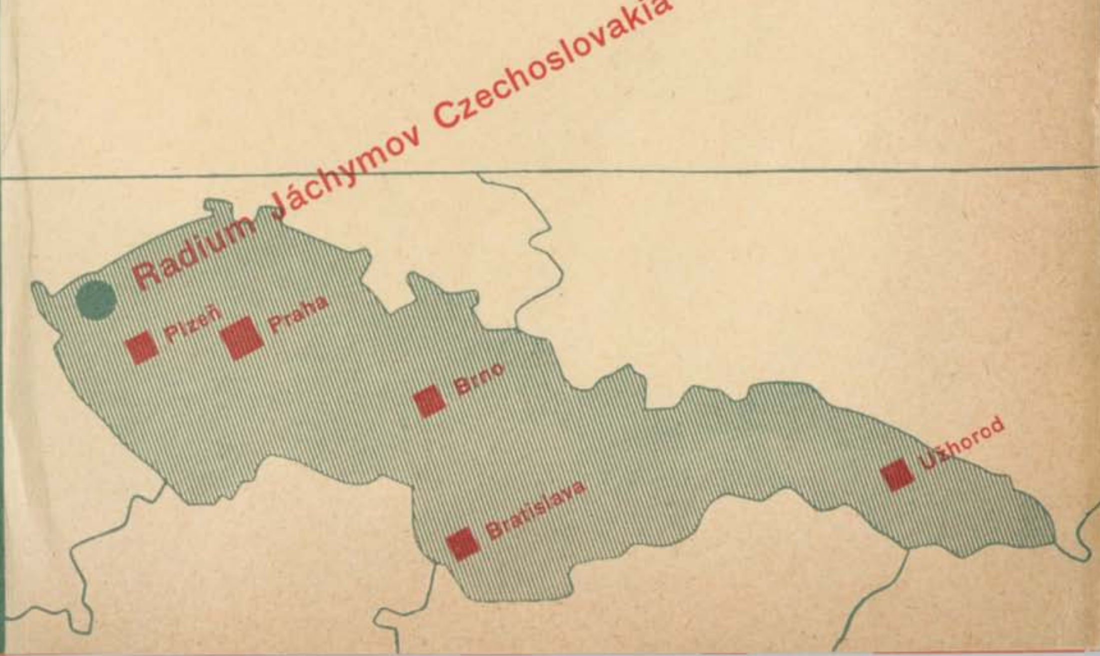
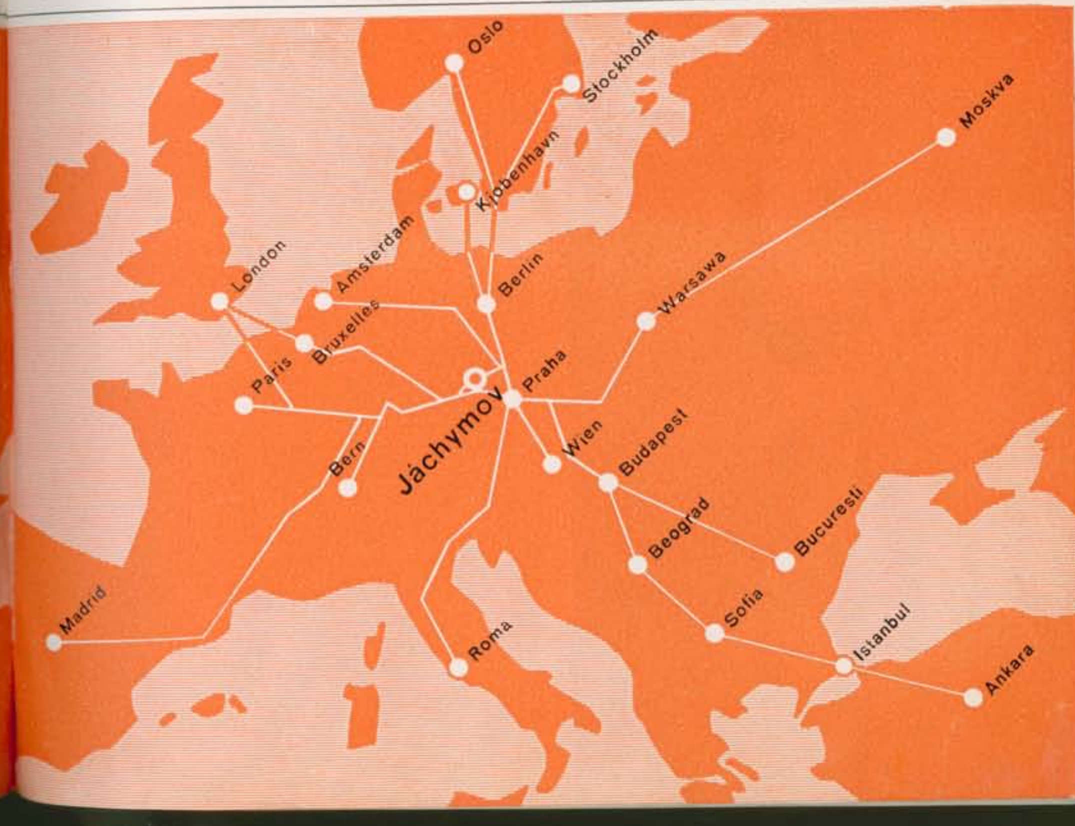
Ra


Radium Jáchymov Czechoslovakia
Plzeň
Praha
Brno
Bratislava
Užhorod


Jáchymov
Czechoslovakia


Oslo
Stockholm
Moskva
København
Amsterdam
London
Berlin
Warsawa
Bruxelles
Paris
Praha
Jáchymov
Wien
Budapest
Bern
Beograd
Bucuresti
Madrid
Sofia
Roma
Istanbul
Ankara

The Radium preparation
in its original packing

Radium-Jáchymov

Czechoslovakia

Contents

Czechoslovakia

Prague 1933
Published by the Ministry of Public Works
of the Czechoslovak Republic
●
Typographical arrangement by Ladislav Sutnar

View of Jáchymov

View of Jáchymov
A part of the uranium factory (in lower right hand corner)

1

Radioactive Elements

Through Becquerel's discovery in the year 1896 and through others, depending on the same, especially those of M. and Mme. CURIE and Messrs. Rutherford and Soddy, a series of chemical elements was completed to 40 members in the last three decades. This group differs from other chemical elements by the instability of their atoms, which break rapidly and spontaneously into atoms of other elements, which means, that in certain sequence they alter themselves one into the other.
As these atom alterings are accompanied by radiation, the entire group of these elements was called "the radioactive elements" (radiating).

2

Radium

Of the greatest practical significance of these elements is Radium, having chemical symbol Ra and atomical weight 226. Its chemical property as well as the property of its combinations is nearly identical with that of barium, so that together with strontium and with calcium they form a certain group of alkali earth metals. In the elementary form it is a silver-glittering metal, melting at approximately 700° C. It changes quickly when exposed to air combining with nitrogen as well as water vapor. For that reason it is kept only in the form of compounds. (Chloride, bromide, sulphate, etc.)
Even though its chemical properties are of quite regular character, its physical properties are so remarkable that it drew the attention of the entire world.
Radium salts are colorless in their fresh state, but with age they take on color.
When regarded in darkness, they not only shine by their own light, but they also bring out the phosphorescence of many other substances (diamond, sulphide of zinc, willemite, troostite, kunzite, platinocyanide of potassium, etc.) An especially strong effect is to be seen on a photographic plate. But the most sensitive medium of discovering Radium is the electroscope. By approaching the inner electrode with the slightest trace of Radium, it unloads itself almost immediately.

3

Discovery of Radioactivity

Discovery of radioactivity is connected closely with the discovery of X-Rays by Röntgen in the year 1895. These rays, thanks to their wonderful qualities, created in their time not only a sensation, but also drew the attention of the entire scientific world to the luminous phenomena.

Impressed by the strong fluorescence of the Röntgen glasstubes, Poincaré, a French physicist, ventured the opinion that perhaps almost every fluorescent substance is able to emit Röntgen's X-Rays.

This theory seemed to another French physicist, Becquerel by name, so remarkable that he undertook to examine it experimentally.

Being occupied for some time previous with the study of the fluorescency of various uranium compounds, he used for this purpose crystals of double sulphate of uranyl and potassium.

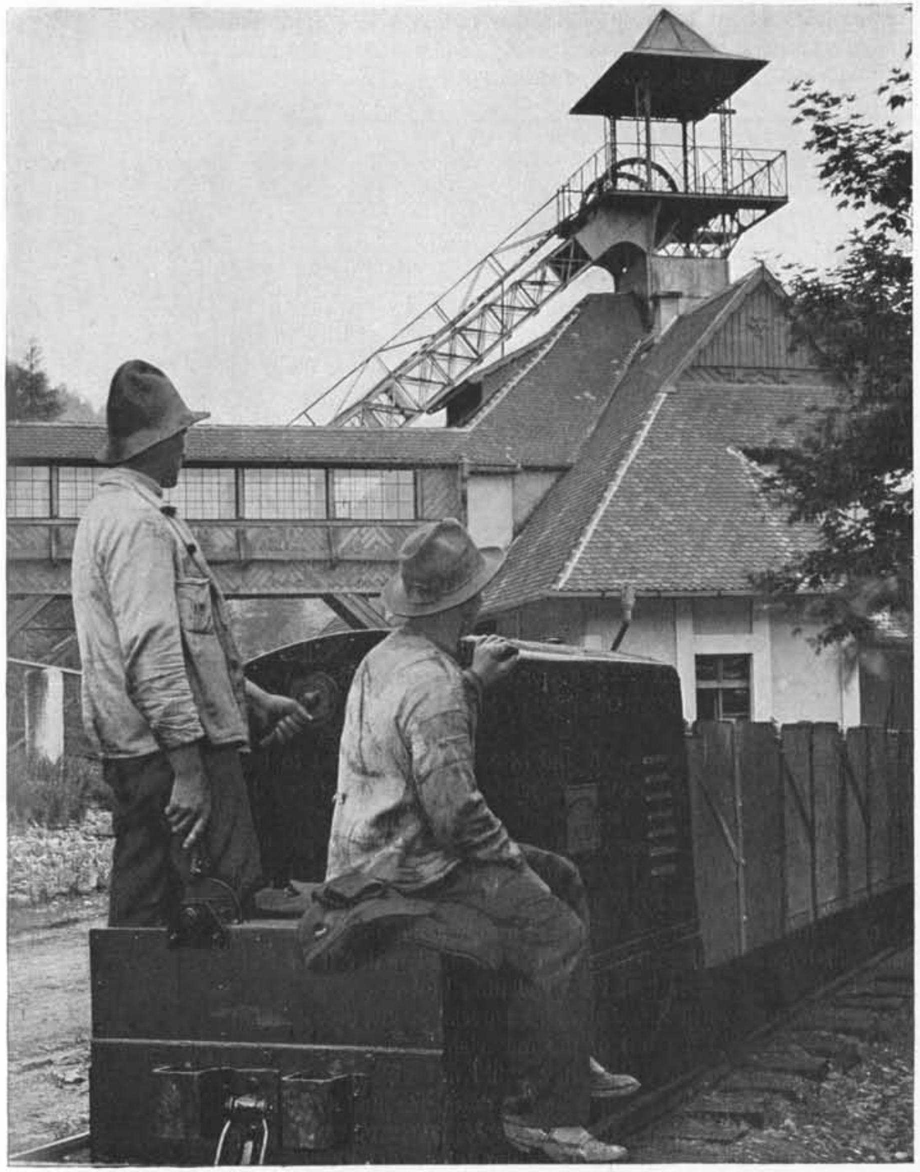
The crystals of uranyl salt were put on a photographic plate, which was enveloped in black paper and covered with a lead plate. Supposing that in this way the aroused Röntgen rays would penetrate through the covering of the photographic plate, he let the sunlight fall on this salt for a longer period of time.

After developing there appeared on the photographic plate actual silhouettes of the salt crystals.

One day, while repeating this experiment, the sky was dark and Becquerel, having insufficient sunlight, provisorily inserted a new covered photographic plate, which was being prepared for an experiment and which was covered with crystals of uranyl salt, into a slide.

The sky cleared three days afterward. When the sun began to shine, he commenced to experiment again; through carefulness developed the plate which had been closed for three days in the slide. To his surprise he found that the silhouettes of the crystals were to be seen more distinctly than in the experiments in which the uranyl salt was exposed to the sunlight.

By these experiments he proved in the year 1896 that Poincaré's hypothesis was wrong, discovering also that the uranyl salts were emitting quite spontaneously penetrating rays similar to Röntgen's X-Rays, without however being previously illuminated by sunlight. Henry Becquerel also noticed other important properties—that uranium radiation makes the air a conductor of electricity so that insulated objects, charged with electricity, lose their electrical charge upon proximity to uranium or its compounds, the same as when illuminated by Röntgen rays. This behaviour is of great importance. On the basis of these properties he could make exact



Concord Mine

comparisons of the intensity of the new radiation by placing the uranium preparations into an electroscope and observing the rapidity with which the electroscope discharged.

4

The Discovery of Radium

Through the adaptation of the electroscope, by increasing its sensitivity, M. and Mme. CURIE found that the activity of the compounds of uranium is merely proportional to the quantity of uranium contained in them.

Therefore they were surprised to find the activity in different minerals of uranium in a much greater degree than should be on this basis of percentual content of uranium.

For example, pitchblende from Jáchymov showed a five times greater radioactivity than expected. M. and Mme. Curie explained this phenomena by the supposition that the examined minerals contained some other material or materials, which were more active than the uranium itself.

Since through chemical processes they did not discover a new material, they supposed such material to be present in a very small quantity but with an enormous radiating power in comparison to uranium.

Led by these suppositions, M. and Mme. Curie decided to isolate this unknown, mysterious material. The pitchblende of Jáchymov was used in this experiment.

They acquired, after an exhausting work, a very active product, a compound of barium. (1898) Barium is a chemical element, known to chemists more than 100 years, but without activity. Both scientists, remaining steadfast in their hypothesis, named this still hypothetical radiation of the affected material of isolated barium-radium — that is, a radiating body.

To be able to prove this new element experimentally, they decided to work up a large amount of the material.

Instead of pitchblende, which they could not obtain due to its high price, they chose as substitute material insoluble residues, which are to be found in abundance in Jáchymov as waste after working up the pitchblende into uranium colors. (The radioactive residues).

They believed that Radium, which was not easily separable from Barium by simple chemical processes, remained in these residues resulting from the disintegration of pitchblende by sulphuric acid and that it changed, being affected by this sulphuric acid, into an insoluble sulphate similar to Barium.

When a laboratorial experiment showed a favorable result, they began to work up about 1000 kilos of radioactive residues from Jáchymov, which were given them by the ex-government of Austria.

After a slow and tedious work (the original process of which will be described in the discussion on the production of Radium) conducted in a French factory, they finally succeeded in 1902 in winning a 0·1 mg of the long awaited and really new element of Radium in the form of a chloride, the activity of which was at least a million times greater than that of uranium.

Thus they excellently proved their enterprise.

5

Production of Radium in Jáchymov

Radium is produced in the state factory in Jáchymov, which is situated between the radium-bathing establishment and the pavillon for irradiation.

The ore from which the Radium is produced here is known as pitchblende. In pure state it is a black mineral of pitch lustre, very heavy, chemically in substance an oxide of uranium U_3O_8, containing about 65% of uranium.

The pitchblende, partially mixed with ambient ores and other compound materials with which it is associated, is worked up in the factory, so that this ore generally has only about 50% of uranium. In 10,000 kilos of ore there is to be found only 1 gramme of Radium.

As the pitchblende is hardly soluble in acids, it is first burned with soda and nitrate. In this way it is changed into uranium, which is a compound easily soluble in any acid.

This burned ore is then dissolved in sulphuric acid. In this way $^2/_3$ of this mass comes into a solution containing the uranium and $^1/_3$ remains insoluble; these are the so-called radioactive residues* in which is now found all Radium, originally contained in the ore in the form of a hardly soluble sulphate. (From this uranium solution are prepared various compounds, for instance uranium colours, which in the glass and ceramic industries serve for colouring glass and various porcelains, etc. The radioactive residues are first purified by boiling with lye and an extract of a raw acid salt. By this method all materials, which might disturb the next isolation of Radium are removed.

The residues, purified in this way, are boiled with soda, by which means the radium sulphate contained in them changes into carbonate.

*These residues serve for making radioactive pads, which are put on places attacked with rheumatism, ischias and many other diseases.

Hoisting equipment
Concord Mine
●
Ore transportation in the mine

→

Drilling with pneumatic hammer in the mine

This product after a thorough purification is dissolved by salt-acid, whereby the Radium carbonate with some other material changes into a chloride solution, which is separated through filtration from the insoluble residues leaving the residues deprived of Radium.
The filtered solution called Radium lye is precipitated by sulphuric acid, whereby the Radium is partially separated from the materials which have accompanied it until now. The excluded sulphates (called the raw sulphates) besides containing Radium and barium sulphate, also contain lead sulphates and calcium.
These sulphates are again changed, by boiling with soda, followed by disintegration with salt acid, into a chloride solution which is now purified by various methods so that finally a mixture is achieved consisting only of barium chlorides and Radium, from which, through many repeated difficult crystallizations, the Radium is deprived of barium.
The almost pure Radium-Chloride gained in this way, is sealed into glass-tubes, its contents exactly measured, and put on the market.

6

Parent Elements of Radium

Of all the radioactive elements being used in therapy, those mostly employed are Radium salts because of their constant intensity of radiation. However the Radium preparations weaken with age. Out of every gram of Radium during one second 37 billion atoms will decay which means that in 25 years out of every amount a decrease of 1% of its original amount will take place.
The so-called period of semi-decay called "the period" in which the fixed quantity of Radium will decay 50% of its original quantity amounts to about 1,590 years. This disintegrating property of the atoms of radioactive substances proceeds spontaneously. In every radioactive element it is a constant characteristic, the speed of which it is not possible to influence in any way.
The final product of this radioactive disintegration is lead. The radioactive products of the parent elements are described on the chart which follows. Most of these elements have but a short durance. Therefore we know only their "period" and their type of radiation.
In other words, the Radium atoms after having made 8 different changes, have changed themselves into common lead. We must mention that the marking Radium A (Ra A), B a. s. is purely of a genetical character. It signifies in what sequence the mentioned atoms emanate from Radium, respectively the Radium emanations. Their chemical properties have nothing in common with Radium.
Ra B and Ra D are isotopes of lead, which means that their properties are identical with those of lead and that nothing can separate them from lead.
Ra E and Ra C are isotopes of bismuth, Ra A and Ra C are isotopes of polonium.

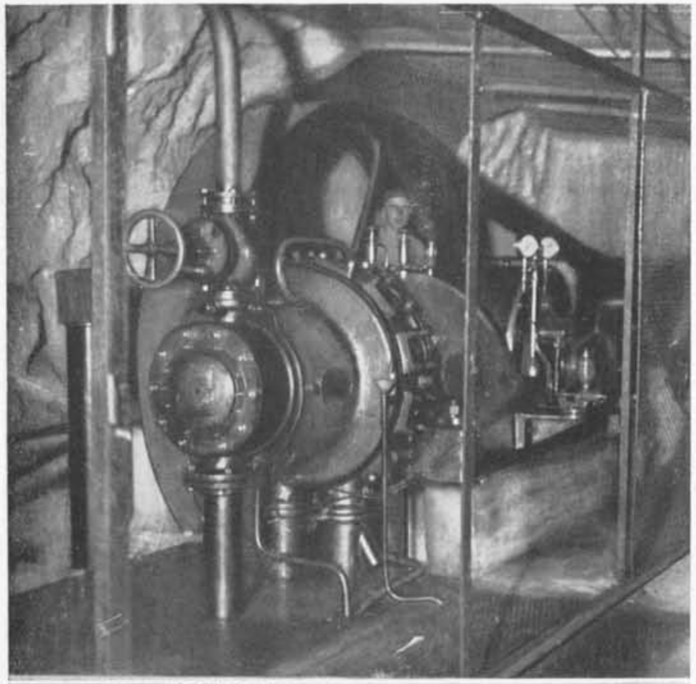
Element	Atomic weight	Half Life Period	Type of radiation
Radium	226	1590 years	α, β, γ
Radium emanation (radon)	222	3·82 days	α
Radium A	218	3 minutes	α
Radium B	214	26·8 minutes	β, γ
Radium C	214	19·7 minutes	α, β, γ
Radium D	210	22 years	β, γ weak
Radium E	210	5 days	β, γ
Radium F (polonium)	210	140 days	α
Radium G (lead)	206	infinite	—

7

Origin of Radium

During 16,000 years any quantity of isolated Radium will change completely into inactive lead. Now, everyone would like to know, how it is possible that we are still finding Radium to-day in nature, although the geologists estimate the age of the earth's crust to be many millions of years.
For explanation it is necessary to say that it was proved after long and careful work that Radium originated from uranium just as lead from Radium. Therefore to-day we find Radium in minerals containing only uranium.
For this purpose we place here a list of uranium parents, which shows in what form Radium is yielded up by nature at the present time.

Element	Atomic weight	Half Life Period	Type of radiation
Uran I	238·2	4.4×10^9 years	α
U X_1	234	24·5 days	β
U X_2	234	1·14 minutes	β, γ
Uran II	234	3×10^5 years	α
Ionium	230	8.3×10^4 years	α
Radium	226	1590 years	α, β, γ
:	:	:	:
Lead Ra G	206	∞	ø



Mining pump
●
Ore Dressing Department at the "Saxon Noblemen" Mine

8

Radioactive Radiation

The physical effect of Radium consists of radiation. Through detailed study it was found that the rays being emitted by Radium, are not homogenous and that they differ in three distinct types of rays designated by the terms α β γ.

The rays α deviate through the electrical or magnetical field, from their original straight movement. It was to be seen from the size and the direction of deviation that they were small and positively charged material particles which moved very quickly. Their initial speed is about 100,000 times greater than the speed of a bullet from a Browning rifle, that is, about 20,000 km per second.

The α particles in air quickly lose their speed, being influenced by atomical power. This speed after having traveled some cms, drops to the common speed of molecules. At this time the α particles do not differ from the other gas molecules. The length of the path (traversed from the beginning up to the time when the α particles no longer differ from other molecules) we call the "reach of rays". This reach varies from 2 to 11 cms, according to the element which is emitting the α particles.

It is evident that all substances heavier than gas, (this means every liquid or solid substance) stops the α particles faster than air. In the same way as in α rays, it was found that the β rays are fast moving, negatively charged elemental particles, this means, certain atoms of electricity, often called "ELECTRONS". They are shot out from the nucleus of radioactive elements about 15 times faster than α particles, so that their initial speed is nearly equal to light speed, that is 300,000 km per second. Nevertheless they are completely absorbed by an aluminium board of 5 mm thickness.

The γ rays are their constant companions. Between the β and γ rays there exists the same relation as between the cathode rays and the Röntgen.

The γ rays are, therefore, of an electromagnetical vibration of considerable frequency. Their speed is equal to the speed of light rays and are so penetrating that they are completely absorbed only by a lead board of 10—15 cms thickness.

Although the γ rays represent 5% of the energy irradiated by Radium alone, still they are, thanks to their penetration, the principal agent in therapy.

9
Secondary Radiation

Between the material and electromagnetical rays of Radium there exists a far reaching internal relation.
For example the γ rays originate always when β particles are hindered in their movement by certain substances. Reciprocally, the passing of γ rays through a substance results in the splitting of electrons from the attacked atoms of the substance. In this way the so-called secondary β rays originate, which as far as their energy suffices, arouse again the secondary γ rays etc.
These secondarily aroused β and γ rays all together are called SECONDARY RADIATION. To this secondary radiation we attribute the principal therapeutic effect of Radium rays on the cellular tissues of organism.

10
Absorption of Beta Rays

The rays, passing through some given substance are slowly absorbed by the same; the degree of the absorption depends not only upon the type of rays and their speed, but also upon the type and thickness of the material through which they are passing. If the rays penetrate a layer of aluminium having 0·5 mm of thickness and if their intensity weakens to 50% of their original

Table of absorption of β Radium rays

Substances	D per mm	P (thickness, necessary for complete absorption)
Water, Soft tissue, Gum Rubber	1·2	12
Bone	0·72	7·2
Glass (common), Aluminium	0·52	5·2
Brass	0·16	1·6
Copper, Nickel	0·15	1·5
Silver	0·13	1·3
Lead	0·12	1·2
Gold	0·07	0·7
Platinum	0·06	0·6

value, we say that the "halfthickness" of aluminium for these β rays mentioned amounts to 0·5 mm.
The tenfold thickness of aluminium practically absorbs these rays mentioned almost completely.
The following table indicates the "half-thickness" D of various materials in mm, this means, the thickness which is necessary to filter off the 50% hard β rays being emitted by the Radium B and Radium C.
The tenfold thickness P absorbs these rays almost completely.

11
Absorption of Gamma Rays

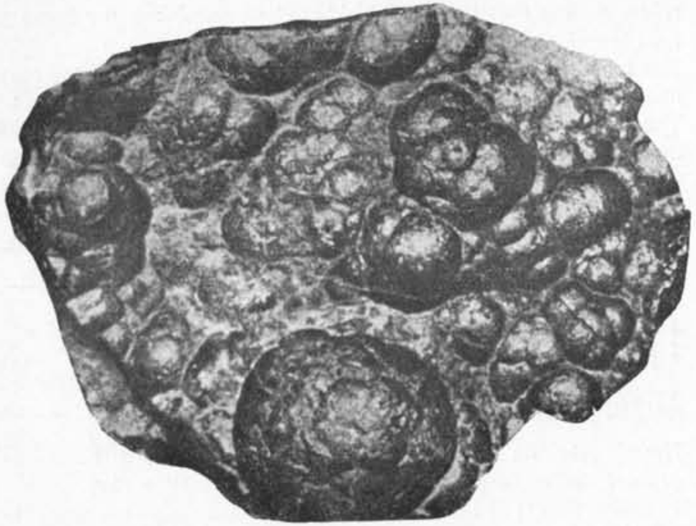
The shorter the length of their wave or the higher their frequency, the more penetrable or harder are their γ rays.
The wave length of the most penetrating Radium γ rays amounts to $5 \cdot 10^{-11}$ cms.
The degree of their absorption through various materials and various thicknesses is shown in the following table:

Table of absorption of γ hard Radium rays

Substance	Percentage amount of hard γ rays absorbed					
	0·1 mm	0·25 mm	0·5 mm	1 mm	2 mm	3 mm
Water, Soft tissue, Gum Rubber	0·05	0·12	0·3	0·5	0·9	1·4
Bone	0·1	0·22	0·45	0·9	1·8	2·7
Glass, Aluminium	0·1	0·25	0·55	1·0	2·0	3·0
Copper, Nickel	0·40	1·10	2·2	3·9	7·6	11·2
Silver	0·45	1·15	2·3	4·5	9·0	12·8
Lead	0·5	1·25	2·5	4·9	9·5	14·0
Gold	0·9	2·25	4·5	8·6	16·4	23·6
Platinum	1·2	3·0	6·0	11·5	—	—

12
Measurement

The measurement of Radium preparations is performed with the help of physical methods.
The radiation of Radium preparations effects an electrical conduc-



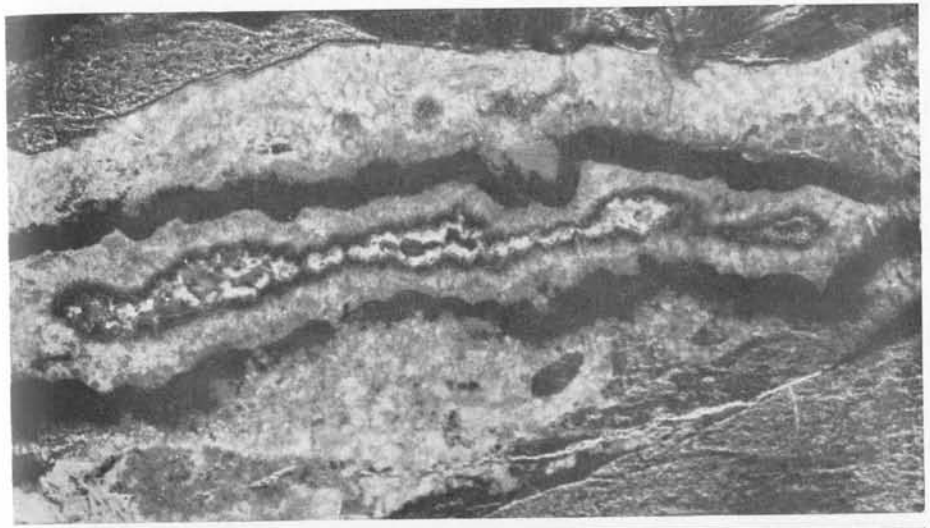
Pitchblende

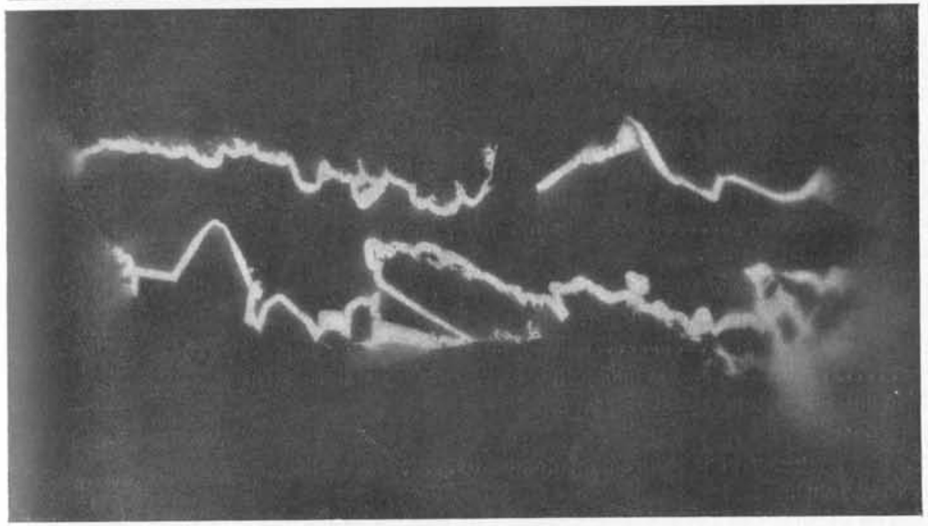
tibility or ionization of the surrounding air. The intensity of this ionization is proportional to the quantity of Radium. This ionization intensity can be easily and accurately measured by means of sensitive electroscopes.

A preparation containing an unknown quantity of Radium is compared under the same conditions with the so-called "Standard", an internationally recognized preparation, containing a correctly known quantity of Radium. From the fixed speeds of the diminishing electrical charges of the electroscopes, one can set up the contents of Radium, which is to be found in the compared preparation. These measurements are performed in the State Radiological Institute of the Czechoslovak Republic.

As a comparing unit for measurement a Secondary International Radium Standard is used, prepared from the Radium from Jáchymov, which doesn't contain any MESOTHORIUM. This Radium Standard, containing 25 mg Radium element was compared with the Primary International Radium Standard, which is kept in Sèvres and also has been measured at Cambridge and in Vienna. The certificate of this Radium Standard is signed by Mme. CURIE, Lord Rutherford and Professor S. Meyer, the head of the Radiological Institute in Vienna.

Every Radium preparation, put on the market by Státní prodejna báňských a hutnických výrobků (State Sales Department for Mining and Metallurgical Products at Prague) Praha, is accompanied by a certificate from the State Radiological Institute of the Czechoslovak Republic in Prague, which reads as follows:





Small vein of pitchblende grown into vein filling

●

Radiogram

State Radiological Institute of the Czechoslovak Republic at Prague

CERTIFICATE No........................ Prague, the ....

Concerning the quantity of Radium element contained in the preparation belonging to Mr. ....
and brought to State Radiological Institute by Mr. ....

Description of preparation

The presented preparation is sealed ....
and contains according to the report of the deliverer ....

Measurement method

Measurement is performed by means of gamma rays. The preparation is compared with the Radium Standard of the State Radiological Institute. If the preparation is not of a radioactive equilibrium, then the maximum intensity of the radiation will result in the computation with other measurements.

Measurement results

The maximum intensity of gamma rays penetrating through the cover of the preparation is equivalent to the intensity of....... milligrammes of Radium element. Measurement was made..... times.

Correction regarding the absorption of gamma rays

Through the computation of correction it has been found, that the absorption of gamma rays in the preparation itself and in its cover amounts to ....% gamma rays, which are emitted from the preparation.

Amount of the Radium-element

From the performed measurement it is to be seen that the preparation contains .... milligrammes of Radium element or .... milligrammes of Radium Chloride (or Radium Sulphate).

Remarks:

1. The accuracy of measurement comes to ...... % of the resulting value.
2. The accuracy of the measured content of Radium in the presented preparation presupposes that the preparation contains only the parents of Radium-element.
3. Concerning the preparation:

This certificate is issued in original only; its copy is never issued. It must be attached to the preparation which is provided with a seal of the State Radiological Institute of Prague and marked with the number ....

Measured by:

The Chief of the State Radiological Institute (Chief's signature)

Seal of the State Radiological Institute in the Republic of Czechoslovakia.

13

Purity of Radium from Jáchymov

The Radium preparations prepared in the State Radium factory in Jáchymov are distinguished by absolute purity and they do not contain the smallest trace of Mesothorium.

The ore used for the manufacture of Jáchymov-Radium is always of the same origin as it is extracted from the pitchblende deposit in Jáchymov.

By eminent scientists, for instance by Professor Soddy, (Oxford) Professor Meyer (Vienna), and many others, it was proved through many experiments, that the Radium from Jáchymov is the purest in the world. Therefore, the Radium preparations from Jáchymov through their origin give a guarantee that they are absolutely pure. A special certificate, concerning the purity of Radium from Jáchymov is supplied upon request by the Ministry of Public Works of the Czechoslovak Republic.

The text of this certificate is cited as follows:

The Ministry of Public Works-
Central administration of the State Mines and Metallurgical Works
Prague XVI., Preslova street 6

Ministerstvo veřejných prací
Ústřední správa podniku Státní báňské a hutnické závody
Praha XVI., Preslova ulice 6

Telephon 411-51, 411-17, 411-15, to 53, 456-15 to 16, 408-83 to 86, for the interurban connections 408-82, 411-25

Cable-address: STUBAH-PRAHA.
Account number in Postoffice Saving Bank 42.600

CERTIFICATE No........................ Prague, the ....

The Ministry of Public Works of the Czechoslovak Republic hereby certifies that the Radium preparation, sealed in .... the contents of which amount to .... mg Radium-element was attested by the State Radiological Institute of the Czechoslovak Republic under certificate No .... of the .... day of .... 19......., and was manufactured from the pure pitchblende which is to be found in the State mines in Jáchymov, containing neither Thorium nor any derivative of Thorium; therefore the gamma radiation of this preparation is due entirely to Radium and its derivatives and not to Mesothorium or any products of its disintegration.

For the Minister:

14

Radium Emanation

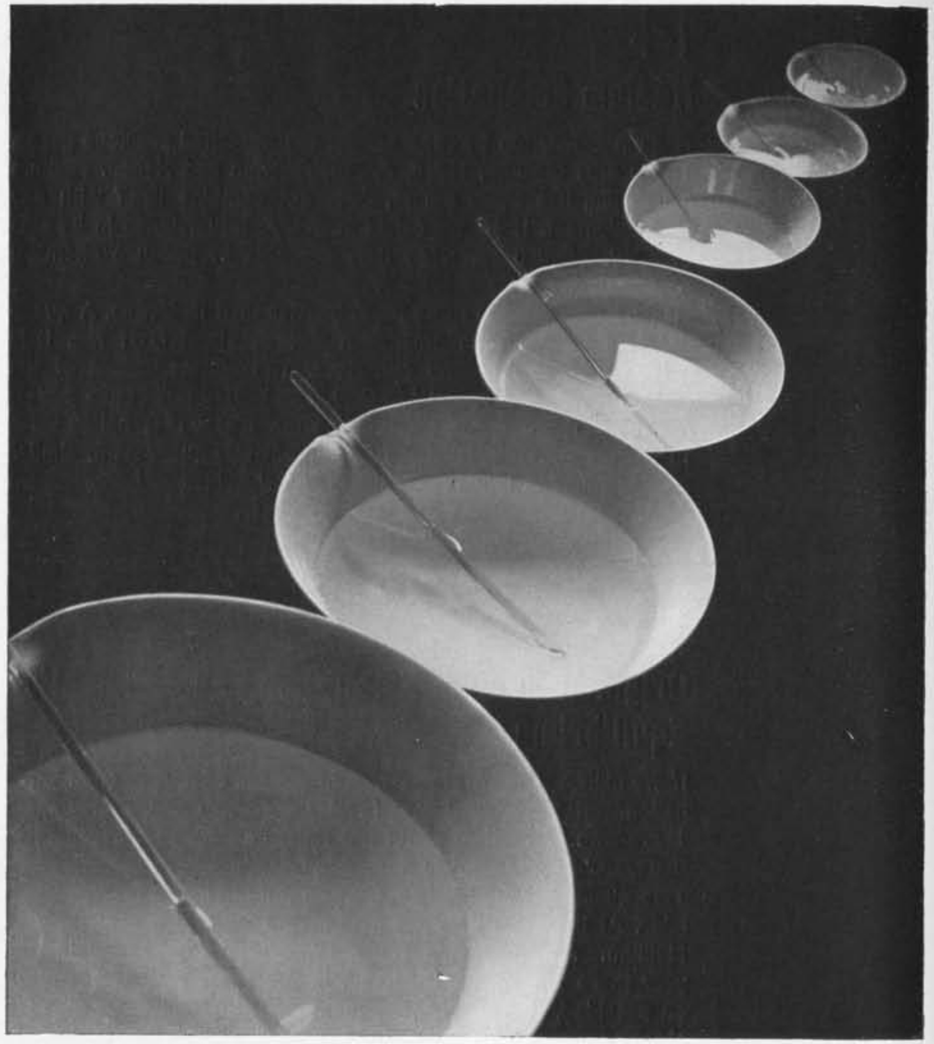
Radium emanation belongs among the so-called precious gases. These are: Hellium, Neon, Argon, Crypton and Xenon. Radium emanation, like these others, does not combine itself with any other element. It always exists in every circumstance in its elementary, original form, as it is not able to produce chemical combinations.
Radium emanation is three times heavier than hydrogen. A quantity of 1 mm^3 of the emanation weighs about 0·01 mg. It is colourless, tasteless and odourless. The atomic weight of the Radium emanation is equal to 222. The boiling point is — 62^0 C; it solidifies into a white crystalline mass at 71^0 C below zero. In such a concentrated form it is intensively fluorescent, similar to Radium. The liquid emanation is a colourless and transparent fluid. It is seven times heavier than water.

15

Origin of Radium-Emanation and Radioactive Equilibrium

If we melt a Radium preparation in a glass tube, a Radium emanation will be heaped up. In 4 days there will evolve from 1 gramme of Radium about 0·3 mm^3 of Radium emanation, in 8 days 0·45 mm^3 and in 1 month 0·6 mm^3.
This quantity is the maximum, which will not increase even years later. At the same time, we find in the tube also a quantity of Hellium. The volume of Hellium grows symmetrically: in one year there will evolve 165 mm^3, in two years 330 mm^3 and so on provided, of course, that the quantity of Radium in each instance amounts to 1 gramme. We shall explain these different reactions by observing both gases separately. The volume of Hellium always remains the same, whereas the volume of Radium emanation decreases steadily. In 4 days it will drop to about one half, in 8 days to about one fourth, etc. One month later it will have completely disappeared.
In its place we shall find the Hellium again and a lead coating, deposited on the walls of the tube. In other words, a Radium emanation will disintegrate into Hellium and lead during one

← Dissolution of radioactive residues



Crystallization of Radium

Manipulation during crystallization
Chemist is protected by a mask

month. The Hellium, developed by this method is identical with the material α rays of emanation and with its enfeebled disintegrated products.
The maximum, unchangeable quantity of the emanation developed per month, is called "the quantity in radioactive equilibrium" or briefly "equilibristic quantity".
In an equilibristic state the quantity of Radium emanation is kept on a well defined, constant level, because the same quantity of emanation, which in a certain unit of time will disintegrate, will again at the same time be produced from the Radium.
The quantity of Radium emanation, being in equilibrium with 1 gramme of Radium $=$ 0·6 mm^3 (at 0^0 C and of pressure $=$ 760 mm Hg) was fixed as a unit and is called 1 CURIE. A thousandth part of this unit is called 1 Millicurie and is the most current practical unit for larger quantities of Radium emanation. A smaller unit, called Mache's unit is used for the activity measurement of the mineral sources.
The emanation quantity explained by 1 Mache's unit is equal to $3{\cdot}64\ 10^{-10}$ curie.

16

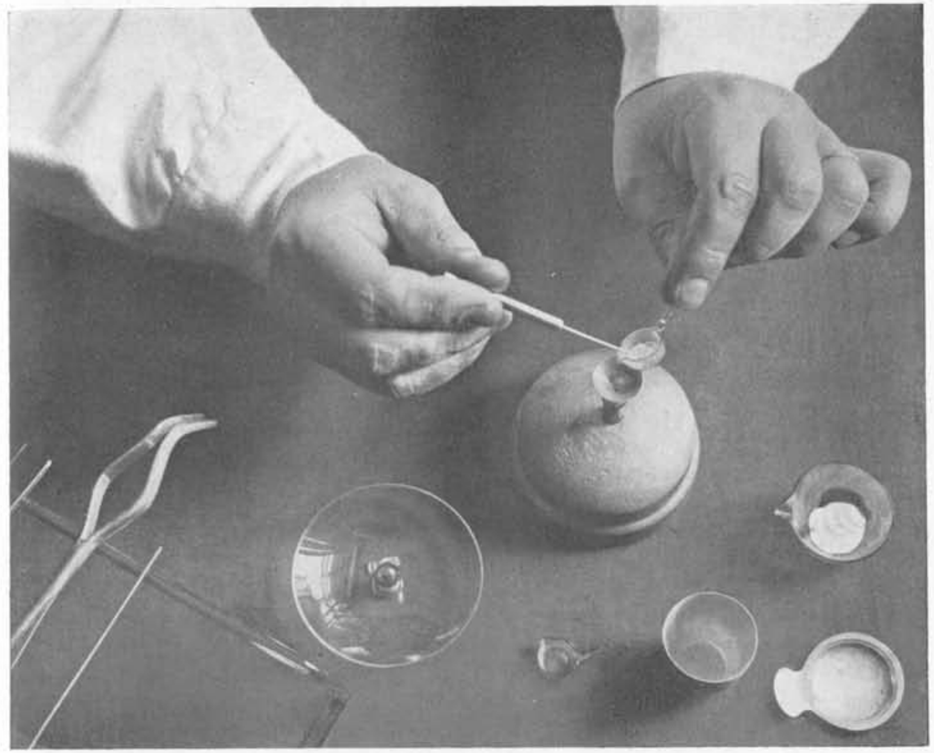
Use of Radium Emanation

As the γ radiation applied in therapy is aroused by Radium C, the physiological effects of condensed emanation are the same as those of Radium preparations. For that reason in many large institutes there are applied glass capillary tubes filled with condensed emanation.
This use of Radium emanation is well known, especially in the United States of America, because emanation has the great advantage that it can be filled into glass tubes which may be given a convenient form. The loss or breaking of the tube containing emanation does not result in a loss to the owner for the emanation arises uninterruptedly from the Radium, which is kept separately.
In the next chapter there is cited a description of apparatus serving for the concentration of Radium emanation.

17

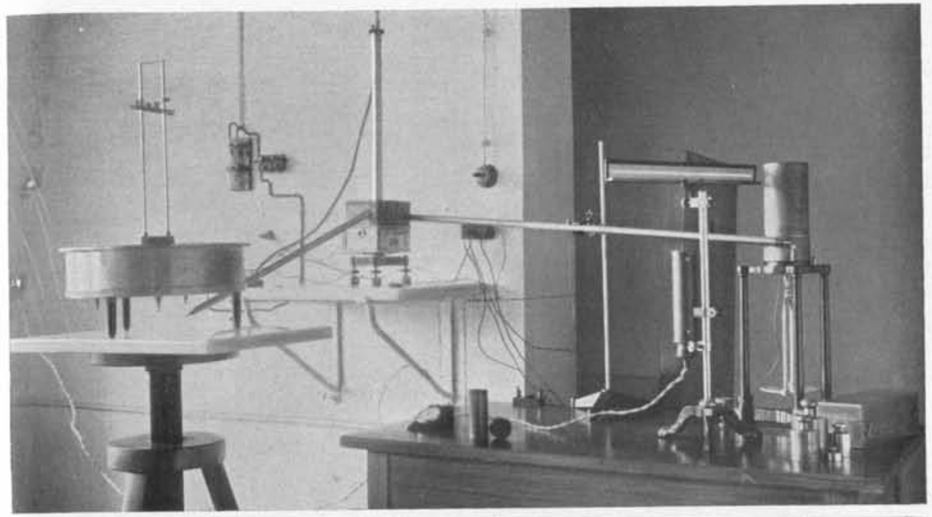
Emanation Apparatus

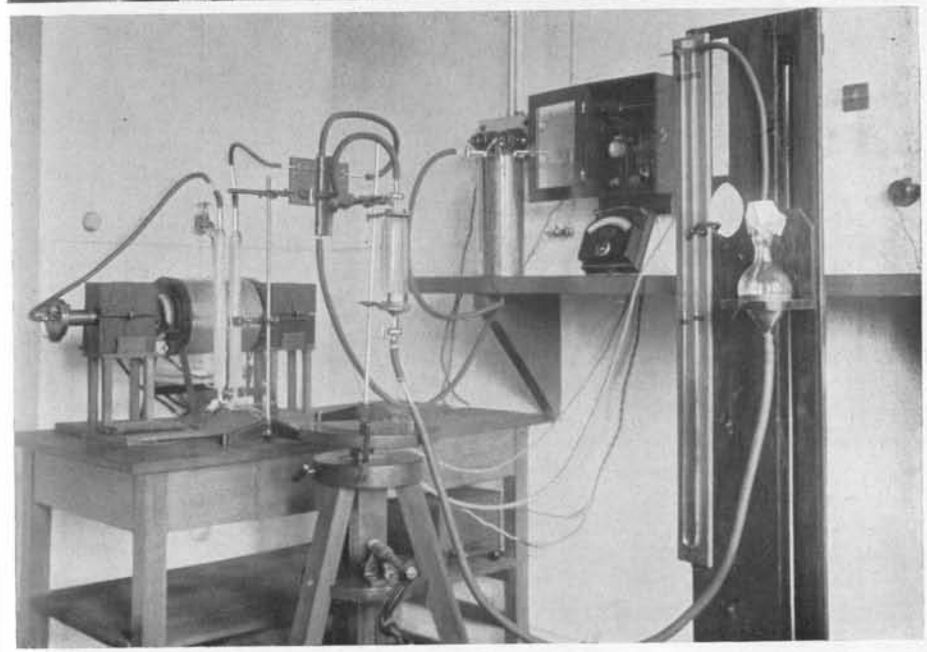
Apparatus for the production of condensed emanation.
A slightly acid concentrated solution of Radium, containing at



Filling of Radium preparations

least some decigrammes of Radium element, is used for the production of Radium emanation.
There are two different methods which may be used for the production of emanation and for its concentration into a very small volume. According to the first method the emanation is forced into a capillary tube immersed in liquid air.
The emanation solidifies at the low temperature of liquid air minus 181° C, while the other impurities such as oxygen and hydrogen remain in the gas state and are easily removed by means of an air-pump.
The emanation can be prepared in a very pure state according to this method. But for this process liquid air is necessary, which is often difficult to obtain and which must be handled with care.
Therefore the second method is generally used. The emanation is firstly freed of all impurities by means of definite reagents and then forced by means of quicksilver into glass capillary tubes previously made thoroughly vacuous by means of a pump.
The apparatus, serving for preparing emanation, according to this method and constructed by Messrs. Duan and Faillan, is illustrated here.
The Radium solution is hermetically enclosed in a container and the emanation is pumped up by means of a movable column of quicksilver into a tube with reagents. The radium emanation pumped up out of the solution is always accompanied by a large amount of gas, produced out of the water (the mixture of oxygen and hydrogen) and by traces of the water vapor and carbonic acid.
This gas is a product of water dissolution, produced by Radium rays, which are irradiated from Radium dissolved in water.
All these impurities are absorbed by chemical reagents and the emanation, free of the impurities is then forced by means of quicksilver into a glass capillary tube.
Finally this glass capillary tube is separated by means of a small flame from the apparatus and is divided into an arbitrary amount of small, sealed tubes, which act similar to cells filled with Radium.
Into a glass cappillary tube 1·0—1·5 cms in length and with a diameter of a few tenths of a mm, one can easily concentrate several millicuries of radium emanation.
When using radium emanation in curietherapy it is necessary to calculate with its comparatively rapid diminishment. Emanation is the source of a radiation of a variable intensity, dropping during one month to zero and is, therefore, less suitable than Radium for repeated applications.

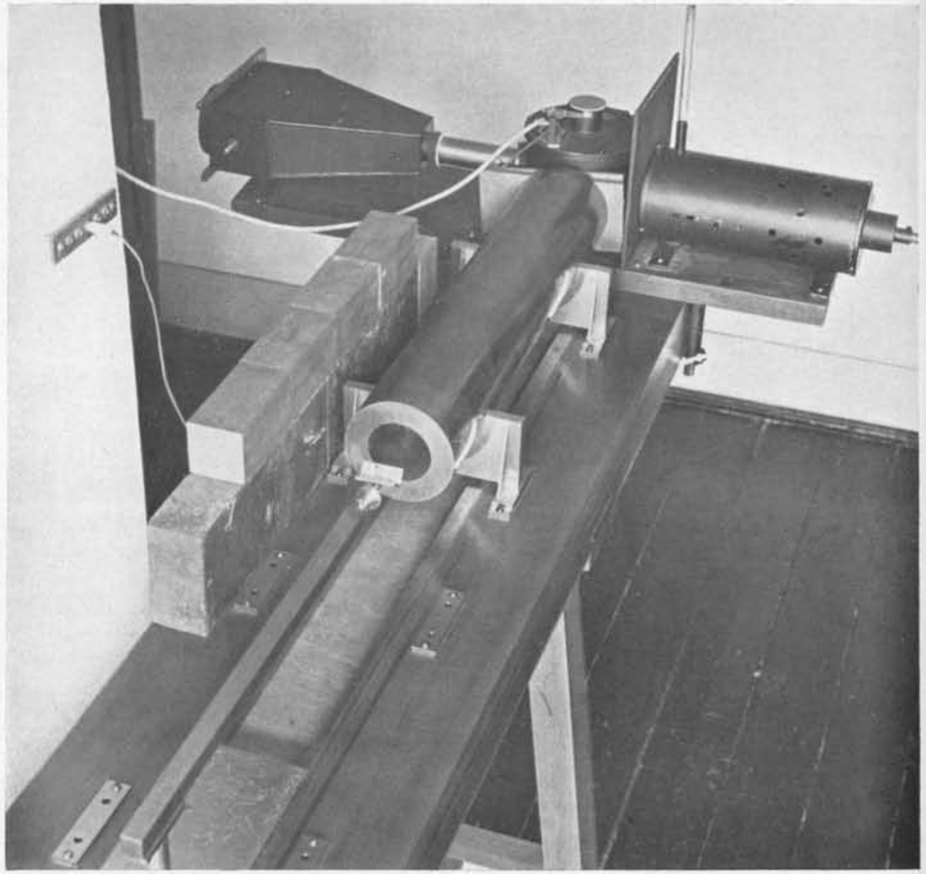




Piezzoelectrical method of Mme. Curie,
used for intensity measurements of Radium-preparations

●

Apparatus for the analysis of radioactive ore



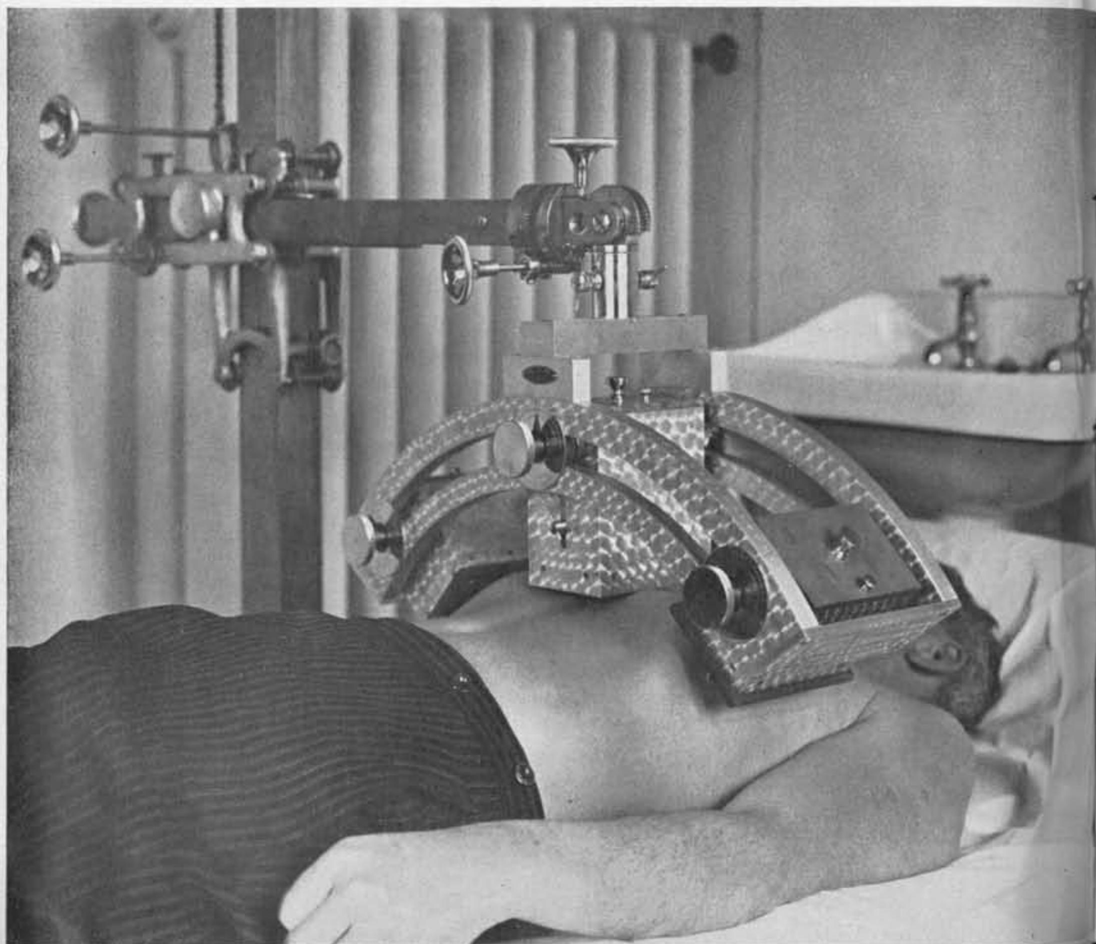
Electrometrical equipment
used to measure Radium preparations to be used in radiumtherapy

18

Radium used in Therapy

The original experiments in this direction were made by first researchers on themselves unwittingly; they, without knowing the power of Radium, carried Radium salts in their vest pockets. They noticed sometime afterwards, that the skin under the place where the Radium salts had been carried, grew red and later on an ulcer was to be seen on this red spot. Through this was given the first proof of the power of this new radiation on living tissue. This proof was very useful in medicine. All authorities agreed that diseased cells are more Radio-sensitive or susceptible to radiation than normal cells of healthy tissue.
Radium is primarily a therapeutic agent against malign tumours (neoplasm) such as carcinoma and sarcoma. Likewise the treatment by Radium or Röntgen is well recommended after removal by operation of the malignant growths, to hinder regrowth. Myomata of the matrix which belong among the benign tumours, and angiomata and keloids, belonging to the tumours of the skin, are treated with very good results. For blood diseases, the treatment with Radium in addition to Röntgen, is at the present time the only therapeutic possibility.
In this group of diseases belong anaemia in all its different forms, Biermer's destructive anaemia, as well as all secondary anaemias, originating from the most diverse causes.
In these cases by the application of Radium on the pith of the bone and on the milt one may increase the red blood corpus cles. The result is sometimes quite surprising.
With polyglobules or with Vaguez's disease, which is caused by an increased amount of red blood corpuscles, one may decrease this amount by strong irradiation on the pith of the bone.
In leucocytosis, due to an up-to-now unknown cause of the sickening of the lympathic glands, milt and the pith of bone, the inflammation of the ill organism will decrease after the application of Radium and the patient will find himself well again and life can be prolonged. The inflammation of the gland and milt accompanying the diseases known as lymphogranulomatosis can be controlled by irradiation for many years.
The tuberculous gland and the fistulas may be treated by Radium. Good results have been had with some skin diseases, for instance, skin tuberculosis, lupus, eczema, pruritus, etc. Irradiation also has analgesic and antiphlogistic powers. For that reason irradiation is used in the treatment of deforming rheumatism of the joints. Quickly, and often permanently, the pain disappears from the sciatic nerve, neuralgia of the trigemenal nerve, from the nerves passing through the ribs, etc.

Apparatus for depth radiumtherapy by Mallette



19

Units of Dosage mostly applied in Therapeutics

The biological effect of the irradiator depends on its strength, application period and the sensibility of the tissue.

The dosage unit mostly used is a milligramme-hour. (In emanation, a millicurie-hour).

A milligramme-hour is the amount of radiant energy given off by one milligramme of Radium element during one hour. For instance: a dosage of 3,000 mgh may be administered; with the application of 1 gramme of Radium during 3 hours, with the application of 0·5 grammes of Radium during 6 hours or, with the application of 100 mg of Radium during 30 hours, etc.

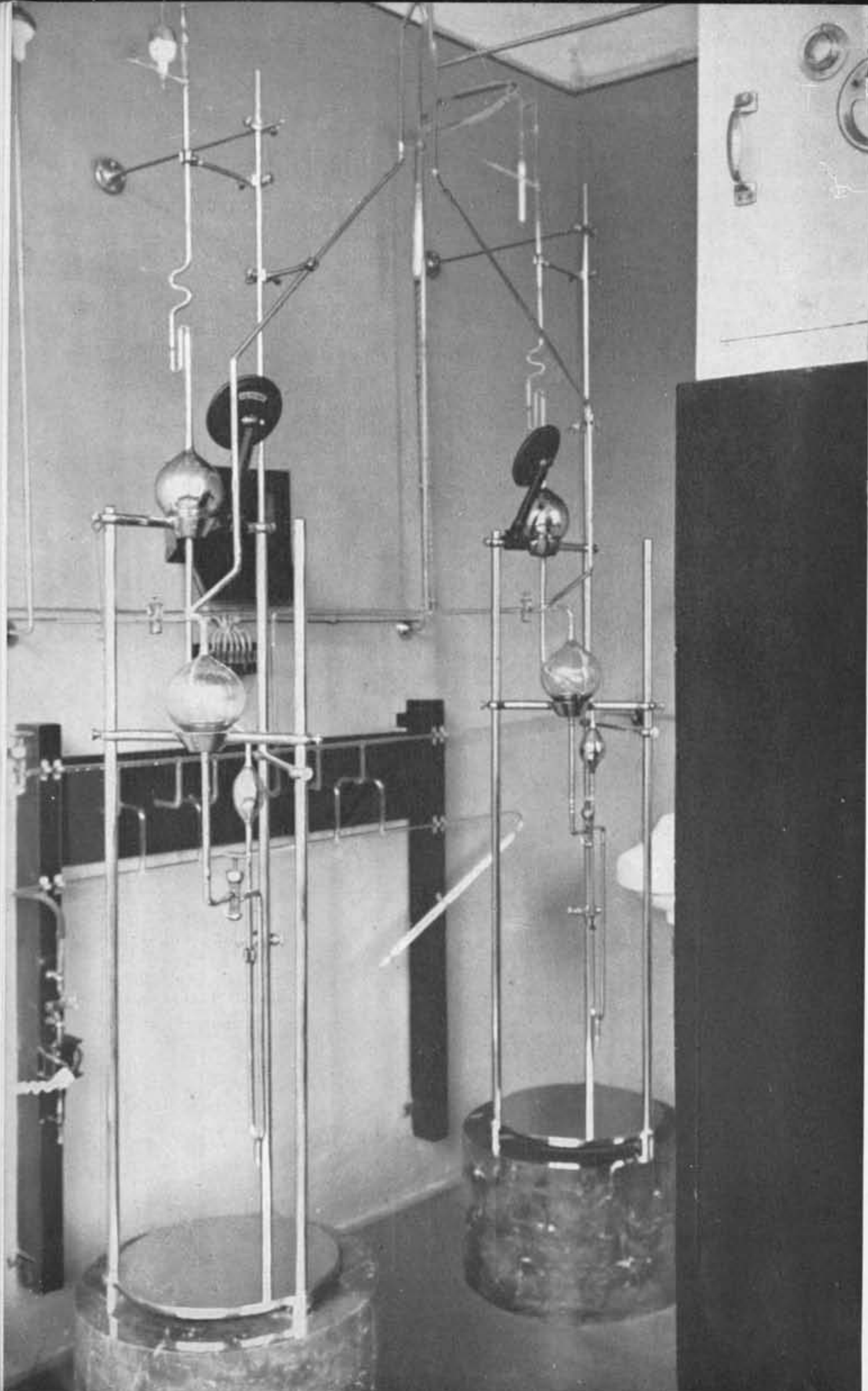
When using Radium emanation there is applied a unit, called "millicurie destroyed".

By means of this unit one can compare the application of Radium, which is a constant source, and the application of Radium emanation, the intensity of which is variable. In both these cases this unit represents the quantity of emanation atoms, which during application have disintegrated and freed a part of their energy in the form of radiation.

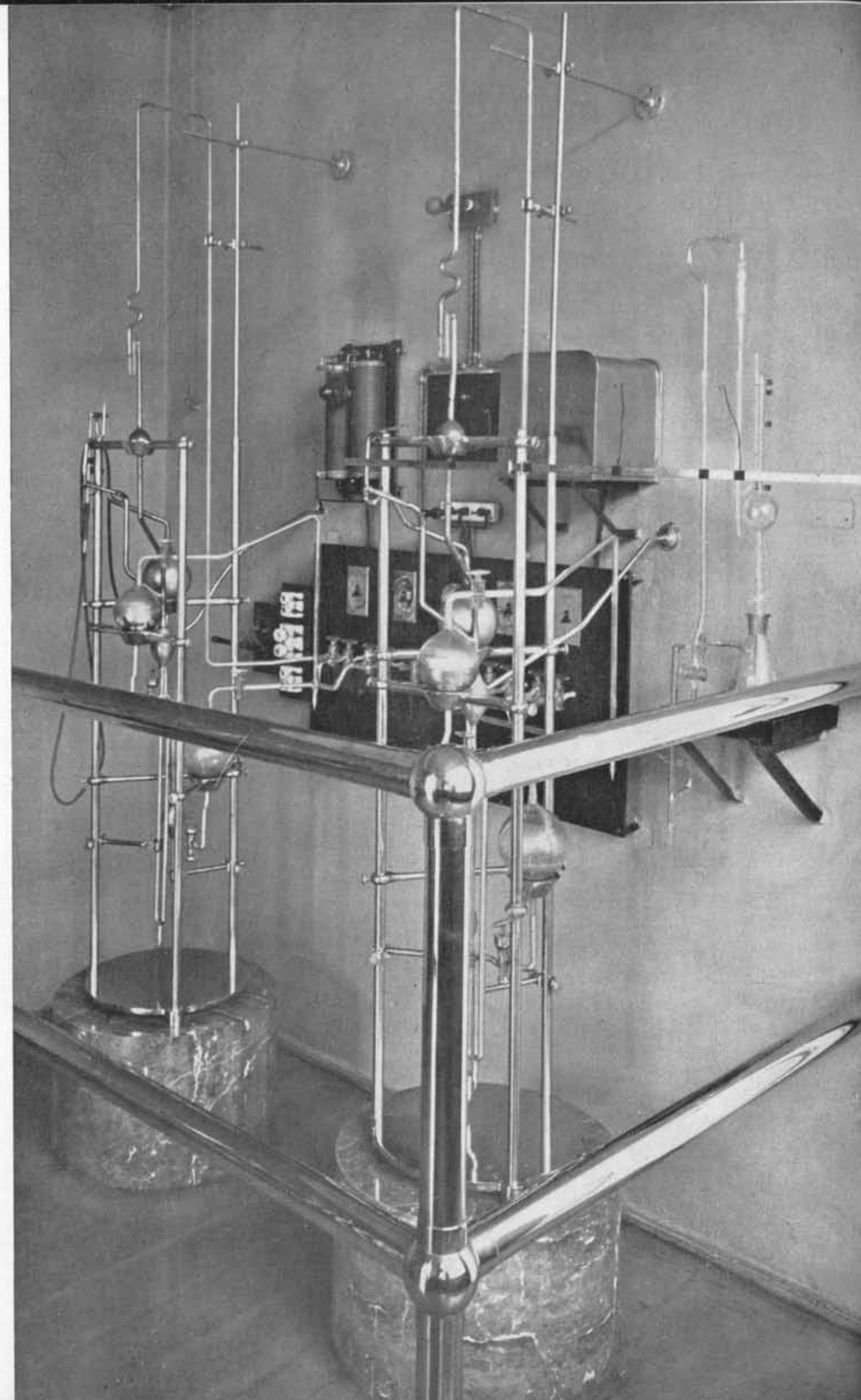
The total quantity of the applied radiation is then measured by this unit. If one gramme of Radium is in equilibrium with the emanation which arises from it, then 7·51 millicuries are destroyed per hour. The application of 100 mg after 30 hours is, therefore, equal to $0{\cdot}1 \times 30 \times 7{\cdot}51 = 22{\cdot}5$ millicuries-destroyed. In case only emanations are used the energy of radiation in millicuries-destroyed is stated as the difference between the quantity of emanation existing at the beginning and at the end of irradiation.

Decrease of Radium emanation:

Time	Quantity remaining present per millicuries	Quantity disintegrated in millicuries destroyed	Time	Quantity remaining present per millicuries	Quantity disintegrated in millicuries destroyed
Ø	1000	Ø	4 days	484	516
1 hour	996	4	5 days	404	596
2 hours	985	15	6 days	337	663
4 hours	970	30	7 days	281	719
8 hours	941	59	8 days	235	765
12 hours	913	87	12 days	114	887
16 hours	886	114	16 days	55	945
20 hours	860	140	20 days	27	973
1 day	834	166	24 days	13	987
2 days	696	304	28 days	6	994
3 days	581	419	38 days	1	999



Apparatus for the production of Radium emanation



Apparatus for the production of Radium emanation (View from the other side)

So, for example, when applying 100 millicuries of emanation after 20 hours, according to the attached index it will be found that from the formerly present quantity there remains only 86% of the original, and that 14 millicuries were destroyed during this period. The application is equal, therefore, to 14 millicuries-destroyed.

20

Radiophores (containers)

In Radium treatment 4 kinds of containers (radiophores) are usually used which are filled with Radium sulphate. For instance:
1. Platiniridium, thin walled cells of 0·1 to 0·2 mm thickness which, when applied, are inserted into metal filters in the form of a needle, tube or plaque.
2. Platiniridium needles of 0·5 to 1 mm wall thickness, which by means of an acceptable apparatus are pricked into the body.
3. Platinum or golden tubes of 1 to 2 mm wall thickness which are inserted into cavities of the human body and
4. Plaques of different sizes, made of different metals but always having a thin botton (0·1 to 0·3 mm) which are placed on the attacked parts of the human body.

21

Sale of Jáchymov Radium

The sale of Radium from Jáchymov in any form whatsoever is reserved to the Ministry of Public Works of the Czechoslovak Republic. The Ministry mentioned will fix the conditions of sale and will guarantee that the Radium sold by them has been extracted from the Jáchymov ore and is, therefore, free from Mesothorium.
The State Radiological Institute of the Czechoslovak Republic in Prague, is competent to measure the quantity of Radium to be sold.

22

Development of Jáchymov and its Mining

The old mining town of Jáchymov is located about 20 km north of the world-famous spa, Karlovy Vary.
Jáchymov was formerly called Konradsgrün, after its founder,

Jáchymov silver money, coined in the year 1543

The Old Town Hall
1520

●

The Mine Administration
The old balcony

Count Konrad Vohlburg. The colony Konradsgrün consisted of a few cottages, a mill and a chapel.
The Bohemian King Zikmund in the year 1454 presented this Konradsgrün to Count Kašpar Šlik, the chancellor of the Bohemian country, for services rendered to him. Königsgrün received the name Jáchymov (Joachimsthal) from King Ludwig in the year 1519 of the diet.
It is not known exactly when mining was begun in Jáchymov. The first regular mining was begun in the year 1512 by Kašpar Bach, a miner from Saxony, but he was obliged to abandon it because of lack of funds. A rich count, Štěpán Šlik, with other gentlemen established a mining society in the year 1515.
The results of mining were so favourable that a rumour of a great wealth of silver was quickly spread and many miners came to Jáchymov, especially from Saxony. Jáchymov in the year 1519 had 1,200 houses. In the year 1518 the first mining court of justice was established, as well as mining order. In the mining industry there were employed over 8,000 miners in the year above mentioned.
The greatest population was reached in the year 1534 with a total of 18,200 persons. Count Šlik established a mint in the year 1519, in which was coined the first Jáchymov money, later on called Šlik's tollars. On one side was found a Bohemian lion, on the other side St. Jáchym and Count Šlik's escutcheon.
The name tollar was used also on other money and is still used in America as the dollar.
During the period between 1516 until 1546 there was coined a quantity of silver amounting to 10, 431, 091 gulden and during the period between 1516 and 1594, according to Count Kašpar Šternberk's report, the total gain amounted to 35,726,577 gulden.
Jáchymov was renowned in the sixteenth century because of its Latin College and was, therefore, called a town of scientists. Here lived George Agricola, who was called "the father of mineralogy". In his book "Bergmannus sive de re metallica" he wrote about minerals, mining and metallurgical works. Another eminent person living at this time in Jáchymov was Johannes Mathesius, a humanist and rector of the Latin College. He also wrote "The Bergpostille" or "Sarepte".
Count Šlik joined the elector John Frederic's party and after his defeat they were obliged to give up their rights to King Ferdinand. At this time there set in a slow decline of mining because of more difficult and expensive mining in the deeper depths and because of the decrease in the mineral richness of the mines. Mining during the Thirty Years War nearly vanished and not until the eighteenth century did it begin again, and then principally of arsen, lead, cobalt and nickel, as the silver veins had weakened.
The Jáchymov mining was saved from complete decline through

the efforts of Adolph Pater, the government mine chemist who in the year 1593 discovered that beautiful colours could be made from the uranium ore for painting on porcelain and glass. The uranium ore-pitchblende was discovered in Jáchymov while digging for silver ore, but this only made trouble, as difficulties arose during the melting of the silver ore. Therefore this ore, which was found in great quantities in the lower strata was evaded by miners.

Pater's discovery made it possible to utilize this ore, which heretofore had been heaped in piles, or left unmined in the mines. In the year 1856 they began to mine pitchblende and to produce yellow uranium colours in larger quantities. Then the unprofitable production of bismuth, nickel and cobalt preparations was completely discontinued and only uranium colours produced. A new development and a boom for Jáchymov was achieved through the discovery of Radium in the year 1898. Through its production the real value of uranium ore was established.

The confirmation of the therapeutic properties of the radioactive springs resulted in the construction of a state spa in 1911 and Jáchymov, as a result, became known throughout the world.

23

Geology of Jáchymov

Jáchymov is situated on the south slope of the Krušné Hory (Metalliferous-Mountains). The Jáchymov territory is built out of crystallitic primary mountain slate. In the southwest these slates border upon the Eibenstock-Nýdek massive granite with which the richness and origin of ore of the Jáchymov veins is closely connected. With the magma granite solidification there begins granite differentiation where the sour and basic elements of granite have separated themselves.

The intrusion of these differentiating products (the gravel like porphyries, aplite, microsyenite) lasted until the chalk age. Later on there developed two new kinds of veins: "Dawn veins", passing the east to west direction and the "midnight veins" with a north to south direction.

The metalliferous veins are only the "midnight veins", which are filled with post vulcanical thermal springs.

Radium Palace Hotel Jáchymov

Jáchymov Environs

24

Jáchymov Pitchblende Deposits.

The midnight veins are breaks, approximately of a north to south direction, descending to the west under $45^0 - 85^0$. Their powerfulness ranges from a few mm to 2 m.

Out of the post vulcanical springs, in which were contained overheated solutions of metallic compounds, there began to deposit in the midnight veins, at the first depths, silver ores, deeper Co, Ni, Bi ores and deepest the uranium ore.

The remaining space in the cracks was filled with quartz, dolomite and with ground slate. The pitchblende from these veins is of some mm to 20 cms thickness.

25

The Mining of Pitchblende

The mining method employed is by graduation. The width between steps is at least 1·2 m, so that with the contents of a vein of lesser thickness there will also be mined surrounding rocks. Exhausted places are filled with unneeded rocks. Pickmen work on the filling and for vein filling they use pneumatic compressing hammers. From the mined ore there is taken rough uranium ore with compact pieces of pitchblende and other poorer ore containing mostly small fragments of pitchblende.

26

Ore Dressing

The rough ores, as well as the pure, are brought up from the mine. In the rough ore the pitchblende is often associated with dolomite from which it is separated by means of a hammer in the sorting department. Weaker veins of pitchblende, which are to be found in dolomite cannot be separated in the sorting department and are, therefore, transported to the mechanical dressing department, where the poorer ore is also worked up. The pitchblende, produced in the sorting department is called rich ore and it contains up to 65% of U_3O_8. In the mechanical ore dressing department there is produced the uranium slime, containing up to 50% of U_3O_8.

27

Jáchymov Therapeutic Springs

Down in the mines there are springs containing a quantity of radioactive-mineral-water of varying potency.
At first, water from the so-called Štěp Springs was used for therapeutic purposes in the baths, the same flowing in the Werner Mine, which is on a level with Daniel's Shaft at a depth of 350 m. The springs are cold and of a temperature of 7° C. Their activity is various. The strongest one has 5,000 Mache's units in 1 litre.
They are all caught in a basin, from which they are conducted through a conduit 4,200 m in length from the old shaft to the bath house, where they are drunk as a cure-water.
The main radioactive spring was discovered in the year 1864 when deepening the Concord Mine at a depth of 534 m under the surface. At first it produced 500 litres per minute.
Since Radium and its activity were unknown at that time, the spring was closed up with a cement wall and at a pressure of 26 atm. its capacity was lowered considerably.
Water from this spring has a temperature of 28° C and its radioactivity fluctuates around 450 Mache's units per litre. The capacity at this time amounts to 138 litres per minute. It flows freely into a closed basin hewn directly in rock, from which it is pumped 400 m high into another closed basin, and from there conducted through conduits placed in Daniel's shaft to the bath house.
The latest discovery in the year 1928 was a new spring in the XIIth gallery of the Concord Mine at a distance of 500 m from the shaft; it gives out 180 litres per minute, an activity of about 120 Mache's units per litre. This is also caught and can be used for medical purposes. The other springs, which are many, have a less important supply but can be eventually utilized.
Very careful attention is paid to every new spring and its activity measured. A further occurence of important radioactive springs is always expected.

28

Jáchymov as a Spa

Jáchymov was established in the year 1906, when the water from the mines was brought in vessels to the baker, Mr. Kuh, at whose establishment bathing was done in wooden bath tubs.
Cure results were very favourable. The number of guests continued to grow. In the year 1908 water from Štěp's Spring was conducted through a conduit into the new bath cabins built in the uranium factory.
In the year 1911 a new bath house was opened to the public. Jáchymov in that year had 6,775 guests. This number constantly increased especially after the proclamation of the new Republic of Czechoslovakia. In the year 1930, 10,000 guests visited Jáchymov.
The government spa-establishments are very tastefully arranged and are provided with the most modern medical equipment. The number of cabins has been greatly increased. There are lodgings, especially in the Radium-Palace-Hotel, which would please even the most distinguished visitors.
Besides the Palace there are many other private pensions (Boardinghouses).
The Jáchymov-Spa has a great advantage over the other radioactive spas because of the proximity of the Radium factory, which makes possible the preparation of the oils and high radioactive waters for drinking-cures.

29

Jáchymov and its Environs

Jáchymov is a typical mountain town, situated in a long valley, which narrows from the south to the north. It lies at an altitude of 650 m and has over 7,000 inhabitants. The upper section of the town has beautiful and valuable architectural monuments from the XVIth century. (Townhall, building of the government metallurgical establishment, in which in the XVIth century the mint office was located, church and portals of some private houses). In the southern section of the town there is developing a spa-quarter. The encompassing slopes of the town are covered with beautiful pine-forests. Very comfortable walks with resting places have been laid out for patients.
It is seldom that a guest to Jáchymov fails to visit the town situated highest in Central Europe, i. e. Boží Dar (Gift of God) and the Klínovec Tower which is 1244 m high. It is a very pleasant walk to the quiet pilgrimage called Mariasorg.

30

Jáchymov as a Sport Center

Jáchymov and its surrounding country is a very agreeable and restful place for tourists in summer and in winter. In summer the

Winter sport in Jáchymov

forests are alive with tourists, enjoying the fragrant mountain air and walking over the ridges of the Krušné Hory (Metalliferous Mountains), from which there is a nice view far into Čechy (Bohemia) and into the neighbouring hills of Saxony. A pleasant time can be had in the mountain cottages and at the Hotel Plešivec, Boži Dar (Gift of God), on Klínovec and in Saxony on Smrkovec (Fichtelberg Pine-Tree-Mountain). In winter the extensive mountain plains are alive with people skiing, who have here a splendid choice of topography unequalled elsewhere.

Town of Boží Dar (Gift of God) near Jáchymov
The town of highest altitude in middle Europe 1027 m

The Government-Owned Hotel Palace Hotel Praha
in Mariánské Lázně (Marienbad)

31

Radiumchema

According to the agreement made by the Central Administration of the Government Spa with the firm Akciové továrny na vyrábění lučebnin ("Stock Company for the production of chemical products Ltd") in Kolín in 1927, an association called Radiumchema, which is engaged in the production and purchase of radioactive preparations from Jáchymov-Radium, together with its by-products, came into existence.

The Radiumchema as a results of this agreement and according to the Ministry of Public Works and the Ministry of Public Health and Physical Education, is the only firm authorized to work up radioactive products from Jáchymov and place them on the market. These products mentioned are to be marked "The only radioactive products authorized by the state plants administration in Jáchymov".

At the head of the Radiumchema is a council of administration, composed half of representatives from the Ministry of Public Works and the Ministry of Public Health and Physical Education and half of the representatives of the Akciové továrny na vyrábění lučebnin in Kolín and the scientists.

The technical and commercial administration is in the hands of a three-membered directorate, at the head of which is the chief executive of the Akciové továrny na vyrábění lučebnin.

The Radiumchema represents in the Czechoslovak Republic the first instance of the close co-operation of the government with a private firm and it can be said that this co-operation has proven to be very succesful.

In the realization of this ideal of co-operation, the Ministry of Public Works chose the Akciové továrny na vyrábění lučebnin in Kolín, because this firm represents the oldest and largest Czech chemical organization of considerable tradition, whose pharmaceutical department established itself during the last ten years at the head of this industry.

The products from Radiumchema belong in two main groups. These are: emanated preparations and preparations of a constant activity. The emanated preparations, for obvious reasons, are not exported since the volatility of their activity cannot bear the delay caused by transportation and customs house manipulation. On the other hand, there are also preparations of constant activity, whose half disintegrating period is about 1,600 years, so that it can be stated that their activity is practically inexhaustible. Therefore many foreign countries are interested in these preparations.

To these preparations belong the Radiumchema pads, the radioactive vaginal globuli, Radiumchloride-injections and radioactive soap "Radisapon". In the near future there will be placed on the market tablets to be taken orally as medicine and radioactive toilet cream.

In order to make it possible for Jáchymov-Spa visitors to continue their cures beyond the season and thus heighten and make more permanent the benefits derived, there have been introduced on the market emanation apparatus with which it is possible to prepare radioactive water, either for drinking or bathing purposes.

However it must, of course, be pointed out, that the use of this water at home cannot fully replace the Jáchymov cure, as it can only, as explained above, fortify the benefits of a cure taken in the Jáchymov-Spa.

Czechoslovakia

Anyone who desires to get a real and exact idea of Central Europe, should not fail to visit Czechoslovakia, which is not only situated in the heart of Central Europe and is in many ways a key to the understanding of the historical, racial, political and nationality problems of that part of the Continent, but is also at the same time, a country that is well worth visiting for its own sake.

THE REPUBLIC OF CZECHOSLOVAKIA is one of the states which arose out of the ruins of the former Austrian Empire. It is situated in the middle of Europe, lying like a long cone (1000 kilometres long) which grows slightly narrower from West to East. The name Czechoslovakia is a combination of the names of the two branches of the Czechoslovak nation — the Czechs and the Slovaks. The main characteristic of Czechoslovakia is that it is the only state in which the Czechoslovaks live an independent life, sharing it, it is true, with other nationalities as racial minorities. The Republic of Czechoslovakia was formed after the war; its independence was proclaimed on the 28th of October, 1918. However, in the year 1929 it commemorated the thousandth anniversary of the foundation of the Czech State (Bohemia) which had mantained its independence until 1620, after which it spent nearly 300 years in subjection to the Austrian Empire.

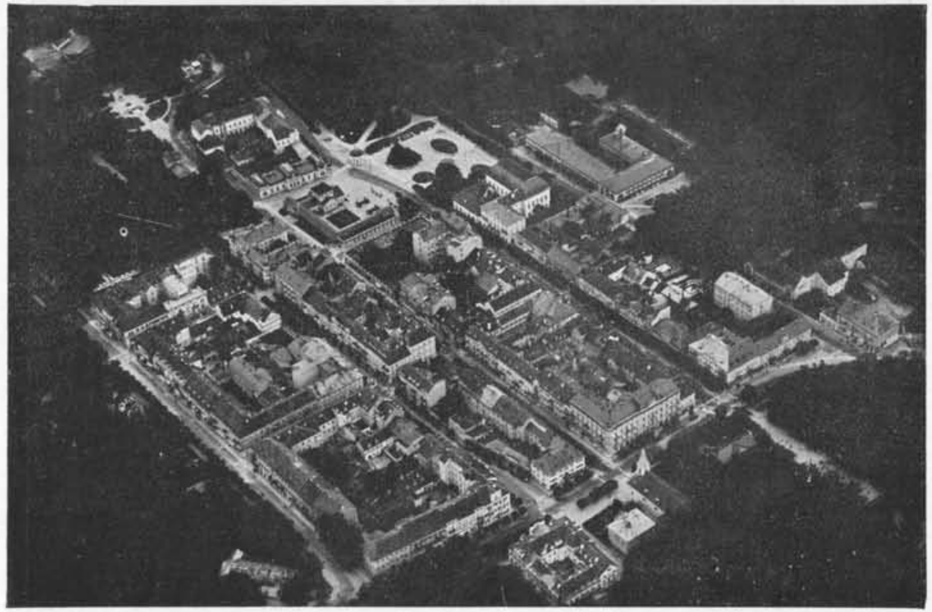
But the remembrance of its former independence remained steadfast in the hearts of these people and lead during the war to its restoration. Up to 1918 the Western part of present-day Czechoslovakia (1. Bohemia, 2. Moravia-Silesia) belonged to the Austrian half of the Austro-Hungarian Empire, while the Eastern (Carpathian) part (3. Slovakia, 4. Carpathian Ruthenia) formed the northern, mountain regions of Hungary. Czechoslovakia is thus (since 1927) divided into four administrative areas (provinces) each possessing considerable autonomous powers.

These western provinces (Bohemia and Moravia-Silesia) are primarily industrial, while the eastern provinces are mostly agricultural.

Population	Area-km²	1910	1921	1930
Czechoslovak Republic .	140,394	13,602,282	13,612,424	14,726,158
1. Bohemia	52,064	6,781,997	6,670,610	7,106,766
2. Moravia-Silesia . . .	26,738	3,296,640	3,338,977	3,563,157
3. Slovakia	48,936	2,928,042	2,998,244	3,330,885
4. Carp. Ruthenia	12,656	559,603	604,593	725,350

View of Prague, Castlehome of the President
(Hradčany)
and Bridge of Charles the Fourth
(Karlův most)

Karlštejn
Castle founded in the year 1348 by Charles the Fourth



Karlovy Vary (Karlsbad)
View from aeroplane

●

Františkovy Lázně (Franzensbad)
View from aeroplane

Hot springs in the world-wide known spa Karlovy Vary
(Karlsbad)

The Czechoslovak Republic occupies by its size the fourteenth place in Europe, the nineth by its population and the seventh by the density of the same.
The total number of Czechs and Slovaks amounted to 11,000,000 in the year 1930. (In this number there were also included those residing in foreign countries).
The topography of CZECHOSLOVAKIA, like that of the whole of Europe, has a twofold character. The Western portion of the Republic is a part of the oldest mountain range in Europe, broad, easily accessible ranges which form the frontiers of Bohemia and Moravia called Krkonoše, or Giant Mountains, Jeseníky, Šumava, Krušné Hory or Metalliferous Mountains, etc. These ranges are of medium height (the highest mountain is the Sněžka, 1610 metres above the sea level) and are attractive to tourists in winter and in summer because of the long and agreeable excursions that can be made.
The eastern part of the Republic has wilder scenery, its mountains are higher (they rise to an altitude of 2,600 metres), and their character, age and type is that of the Alps. They culminate in the High Tatras (2,600 metres) with their splendid health resorts, where on the sunny, Southern slopes of these mountains, visitors find every possibility for comfort and enjoyment.
Another feature of this region is its magnificent mountain lakes, lying towards the South.
In the North and South of Czechoslovakia the German element has advanced far towards the East, so that the territory now inhabited by the Czechs juts out like a peninsula to the West. It would not be out of place to compare the shape of Czechoslovakia to that of a fish, the tail of which is in Slavonic and Eastern European waters, while the head is in the German sea on the West. And the whole Czech — or as we may say to-day because of the wider connotation — the whole Czechoslovak history shows a constant equilibrium of tentative cultural influences coming from the Occident and from the Orient.
Six races meet within the territory of Czechoslovakia (Czechoslovaks, Ruthenians, Germans, Magyars, Poles and Rumanians) and the manner of their existence side by side presents an interesting field of observation. In the disturbed conditions of Central Europe, Czechoslovakia has already created a certain tradition peculiar to itself and it is not without interest to compare this with developments in the neighbouring states.
From the standpoint of tourist traffic, Czechoslovakia's features in the general European scheme may be characterized as follows: It is a land of unlimited variety of scenery. Within a comparatively small area every possible type of landscape is compacted. All in all it is a picture of the "Heart of Europe", meaning the Continent.
Those, who are studying intellectual culture and folklore, will

find here an abundance of material. The west of the country is mostly soberly industrial with complicated problems of city and social conditions. The east is mostly agricultural and in certain regions they still wear their beautiful national costumes.

The towns of Czechoslovakia have not, of course, reached the stage of development which prevails, for example, in the west of Europe, but they represent an interesting stage in the transition from the West-European to the East-European type.

In the past in the territory of present Czechoslovakia there alternated during centuries creative work with the periods of wars and national and religious struggles. For this reason Prague, the capital of the Czechoslovak Republic (in the year of 1932 it had over 900,000 population) has been designated the museum of the mediaeval history of Central Europe. On account of its picturesque situation and its architectural and other relics Alexander Humbolt ranked Prague among the four most beautiful cities of Europe and called it the most beautiful town of all those situated in the interior of the Continent. In addition to Prague, Czechoslovakia has many interesting towns from an agricultural or industrial viewpoint. For example: Plzeň (population of 120,000) has large engineering works and breweries, Liberec (population of 70,000), textile industry. In Moravia-Silesia there is Brno (population of 280,000) which has notable engineering and textile industries and is the seat of the administrative offices of the province and state. Olomouc (population of 70,000) is the center of the fertile and typical farming region of Haná, notable for its highly developed agricultural cooperative enterprises. A third Moravian town, Moravská Ostrava (population of over 200,000) has a particular character of its own due to the fact that it is really a conglomeration of industrial and mining townships in a famous coalfield. It is also the site of the Vítkovice Company, the largest ironworks in Czechoslovakia.

The capital of Slovakia is Bratislava (population of 150,000), situated on the Danube and a city of numerous architectural features of note. Košice (population of 70,000), the second town of Slovakia, with its textile industry is the center of oriental Slovakia. Among the cities of Carpathian Ruthenia belong: Užhorod (population of 24,000), the capital seat of province and state offices and Mukačevo (population of 22,000) notable for its large number of orthodox Jewish synagogues and for its picturesque surroundings. Both towns have expanded and grown considerably during the past ten years. Altogether Czechoslovakia has 23 towns with a population of over 30,000 and 40 towns of 20,000 population.

Czechoslovakia has many notable historical features — old castles, mediaeval towns, magnificent country seats as well as modern, industrial towns (the Baťa factories in Zlín); it has vast areas of

Brno

underground grottos and caverns of stalagmites and stalactites, such as the Sloup Caverns near Brno, the Demänová Cave at the foot of the Tatras and the newly discovered caverns near Plešivec in South Slovakia.

The Czechoslovak spas are famous throughout the world, including for example Karlovy Vary, (Karlsbad) Mariánské Lázně, (Marienbad) Františkovy Lázně, (Franzensbad) Jáchymov, (Joachimsthal) the MOST POWERFUL RADIOACTIVE WATERS IN THE ENTIRE WORLD, and Poděbrady in Bohemia, Luhačovice, Gräfenberg and Frývaldov in Moravia-Silesia, Piešťany and Trenčianské Teplice in Slovakia. Not less famous are the beautiful health and pleasure resorts in the High Tatras (Štrbské Pleso, Starý and Nový Smokovec, Tatranská Lomnica) as well as in the Krkonoše, (Giant Mountains) the Šumava (Bohemian Forest) and elsewhere.

The Czechoslovak Republic has its own special characteristics in other directions too. It has highly developed industries, some of the output of which is world-famous. Who does not know of "PILSEN"beer, of the fine Prague hams, of the magnificent products of Bohemian glass, of the Czechoslovak sugar, hops and malt and last, but not least, of the Baťa boots, turned out in Zlín, a town growing with a truly American rapidity.

At the foot of the Metalliferous Mountains stretches one of the biggest of all lignite coalfields and in the environs of Moravská Ostrava one finds conditions reminiscent of Westphalia or of the English "Black Country". In the vicinity of these coalfields there have developed powerful industries, especially iron and engineering works (the Škoda Works in Plzeň, the Vítkovice and Kladno Ironworks,) textile mills (Liberec and Brno) and others. Twice a year a survey of the industrial output of Czechoslovakia is provided by the Prague Sample Fair, while other interesting trade fairs are held regularly in Liberec, Brno and in Bratislava.

Judged as a whole, the Czechoslovak Republic may be classed as a country partly agricultural and partly industrial. The industries are highly developed and the output is in excess of domestic requirements, so that large quantities of goods are exported. The surplus of foreign trade alone enables Czechoslovakia's balance of payments to be maintained on the right side. The imports consist mainly of raw materials and the exports largely of manufactured goods.

Persons who are interested in old peasant arts should not fail to visit, preferably on a Sunday or a holiday, one of the typical villages of Slovak-Moravia or of Slovakia. They will see there picturesque, handmade national costumes still worn, they will listen to charming folksongs and will, in short, find themselves in a world which vanished from Western Europe hundreds of years ago. Visitors who can content themselves with simple condi-

The High Tatras
View from aeroplane

Hotel Hviezdoslav, Štrbské Pleso in the High Tatra
(the highest climatic resort in Czechoslovakia)

tions of travel will find much to interest them in the most easterly sections of the Czechoslovak Republic.

A Sunday spent at Jasina among people dressed in typical costumes, an easy climb to some mountain summit (2,000 metres) famous for its panoramic view over the bare ridges and mountain pastures to vast oceans of primaeval forests where the wolf and the bear still make their home, will well repay the visitor for all the trouble he has taken.

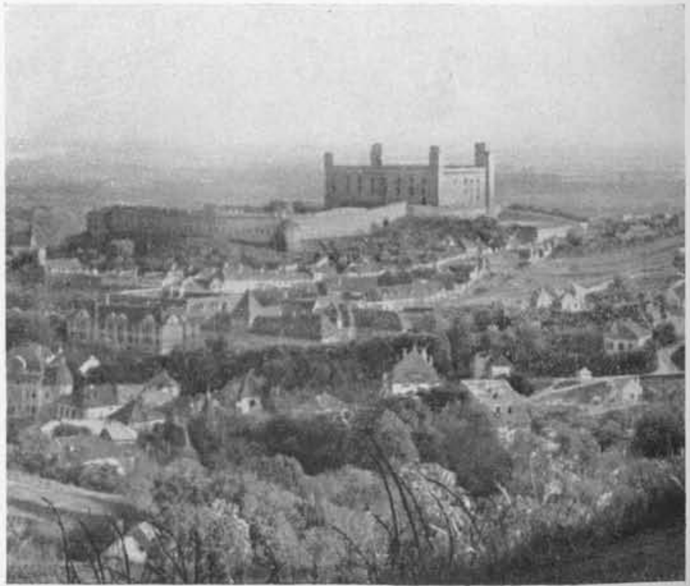
One also has opportunity to travel comfortably by autocar throughout the Republic. The highways are in good condition. On principal streets there exist information-bureaus and many other useful organizations. The highways for autocars lead up to the summit of the Giant Mountains and traverse the entire forest of Bohemia. They also penetrate into the high Tatras.

Prague, being the capital of the Czechoslovak Republic, and also because of its aeronautical connections, forms the most important centre of entire Europe.

Thanks to its geographical position, the Czechoslovak Republic may be visited by all tourists travelling into Central or Oriental Europe.

Besides, travelling in Czechoslovakia is not at all expensive. The hotels and boardinghouses are good and cheap, people hospitable and willing towards foreigners. There is no difficulty with formalities; on the contrary, officers are perfectly willing to offer advice and assistance in every way.

Bratislava
the greatest harbour of the Czechoslovak Republic on the Danube, and the capital of Slovakia.



Státní tiskárna v Praze