FROM THE HISTORY OF INDUSTRIAL CULTURE OF THE URALS

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Ekaterinburg, 1993

CONTENTS

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WORKS-TOWNS IN THE URALS.

The most significant objects of our industrial heritage are urban towns or settlements,closely connected with industry as they enable us to view the life of many generations in its social environment. Such objects are abundant in industrially developed countries. Many of them have become museum exhibits. There is quite different situation in Russia,the country which hasn't entered yet the post-industrial era and so it doesn't show deep concern for the monuments of its industrial culture. They,however,are unique and have been well preserved in abundance in the country and the Urals - its industrial heart - particular.

At the turn of the 17th-18th centuries the Urals started its way towards being one of the largest metallurgical base. Peculiar combination of iron ore,wood and water resources promoted the process. During the 18th century at least 200 mining and metallurgical works were built there. Towards the early 19th century about 2/3 of all Russian iron and 90% of copper were produced in the Urals.The Urals works delivered metal to many European countries and even to the American continent.

Wars of the 20th century gave a new impetus to the development of the Ural industry and World War II particular,when the region became a big supplier of products of metallurgy and machine-building. Only one engineering works in Izhevsk produced 93% of total national output of rifles and carbines during the war. After the war the severe winds of the Cold War brought clouds of secrecy over the Urals,which became the largest arsenal of modern arms. The USSR atomic and rocket power was formed there. In the course of conversion it also becomes history. A good deal of work should be done in future to write it down and to preserve the monuments of industrial heritage.

The peculiarity of the Urals as an industrial region is its early and very specific urbanization,which due to much conservatism in the development of the region before the revolution and due to stagnation of environment in the times of the Soviet Power has preserved up to now peculiar features of past centuries and thus it provides rich material for industrial archaeology. Nevertheless,methods of industrial

archaeology have not been applied practically in the Urals. A few books are published,which give us description of Ural towns,using traditional sources,from the viewpoint of economy,geography and local history [1].

In these books,as well as in other publications we often come across a notion of "a works-town" or "a works-settlement", but no definition is given.No special research has been carried out on this problem. Mining and metallurgical towns or "works-towns" are common in the Urals. They originated together with industrial works and passed through all the main stages in their development,preserving unique architectural colour and their own mode of life. Their investigation is of great interest from the viewpoint of the industrial heritage conservation and museum-making. The paper presented aims to touch upon this subject and to characterize main approaches to the matter.

"A works-town" is such a monument of industrial culture,where industrial and social infra-structures are closely connected. This phenomenon in the Urals is characterized by the territorial unity of production and everyday life,as well as by a specific character of people's employment,by subordination to works administration. All that had a great impact not only on the type of building organization,but also on the whole social environment. Most of such settlements were not considered to be towns,so there was no official statistics on them.At this or that time the notion had different content,and only one thing would remain unchanged,i.e. localization of the specific unity of industrial and social spheres.The Stroganovs' salt works-towns / Konkor,Kargedan,Nizhne-Chusovskoy/ of the second half of the 16th century were a prototype of other works-towns. Their first function was to produce salt. The towns had good fortifications and they trade in furs. Later the mining and metallurgical production emerged.

A large-scale construction of works-towns started at the turn of the 17-18th centuries. New works sprang up: Nevjansky/1699-1701/, Kamensky /1704/, Alapajevsky /1704/, Uktussky /1702-1704/. The first three works mentioned soon became typical works-towns.In the same 18th century they were joined by new works-towns: Nizhni Tagil, Sysert, Kushva, Zlatoust, Kyshtym.

As a rule those towns were developed on the basis of metallurgical works. More often a works pond dominated in the towns landscape. The main town road usually led across a dam. The streets were oriented to the works and lined mainly with wooden

houses of a village-type with out-buildings. Public buildings and worksowners' houses were made of stone.

The most picturesque towns were Nevjansk and Nizhni Tagil - the domains of the Demidovs,famous industrialists in the Urals. The first blast-furnace in the Nevjansky works was built in 1701, the second - in 1704, the third - in 1716-1717. A bit later the Tsar Blast-Furnace was erected. It was one of the biggest blast-furnaces in the world at that period. Its volume was 72 cbm, the height - 9.3m . Metal of the best world quality was founded there,including pig iron,iron,castings of great art value. Up to the mid 18th century the works was the largest and the most advanced metallurgical enterprise not only in the Urals and Russia,but in Europe too.In the middle 19th century its blast-furnace works was rebuilt and in this form it has been preserved up to now. There is a chance to reconstruct the blast-furnace according to plans and drawings,dated from the second half of the century.

One of the most interesting objects is a dam in Nevjansk. It is 102 sazhens in length and 4 sazhens in height / 1 sazhen - 2.134m /. Several times the dam was reconstructed : the late 18th century, the first half of the 19th century and finally the late 1960s - the early 1970s. It seems to be possible to reconstruct a working unit of a hydrotechnical installation of the 18th century according to survived drawings,pictures and photoes of the dam,dating from the time before its reconstruction.

The inclined Tower of Nevjansk has preserved its original appearance of the 18th century. Even today we have not established yet the exact date of its erection,as well as the names of the architects and builders. The dating fluctuates between 1702, 1725 and 1741. The preference is given to 1725. The Tower is 57.5 m in height, its foundation is 9.2 x 9.2 m. It was built like many other old-Russian many-tier towers or church-towers, but at the same time it accumulated specific features of Russian architecture of the late 17th century. As such it is a unique architectural monument of the first half of the 18th century. Specialists note a very interesting combination of cast-iron beams,used in its design. The introduction of such elements into the design of the Tower and its dome was the first experience not only in Russia, but in Europe too. The construction of domes of the Maintski and Isaakijevski Cathedrals only repeated that experiment. The Tower served as an administrative building and as a

watch-tower. It became a monument to the Demidovs family. Its history is presented by numerous tragic and sentimental legends.

From the viewpoint of reconstruction of the 18th century social infra-structure the Demidovs' house in Nevjansk / built between 1725-1741 / is the subject of special interest. The house consisted of two separate two-storeyed buildings, put at angles to each other. It was divided into separate sections; each section had a hip roof, common for the 17th - 18th centuries. The roof was topped with a crest made of sheet iron decorated with carved figures. A porch with a cast-iron stairs led to the second floor. Ceilings in the house were vaulted and decorated with frescoes in the old-Russian style. Later new premises were added to the earlier structures, which served different purposes. As a result a unique complex was set up, consisting of various structures, which formed a rectangular yard of irregular form. The yard was 56 sazhens in length and 35 sazhens - in width. It was paved with beautiful cast-iron plates. Near the yard there was a kitchen-garden, an orchard, a green-house, where trees and floweres from different countries of the world grew, and a small Zoo. Unfortunately,everything was burnt down in 1890. Only one of the walls and a cellar made of brick have survived. Fortunately plans of the yard, facades of the owners' house and other structures have also survived, so there is a chance to restore them.

From the second half of the 18th century the Nevjansky works yielded the palm to the works in Nizhni Tagil. The production of iron began on 25th December, 1725. By the end of the 18th century there were 26 different kinds of production at the works. About 1 mln poods of iron were produced there. The iron was transported to many finery works in the Urals. Bar iron made in Nizhni Tagil was well-known throughout the world. It had a special mark - "an old sable" and was exported to many industrially developed European countries. Distinguished experts and inventors, outstanding scientists and technicians worked at the works in the Nizhni Tagil mining and metallurgical district. The first Russian locomotive and the first rolling-mill of "double operation" were created there. In 1875 for the first time in Russia the Bessemer process was introduced at the works. The production of ferro-alloyes for armoured steel made directly in blast-furnaces was mastered there in the 40-s of the 20th century during World War 11.

At present the old works is of great significance as it is a unique monument of metallurgical history of the 18-20th centuries. The whole set of industrial architecture

monuments has been preserved on its territory. Together with partially survived working equipment it is a good evidence of metallurgical history and the evolution in planning of the typical Urals ironworks, which has gone the way from being a manufactory to becoming an industrial enterprise.

From the end of the 80-s a museum-park of mining and metallurgical industry of the Middle Urals ,which is to include not only the works itself, but also a working settlement, adjacent to it, has being developed. In the former house of worksowners, in the house of the Khudojarovs / the family of artists / there is a display of varnished paintings and tray-making. Thus, we deal with a monumental complex of world significance, where such notions as "monuments of technical history", "A monument of industrial architecture" and "a monument of town-planning" form a fundamental unity. A complex of Verkhne-Kyshtymsky works-town of the 18th century, which included a dam with a set of hydrotechnical installations, creates a very picturesque view. Excavation and restoration works, concerning the systems of ponds,dams, canals, an underground tunnel, the main water canal with water-gates and retaining walls will make valuable contribution to a better understanding of our technological past, as well as they will stimulate tourist business. " The White house " - a minor-house in the style of Russian classicism with a large garden, a fountain and watch-towers, as well as the Svjatodukhovskaya church, situated on an island, being a unique monument of the late baroque and the main architectural landmark of the town complex, are waiting for the researcher and the restorer.

And what were those "works-towns" from the viewpoint of demography? At that time they were settlements with relatively large population. By the middle of the 19th century the population in Nizhni Tagil was 21,000 people, 13,000 people - in Zlatoust; 12,000 - in Kyshtym, more than 10,000 - in Nevjansk [2]. In the second half of the 19th century, when the role of Ural metal began to fade and because of deep economic crisis in the region, new subsidiary industries and trades started to develop. It led to a change in a traditional scheme of employment and social structure. But the population continued to increase in number. From 1897 - 1910 the increase in population was 17% in Nizhni Tagil, 10% - in Nevjansk, 15% - in Sysert, 20% - in Kushva [3]. Despite all changes those towns have preserved their destination and original appearance.

From several works-towns large cities of a regional scale emerged. Ekaterinburg

and Perm cities can be cited as an example. Ekaterinburg was founded in 1723 on the site of the works, having the same name. According to a plan of 1730 the works had about 30 separate industrial premises, including workshops, warehouses, a dam with a hydrosystem, which set in motion up to 50 water wheels. Some of the remains have survived till nowadays and the working dam particular. It is known, that in 1725 there were 203 houses in Ekaterinburg, but in 1734 their number increased up to 335 dwellings [4]. In 1850 the population was 15.4 thousand people. It should be noted, that 52% were engaged in mining and metallurgical production [5]. From the very beginning the town was destined to be not only an industrial producer, but an administrative centre of large mining and metallurgical district. In the first half of the 19th century about 2/3 of Ural works were connected with Ekaterinburg.

Perm, a big provincial city, was founded on the site of the Egoshikhinsky copper works, built in 1723. Academician I.G.Georgi, having visited it 50 years after its foundation, wrote: "Egoshikha is a real mining town. It is situated on the left bank of the Kama river and on both sides of the Egoshikha river. It has over 400 wooden houses and one stony church. In the market-place there are over 100 shops with all necessary goods" [6]. According to Academician I.P.Falk there were 759 males and 775 females together with 76 raskolniks - 1610 people in all [7]. In 1781 the Egoshikhinsky works was designated to be a residence of Governor-General and renamed in Perm. According to a census of the same 1781 364 householders lived in 5 streets and one side-street. They had 476 lodgings,accomodating 3,000 people. The local population of 1,820 people included 51 merchants, 86 representatives of lower middle classes, 545 works employees, 312 peasants, 427 residents at the works, 23 retired soldiers and soldier's wives, 72 widows. Most of the town people were busy with ore-mining and copper-smelting [8].

The development of metallurgical works depended greatly on ore and wood resources. Satiation came about in the last quarter of the 18th century and the rate of construction was reduced. From 1761 to 1770 27 works were built, from 1771 to 1790 - 27 works as well, but from 1791 to 1800 - only 4 [9]. At the same period the process of intensive development of towns also came to its end. By that time 85% of all works-towns had been already founded, later they would become modern cities [10]. Therefore, the Ural works-towns played the leading part in the creation of towns network in the region. They are a clear evidence of early urbanization in Russia and

they make us think about revaluation of socio-cultural development on the brink of industrial civilization.

In the 20th century under radical social and economic changes in the country and large-scale industrialization particular, Ural works-towns have become a centre of great events. On the one hand, many of them are large industrial centers. On the other hand, they are losing their original appearance in difficult socio-economic situation, gradually turning into common urban settlements with differential employment of population and significant delimitation of industrial and social spheres. However, at the period of industrialization new very big cities, such as Magnitogorsk, Bereznyaki,etc. came into being. In old cities,f.e. Ekaterinburg,on the base of super-powerful works so-called socio-towns have emerged,like Uralmash. They remind greatly of old works-settlements, but have more differential function. After World War II the Urals became the main supplier of automic weapon. Several secret works-towns were founded. They had their own mode of life. They reminded feudal works-towns, but of much higher level and this seems to be interesting from the viewpoint of general historical conclusions, including the problem of industrial heritage conservation.

Thus, the 400th history of Ural works-towns should be of great interest for researchers and urban archaeology particular. The long history of those unique objects of industrial culture has left us a lot of historical sources: reports, drawings, maps, records, letters, old lithographs and modern photoes and at last unique monuments of material culture, impressive architectural ensembles,etc. All this is a good ground for carrying out a successful restoration work and making a display of monuments of our industrial heritage to form an integral unity of production and every day life, surrounding landscape and the remains of man's impact on nature.

NOTES

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UTILIZATION OF WATER POWER AT THE URAL OLD IRONWORKS

In 2001 the Ural heavy industry will celebrate its three centuries' jubilee. The earliest appearance of the first large-scale for that time metallurgical works - Neviansky and Kamensky - is traced back to 1701; by the early XIX century already 104 ironworks only were in motion in the Ural. (1) A great number of works, the famous Verkh-Isetsky, Seversky, Neviansky ones among them, being erected in the very beginning of the XYIII century have still been functioning today. By all means, their shops were continuously rebuilt, the equipment was being replaced by a more improved one, the profile of the production changed repeatedly; however, the major element of the planning and exterior of the Ural works remained unaltered which made them recognizable and identical to each other. This element was hydrotechnical constructions, ponds and dams.

Works ponds and dams were a common part of the urban landscape of the majority of the old Ural towns and settlements. As many as three of them occupy the territory of the capital of the Ural, Ekaterinburg. Many years ago they supplied Verkh-Isetsky, Ekaterinburgsky and Nizhne-Isetsky metallurgical works with water power. The aggregate of the dams intended for driving metallurgical works built over the XYIII-XIX centuries amounted to more than two hundreds. (2) The majority of them have been retained until today without any essential alterations. They have already lost their production purpose, in some cases the woks themselves have disappeared; the ponds have been transformed into mere water reservoirs for urban demands as well as into the places of the citizens' rest. Today the hydrotechnical constructions are the main evidence and monument of the XYIII-XIX-century industrial activity.

The works' dams and ponds are the most widespread as well as the most attractive monuments of the industrial culture of the Ural. All the metallurgical technologies applied at the Ural works were identical with the West European ones, the main distinction was rather the immense dimensions of the equipment than the details of its construction. Hardly any European country had ironworks of such a

productive capacity as the Ural had on the turn of the XYIII-XIX centuries. The high achievements of the XYIII-century Ural industry apart from technological novelties were based also on much wider power potentialities in comparison with West European counries' enterprises. This, in its turn, was caused by the original, inimitable planning of hydrotechnical constructions, first and foremost of dams and ponds.

The principal distinction of the Ural dams from the European ones was emphasized by an engineer and prominent mining figure Wilhelm de Gennin as early as the very bginning of the XYIII century. (3) Being born in Amsterdam he had visited the best West European works for many times and could have quite adequate and qualified conception of this problem. According to Gennin's description two methods of water power utilization were in use at that time in Germany:

Conforming to the precepts of the first method a site with a steep water fall was selected on the river, and a drain was dug to such a level "... so that at its end its bottom and the water current in it were higher the wheels and therefore could set the latter in motion."

The second method implied the erection of a stone dam for which large square or quadrangular trimmed stones were used. For a greater durability the stones were connected by iron cramps the ends of which were poured with lead. The dam required special durability during spring high water: ice and spring floods waved over it and thus all the weakly strengthened parts were destroyed. The water for mechanisms and machines driving was drained as in the first method through special channel.

However, in both cases no considerable water resrvoirs were made, in the second variant the dam only generated the overfall of water level. The spring water power was not used which substantially decreased the productive capacity of a works. Nevertheless, the European system had some advantages as well: the shops were erected on a plain and firm site aside the river bed, all the water-driven mechanisms could be operated all the year round.

The builders of the Ural hydrotechnical consructions unlike their European colleagues initially orientated towards the maximum possible utilization of water power. As de Gennin pointed out, for a dam building such river sections were selected "... where the navigation is impossible, the both banks are steep and high and by all means not lower 5 or 6 sazhen's, the water fall being not too steep but upstream the dam a

considerable overflow of the closed water should be possible. When at such a site a dam 4 sazhen's high would be built equipped with high breast wheels, since the low breast ones are not used for the purpose of water saving, and the spillways would be closed, the spring water would be accumulated in the pond and would suffice for the works supplying for the whole year, as for example in Siberia in Ekaterinburg the water in the pond has overflew at 15 verstas distance and thus the pond's boundary is more than 30 verstas. In such large ponds the water does not get too cool due to their depth so that the water level in the conduits is always over 5 arshins deep and is upper the wheels. As a result the water pressure on the wheels is greater and consequently a less quantity of water is required. Also it is not necessary to warm the conduits with fire in order to prevent the wheels' freezing for the water in the ponds is warm and the wheels don't get freezed without any heating.

A vivid illustration of this is the river Iset' on which all the Ekaterinburg works have been erected, since in case of absence of such a dam and lacking of spring water which would flow aside the Iset' hardly would be capable od driving more than 15 high breast wheels, whereas now it is operating over 50 wheels the whole year round without intervals. Though ice takes place on such rivers, it is quite friable and even weak winds break it and it disappeares almost not reaching the spillway, and all this due to the fact that the ponds are quiet and the current is slow..."

Selecting the site for a dam erecting the Ural specialists sought for meeting the following requirements apart from the above mentioned (proximity of the high river banks and possibility of water overflow upstream the dam):

1. The presence of waterways for transportations of ready products to the markets. Therefore many Ural works were situated on small rivers but not so far from their confluence into large rivers.

2. The second condition was more or less considerable charcoal sources near a works. The cartage transportation of firewood or charcoal made economically possible the woods exploitation in the radius no more than 50-80 km from a works.

3. The third condition was imposed by the application exclusively of water power in metallurgical production and consisted in an inevitable division of the technological cycle among separate blast furnace and finery works. Even the powerful Ural dams were incapable of supplying with motive power simultaneously several blast furnaces and the number of forges, hammers, rolling mills of

corresponding capacity. By all means in the Ural as well as in West Europe the builders sought for locating blast furnace and finery works as close to each other as possible. The best settlement was their erection on one and the same river; a blast furnace works being placed upstream and the finery one - lower downstream. The river was thus not only a power source but a means of transportation. A semi-product - pig iron - without considerable expenses was delivered downstream from a blast furnace works to the finery one. It was this scheme according to which the majority of metallurgical enterprises were located in West Europe; in analogous way the first ironworks in the XYIII- century Central Russia were built.

However, in the Ural this rule was not followed too strictly; the major part of semi-products was transported among blast furnace and finery works by cartage. The price of these transportations did not trouble the works-owners due to the cheap serf labour.

To obtain a better idea of the planning and methods of the construction of the Ural dams the Wilhelm de Gennin's work may be supplemented by the research of the Ural engineer of the first half of the XIX century P.P.Anosov. (4)

The chosen for a dam place was thoroughly cleared of loose ground. After that the marking-out of the future parts of a dam was performed and the dam building proper commenced. The majority of the Ural dams was not made of stone but of wood and clay. For this purpose usually larch logs were applied for this kind of wood is not liable to be destroyed in a moist ground. A special attention was focused on the selection of clay. P.P.Anosov approached it as follows: "The clay should not be sandy and stony: the quick penetration of water through the sand makes to consider it as inappropriate. The fat and somewhat saponaceous clay should be avoided as well; due to a large content of fat it is liable to be sliced and even to crumble when it is dried up. The clay that after drying up is tightly coagulated without any cracks is considered as the inferior one."

In the course of the construction clay was not to be too dry since dry clay was packed with difficulties. At the same time it had not to be too moist as well: very wet clay was liable to crack when drying up. Therefore the dams were not to be erected during rainfalls.

After clearing of a site of loose ground at the both sides of the obtained trench along the whole length of the future dam body several rows of piles were hammered

in. Two rows of 'rezh' (a log grating) were floored on the piles, holes for the future water outlet and spillway being left. The spaces between the log framework were filled by layers with clay. Apart from this from the future pond side a sloping clay embankment was erected. From the works side the dam was strengthened with a breast-wall made mostly often of stone.

In the dam body special working holes were arranged through which water wheels were fed with water. The fact, that at the majority of the Ural works tens of water wheels were operating so that they could not be located near the dam, necessitated extending of long water pipe-lines - fre-flow conduits - perpendicular to the dam. They transported water directly to the wheels. Each of the conduits was a wooden pipe with a quadrangular or oval section. In the second half of the XYIII century at some works metal conduits were substituted for wooden ones.

Apart from working holes there was a kind of safety valve - a spillway - in the dam. When the pond was overflooded during spring high water or incessant rains it let out the excess of water to prevent the danger of the dam destruction.

In the course of exploitation the majority of dams were heightened and strengthened. The waste cinders of metallurgical furnaces were used as the building materials. Thus two problems were handled simultaneously - storing of slags and increase of the dams' dimensions; the dams' foundations, all the wooden-earth constructions remained unaltered. Only as late as the XX century in the course of the complete reconstruction some old dams were replaced by concrete constructions.

The construction of the water wheels proper hardly differed from the analogous mechanisms of West European works. It may be only pointed out that in the XYIII-century Ural chiefly 5-6 HP high breast wooden wheels were in use. (5) In the XIX century they were substituted by more powerful wooden and later metal ones. In the second half of the XIX century all over the Ural works water wheels were overpowered by turbines.

The design of hydrotechnical constructions of the Ural works completely determined their dimensions and the interior planning.

Immense water sources in the ponds, the area of which reached several tens of square kilometres, allowed to build many water wheels at every works. For instance, the aggregate capacity of water engines at Nizhne-Tagilsky works amounted to 610 HP in the late XYIII century (6); at the same time the British metallurgical works of the

early XX century having typical dimensions applied 100-150 HP steam engines (7). However, it should be stressed that the British steam engines were in motion all the year round and were not in dependence on weather and water level in the ponds, whereas all the Ural water wheels could function only a certain part of the year.

The existence of several tens of furnaces, hammers, mills on a works site of limited area necessitated concerning about the most rational methods of their location. The first and foremost attention of the Ural works-builders was focused on a complete utilization of water power. The more remote from a dam wheels were less powerful, therefore the most power-consuming technique was situated near a dam and the less power-consuming one - lower donwstream. (8)

Below follows a traditional scheme of the shops location in the XYIII century. Blast furnaces and a saw mill were built adjacent the dam, as a rule at different sides of the conduit. The additional convenience of such a location was the possibility to transport the ore, coal and fluxes along a special bridge from the dam right to the mouths of the blast furnaces, thus there was no necessity to built special lifts.

Also near the dam forge shops were erected. They had a form of an elongated rectangle the short side of which faced the dam. In case of existing of a blast furnace shop at a works the forges were placed either near or following the latter, farer from the dam.

Various less power-consuming productions were located after the blast furnace and forge shops lower downstream - the shops producing tin, wire, anchors, metal workshops and smithies.

The high for that time aggregate of power sources imposed however a number of significant inconveniences in the building and operating of the Ural works. The most essential of them are outlined below.

The cost and complexity of the erection of shops, buildings and constructions increased sharply. Their foundations were arranged in a loose moist ground of the former river bed. As the works site was lower the water surface in a pond, any attempt to excavate a considerable foundation area resulted in flooding it by underground water; this fact necessitated hammering of tens of thousands of piles. The Russian scientist I.M.Ryabov pointed in the nineteenth-forties: "... there is a vivid awareness of the great efforts and immense expenses required for the building of one works, of the amount of hands and minds necessary for an erection of a dam a

quarter of versta long and three or five sazhen's high on a navigable river, to say nothing of the preparation of materials, of clearing the locality at several verstas distance, of drying of swamps, of hammering of tens thousands of piles and so on". (9)

Nevertheless, the numerous piles could not ensure normal conditions of the mechanisms operating, especially of those suffering great dynamic loads. The British master Samuel Penn, having arrived at the Ural Kamsko-Votkinsky works in 1834, was astonished by the fact that "The machines have not firm foundations so that their details require permanent repairs. The forges are installed on one wooden framework and foundation and it is extended from one end of a house to another, so that the forges are connected by a common framework which has no firm foundation and consequently all of them come to motion when only one forge is operating; as a result none of the forges can not function properly". (10) However, these shops' builders were not to blame: it was the ground that prevented from making firmer foundations.

The orientation towards the maximum possible utilization of water power entailed such a situation when the place occupied by this or that shop not always coinsided with its position in the technological succession of metal producing. Thus a rolling mill might occur near a blast furnace and only after it forges were placed. This imposed cross transportations of semi-products inside a works. However this shortcoming had to be condoned, fortunately there was an excess of a cheap serf manpower.

Hydrotechnical constructions of the Ural works had great effects not only on the planning of the production constructions but on the planning of the emerging surrounding settlements as well. As the Ural architect L.P.Kholodova treated it "The compositional-spatial centre of an Ural industrial town was a pond which was a functional-technological element of a works... The works' territory was a kind of the pond's "lock" and guide in composing the planning of a settlement. The latter was located near a works, the main streets being orientated towards a works". (11) The streets of the old industrial Ural towns were akin to rays radiated from one common centre - a works. This planning of the historical parts of the Ural towns to a great extent has been preserved until today.

NOTES

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