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ECONOMIC STRENGTH – CRITICAL RAW MATERIAL STOCK

ABSTRACT

The history of mankind and the use of mineral resources are closely linked. We can associate with each historical period raw materials that are necessary for the development of that period. Ages go, raw materials come. Throughout the history of mankind, we have witnessed the rise and disappearance of raw materials. In this paper our aim is to discover which raw materials were of strategic importance in each historical period, in other words, which were the critical raw materials for the economic development of those periods.

STRATEGIC RAW MATERIALS OF PREHISTORIC TIMES

Even the prehistoric age is divided according to the raw materials used. By the Stone Age, Homo sapiens was already using many types of stone tools. Obsidian and flint were strategically the most important raw materials during this period, because they were easy cracked and made into arrowheads, which were essential for getting food.

In the Iron Age metal production is associated with the use of ores that appear on the surface. The use of different metals became possible only when fire could be harnessed for forging. Within the Iron Age we distinguish between the copper, bronze and iron age.

5000 years ago, copper was the first raw material for the production of metal tools. The caveman came upon moldable "stone" while making stone tools. Copper was used not only for making tools, jewellery and ornaments, but also for payment after the development of trade.

With the development of alloying technology, around 4000 B.C., we reach the Bronze Age. Bronze is an alloy of copper and tin and is harder than copper.

The appearance of iron marks the end of prehistoric times, when iron was extracted from iron ore using melting furnaces. Iron tools and weapons were more durable than their copper or bronze counterparts. During this period, the use of gold and silver as jewellery appears.

STRATEGIC RAW MATERIALS OF ANCIENT AND MEDIEVAL TIMES

Let's start the list of minerals from ancient times with halite. Salt was an essential raw material in ancient times for the preservation of food, and accordingly it was very expensive. Salt was a common currency in ancient times, but also in the Middle Ages. It retained its strong strategic role for centuries. At the end of the 8th century in the Chinese Empire, more than half of the government revenue came from the salt tax. One of France's most hated taxes was the gabelle, introduced in 1286, and only permanently removed from the tax list in 1945. In ancient and medieval times, many cities became rich from the salt trade. Salt played a huge role in the rise of medieval Venice. Because of the huge profits from salt mining and trading, it often had a royal or state monopoly.

In ancient times, seven metals enjoyed a key role: lead, gold, silver, iron, mercury, tin, and copper. In ancient states, precious metals were primarily used as money or made into jewellery.

From ancient times and for centuries after that lead was used to glaze clay pots. The floor of the Babylonian Hanging Garden was made from lead to retain moisture. The famous Roman aqueducts consisted of lead pipes. Lead was often used for making jewellery or sarcophagi. From ancient times to the late Middle Ages, lead acetate was used as a sweetener and as an ingredient in cosmetics. In other words, half of the empire was poisoned with lead, and the poisoning of the rich was more intensive. Symptoms of lead poisoning can be observed in several Roman emperors, including Claudius, Caligula and Nero.

The use of mercury has a history of several millennia and was used for various purposes without users being aware of its serious health effects. Mercury became really important in the Roman era, when it began to be used to extract gold. The metal, called liquid silver, was considered a kind of miracle in ancient times. People believed that it help maintain health, and it was used in the preparation of ointments, cosmetics, medicines and also in red paint.

By repeatedly heating and forging iron from the smelting of iron ore, high-quality iron was obtained to make the weapons and chariots of the distinguished warriors. Iron and iron-slag combinations were successfully used to improve Roman roads.

Already in ancient times the strategic raw materials of later days –coal and oil – were used. Coal mining began industrially in England in the 13th century. Coal was used for heating and for the production of high-quality steel, and oil was used as a medicine or insecticide. From the mixture of petroleum and burnt lime came the "Greek fire", one of the most formidable weapons until the invention of gunpowder in 1350.

STRATEGIC ELEMENTS OF INDUSTRIAL REVOLUTIONS

The Classic Industrial Revolution (1750-1850) revolutionized the use of raw materials. In heavy industry, the appearance and spread of steam engines multiplied the required amount of iron and coal. Demand for coal and iron increased due to the rapid construction of railways. Iron and coal mining gaining in importance. Brick was increasingly used in the field of architecture.

During the Second Industrial Revolution (1850-1914) the appearance of new materials brought a qualitative change, for example the using of steel, which displaced the use of less resistant iron. In 1869 Mendeleev published his periodic table of elements. The advancement of the science of chemistry led to a boom in the chemical industry, and Pierre and Marie Curie separated radium and polonium.

During this period Ford's iconic product, the Model T, began production in Detroit, and thanks to József Galamb, it became the world's first "people's car" in a few years. The mass production of the automotive industry required many new materials, such as gasoline, rubber, plastics, batteries and glass.

The construction industry started to use new materials such as glass, iron and reinforced concrete. From the middle of the 19th century iron-frame architecture appeared. At the London World Exhibition in 1851, visitors could first admire the Crystal Palace in London, and then in the 1880s Eiffel built his famous tower in Paris.

Even at this time, coal was the main source of energy, but by that time the use of crude oil had begun. At the end of 19th century most of the world's oil production was from Baku and from Pennsylvania. As a result, Baku's black gold made the area a strategic target in both world wars. Germans, Turks, Russians and the English competed for control of the area.

As a result of industrial development and colonialism, demand for raw materials which could be abundantly and cheaply produced in Africa, such as copper, tin, rubber and palm oil, increased significantly in Europe, and competing for new colonies in Africabegan during this period.

CRITICAL RAW MATERIALS IN THE 20TH CENTURY

The period between the two world wars is extremely important in the history of flight, as it is the period when regular air travel began. After World War II, space exploration began developing more dynamically and soon tourists are moving into space. However, during this period, further changes were made in the field of science and technology. Microelectronics was developing at an ever faster rate, which was necessary for the development and spread of mass communication and telecommunications. All these technical solutions required the use of newer raw materials.

In the 1970s, world models of earth threats emerged, in which separate chapters were devoted to extremely diminishing raw materials. Meadows et al. in their book The Limits to Growth (1972) considered the depletion of eight stocks of metal as critical in view of the known world reserves (Figure 1) (László, 1978; Korán, 1980; Meadows, 1992).

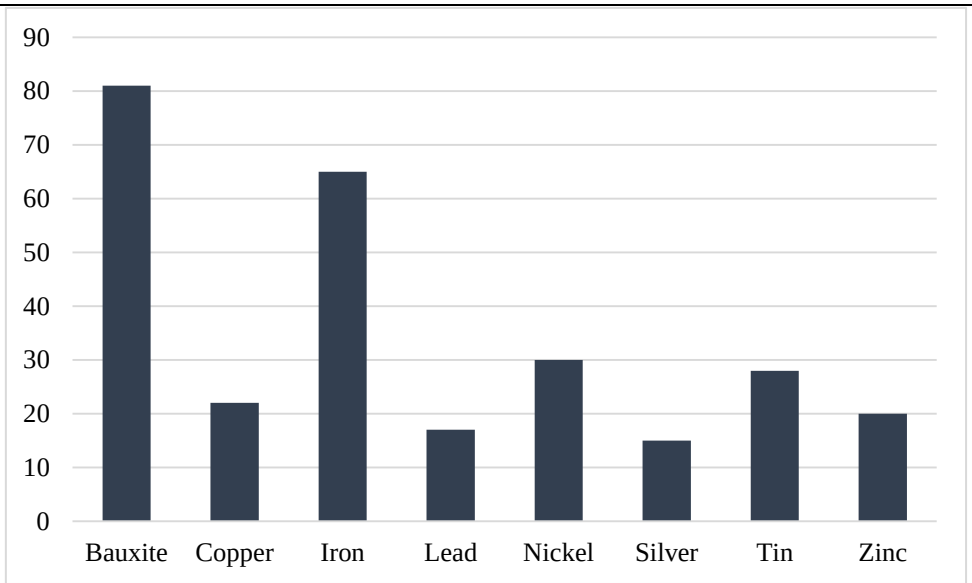

Figure 1

Expected lifetime of known stocks with 2% annual increase in production (years)

Source: Meadows, 1992

Fortunately, these predictions have not materialized up to this point, which may be due to changes in technology and the search for newer stocks.

CRITICAL RAW MATERIALS IN THE 21ST CENTURY

Today, there is another industrial revolution that we are part of. The "steam engines" of this new revolution are cyber-physical systems and digitalization. Many new information and communication technologies have emerged and are spreading. We have smartphones in our pockets, flat-screen smart TVs in our homes, laptops and computers in our offices. In addition, the use of electric cars and drones is spreading. It is important to note that the history of the electric car began more than 100 years ago, but the real breakthrough was the launch of Tesla's serial production. Furthermore, the increasing use of weather-dependent renewable solar and wind energy generates a huge demand for the storage of the energy produced. New innovations not only change our daily lives, but rewrite

again and again the list of elements to which we attach strategic importance. Countries and organizations have responded to these changes and are monitoring the changes.

In an article by Hegedűs (2014), she addressed the topic of "natural security", describing that in the United States, the Centre for New American Security (CNAS) conducted a study in 2009 concluding that a security branch is needed which focuses primarily on the security of natural resources. These resources include energy sources, soil, drinking water and minerals. Not only CNAS was involved in this topic; the United Nations also produced a study. The UN Millennium Project identified 15 challenges that could generate problems in the future. At the top of the imaginary podium were sustainable development and climate change, followed by clean water and then sources of raw materials. The energy issue was not one of the 10 most important challenges, it was only the 13th (Hegedűs, 2014).

The European Commission has also recognized this change and since 2011 has been paying close attention to the evolution of critical raw materials. The European Commission categorizes raw materials as critical that are of high economic importance and have a high supply risk (Gombkötő & Magyar, 2013; European Commission, 2017).

There is no generally accepted, "worldwide" method for identifying critical raw materials, which means that the same raw materials are not necessarily strategically important raw materials for each country. A comparison of the critical raw material list of the United States of America and of the European Commission shows that arsenic, cesium, rubidium, strontium and uranium were not included in the European Commission's survey at all, and that aluminium, chromium, lithium, manganese, potash, rhenium, tellurium, tin, titanium and zirconium are not considered critical by the European Commission, but have been identified by Americans as critical raw materials (European Commission, 2017; USGS, 2018; Gere, 2018).

These raw materials play a key role in today's technology, which is especially true for high-tech electronics and mechanical engineering, since it is difficult to find an element in the periodic table that would not be used in these production areas. For the production they are required only in small quantities, but they have unique properties and special application areas. These factors make their substitution difficult.

We have collected some examples of areas where critical raw materials are used in everyday life. Wind turbines and electric vehicles are becoming increasingly popular these days. Neodymium is a necessary element for these products. It is used in the generators of wind turbines and in the motors of electric vehicles. We use switch buttons several times a day, which would be unthinkable without copper right now. Lithium and cobalt are key components of rechargeable batteries. Tantalum is essential for battery-powered electronics

to keep charging. Tungsten allows the vibration of mobile phones (Major, 2019; Villanyautósok, 2019).

In many cases, these rare raw materials are mined in politically unstable countries, and often these countries have a monopoly or oligopoly in terms of production. For example, the Democratic Republic of the Congo is an important country for cobalt mining. This country was ranked by the Fund for Peace in 2017 as the seventh most stable country in the world. However there is a country, which has a key role in the mining of not only one critical raw material. China controls 90% of the rare earths market, and thanks to that power, it can dictate not only prices but also access to certain raw materials (Hobot, 2017; Horváth, 2017). The *Figure 2* shows the Herfindahl-Hirschman Index of critical raw materials in 2017. In the past years there have been example for this. There was a kind of panic on the world market when China stopped the transport of rare earth metals to Japan due to a diplomatic dispute, and threatened both the EU and America with an embargo (Index, 2011).

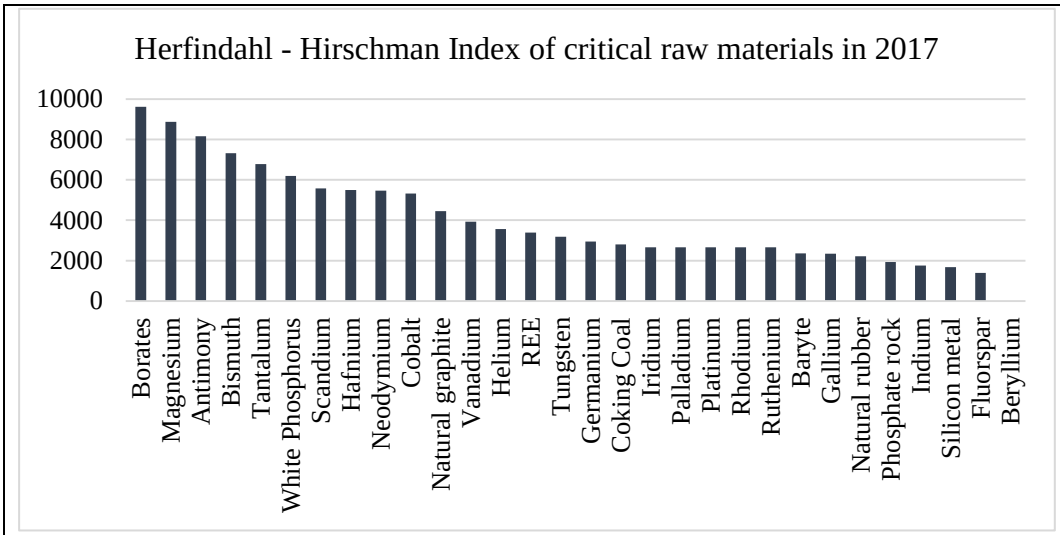

Figure 2
HHI of critical raw materials in 2017
Source: own editing based on European Commission's data

CONCLUSION

The topic of critical raw materials through the ages is a good illustration of the changing world we live in, and it is changing even faster now than in the old days. As the years have passed, technology has evolved, demands have grown, and different raw materials have become strategically important.

To answer the question of what will come in the future is not easy. Countries dependent on importstry to do everything to reduce their import dependency, but they are not in an easy position, because this depends on the opportunities offered by nature. Current conditions indicate that China's power cannot be broken, but exploration of new raw material deposits and development of new technologies may reduce China's importance, so there are encouraging signs. Recent news reports reveal that Serbia has abundant lithium and gold deposits. However, the situation is overshadowed by the fact that there are Chinese mining companies investing in the exploitation of Serbian fields.

Not only new deposits can provide a solution, but also, as we mentioned, new or partially new technologies. For example the newest model of Lamborghini, the Lamborghini Sian, debuted in autumn 2019. This is a hybrid car whose special feature is that energy is stored with capacitors. The capacitors are recharged during braking, and the car is able to drive the electric motor immediately after use the accelerator pedal. But the Sian is not an affordable car for the general market; only 63 of them have been made, as shown by the numbers on the back wing, and its price is more than HUF 1 billion (Lövei, 2019).

We don’t know that tomorrow’s strategic raw material was used in the production of this car, but we can think.

ACKNOWLEDGEMENT

The described work was carried out as part of the “Sustainable Raw Material Management Thematic Network – RING 2017”, EFOP-3.6.2-16-2017-00010 project in the framework of the Széchenyi 2020 Program. The realization of this project is supported by the European Union, co-financed by the European Social Fund.

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