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Resita in Permanent Evolution of Industrial Research and Development

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The paper presents aspects related to the evolution of industry at Reşiţa, where in 1771 they put the first high furnace into exploitation. Along time these furnaces have undergone continuous improvements and modernisations, and in 1868 the Reşiţa Works started producing steel and two Bessemer converters were mounted. Due to the continual operation and enhancement, in conditions of „permanent fire", Reşiţa acquired the name of Romania's „FIRE CITADEL". In parallel machine-building industry also developed at Reşiţa. The increase of the necessary quality products imposed the development of scientific research and of the specialised schools and colleges.

***Keywords**: history, metallurgy, locomotive, industrial products, research*.

1.Brief history or industrial evolution at Reşiţa

Romania's present territory had remarkable material resources, even the king of Dacians, Decebalus, had a colossal gold thesaurus; it was known that there was gold to extract in the Apuseni Mountains, fact proved by the tools for gold exploitation discovered, and this led to the migration of many people along the years. During the archaeological excavations one found tools, jewellery and ornaments, household objects, furnace heaths, mine galleries, slag dumps from the Bronze and Iron Ages. Along with the Roman conquest, under Emperor Trajan one started the exploitation of mines, especially for precious metals, and during the Turkish occupation they exploited the mines in the Mountainous Banat at Sasca, Moldova Nouă, Oraviţa and Dognecea. In 1717 Banat passed under the reign of the Vienna Imperial Court and in 1718 they have the first furnace built at Oraviţa, and then in 1719 at Bocşa, and in 1771 at Reşiţa [1,5].

For the manufacture of quality products they needed well-qualified workers, and consequently on the 22nd of January 1729 they found at Oraviţa ,,The Mountainous School for the learning of iron-processing and mining" which provided well-qualified labour force. These qualified workers, small traders and their apprentices were brought from Sasca, Oraviţa and Biserica Albă on the 1st of November 1769 to start building the Reşiţa Works. In 1952 a special location was built for organising the training of the young workers of the Reşiţa plant, with canteen, accommodation premises, two sports hall and three wings for training courses and laboratory practice endowed with the machines necessary for practical activities. Around the years 1960 the Vocational School of Reşiţa was training more than 3000 apprentices to become workers needed by the Reşiţa plant.

2. Evolution of metallurgy at Reşiţa

Following the order ruled by Maria Theresa in 1768 they started the building of the Reşiţa Works and in 1771 two furnaces were commissioned, called ,,FRANCISCUS and IOSEPHUS" [1,5]. They also built heating furnaces, iron works for tools and iron rods. The experience acquired by the Reşiţa plant and the increasing need for iron imposed the necessity to have a furnace with higher performances, which was built in 1782. Grace to the quality of the manufactured products, Reşiţa's international prestige also grew, fact proved by the canon balls ordered for the Naples Kingdom in 1793, as well as the participation in the Vienna International Exhibition of 1873, and in the Paris industrial exhibition of 1867, for the affirmation of its products. Until the year 1893 four high furnaces were operating at Reşiţa, the largest being built in 1880, which used as fuel coke and not charcoal like the other three, and their yield was of 50 t/day. Due to the increase of the iron demand in 1893 the three high furnaces were demolished and another two high furnaces were built instead, with an output capacity of 80-90 tons/day , being put into operation in the years 1894-1895, but used as fuel charcoal, with negative effect on Reşiţa's image, compared to the similar enterprises in the West. In 1923 one of the high furnaces fuelled with charcoal was rebuilt (Fig.1)[1,3,6], and in 1936 the second high furnace was also rebuilt; in 1940 the Reşiţa Works had two 250 mc high furnaces , their capacity of production being of 120,000 tons per year, which were demolished in 1960. On the 10th of August 1961, and on the 30th January 1962 the two 700 mc. new high furnaces are commissioned, Reşiţa's pride [3,1]. Each produced in one day what the 250 m^3 ones made in 4 days, but in 1991 they were abandoned.

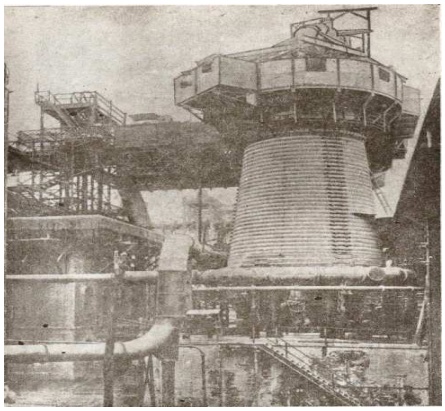
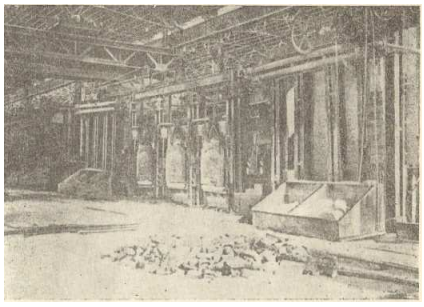


Figure 1 The furnace

Between 1840 -1848 the installations and equipment necessary for iron rolling were refurbished, and in 1850 they installed another two rolling lines with steam machines necessary for their actuation, furnaces for heating, forging and poodling, for the rolling of the rails used in the building of the Oraviţa-Baziaş railroad. In the year 1868 they put into operation at Reşiţa the first two Bessemer converters for steel with a capacity of 8 tons, and thus Reşiţa works were the first plant in Europe using this procedure. In 1870 they install a bandage/hoop rolling mill and in 1876 the railroad rails rolling installation. In order to obtain the necessary power, in 1873 they used 40 steam machines. In 1875 another two Bessemer installations were commissioned, using the pig iron produced at Reşiţa and Anina, and in 1876 steel was manufactured in two Siemens Martin furnaces, in 1881 in 3 furnaces, and in 4 furnaces in 1882. In 1894 they put into operation the Siemens Martin steel casting mill of 3,500-4,000 tons / year (Fig. 2) [1, 3, 6]. Starting with 1888, due to the increased demand on the fine steel market, the Reşiţa Plant passed to the manufacture of caster for producing refractory materials, and in1890 another two Siemens - Martin furnaces were built in Reşiţa, of 15 tons each, and the roller mill in 1981 comprised 9 lines for fine sheet metal, for universal sheet metal, one line being reversible for metal sheet, and another reversible for fashioned iron, endowed with the necessary exploitation machines. In order to meet the demand for energy, in the years 1901-1904 the Grebla power plant was built (Fig 3) [1, 3]. In the period 1915-1962 they continued the refurbishment of the high furnaces, built the electric furnaces and commissioned the non-ferrous metal casting installation.



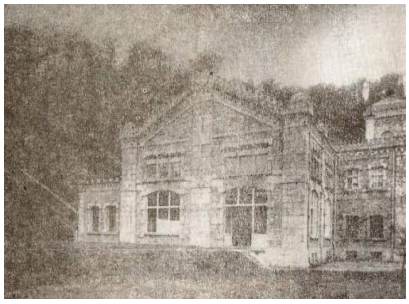


Figure 2. The Siemens Martin furnaces **Figure 3.** Grebla power plant

In the year 1941 at the Reşiţa Plant they were using 8 Siemens-Martin furnaces with an output of 190,000 tons of steel/year, and in 1958 they replaced 5 furnaces by other furnaces of higher performance. In 1936 the Reşiţa Plant was producing 100% of the domestic output of high furnace coke, 75 % of the national pig iron yield, 80% of the internal steel output, 70% of Romania's commercial iron production and 100% of the internal output of rails and bandages. In the year 1969 the C.S.R. works was providing 22.9% of the country's pig iron output, 24.2% of the internal steel production and 34.7% of the rolled products yield. The Reşiţa Steel Works produced 98 steel makes in an assortment of 327 qualities. At present the company T.M.K. produces 25,000 tons of steel per month in an electric furnace with around 700 employees. In 2003 the Government introduced a law draft to Romania's Senate by which three companies should be exempt from certain debts, among which C.S.R. in order to be taken over by T.M.K. Grace to the support of senators Ion Vela and Adrian Păunescu in the Senate plenum, the law was passed only for CSR, and thus it was saved from being sold as scrap iron by the American company possessing it at that time.

3. Evolution of the machine-building industry

3.1 The locomotive factory

The development of metallurgy at Reşiţa imposed also the need for founding the machine-building industry here, to meet the demand for equipment destined to transport materials, products, personnel and a new infrastructure. In this respect, in 1872 they manufactured the first steam locomotive, with a single motor axle (type STEG 52, Fig.4), and in 1874 they manufactured the Type 54 „Orient" locomotive with four motor axles (Fig.5). The steam locomotives were built on the principle of the first steam machine realised by James Watt in 1784 [3, 6, 9].

Figure 4 The first steam locomotive **Figure 5** „Orient" locomotive

The rails manufactured at Reşiţa in 1851 were used for the construction of the Oraviţa-Baziaş railroad, and in 1850 they built the first railroad bridges at Brunn-Stadlau (Bohemia- Austria). Most bridges were mounted in Hungary and Austria after 1870 for the railway system and after 1890 they manufactured road bridges at Reşiţa. In 1930 they manufactured at Reşiţa the first welded bridge in Romania, mounted across the Bârzava River at Stavila (Fig.6), and another one near the Culture Palace in 1937 [3, 6].

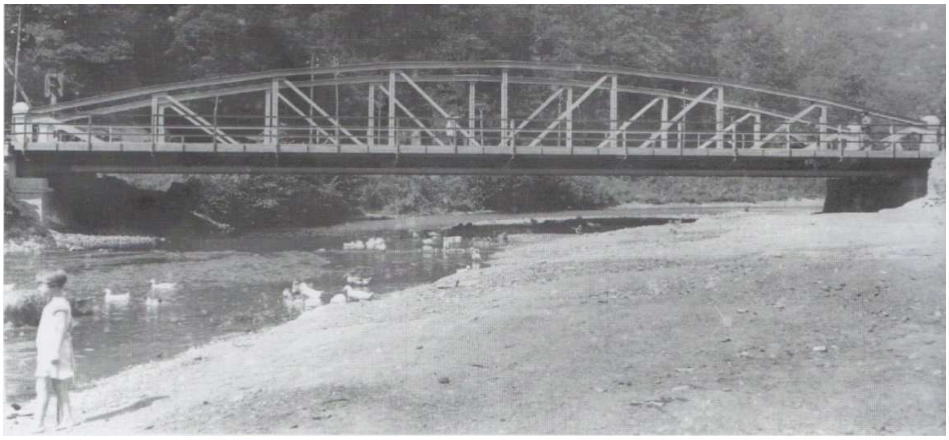


Figure 6 The first welded bridge mounted across the Bârzava River at Stavila

In the year 1920 by Decree no. 2455 one established the company ,,Uzinele de Fier şi Domeniile Reşiţei / Reşiţa Iron Works and Domains" (U.D.R.) which had a number of 16,609 employees in 1939 and on nationalisation 22,892 employees. The Reşiţa Plant was producing around 100 new steam locomotives per year, lighted with petrol lamps, then with burning oil, and then with electric current of 12 V and 24 V. The first locomotive of the 150,000 series is manufactured in 1946, [3, 6], the locomotive number 1000 is produced in 1955, and the last steam locomotive ever manufactured at Reşiţa (Fig.7) [3, 6]. The ,,Decapod" merchandise

locomotive was assimilated in 1946, being the most modern type of locomotive manufactured at Reşiţa. Due to the performances reached the locomotives produced at Reşiţa were exported as follows: 10 pieces to the Peoples' Republic of China in 1958, 24 pieces to the People's Republic of Korea in 1959, one locomotive to the Democratic Republic of Germany in 1960 and 2 pieces to the People's Democratic Republic of Vietnam. When the manufacture of steam locomotive was ceased, the history shows that Reşiţa produced a total of 1461 locomotives.

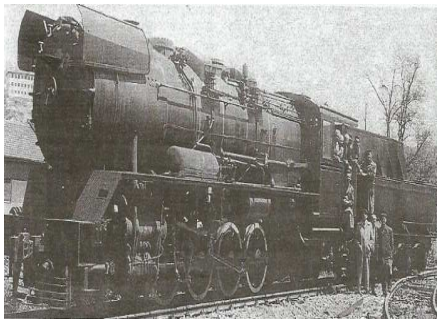


Figure 7 The last steam locomotive

Figure 8 The first Diesel engine at Reşiţa

The manufacture of these locomotives constituted a history of professionals' intelligence, an industrial tradition, a school of specialists who spread it throughout the country and abroad. The steam locomotive became a legend, being called „The Fire Horse", ''the amber eater" taking Prince Charming all over the world. In 1959 Reşiţa started to manufacture Diesel engines for the Diesel locomotives manufactured at Craiova, exported to China, Bulgaria, Egypt, Poland, Czechoslovakia, Iran etc. (Fig.8) shows the first Diesel engine produced at Reşiţa [6, 3].

3.2. Other industrial products manufactured at Reşiţa

The Reşiţa Works founded in 1771, beside the metallurgic activity, carried on other activities of diverse industrial branches: installations for machine-building and metallurgy, in the field of transport, mining and forestry, producing hydraulic wheels, canons and canon balls for the Austrian Imperial army, industrial and farming tools, heating ovens for the population etc. In the year 1855 U.D.R. was acquired by the STEG company in order to build and exploit railroads. In this period they produced turntables, bridges, water supply installations for locomotives, railroad exchangers, wagon wheels, diverse metal structures, steam machines, boilers, cranes, armoured vehicles (Fig.9), components for naval constructions, energy machines for steam locomotives since 1872 [3,9]. In 1920 the plant was taken by of the Romanian company UDR through the Royal Decree no.2455/1923, recorded in the Register of Commerce of Bucharest with no. 338/1920 and ratified by the Romanian Parliament in 1923, which, beside the products already in manu-

facture, started the production of electric machines and apparatus, equipment for oil industry and locomotives for normal railroad. In this period the Reşiţa Works participated in the world exhibitions in London (1862), Paris (1855, 1867, 1878, 1889, and 1900), Vienna (1873) and Budapest (1896). After nationalisation (by Decree Law no. 119 of June 11th 1948) the new regime started to plan the entire national economy and to allot funds by the State investment which led to an unprecedented development of the plant. Grace to a new organisation, the plant was developed according to profiles and specialisations by manufacture enhancement, and thus they founded UCMR , which continued the activity in the machine-building field, focusing on the following main products: Diesel engines for railroad and naval traction, boggies for Diesel and electric engines, hydro and turbo units with ancillary equipment, piston air compressors, the first produced in 1939 (Fig.10), in (Fig.11) we see the rotor of a hot gas exhauster of 6000 m^3 / hour , and Fig.12 shows a lime furnace and cranes.

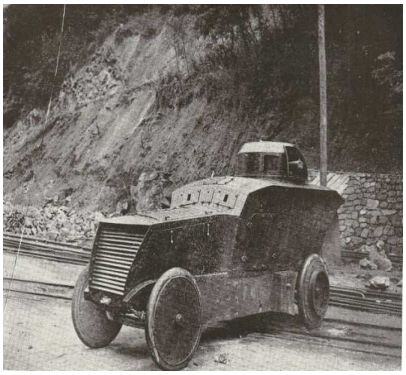


Figure 9 The armoured vehicles

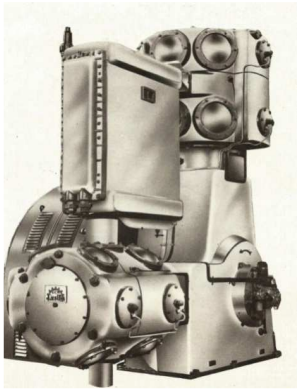


Figure 10 The piston air compressors

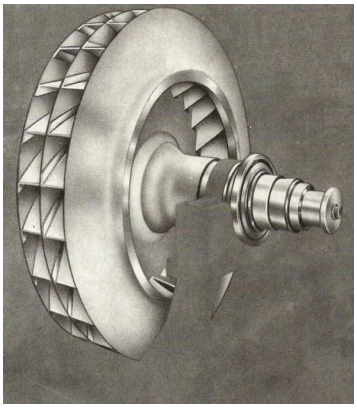


Figure 11 The rotor of a exhauster

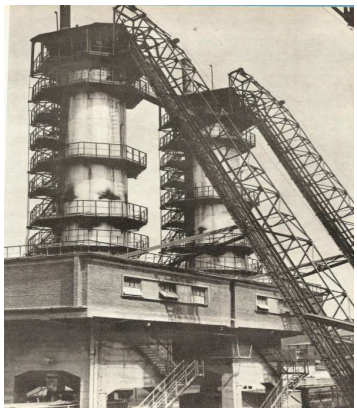


Figure 12 The lime furnace and cranes

Fig.13 presents a synchronous vertical electric elevator, of 3150 KW, for the actuation of the irrigation pumps, exposed at the Bucharest International Fair in 1970. In the year 1946 they started the production of hydro units by a Francis-type unit of 100 KW (Fig.14) and continued with the types Francis, Pelton, Kaplan and Helicoildal. The manufacture of the direct and alternate current electric motors, electric generators, converters, electric equipment etc. [3,9,10].

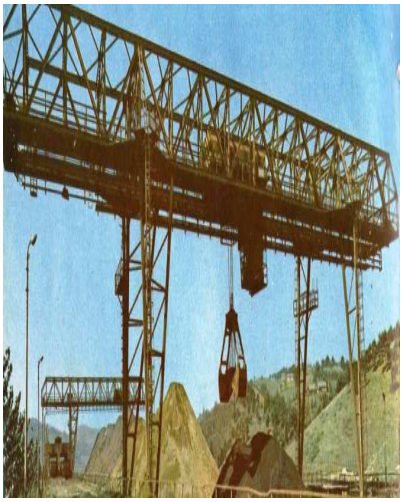


Figure 13 The electric elevator

Figure 14 The hydro units

In the years 1963-1964 in the context of the development of the Siderurgic Work one built the suspended bridge over the town and the lime cableway (Fig.15).

Figure 15 The suspended bridge over the town

With the experience acquired in the building of the string of hydro power plants CHE on Bistriţa and Bicaz, the leaders of Romania and Yugoslavia, together with SUEN and Soviet specialists assigned Reşiţa the task of building the Iron Gate Compound with hydro units of 7.5 MW manufactured at Reşiţa. In (Fig.16) presents the rotor of the 178 MW Kaplan hydraulic turbine rotor, displayed at the Exhibition of the achievements of national industry - 1969, and (Fig.17) the turbo 50 MW unit at the mounting in the power plant.

Figure 16 The Kaplan rotor

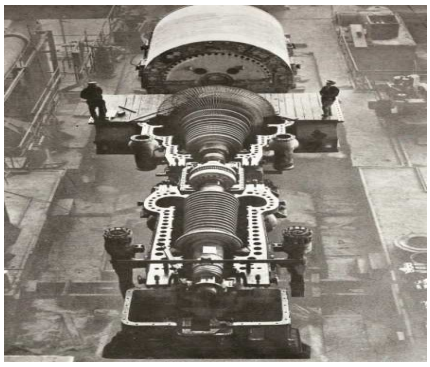


Figure 17 The turbo power plant

UCMR is renowned for its exceptional performances regarding high precision, quality and realisation of large products such as Diesel naval engines, produced for the first time in Romania in 1977 (Fig.18) [10]. At present the Swedish company AUTOLIV Romania started the works for a production hall (Fig.19) with more than 700 jobs in the Reşiţa Industrial Park.

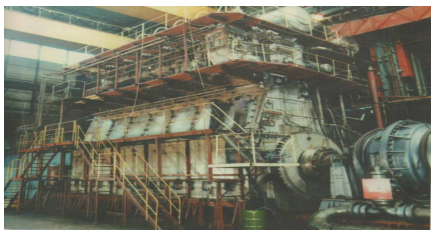


Figure 18 The Diesel naval engines

Figure 19 The company AUTOLIV

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RENK-REŞIŢA, and the production of military equipment, especially canons for the Romanian army, started in 1972 at the Reşiţa Mechanical Enterprise (I.M.R.).

4. Research activity

In the continuous development of the Reşiţa plants by the adaptation of the products to the requirements of the technical novelties of the time was played also by the collaboration of the Reşiţa plants with the Polytechnic Schools of Vienna, Budapest, Munich and Aachen in the period of the St.E.G.company.

After the year 1920 when the Timişoara Polytechnic School was founded a comprehensive cooperation started in the training of engineers and development of creation activity. In 1966 they established at Reşiţa the Institute for Research and Design of Hydro Energetic Equipment I.C.P.E.H.-C.C.S.I.T.E.H., which for Reşiţa was a centre of science and competence with the opportunity to implement the results in Reşiţa's industry, which produced turbines, electric generators and ancillary installations thereof, which contributed to the increase of prestige and success in the competition with firms of tradition. The institute operated between 1966-1991, period in which it participated in the conceiving and manufacture of the hydro units at Reşiţa, which were mounted in the country and abroad. The success reached and the short duration, 25 years of activity of the institute, made eng. Iacob Voia call the institute „A comet in Reşiţa's industry" [2].

The main pieces of equipment designed at ICPEH were: Francis and Pelton hydraulic turbines and accumulation pumps, rapid hydro generators for Francis and Pelton turbines and excitation systems, Kaplan and bulb hydraulic turbines, slow hydro generators for Kaplan and bulb turbines, rotating speed-power regulators, and systems of adjustment, electric engines, valve installations for circular pipes, compressors, thermal engines with piston, rolling equipment / boggies for locomotives, pressure oil units, installations afferent to hydro units, one present the inside of a power plant with FO mini hydro units (Fig.20), whereas (Fig.21) shows a 28 MW bulb generator rotor [3, 4, 10].

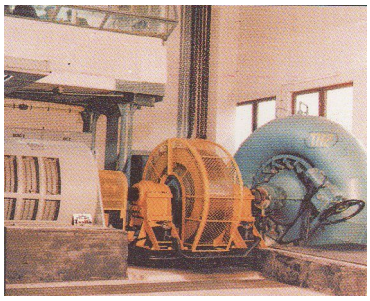

Figure 20 The mini hydro units

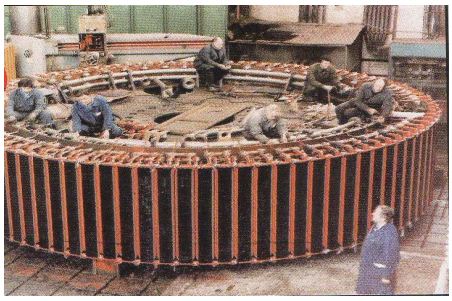

Figure 21 The bulb generator rotor

5. Conclusion

The development of Reşiţa's industry led to the development of the culture and civilisation of the Romanian people, contributing to the higher valorisation of material and human resources of the Mountainous Banat.

Today Reşiţa is undergoing a crisis period, but grace to the intelligence and experience accumulated along the years it will prosper, considering the material and human resource the county possesses, but we must keep in mind that „**The past is the door to the future**", as Bogdan Petriceicu Haşdeu put it.

We must take into consideration also the irresponsibility, non-involvement of the decision makers in the fundamental problems of Reşiţa's industry in the condition of the market economy, irresponsibility reflected in the high number of criminal conviction of some managers of companies or local and county leaders.

At the same time history shows that Reşiţa's industry had undergone financial crises around the years 1770, 1930, 1945, but succeeded in prevailing and becoming a symbol of Romanian industry grace to the intelligence and commitment of the leaders, the material and human resources of the county.

We need industry as it is the driver of civilisation, according to the works of historian A.D. Xenopol from Yassy who said that ,,**the peoples who fail to industrialise their country will eat the crumbles from the industrialised countries' tables".**

From an analysis of the prospects of industry in Reşiţa we find that a series of companies of Reşiţa have started a revival lately.

The RENK-REŞIŢA company is currently manufacturing and has orders for reducing gears and software for the monitoring of ship operation, produces reducing gears for the Galaţi metallurgic industry, for the ships in the Netherlands, for the national railroad company and deliveries reducing gears for electric, hydraulic, Diesel locomotives, it executes orders for actuators and propulsion of ships in Belgium, for auxiliary drives of ships, toothed wheels systems for the railroad industry in Romania etc.

UCMR is in the phase of resuming the manufacture of two hydro units for Hidroelectrica, of generators for the Streja-Bistriţa power plant and the tender is in course for 4 hydro units of 60 MW at Vidraru.

The TMK siderurgic works in the continuous cast electric furnace produces around 20.000-25.000 tons of steel per months. For the revival of industry one needs a partnership between the education, research and manufacture institutions.

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