been published in the journals "Arms and Colour" ("Broń i barwa" 1934—1939), "Arsenal" ("Arsenal" 1957—1958), "Studies and Materials on the History of Ancient Armaments and Uniforms" ("Studia i materiały fo dziejów dawnego uzbrojenia i ubioru wojskowego" 1963—1967). Apart from that many pieces of information on this subject can be found in the works on the history of Polish Army at particular periods.

The history of Polish armements is rather extensively presented in the works on the history of artillery, the kind of arms which for a long time had constituted the main kind of "technical" troops and included in the organizational sense (in Poland until the second half of the 18th c.) also military engineering. In the period between two wars it was M. Wieliczko-Wielicki who studied the early artillery technology and he was author of many works on this subject, the most comprehensive of which was *An Outline of the Development of Artillery and of the Methods of Firing It* (*Rozwój sprzętu artyleryjskiego i metod sirzelania artylerii w zarysie*, in a publication: *Military College of Artillery (Szkoła Podchorążych Artylerii)*, Toruń 1933). After the second World War, the history of the artillery technology has been dealt with by T. M. Nowak who has devoted to this subject this main work, *The History of Military Technology in Ancient Poland* (*Z dziejów techniki wojennej w dawnej Polsce*. Warsaw 1965) and *The Polish Military Technology in the 16th—18th cc* (*Polska technika wojenna XVI—XVIII w.* Warsaw 1970). At the same time there is now a growing interest in the early rocket technology, a subject also studied by T. M. Nowak (a series of works on the problems of rocket technology in the European literature from the 13th to 17th cc, SMHW Vol. XVII part 1—2 and Vol. XVIII part 1—2, as well as the paper: *La technique des fusées en Pologne jusqu'à la moitié du XIX^e siecle. Sources, problèmes et état des recherches* in: *Histoire militaire de la Pologne. Problèmes choisis*. Varsovie 1970, and by M. Subotowicz: *An Historical Outline of the Development of Rocket Technology and of Space Researches in Poland* (*Rys historyczny rozwoju techniki rakietowej i badań kosmicznych w Polsce*. "Kwartalnik Historii Nauki i Techniki" 1974).

There is a rather specific approach to military engineering in Poland. It consists in the fact that only one of its branches, namely the history

of stable fortifications, is the object of continuous interest on the part of the historians, while other branches, i.e. the history of field fortifications, of field bridges, of engineering siege works is very seldom an object of studies. Still in this area too there must be noted a valuable work, dating from the period between two wars, one by J. Giergielewicz on the corps of military engineers in Poland in the second half of the 18th century (Warsaw 1933), and his two works on Polish military engineers of an earlier period, while after the war there was published a small paper by T. M. Nowak on the building of field bridges in Poland during the period from the 15th to 17th cc (SMHW Vol. II).

As regards the history of stable fortifications it has been the subject of numerous, valuable works, written mostly as part of the activities of the polytechnical schools in Warsaw, Cracow, Gdańsk, and Wrocław. A work on this subject had already been initiated in the prewar period by the publication: of an analytical study of the history of the Zamość fortress, founded in the 16th c. as a lay-out of bastions (S. Herbst and J. Zachwatowicz, 1936). The scholars studying this subject after the war were in Warsaw, apart from J. Zachwatowicz and S. Herbst, A Gruszecki (the history of bastion and later fortifications, and J. Widawski (medieval town fortifications); in Cracow — J. Bogdanowski: *Łańcut Fortifications in Little Poland (Fortyfikacje łańcuckie na tle małopolskiej sztuki obronnej. Łańcut 1976)*, *The Strongholds and the Green of Cracow (Warownie i zieleń Krakowa. Cracow 1979)*; in Gdańsk — J. Stankiewicz: *The Seaside Fortress at the Vistula Mouth (Nadmorska twierdza w Wisłoujściu "Kwartalnik Architektury i Urbanistyki"*

1956), *The Medieval Fortifications of the Main Town in Gdańsk redniowieczne fortyfikacje ównego Miasta w Gdańsku. SMHW Vol. IV)*, *The Fortification System of Gdańsk and of its Area (System fortyfikacyjny Gdańska i okolicy. SMHW Vol. XX)*. The very active Wrocław centre, set up by B. Guerquin, has been publishing the results of conferences on the history of medieval castles: *The Initial Castles in Poland (Początki zamków w Polsce, Wrocław 1978)*, and on the little-known problem of bastion fortifications: cannon-turret fortifications in Poland (*Bastejowe fortyfikacje w Polsce, Wrocław 1975*). A similar conference, though a little more wide-ranging, was held in Warsaw in 1965, its subject being foreign fortifications built in Polish territories in the 19th and 20th centuries (SMHW Vol. XII part I). The earliest, wooden-earthly fortifications in Poland have been studied first of all by the Institute of Middle Poland Archaeology in Łódź, headed by A. Nadolski, and the whole history of Polish medieval fortifications till the middle of the 15th c. has been dealt with by B. Miśkiewicz in his work, *The Development of Strongholds in Poland till the middle of the 15th c. (Rozwój stałych punktów oporu w Polsce do połowy XV w. Poznań 1964)*. Consequently, the history of fortifications in Poland is one of the most thoroughly studied branches of military technology.

Also quite satisfactory are the studies of the history of military cartography, mainly owing to the afore-mentioned works by B. Olszewicz and K. Buczek. Lately works on this subject have been brought out by S. Alexandrowicz: *The Development of Cartography in the Grand Duchy of Lithuania from the 15th to the middle of the 18th centuries. (Rozwój kartografii Wiel-*

kiego Księstwa Litewskiego od XV do połowy XVIII w. Poznań 1971), and by T. M. Nowak: *The Polish Military Atlas of 1634—1639* (*Polski atlas wojskowy z lat 1634—1639*. SMHW Vol. XV part II).

The technical problems of the ancient Polish navy are only occasionally discussed in the works of a general type by A. Czołowski: *The Navy in Poland* (*Marynarka w Polsce*. Lwów 1922), by K. Lepszy: *The History of Polish Fleet* (*Dzieje floty polskiej*. Gdańsk 1947), and by S. Bodniak: *Poland and the Baltic Sea in the Reign of the Last Jagiellon* (*Polska a Bałtyk za ostatniego Jagiellona*. "Pamiętnik Biblioteki Kórnickiej." Kórnik 1939—1946). More light is shed on these problems by works on the history of the Gdańsk ship-industry, i.e. Z. Binerowski: *The Gdańsk Ship-Industry from the 17th to the early 19th centuries* (*Gdański przemysł okrętowy od XVII do początku XIX w.* Gdańsk 1963), and the Elbląg one: S. Gierszewski: *The Elbląg Ship-Industry in the years 1570—1815* (*Elbląski przemysł okrętowy w latach 1570—1815*. Gdańsk 1961), and especially by M. Bonar's book concerned with the reconstruction of the appearance of a Polish navy ship, built at the Elbląg yard in 1570: *A Galleon of Sigismund August. An Attempt at Reconstruction* (*Galeona Zygmunta Augusta. Próba rekonstrukcji*. Wrocław 1973), and to some extent by E. Koczorowski's work, *Polish Navy in the years 1587—1632* (*Flota polska w latach 1587—1632*. Warsaw 1973).

It appears from our review that Polish historians are keenly interested in particular subjects of the history of military technology and that Polish historiography has at its disposal a fair number of source publications and general works on this subject. However it must be also stated that all these works are rather unevenly spread in relation to various branches of the military technology, and that there is a lack of synthetic works dealing with the subject as a whole. The only attempt in this sphere relating to only one period (17th c.), has been made by T. M. Nowak in his work *Polish Warfare Technique in the 17th Century. Theoretical Conceptions and their Practical Applications*. In: *Military Technique, Policy and Strategy in History*. Warsaw 1976, in which he discusses the technical problems of artillery, military engineering, fortifications, military cartography, and the elements of theoretical knowledge that went with them, as well as their technical performances and their applications in battle-fields.

So the studies of the history of military technology in Poland can be considered to be initiated but not sufficiently developed yet. One can therefore suggest that the future works in this field should discuss the following problems:

The methods of research in this sphere of study. Indeed an almost complete lack of works on this subject in Polish scientific literature has hampered these studies. So what is necessary is to give more thought to the significance of the history of military technology within the general military history, the history of technology and that of societies, and, at the same time, to work out a detailed method of research in the field under discussion, appropriate to its specific nature. It would also be very helpful in doing these studies to take into greater consideration the auxiliary branches: historical metrology, knowledge of historical materials, historical

technology of producing the objects of wood, iron, steel, bronze, lead, etc., the ancient methods of designing and building earthly, wooden and stone constructions, and many other fields without the knowledge of which the historians of military technology will be helpless. Also very important for the field researches is the knowledge of how to measure the objects under investigation. The historian's equipment in the sphere of military technology should also include such elements as: a comprehensive (both retrospective and current) library of Polish and foreign works in this field and an access to specialized libraries, collecting current and retrospective items (in microfilms).

Then there is the task of cataloguing, editing and publishing of sources. What is called for is a long-term activity at the establishment and then cataloguing of monuments in the field (military structures) and in museums (the armement and equipment of troops) in order to form in both cases a central card-index, the items of which would be published in a series, after the cataloguing of each branch (according to its localization or chronology) or as they would come. The same should also apply to the searches: iconographical, cartographical ones, and the most extensive one concerned with archival and library manuscripts. The results of the two former should be published in specialized series, and the results of the last one — separately in registers. Simultaneously with the cataloguing of field, museum, iconographical and cartographical monuments, it is indicated to photograph them, and as far as archival and library documents are concerned — to microfilm them in order to create specialized documental archives being an important improvement on previous methods of work. In the case of very important sources it would be a good thing to issue them in print integrally. Into this category can fall ancient treatises, text-books preserved in manuscripts, as well as series of bills and inventories casting a revealing light on the military technology of a particular period.

Then there is the continuation of monographic works, among which special attention should be paid to the subjects related to the history of Polish military technology which have not been studied sufficiently or at all. The specific themes to be dealt with before others will emerge at an attempt to draw up a synthesis of the history of particular branches of military technology. And it is indeed possible to make such synthetic presentations, with a view of arriving at a synthesis of the whole history of Polish military technology, precisely because of the monographic studies in this field being now so advanced. This goes for the history of military cartography, history of fortifications and of artillery. The synthesis of this type presented against the background of universal history, will be based on the essential factographical material, will make it possible to pose the problems, to resolve them, to discover the gaps in the studies made so far and, consequently, to indicate the most urgent subjects for research.