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Chemistry in philately
1. Symbols of chemical elements

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Data on alchemical symbols, symbols of chemical elements and Periodic Table of Chemical Elements are presented and discussed in terms of philately. The paper is ilustrated with more than 60 postage stamps, postal cards, envelopes and cancellations.

Key words: alchemical symbols, symbols of chemical elements, periodic chemical element system, philately

INTRODUCTION

Postage stamps, specific postal cancellations and first day covers (FDC) or specific envelopes are issued to commemorate events and to inform and educate the public. Due to their universal circulation, stamps are rapid, powerful and effective messengers, which may raise curiosity and enhance or degrade the public's image of our profession. According to Rappoport [1], collecting chemistry-related philatelic material enables the collector to combine a hobby with professional interest. A term "chemophilately" employed by him denotes studying chemical history in a non-systematic but delightful way and learning about unknown chemists in remote countries, who achieved fame both professionally and as amateurs. Publications on chemophilately appear in serious scientific journals [1–8] and books [9].

In this article, we would like to present and discuss the material on the symbolism of chemical elements in philately that we are familiar with.

ALCHEMIC SYMBOLS

The agreed-upon symbols for various chemical elements, compounds and even processes and laboratory devices have been employed almost until the middle of the 18th century. For example, such symbols were still used by French chemists C. J. Geoffroy (1718) and N. Lemery (1756) in their books.

Later (in 1782) in addition to the earlier alchemical identification, A. L. Lavoisier started marking some new materials with new symbols. French chemists L. B. Guyton de Morveau, A. L. Lavoisier, C. L. Berthollet and A. F. Foureroy in their published book "Chemistry Nomenclature Methods" already used new symbols for various materials in solid, liquid and gaseous states.

In 1808, an English chemist J. Dalton (1766–1844) started using his own symbols of chemical elements and compounds, the base of which was a circle. Various signs or the first letter of an element in English was used.

In 1814, the famous Swedish chemist J. J. Berzelius (1779–1848) offered a literal identification of chemical elements. This method is in use presently.

While discussing symbols that have been used almost until the 18th century, we notice one rather interesting and informative postage stamp of Czechoslovakia. A series of six stamps were issued in 1971 to commemorate "International Pharmaceutical Congress". The series depict medicinal plants and various implements of the Old-World pharmacy: scale, pestle, retort, etc. For this discussion, a 1.80 Kr stamp portraying medicinal plant chicory and archaic flasks and retorts is of interest. The point of the greatest interest is that three parts of the stamp are filled with a variety of alchemic symbols (a total of 35) (Fig. 1). Here we can see not only the alchemical symbols for some elements (Sb, Cu, Fe, Ag, Pb and S), but also the same (alchemical) symbols for compounds and apparatus: $HgCl_2$, H_2O, acetic acid, tartaric acid, air, spirit, crystal, retorts, etc.

In 1963 Sweden issued 0.50 Kr (Fig. 2) and 1.05 Kr postage stamps (identical except denomination), dedicated to engineering and industry ("Ingenieurkunst and Industrie"). They rendered "Symbole für Geometrie, Ingenieurkunst, Architektur, Bergbau, Wasserkraft, Elektro-, Forst-, Maschinen- und chemische Industrie". Six of the ten presented symbols matched the alchemical symbols for Fe, Pb, S, Au, Cu and water.

On November 10, 1993, Germany released a 100 Pf stamp to commemorate the 500th birthday anniversary of the pioneer in iatrochemistry Paracelsus (1493–1541). In the background of

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the stamp there are eight alchemical symbols for Hg, Ag, S, Fe, Sn and others (Fig. 3). Among these stamps there were two FDCs. One of them (Bonn) shows the facsimile of Paracelsus handwriting, the other (Berlin) contains three alchemical symbols for excavated sulphur, mercury and salt (Fig. 3). In another postage stamp dedicated for Paracelsus and issued in Hungary in 1989, we see the alchemical symbol for Hg (Fig. 4).

A stamp of 0.40 E with alchemic symbols for Cu was released in 1970 in Chile to commemorate the nationalization of the copper industry (Fig. 5). Due to the devaluation of the currency, this stamp was later reprinted with new denominations – 70 E and 67 + 3 E (not shown).

A Zambian (former British protectorate of Northern Rhodesia) postage stamp is also worth mentioning. After the declaration of independence on October 24, 1964 two series of stamps were issued; one of them (10 Sh), dedicated to copper mining, contained the chemical symbol for Cu (not shown). The other series, in connection with the Southern African Coordination Conference in 1985, also dedicated to mining, had a 45 N stamp with three alchemical symbols for Zn, Pb and Cu (not shown).

PERIODIC SYSTEM OF CHEMICAL ELEMENTS

All the symbols of chemical elements are contained in the Table of Chemical Elements. That is where we want to start our discussion.

The very first postage stamps with chemical symbols should be attributed to a series of four stamps that was originated in the former Soviet Union on September 15, 1934. They were dedicated to the eminent Russian chemist Dmitrii I. Mendeleev (1834–1907) on his 100th birthday anniversary (Figs. 6–9).

The vertical stamps of 5 and 10 Kp denomination (Figs. 6 and 9) depict the scientist's monument in St. Petersburg (former Leningrad). This monument, designed by a sculptor I. Gintsburg, stands in front of the current Metrology Scientific Research Institute, named after Mendeleev. The institute was established on the initiative and leadership of D. I. Mendeleev in 1893 and was known then as "Glavnaya Palata Mer i Vesov". In the horizontal 10 Kp and 15 Kp stamps (Figs. 7 and 8) there is his portrait. The backgrounds of the vertical and the horizontal stamps contain the symbols of the short periodic element system; however, the fragments in the two types of stamps differ.

The horizontal stamps portray the scientist's portrait and a part of the upper periodic table to the beginning of Period V while in the left side of the vertical stamps we can see the elements of Group I up to Period VI, Group B element gold – Au. The right side of these stamps shows the complete basic subgroup of group VIII – inert gases (this subgroup in the stamps is defined as belonging to zero subgroup). In the current system of chemical elements, the subgroup of inert gases ends with element radon – Rn. Interestingly, these stamps have an unusual symbol – Em (emanation). It turns out that in 1899 a noted English physicist Ernest Rutherford (1871–1937), the laureate of the Nobel Prize in Chemistry in 1908, came to a conclusion, that preparations of thorium emitted gases, which he suggested to be called emanation. Further research proved that they were inert radioactive gases with the atomic number 86. Later this designation was changed into "radium emanation", because the isotope of an identical element also separates at the time of radium split. Only in 1923, it was decided to call this element "radon" with Rn marking. However, we see that even 10 years later the earlier symbol Em was still used. It can also be noted that instead of the presently used designation of "Xe" for xenon, "X" was used in these stamps.

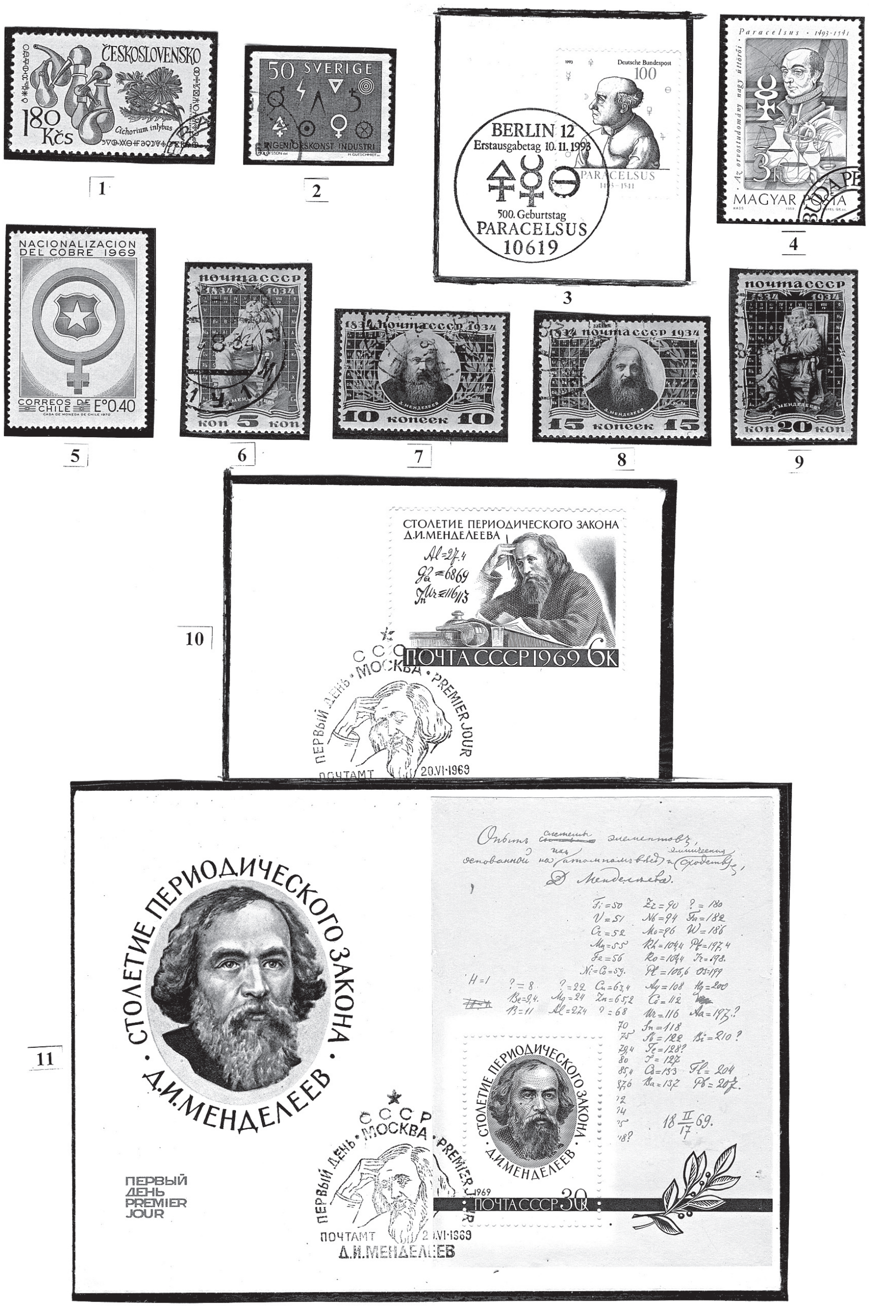
The fragments of the periodic system of chemical elements are also found in a 6 Kp stamp (Fig. 10) and a 30 Kp denomination souvenir sheet (Fig. 11), issued in the Soviet Union on June 20, 1969, to mark the 100th jubilee of the periodic system of chemical elements defined by Mendeleev.

Let us first examine the souvenir sheet. On the left side at the bottom there is a 30 Kp stamp with a portrait of the chemist, made at the time the periodic system was being developed. What is much more interesting and informative is the sheet itself. Here we see a facsimile image of D. Mendeleev's original manuscript of the system created by him, called "Element system trial, based on atomic weights and chemical similarity". This was the time when Mendeleev was preparing his "Chemistry Foundation" course book and needed some kind of system enabling a study based on scientific basis, and not on an incidental observation. He chose the atomic weights of elements (atomic masses, in the present terminology), which were closely related to the structures of elements. On March 1, 1869, D. Mendeleev wrote down on cards all the 63 elements known at that time, and sorted them according to their atomic masses and basic characteristics. Eventually, all of this allowed setting and formulating the periodic system of chemical elements following the law of nature. Interestingly, this facsimile image shows some of the corrections made during the work period, although the document was dated back to the 17th day of February. As for the dates, the calendar used in the czarist Russia until the Bolshevik revolution in 1917 was the Julian (Old Style), by twelve days lagging the Gregorian (New Style) calendar used at that time in Western Europe and American continents. The 17th of February in the Old Style corresponds to the 1st of March in the New Style.

Returning to the souvenir sheet, we can notice that a different date can be found in another place. This variation was printed by typographic method in Russian and French and mailed on March 12 (New Style) to some Russian and foreign scientists for familiarization. On March 18, 1869 (New Style), while Mendeleev was on a secondment, a well-known Russian chemist Nikolai A. Menshutkin (1842–1907) in a meeting of Russian Chemical Society made an announcement concerning this matter.

Even more interesting is a 6 Kp stamp. The scientist's portrait in this stamp was one painted by his contemporary painter N. Yaroshenko (1846–1898). The portrait is now in the archives of Mendeleev Museum of St. Petersburg University. The left side of the stamp shows a part of the manuscript with corrections later made by Mendeleev. This fragment of periodic system fully illustrates the potentiality of scientific foresight, confirming the law of nature.

Let us look more carefully at the data provided in the stamp. It could tell a chemically minded chemist or a philatelist a great deal about chemistry and its history. In the beginning, the scientist recorded the atomic masses of three elements attributing all of them to the same group. Here he identified two known elements, aluminium and uranium (marked as Ur), and



Figs. 1–11

one still unknown – named by him as "eka-aluminium", with an anticipated atomic mass of 68. Considering the atomic mass of the mentioned unknown element (and later other properties), D. Mendeleev based himself on the hypothesis that "it is possible to establish the atomic structure, specific weight and other properties of a hypothetical element when it is surrounded by known elements". He also established the atomic mass, specific weight and other properties of this hypothetical element and foresaw the method how to do it. Only a few years later (1875) a Frenchman P. E. Lekoq de Boisbaudran discovered a new element gallium (Ga), with properties practically matching those established by D. Mendeleev.

He also predicted the existence of two other elements, which were conditionally named as "eka-boron" and "eka-silicon". These were matched by a Swedish scientist Lars F. Nilson, who in 1879 discovered scandium (Sc), and by a German chemist Clemens A. Winkler, who discovered germanium (Ge) in 1886. Interestingly, instead of the question mark, a corrected atomic mass of 69 is already shown for gallium (previously the atomic mass was considered to be 68). Additionally, instead of uranium, the atomic mass of which until 1869 was considered to be exactly 116, indium element with atomic mass of exactly 113 (in 1869 the mass was thought to be 75.6) is listed in its place. It is also worth mentioning that in addition to the corrections shown in the stamp, during the period from 1870 to 1871, D. Mendeleev corrected the atomic masses of other elements: uranium – 240 (116 previously), thorium – 234 (118 previously) and cesium – 133 (92 previously).

These two miniatures were issued and cancelled on June 20, 1969 in Moscow (Fig. 10). After a couple of months, on August

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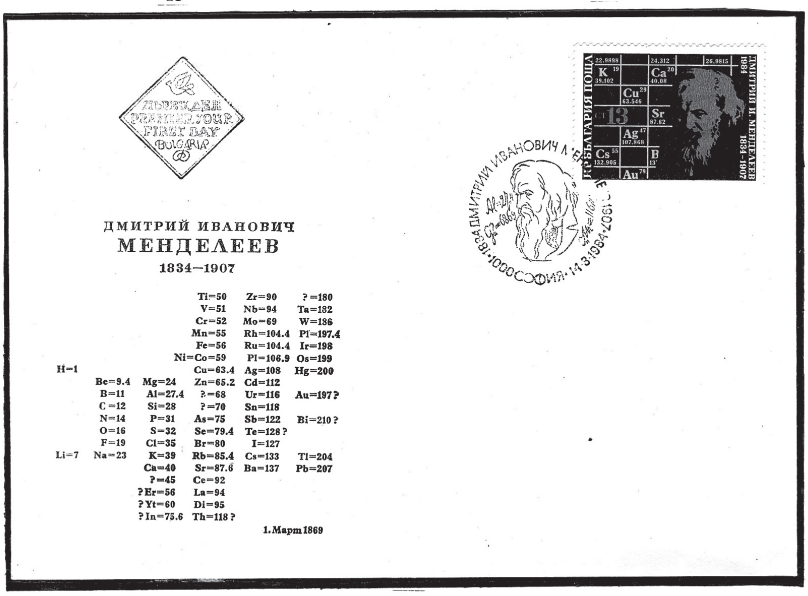

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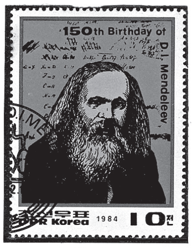
Figs. 12–15

14, the 4 Kp mark envelope was cancelled. It had the same picture as that of 6 Kp (Fig. 12). It is noteworthy that envelopes of such mark were widely spread in the former Soviet Union until the end of 1991, in other words, until the break-down of the Soviet Union – over 20,000 of them had been issued. A month later, during the 10th Mendeleev Anniversary Congress in Leningrad (St. Petersburg presently) on September 23–27 the cancellations of postage stamps and envelopes took place (Fig. 12). The same kind of cancellations also took place in other two cities: D. Mendeleev's native city Tobolsk and the capital Moscow (Figs. 13 and 14).

To finish the discussion about the 6 Kp stamp we, would like to remark that there are three variations of it. There are three different locations of the symbol. For example, the distance of the upper point of the symbol of Al from the text could be 1.0, 1.5 or 2.5 mm. Likewise, the distances also differ underneath. The three variations of the stamp can be seen in the earlier described mark envelopes according to the presented line-up of cities (Figs. 12–14).

The fragments of the periodic system of elements can also be found in a series or stamps issued by some countries in1984 to commemorate the 150th birthday of Mendeleev.

On March 14, 1984, Bulgaria issued a 13 S postage stamp with a special cancellation and FDC (Fig. 15). Mendeleev's portrait appears in the background of the present-day table of periodic system of elements. The background has symbols of some elements of groups I and II (K, Cs, Ca, Sr, B…). First Day Cancellation has facsimiles of the three elements and their corrected atomic masses, discussed earlier in connection with the USSR 6 Kp stamp (Fig. 11). The FDC itself has the same Periodic



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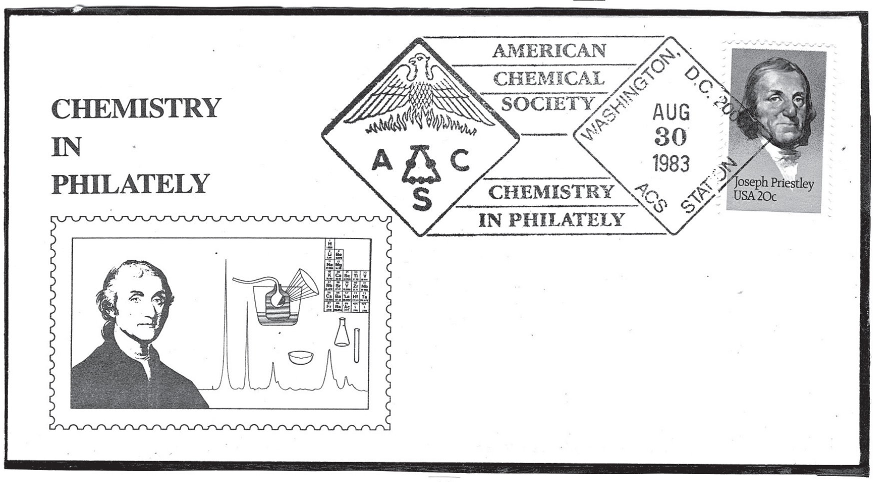

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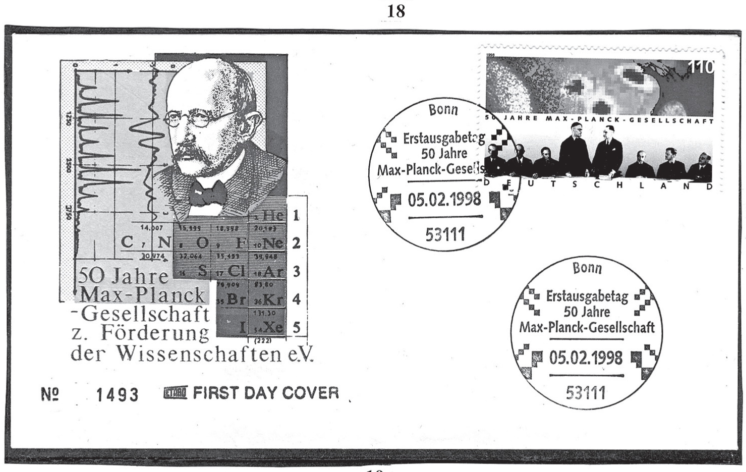

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Figs. 16–19

Table, now printed by typographic method, and which had been mailed to Russian and foreign scientists on March 13 (New Style), or March 1 (Old Style).

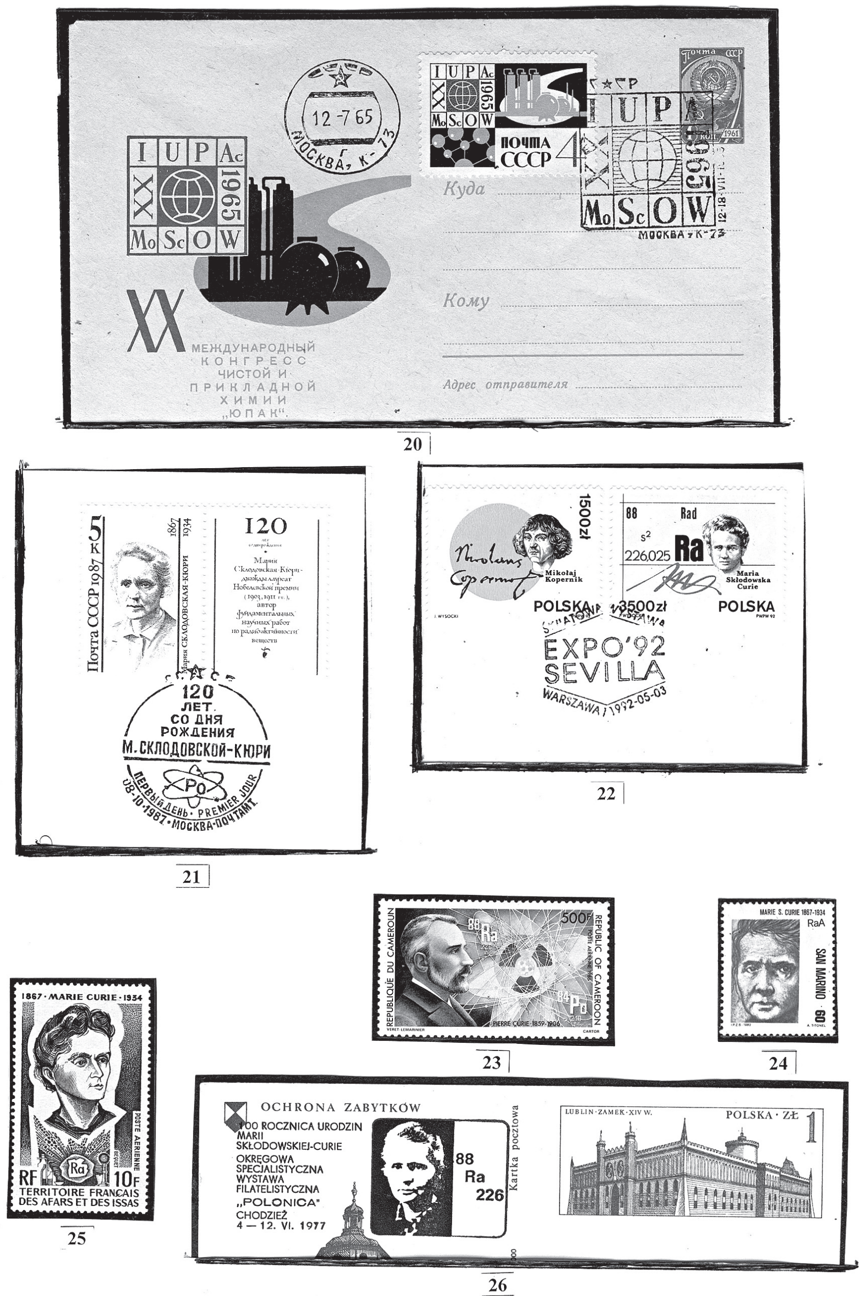
A 10 J stamp, issued by North Korea on December 1, 1984 (Fig. 16), shows the facsimiles of symbols and atomic masses of some elements: on the left side we see Na-23, F-19, O-16, N-14, C and B; while the right site displays Pb-207 and Tl-204. In the background of the 80 J souvenir sheet and of the stamp itself one can faintly discern the fragments of the present-day table of periodic system of elements (Fig. 17).

More or less visible fragments of the Periodic Table can be found in some other stamps; however, they are not related or dedicated to Mendeleev.

A large exposition "Chemistry and Philately" was held in Washington, DC (Washington Convention Center) on August 25–31, 1983. It exhibited 37 collections (26 authors, US Postal Service and Postal Administrations of 10 nations). The American Chemical Society had made available for purchase a special Joseph Priestley cachet envelope that could have been used in connection with the cancellation (Fig. 18). In the envelope, in addition to J. Priestley's portrait, the fragments of expanded Periodic Table are displayed.

A 3,000 Zl denomination postal card, issued in Poland in 1992, showed the Table of Periodic System of Elements and presented the well-known French (of Polish ancestry) chemist and physicist Marie Curie (not shown).

On February 5, 1998, a stamp was released in Germany to mark the 50th Anniversary of the Max Planck Society. The FDC displays M. Planck's portrait and the right upper part of the Periodic Table (Fig. 19).



Figs. 20–26

CHEMICAL ELEMENTS

We can find many symbols of chemical elements in one interesting and original 4 Kp stamp and mark envelope issued in the Soviet Union in 1965 (Fig. 20) in connection with the XXth International Union of Pure and Applied Chemistry (IUPAC) convention in Moscow on July 12–18. The left upper part of this stamp has the convention emblem with an English text (this was proposed by an eminent Russian physicochemist, a future academician, V. Goldansky). Interestingly, the words in the emblem were constructed of the symbols of chemical elements (IUPAc and MoScOW), and inscribed in separate windows, same as in the Periodic Table. Additionally, in this stamp we can see other chemistry-related symbols: a chemical plant in the background of a retort and a fragment of crystal lattice. Both the emblem and the plant view are also imaged on the envelope.

Probably the largest number of the symbols of chemical elements can be found in a 1.10 $ postage stamp issued in 1987 by a small country Grenada in the Caribbean Sea (not shown). This stamp was dedicated to the eminent Swedish chemist Jöns Jacob Berzelius, who was the one, who proposed the presently used literal symbols of chemical elements (in 1814). However, the presentation of the element symbols in this stamp raises some doubts, which were expressed by Z. Rappoport [1]. He remarks that "the semi-alphabetical order (e. g., Cd, Ca, Cf C, Ce, Cl, Cr) follows the complete spelling of the elements names: the appearance of elements such as Cf, No, Es and Md, whereas more important elements such as Al, Hg, As, Sb and Ne are missing, is puzzling. Luckily, the elements discovered by Berzelius do appear in the list".

A consideration of the symbols of elements in philately gives an impression that a comparably great number of postal stamps show the symbols of radium (Ra) and polonium (Po) that are associative with the famous couple Pierre and Marie Curie and their discoveries.

A 5 Kp stamp was issued in the Soviet Union on October 8, 1987 to commemorate the 120th Anniversary of M. Curie's (1867–1934) birthday. The stamp's coupon informs that she received the Nobel Prize two times (in 1903 and in 1911), and that she was the author of fundamental scientific works in the area of radioactive materials. The FDC for this occasion shows Po in the background of the atom symbol (Fig. 21).

The symbol of polonium is also seen in a Polish postal card issued in 1993. The original 5,000 Zl stamp also has Po symbol and M. Curie's portrait (not shown).

On May 3, 1992 Poland issued a four-stamp series in connection with "Expo'92" exhibition in Seville, Spain. One of the stamps – 3,500 Zl – was dedicated to M. Curie and depicted her portrait, the facsimile of her signature and the symbol of Ra, including the element's name, the values of atomic masses and the characteristics of the electronic structure – s^2 (Fig. 22).

A Cameroon stamp (500 Fr) issued in 1986 in the honor of Pierre Curie (1859–1906) shows symbols of Ra and Po, their names and the values of atomic masses (Fig. 23).

The symbol of Radium is also found in postage stamps imaging a portrait of M. Curie, issued in some other countries, for instance, a stamp of 60 L of San Marino (1982) (Fig. 24) and a 10 Fr stamp (Fig. 25) of Afars & Issas. The symbol appears in a Polish postal card with M. Curie's portrait and an additional inscription about the philately exhibition "Polonica" that took place in the city of Chodziez on June 4–12, 1977 (Fig. 26).

On September 18, 1998, in connection with the 100th Anniversary of the discovery of radium and polonium, Poland released a 1.20 Zl postage stamp with portraits of P. and M. Curie. However, the symbols of the elements were not shown, they appeared only on FDC in the background of diaries of the discoverers (Fig. 27).

In 1975 France issued a 1 Fr stamp attributed to the Centenary of the International Meter Convention. Here in the background of the atom symbol in all three cases, i.e. the stamp, first day cancellation and FDC, we find the isotope of krypton ^{86}Kr symbol (Fig. 28). This is in connection with the unit of length – meter. The earlier Pt–Ir prototype (located in France) had the strip width equal to 10 micrometers (10^{-5} m); therefore, there was a considerable error (of 0.1 micrometers) in defining the meter length. Presently, according to the international SI system, a meter is the unit of length equal to 1,650,763.73 wave length, which is emitted by ^{86}Kr, progressing in vacuum from the level of $2p^{10}$ to $5d^5$ (this number is given in the stamp and FDC). Therefore, the use of this emission and the utilization of an interferometer benchmark improves by 10 times the accuracy of the unit of length. In the stamp and the FDC, we also find all basic symbols of the SI system units of measurement.

Many symbols of elements can be seen in an 80 Pf stamp released by FRG on July 14, 1988 and dedicated to the well-known German chemist Leopold Gmelin (1788–1853) in commemoration of his 200th birthday (Fig. 29). The stamp shows the chemist in the background of bookcases. The shelves display his collected compendium of inorganic chemistry that is still being published and updated continuously. On the spines of the books (after a careful examination) one can see the symbols of the elements to which special issues were devoted: I, In, Mo, N, Na, Nb, Se, Si, Sm, Sr and Ta. In addition, many symbols of elements with the Gmelin system numbering can be seen in the first day cancellation: 46-Sn, 47-Pb, 48-V, 49-Nb, 50-Ta, 51-Pa, 52-Cr and 53-Mo. Additionally, a couple of formulas for inorganic chemical compounds are given, namely $CrCl_2$ and $ZnCrO_4$ (Fig. 29).

We also find many symbols in the first day cancellation in connection with the "World Philatelic Exhibition Polska'93" that took place in Poznan, Poland in May 1993 (Fig. 30). In this cancellation, there are 13 symbols of elements: Te, Re, Sr, Ac, J, Sn, Er, Po, Hf, Sb, At, Bi and Pb.

A few positions are given to the elements that are inherent and necessary for agriculture, and are the basic components of fertilizers: potassium (K), phosphorus (P) and nitrogen (N). Very interesting is a post card with an original 14 Kp stamp of the former USSR. It was dedicated to the "VIII International Congress of Mineral Fertilizers (CIEC)", which took place in Moscow on June 21–27, 1976. Here we see the symbols of the three elements (N, P and K) in all possible places: the original stamp itself, first day cancellation and the postcard (Fig. 31). Likewise, in the DDR-released postage stamp series of 1978, one stamp was dedicated to the known German chemist – a pioneer of agrochemistry Justus von Liebig (1803–1873). Here we see the symbols for all the three elements mentioned (Fig. 32).

Belgium issued a six-stamp series in 1955 in the honor of the Belgian scientists. An 80 + 20 C stamp is of importance for us, because here we find a portrait of a Belgian abbot and a discoverer J. J. Dony (1759–1819) and a zinc melting furnace, in the background of which the symbol of element Zn is inscribed (Fig. 33). It must be noted that the extraction method for this metal had been known in China for a long time, but only in 1807 Europe became aware of it when J. J. Dony established that zinc is volatile and constructed a special furnace to extract it.

On the occasion of the 125th anniversary of the discovery of indium in the city of Freiberg, a postal card was issued in 1988 by DDR. It portrays the discoverers of the element: Ferdinand Reich (1799–1882) and Theodor Richter (1824–1894). For this jubilee, the whole month of September was devoted for the cancellation that showed the chemical symbol of indium and basic characteristics of the element (Fig. 34).

The 200th anniversary of the discovery of another element – tungsten – was commemorated by a 16 P postage stamp issued in Spain in 1983 showing it's discoverers brothers – Fausto and Juan de Elhuyar – and the symbol of tungsten W in the background of chemical vessels (Fig. 35).

In 1987 DDR issued a scientists series, a 50 Pf stamp of which was dedicated to a well-known German physicist and the Nobel Prize laureate in physics in 1925 Gustav Hertz (1887–1975). In the stamp, we see an apparatus using mercury, and symbol Hg can be distinguished (Fig. 36).

Also, in the honor of scientists a four-stamp series was issued in the People's Republic of China on April 28, 1988. Among the scientists there is a physicist and educationist Wu Youxun (1897–1977), who made important contributions to the proof of the Compton Effect in the 1920's (Fig. 37). In this stamp we see

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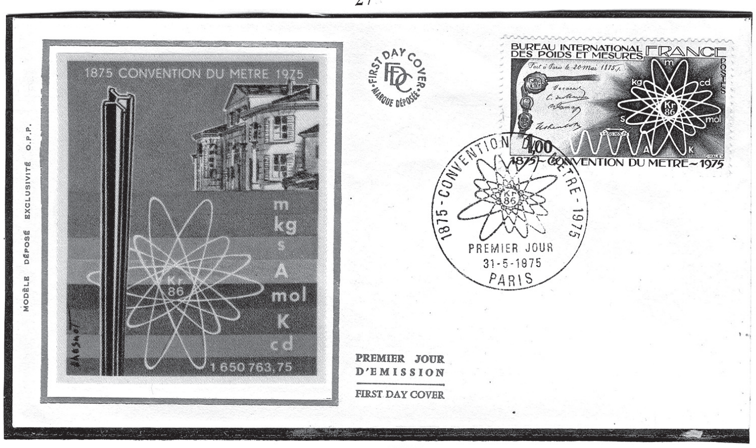

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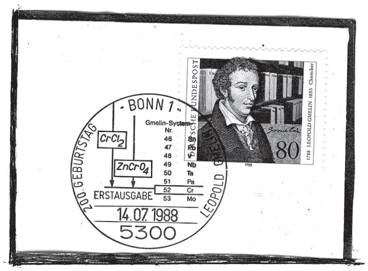

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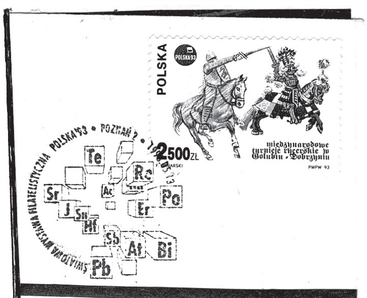

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Figs. 27–30

two rows of element symbols: Li, Be, B, C, Na, Mg, Al and Cl, S, V, Cr, Fe, Ni, Cu.

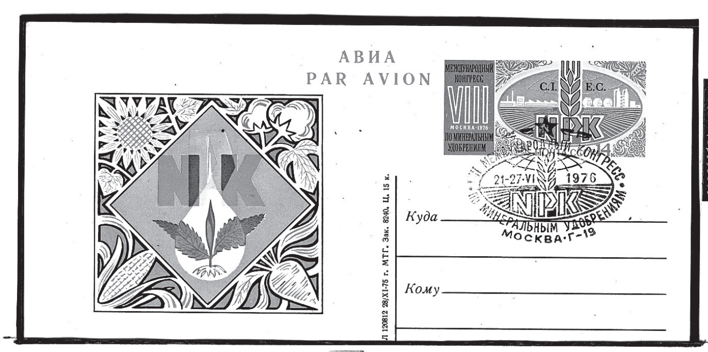
The "III International Conference on the Subject of Titanium" took place in Moscow in 1976. On this occasion, the Soviet Union issued a mark envelope with the symbol of Ti (Fig. 38).

In the beginning of April, 1971, the USSR released a postal card with an original postage stamp dedicated to the "International Geochemistry Congress (IAGC)" at that time taking place in Moscow. On April 28 the second card with a 4 Kp original stamp appeared. In the postal card itself, we see the noted Russian naturalist – chemist, mineralogist and crystallographer Vladimir Vernadskii (1863–1945) and his locution: "Geochemistry is the chemical element history of our planet". The stamp contains four symbols of chemical elements: Ce, Na, Fe and W (Fig. 39).

In the post stamp series dedicated to Nobel Prize Laureates of 1988 (the series was started by Sweden in 1961), one 3.10 Kr stamp (Fig. 40) was dedicated to an American chemist Willard Frank Libby (1908–1980). He received the Nobel Prize in 1960 for his method to use carbon-14 for age determination in archaeology, geology, geophysics and other branches of science. The stamp depicts various archaeological artifacts and the radioactive decay plot of C-14.

The isotope symbols of a few elements (^{13}C, ^{14}C, D, ^{18}O, T and ^{15}N) together with compound formulas (CO_2 and H_2O) are found in a DDR envelope of 1986 (Fig. 41) that was dedicated to the beginning the Antarctic research expedition (1986–1988) in the Soviet polar station Novolazarevskaya pursued by DDR.

The Canadian four-stamp series for science and technology of 1988, dedicated to chemotherapy, presents a radiological



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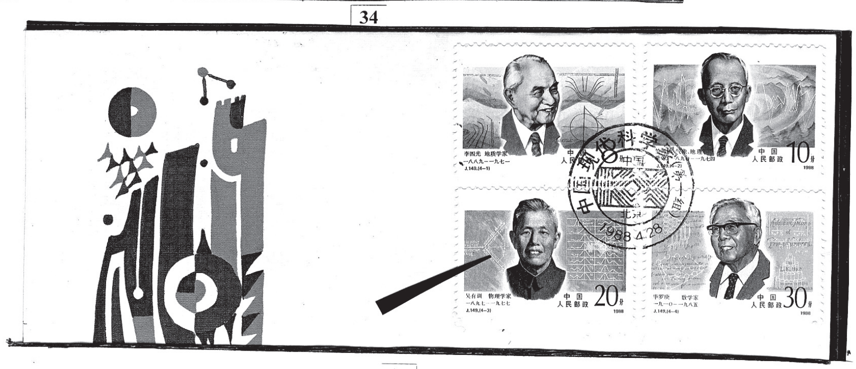

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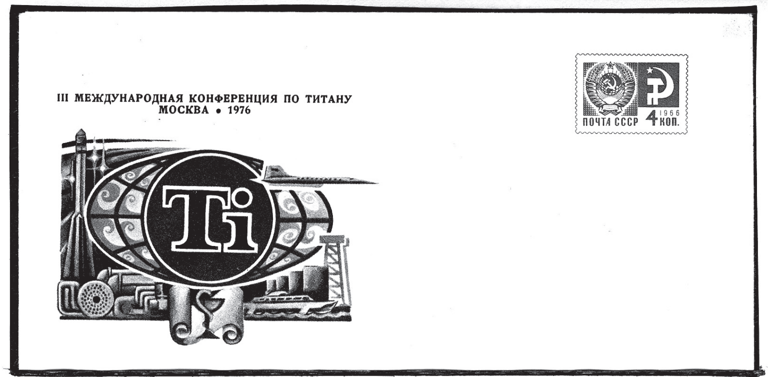
Figs. 31–37

X-ray scheme, where we see the symbols of radioactive ^{60}Co and of ^{60}Ni (Fig. 42).

In 1971, a few countries (New Zealand, Canada, USSR and Romania) issued postage stamps, commemorating the 100^{th} anniversary of the birth of an eminent English physicist Ernest Rutherford (1871–1937). His accomplishments are particularly important to the research of atomic structure. He found the existence of α and β rays (1898), developed the theory of radioactive fission of atoms (1902), explored the nature of α rays and proved them being helium ions (1908), determined the existence of atom nucleus and proposed the planetary model of atoms (1909–1911). In 1919 for the first time he conducted nuclear reactions and proved the possibility of artificial element transmutation and in 1920 he gave the nucleus of hydrogen a name of "proton" and anticipated the existence of neutron. Although he was a physicist, in 1908 he became the laureate of the Nobel Prize in chemistry for his investigations into the disintegration of the elements and the chemistry of radioactive substances. On this occasion, New Zealand (his homeland) issued two stamps, associative with the nuclear reactions. The beginning of these reactions was the investigation of elastic α particle scattering in air performed in 1906, which is depicted in the first 1 c stamp (not shown). These investigations, in turn, enabled the changes of the nucleus of an atom by bombarding it with α particles. As a result, the first artificial transmutation (observed on November 9, 1917 and published in 1919) was performed by bombarding the nitrogen nuclei with α-particles: $^{14}_{7}N + ^{4}_{2}He \rightarrow ^{17}_{8}O + ^{1}_{1}H$. This reaction is shown in the second 7 c stamp (Fig. 43). It should be noted that the nuclear reactions are written the same way as the chemical reactions, except on the left side of the element symbol,



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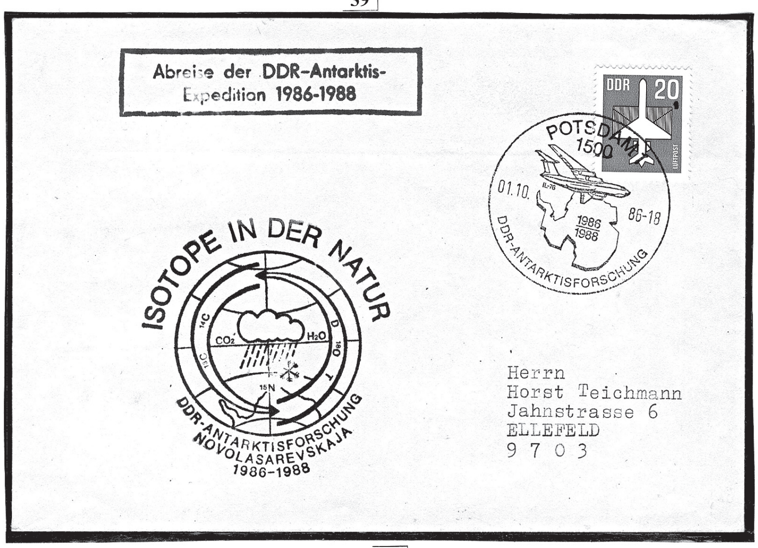


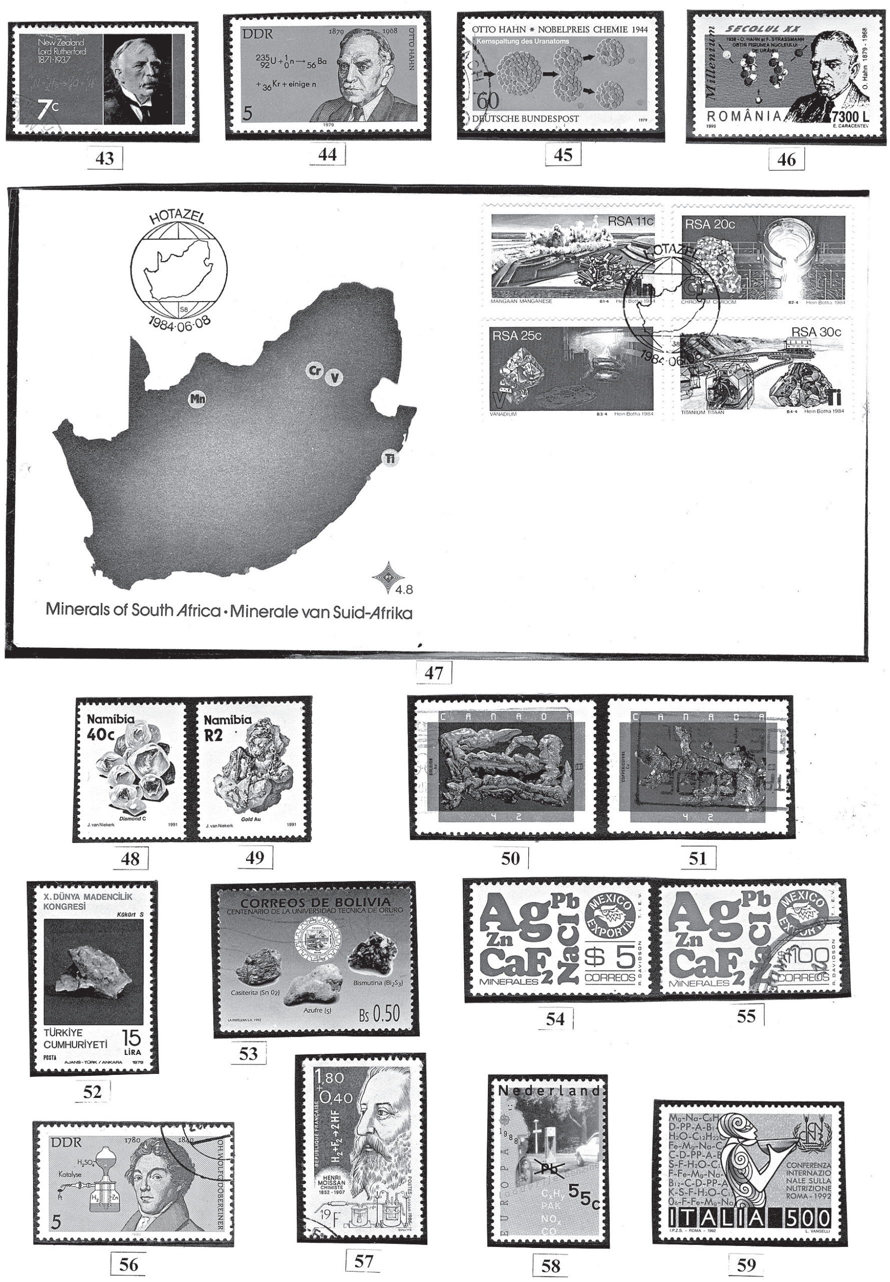
41

42

Figs. 38–42

the mass number is shown above, and the number of protons is given below.

One more nuclear reaction involving symbols of elements is found in a 5 Pf stamp issued by DDR in 1978, which was dedicated to an eminent German chemist Otto Hahn (1879–1969). He was awarded the Nobel Prize in chemistry in 1944 for his discovery of the fission of heavy nuclei. It all started before the Second World War, when on December 22, 1938 he and his assistant Fritz Strassman (1902–1980) discovered uranium fission by an interaction with neutrons. This reaction – $^{235}_{92}U + ^{1}_{0}n \rightarrow {}_{56}Ba + {}_{36}Kr$ + several n – is depicted in the stamp (Fig. 44). The publication, which appeared on February 10, 1939, aroused the interest of scientists all over the world – the experiment was repeated in many laboratories. However, this subject quickly disappeared from the scientific literature, because it was associated with the possibilities of atomic energy utilization. Actually, O. Hahn worked with an Austrian physicist Liza Meintner for over 30 years and already in 1934 he studied the effects of irradiation of uranium and thorium with neutrons (F. Strassmann joined them a year later). When Germany annexed Austria in 1938, L. Meintner, who was of the Jewish ancestry, had to exile to Sweden. She continued working with O. Hahn by correspondence, and theoretically explained the essence of this reaction. On November 15, 1945, the Swedish Academy of Science awarded the Nobel Prize in chemistry in 1944 only to O. Hahn, although L. Meintner probably was also worth receiving it. That is why one scientific research institute in Berlin has been named after O. Hahn and L. Meitner. O. Hahn found out about the reward from the radio in England, where he was a prisoner of war, and received the prize during a ceremony in1946. In fact, in 1966



Figs. 43–59

O. Hahn, F. Strassman and L. Meitner received the Fermi Reward of the U. S. Atomic Energy Commission and were the first foreign scientists to receive this honor. Additionally, the nuclear fission is depicted on stamps of FRG issued in 1979 (Fig. 45) and stamps of Rumania issued in 1999 (Fig. 46), all of them being dedicated to O. Hahn.

Quite a few chemical element symbols can be found in postage stamps associated with minerals. A four-stamp series issued in the Republic of South Africa on June 8, 1984 is worth mentioning. The stamps image minerals without their names, giving only the symbols of basic elements – Mn, Cr, V and Ti. The same symbols are also found in FDC. Here, on the country map, the stamps show places where the minerals are found (Fig. 47).

In stamps of Southwestern Africa (SWA) of 1989 and in analogous Namibian (former SWA) stamps of 1991, we see C (mineral–diamond) and Au symbols (Figs. 48 and 49); in the Canadian mineral series of 1992 – Au and Cu (Figs. 50 and 51); in the Turkish stamps of 1979 and in the Bolivian stamps issued in 1979 – S (Figs. 52 and 53). In 1978 Mexico started issuing a large postage stamp series dedicated to the export, in which a 5 P denomination stamp was devoted to minerals. The symbols Ag, Pb, Zn and formulas NaCl, CaF_2 were given (Fig. 54). In 1989 an analogous stamp of different (1,100 P) denomination was issued (Fig. 55).

A few more postal miniatures could be mentioned, where in addition to the symbols of elements, formulas of compounds are shown.

In a postage stamp series released by DDR in 1978, one stamp was devoted to an eminent German chemist Johann Wolfgang Dobereiner (1780–1849). His research dealt with problems of the classification of chemical elements, such as

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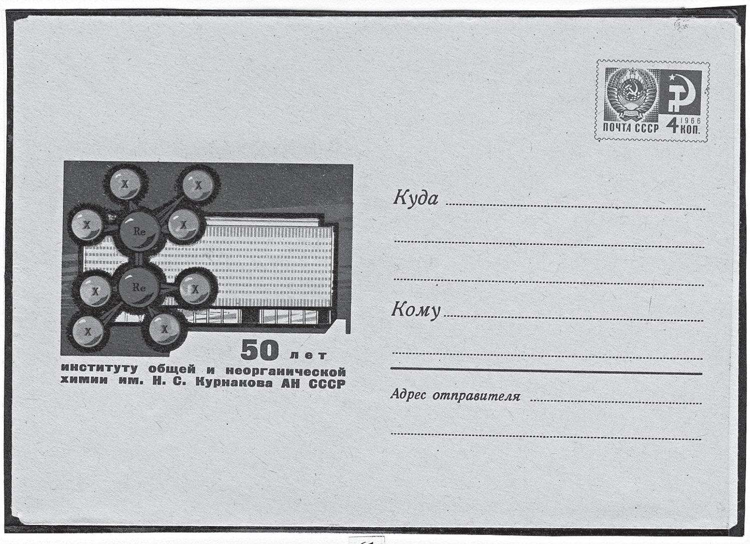

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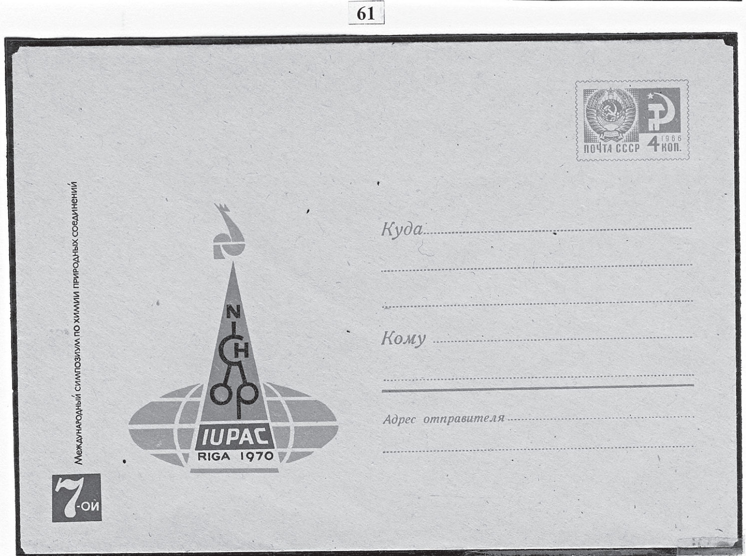

62

Figs. 60–62

the "triad rule" and the explanation of platinum-induced (especially platinum black) miscellaneous catalytic processes. In the stamp, we see an apparatus used for these purposes, and the symbols of the employed and obtained materials (Zn, Pt, H_2SO_4, H_2) (Fig. 56).

In 1986 France issued a 1.80 + 0.40 Fr postage stamp dedicated to a well-known chemist Henri Moissan (1852–1907). He received the Nobel Prize in chemistry in acknowledgement of the great services rendered by him in his investigation and isolation of the element fluorine. The stamp was issued to commemorate the centenary of the discovery that was made by him on June 26, 1886. In the stamp (Fig. 57) we see fluorine symbol ^{19}F, the electrolysis apparatus and the equation for the highly exothermic reaction of hydrogen and fluorine. This is an error, because the direction of the reaction shown is reversed.

A stamp of 55 c (Fig. 58) appeared in Holland in 1988. It was related to the environmental protection. The stamp shows formulas of hazardous chemicals damaging the environment – air pollutants related to gasoline (C_xH_y, PAK-polyaromatic hydrocarbons, NO_x and CO), the words "lead-free gasoline" in Dutch and the symbol of lead (Pb) crossed out in red.

In connection with the "International Food Conference" in Rome in 1992, Italy released a 500 L postal stamp (Fig. 59), where we see recurrent symbols of six elements – Mg, Na, Fe, K, S, and F. Besides, the formula of water (H_2O), fragments of some organic compounds ($C_6H\ldots$, $C_{12}H_{22\ldots,\ldots}O_6$) and the designations of vitamins (D, PP, A, B_1, B_{12}, C) are presented.

A cancellation, which showed a chemical reaction $2HgO = 2Hg + O_2$ (not shown), was conducted in Birmingham, England on November 7, 1974. This cancellation was devoted to an English chemist and philosopher Joseph Priestley (1733–1804), and commemorated the 200th anniversary of the method to obtain oxygen according to the above reaction discovered by him. The truth is that J. Priestly himself was a devotee of the theory of phlogiston, and called the separated gas "dephlogistoned air". In 1794 due to political victimization, he immigrated to the USA, and did not practice chemistry anymore. On April 13, 1983, a 10 c stamp dedicated to him was issued in the USA, which is shown in the earlier discussed envelope with his portrait and stamp (Fig. 18).

In conclusion, a couple of USSR mark envelopes with element symbols can be mentioned. Commemorating the 50th Anniversary of the N. Kurnakov Institute of General and Inorganic Chemistry a 4 Kp stamp (Fig. 60) and a mark envelope with an identical painting (Fig. 61) were issued in 1968. They show the complex anion of rhenium (marked with symbol Re) synthesized in this institute with two Re central atoms and most likely halogen ions (marked X) as ligands. Therefore, the formula for this anion should be $[Re_2X_8]^2$. The "International Chemistry Symposium of Natural Compounds" took place in Riga, the capital of Latvia, in 1970. A mark envelope (Fig. 62) was issued on this occasion. It showed no organic compound, but we can clearly see the symbols of atoms found in organic compounds – nitrogen (N) and hydrogen (H). Besides, one can imagine there the presence of carbon (C) and oxygen (O) symbols.

CONCLUSIONS

To summarize our material, we can say that there are no less than 80 philatelic issues with the symbols of chemical elements: 56 postage stamps, 10 cancellations, 15 FDC's, envelopes or postal cards and 2 souvenir sheets from 33 countries. As for the countries, the majority was issued in USSR – 17, DDR and Poland – 6; USA had only one – the special Joseph Priestley cachet envelope (Fig. 18).

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CHEMIJA FILATELIJOJE
1. CHEMINIŲ ELEMENTŲ SIMBOLIAI

Santrauka

Pateikiami ir aptariami filatelijoje surinkti duomenys apie alcheminius simbolius, cheminių elementų simbolius bei Periodinę cheminių elementų lentelę. Straipsnis iliustruotas daugiau nei 60-čia pašto ženklų, atvirlaiškių, vokų ir proginių pašto ženklų antspaudų.