BUILDING UP A SEISMIC NETWORK IN THE EARLY DAYS OF SEISMOLOGY IN ROMANIA

Adina Vanciu Rău[1*], **Mihaela Popa**[1, 2], **Constantin Ionescu**[1], **Daniel Paulescu**[1]

[1] National Institute for Earth Physics, **Romania**
[2] Academy of Romanian Scientists, **Romania**

ABSTRACT

At the beginning of the XXth century, the scientific community, worldwide, awarded much more attention to the understanding of geological peculiarities that influences earthquake occurrence and the development of seismological instruments.

Romania was among the first countries in the world that had a seismological service in the late 1890s at the initiative of some dedicated researchers in the field of astronomy, geosciences, mathematics and physics.

In the early twentieth century, Romania already had two functional seismological services, one in Bucharest and the other one in Timisoara and a seismic observation system. Today, Romania has a Seismic Network with over 200 stations fully equipped with digital high-precision instruments and international collaborations in data exchanging.

[*] Cite as: Rău A.V., et al., 2022. BUILDING UP A SEISMIC NETWORK IN THE EARLY DAYS OF SEISMOLOGY IN ROMANIA. https://doi.org/10.5281/zenodo.7022928 in Chitea F. (Ed). Insights of Geosciences for hazards and education. ISBN –print 978-606-537-563-5, ISBN –e-book 978-606-537-564-2, Cetatea de Scaun Editorial House.

Keywords: seismic network, seismological instruments, history of seismology in Romania

INTRODUCTION

One of the key elements that showed the need for a seismological service in Romania, was the recording in 1889 by Ernst von Rebeur-Paschwitz, in Potsdam, Germany, of the first teleseism. The fact that instruments can detect and record seismic waves from large distances have changed the course of seismology, separating it, as an independent science of studies associated with meteorology. Consequently, the need for international cooperation in the field of seismology has become a subject of global interest in the scientific community.

ROMANIA'S FIRST SEISMOLOGICAL SERVICE

The discovery made by Ernst von Rebeur-Paschwitz motivated the Romanian meteorologist Ștefan Hepites to acquire, in the same year 1889, two Guzzanti seismoscopes and install them at the Meteorological Institute in Bucharest (Filaret). As reported by Prof. L. Constantinescu (1977), these instruments only indicated the occurrence of an earthquake, without being able to record it. Later, in 1895, a second type of instrument was purchased, a Tacchini pendulum. Ștefan Hepites was a visionary and managed to organize a network of points of macroseismic observations committed to the meteorological service he led. He created a system of seismic observations, with well-trained people, focused on the psychological impact that previous earthquakes. The effectiveness of this system was strengthened in 1893 when Hepites published the first list of macroseismic effects for the local earthquakes that occurred between 1838 and 1893.

The macroseismic data collecting system, created by Hepites, served as a model in organizing similar networks in Bulgaria and Chile, according to Prof. L. Constantinescu (1977). The results of the macroseismic studies published by Hepites were used by researchers

such as Ferdinand Montessus de Ballore, Emmanuel de Martonne and Heinrich Sieberg in their studies.

By proving the efficiency of this system, authorities have understood the usefulness of installing more instruments for earthquakes recording. Thus, in 1895 Stefan Hepites establishes the first Romanian seismic station, in Bucharest, by installing a microseismoscope and a seismometrograph.

According to Prof. L. Constantinescu (1977), in 1902, two Bosch horizontal seismographs (NS, EW components) with mechanical recording on a reel covered with blacked (smoked) paper, were successfully installed. The seismic pendulums with only 10 kg weight each, with reduced amplification, were continuously recording the seismic events on the horizontal components. The NS component was maintained in operation until 1958. These instruments played a key role in the development of seismological research in Romania and were considered a landmark for the next generation of instruments.

According to Gh. Demetrescu (1937) in 1914, two Galitzin seismographs, of high sensitivity (photogalvanometric recording), excellent for long distance events, operated at the Bucharest Observatory (Figure 1).

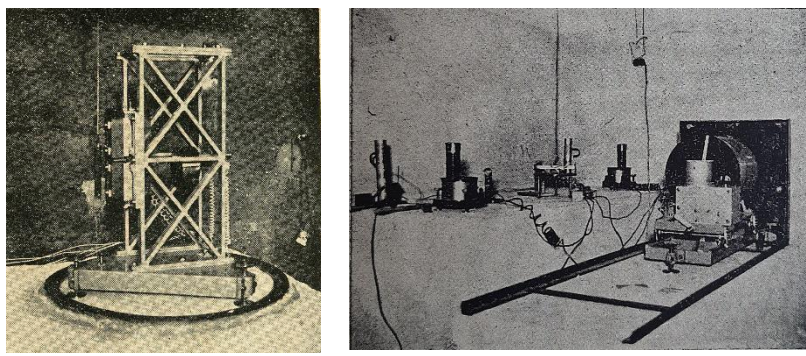

Figure 1 – The Galitzin seismographs (left) and the system recording (right) at the Bucharest seismic station
(Source: Gh. Demetrescu, 1937).

Based on its research studies, Ștefan Hepites has demonstrated the need and usefulness of establishing a seismic network in Romania.

During the same time period, in the late 1890s, in the actual region of Banat – Romania, at the Meteorological station of Timișoara, a seismological service was established by the count Thege Miklosi Konkoly. The meteorological and seismic service was led by prof. Edé Berecz from the Normal School of Boys in Timișoara (the actual Jean Louis Calderon high school).

At that time, the historical Banat region was part of the Austro-Hungarian empire, and was a prosperous region subjected to western influences. According to L.Tőkës (1906), in 1899, by installing Cacciatore seismoscope, the Timișoara Meteorological Station was promoted to rank I of importance. Since 1900, bulletins of seismic observations have been issued in the Természettudományi Füzetek magazine. In 1902, a new instrument was installed for seismic measurements: a Rossi seismograph.

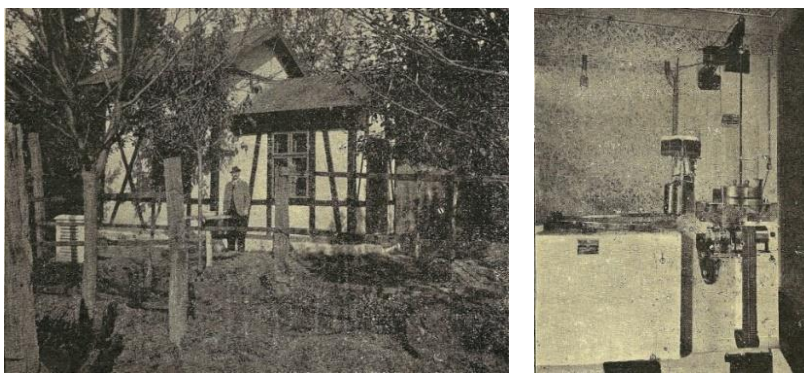

Figure 2 – The first establishment of the Timișoara seismic station, around 1904 (left) and the Vicentini seismograph, around 1904 (right) (Source: Természettudományi Füzetek, 1906).

In June 1902, the station appeared under the reference of "The meteorological and seismological station of Timișoara". In 1903 a separate building was constructed (Figure 2- left) for the seismographs, where, in 1904, a set of Vicentini seismographs was installed. The instruments were built and modified by dr. M. Konkoly in the Central Institute workshop from Budapest (Figure 2 - right). Starting with 1905 the seismic observations were published in a quarterly review issue, under the reference of Konkoly-Vicentini. The Vicenti seismograph weighed 180 kg.

As mentioned by L.Tőkës (1906), the Timișoara meteorological and seismological station was coordinated by Edé Berecz until his death in 1909. From 1910 until the beginning of the First World War, the station was led by his daughter, madame Ehmann Otilia (born Berecz). During the war, the station operated intermittently until 1919, when its activity was interrupted for about twenty years.

A new seismic station was established in 1911 in Cluj, as reported by I. Curea (1940). The seismic service was coordinated by the Hungarian University. The station was initially equipped with two Mainka seismographs which operated between January 1911 and July 1914. The seismographs were installed in the basement of the old theatre, but after the war started, the building was occupied by soldiers who dismembered and destroyed the instruments. What remained from the equipment was then exposed to humidity and rust, deteriorating even more. Since 1921, prof. Gh. Demetrescu and Gh. Bratu from the Astronomical Observatory in Cluj had the initiative to restore these instruments and find them an appropriate operating space. The main issue was to find a proper basement and obtain the agreement for the seismographs installation, a search that extended for a period of 14 years. In 1929, the University of Science from Cluj contacted prof. Carl Mainka in order to find support for the instruments restoration process. The answer from prof. Mainka was quick and positive, with no other fees rather than transportation and materials needed, but the Ministry of Instructions could not support these costs. The seismographs restoration was possible only in 1934,

when they had been moved to the Astronomical Observatory of Bucharest, conducted at the time by prof. Gh. Demetrescu. In January 1935, the seismographs were fully restored and put it into operation in the basement of the Astronomical Observatory of Bucharest for a testing period. The seismic observations proved to be accurate and the results of the recordings were published by prof. Gh. Demetrescu in the Seismic Bulletins of 1935 and 1936.

After 1936, according to I. Curea (1940), at the Astronomical Observatory of Bucharest a new set of seismographs were made in the Observatory workshop, after the Mainka instruments of Cluj.

In October 1939, with the efforts of prof. I. Curea, the seismographs have been relocated in Cluj and installed in the basement of the newly built wing of the University of Cluj – King Carol II Academic College (Figure 3).

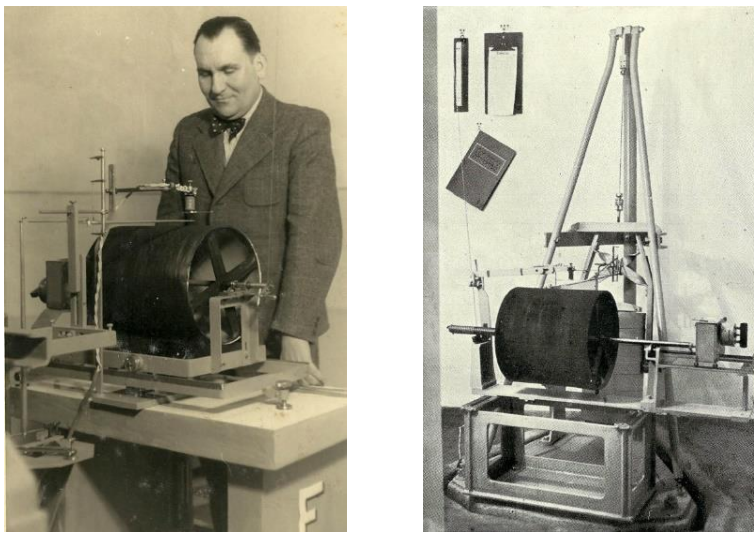

Figure 3 – Prof. I. Curea in front of the Mainka Modified seismograph (left). The NS component of the Mainka Modified seismograph in Cluj station (right). (Source: Timișoara seismic station Archive).

On January 24th, 1940, the first Seismic Bulletin of the Cluj seismic station was issued, printed in 100 copies and sent worldwide at other seismic stations. So, prof. I. Curea established a long term and important partnership of information exchange.

As related by prof. I. Curea (1944), the activity of the Cluj seismic station has ceased in September 1940, after the Vienna Dictate lead by Germany and Italy on 30 August 1940, when Romania had to subside the region of Northern Transylvania (almost half of the historical Transylvania region) to Hungary. The teaching staff from Cluj University, including Prof. I. Curea, was relocated to Timișoara Polytechnic Institute. Given the severe conditions of the departure, prof. I. Curea was forced to leave the Cluj Seismic Station, which was in a perfect state of operating at that time.

The major impact of the earthquake that occurred on November 10, 1940 (Mw = 7.7) demonstrated the urgent need for a seismic network, considered as a necessity for the study and understanding of the Vrancea earthquakes mechanisms.

THE SECOND STAGE OF THE ROMANIAN SEISMIC NETWORK DEVELOPMENT

After losing the Cluj seismic station, as prof. I. Curea (1944) himself relates, the only possibility was to start all over again and organize a new seismologic service at Timișoara. The old Austro-Hungarian seismic station from Timișoara, where the Konkoly-Vicentini seismographs were installed, was destroyed.

With nothing more than the blueprints of the Mainka seismographs, prof. I. Curea asked for support from the Timișoara City Hall. He immediately receives a positive response and the first financial support for building a new set of seismographs.

With the help and technical support offered by prof. Gh. Demetrescu from the Bucharest Seismic Station a new set of seismographs were designed starting from the original Mainka instruments. The Mainka Modified seismographs were constructed with

significant improvements at the Electro-Mechanic Factory of Timișoara, in times of war and restraints. The mass of the pendulums was three times heavier than of the original Mainka instruments, with a weight of 540 kg each. The pendulum suspension system had to be modified, given the fact that, at the original instruments the weight was suspended from the ceiling, which meant that the chamber of the instruments needed also to have a special structure. In collaboration with prof. Gh. Demetrescu, a new and better type of air damper was constructed for the seismographs.

Even though the seismographs were finished by the end of 1941, the issue of finding a suitable location was solved only in 1942, when the Polytechnic Institute provided two chambers in the basement of the building (Figure 4).

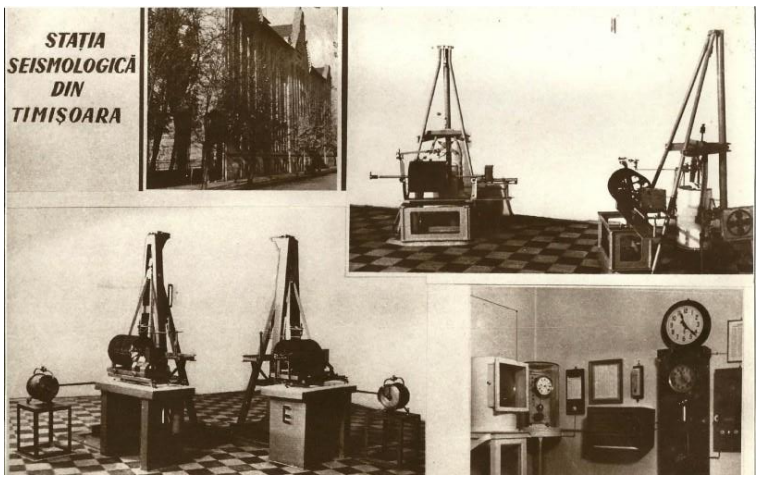

Figure 4 – The Timișoara seismic station installed in the basement of the Polytechnic Institute (Source: Timișoara Seismic Station Archive).

I. Curea (1944) relates that the Act of Establishment of the Timișoara seismological station was issued by the Timișoara City Hall on 15 November 1942. With all the organization needed to prepare the chamber of instruments, the station began functioning only in September 1943. By

the end of the year, the seismographs recorded a number of 59 earthquakes. Thus, in January 1944, Timișoara seismic station issued its first bulletin from the newly organized service. The Timișoara seismic station functions until April 1944, when its activity is ceased due to the bombing of the city. Its activity was reorganized starting with 1950, in a new location provided by the Polytechnic Institute.

Simultaneously, prof. Gh. Demetrescu continued developing the seismic network by establishing two new stations in 1942 at Focșani and Bacău followed by Câmpulung seismic station in 1943 (Figure 5*)*. In 1951, the Vrîncioaia station started its activity, and in 1952, the Iași seismic station was organized. The stations set up between 1942 and 1952 aimed to monitor earthquakes in the Vrancea area, and as a result, were equipped with low-magnification seismographs. About the Cernăuți seismic station (Bucovina), we have relative scarce information. According to Gh. Demetrescu (1937), I. Curea (1942) and F. Rădulescu (2001) the seismic service was first established by the Austro-Hungarian empire in 1911, in the same period with the establishment of the seismic station from Cluj.

Figure 5 – The Câmpulung seismic station
(Source: Timișoara seismic station Archive).

At that time, the station was equipped with Mainka seismographs. After 1919, the station was abandoned. In 1931 H. McComb (1931) published a list of seismological stations of the world in which the Cernăuți station is mentioned but it does not appear to have been in operation. Gh. Demetrescu (1937) and I. Curea (1942) mention the restoration of the seismic station in the period 1932-1934, under the guidance of prof. I. Popescu from the Faculty of Sciences in Cernăuți (director of the Cosmic Physics Institute). As related by F. Rădulescu (2001), the seismological service was completed with one Wiechert vertical seismograph (mass of 80 kg) and one Conrad horizontal seismograph. The seismic station of Cernăuți operated until June 1940 when Romania lost this territory as a result of the Soviet occupation of Bassarabia and Northern Bucovina that took place from June 28 to July 4, 1940.

THE THIRD STAGE OF THE ROMANIAN SEISMIC NETWORK DEVELOPMENT

The Romanian Seismic Network constantly continued to develop after 1950. In Timișoara, by the end of 1965, a new building to host the seismological service and the team of researchers and technicians was built. Thus, Timișoara becomes the first Romanian station to have its own building designed specially to contain seismological equipment (Figure 6).

In his memoirs, prof. I. Curea (1969) offers details about the unique structure of this building: the edifice is composed of two structures, the upper part dedicated for the office, time service, mechanical and photographic workshops, and the lower part composed of four chambers at the basement for the instruments. The two structures are connected by a stairway and a hallway that make the transition to the second part of the building at a depth of two meters underground. The chambers of the instruments have doubled walls and plateau in order to confine a constant air temperature and to damper the possible vibration induced by urban activity.

Figure 6 – The new building of the Timisoara seismic station in 1965 (Source: Timisoara seismic station Archive).

The building foundation is set up on 90 pillars of reinforced concrete with a length of two meters each. Each component (NS and WE) of the Mainka Modified seismographs are set on individual reinforced concrete pillars. Each set of instruments is enclosed with glass windows (to prevent air flow disturbing the recordings) separated by a slot in the pavement.

The underground chambers were designed to contain the sensitive instruments. The first two rooms were dedicated to the Mainka modified (540 kg and 180 kg) seismographs (Figure 7).

Later on, in 1967, a set of short period electrodynamic seismographs, Vegik type were constructed in the mechanical workshop of the Timișoara seismic station. The recording was made using electrogalvanometers type GB-III. In 1970, the station was equipped with another set of electrodynamic long period instruments, Kirnos - SKD type, of Russian production (Figure 8).

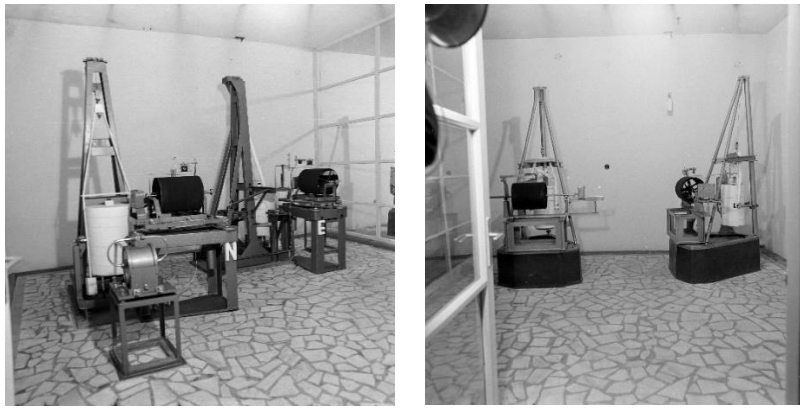

Figure 7 – Mainka Modified seismographs with 540 kg mass (left) and Mainka seismographs with 180 kg mass (right) at the Timișoara seismic station (Source: Timișoara seismic station Archive).

Figure 8 – Vegik Electrodynamic seismographs (left) and Kirnos – SKD (right) at Timișoara seismic station
(Source: Timișoara Seismic Station Archive).

In 1967, prof. I. Curea established another seismic station, at Șușara, only 150 km from Timișoara, near Sasca Montană. Given the remote location, Șușara seismic station achieved exceptional recordings. It was originally equipped with the Vegik electrodynamic

type seismographs and completed in 1972 with a set of short period electrodynamic seismographs type SKM-III.

In 1970, E. Bercei (1970) in collaboration with prof. I. Curea, designed a new type of vertical seismograph with electromagnetic resort, that functioned for a year at the Timișoara station. Due to lack of finances, the instrument could not be built in mass production and the project was suspended.

Another important station for Romania as well as for the neighboring countries is the Vrîncioaia station, installed in the central part of the intermediate-depth earthquakes epicenter area. Built in the early 1950s, the station has been equipped over time with different types of analogue seismometers like Mainka modified, Vegik, Kirnos-SKM, DD1 and S13.

In 1971, the seismic station of Muntele Roșu was installed, equipped initially with a Vegik instrument, installed in the station tunnel, followed by Kirnos-SKM-III instrument in 1974, Kirnos-SKD and Sprengnether instruments in 1975 and after 1977, DD1 and S13 seismometers. Muntele Roșu station was the first digital station in Romania.

After the big earthquake of March 4, 1977, three telemetry seismic stations were installed in Bucharest, donated by the German government. The stations were installed in Sinaia, Carcaliu and Istrița, the recorded data being telemetry on the radio link to Bucharest, at the Center for Earth Physics. In 1978, Romania received financial support from the United Nations Development Program (UNDP) and 15 Chinese DD-1 seismic stations (with three components) were installed in the locations of existing stations. In 1980, the development of the first Romanian Seismic Telemetry Network began, composed of 10 stations: Bordești (BRD), Carcaliu (CFR), Călugăreni (CGN), Muntele Roșu (MLR), Colonești (CLI), Istrița (ISR), Popeni (PPE), Sfânta Ana (AAR), Topalu (TLB) and Vrîncioaia (VRI). The seismic stations were equipped with Geotech S13 short-period seismometers and the data were telemetered by radio links to Bucharest. In the next two years, another 8 stations were installed. In 1995, the network was expanded in the western

part of the country, by installing Banloc - BANR, Șiria - SIRR, Buziaș - BZS stations, equipped with S13 short-period S13 sensors. An S13 type sensor was also installed at the Timișoara station.

CONCLUSIONS

The beginning of the XXth century in Romania was marked by the rising interest in seismology coming from scientists that activated in fields such as meteorology, mathematics and physics.

Given a history of important seismic events, Romania is one of the first countries in the world where an instrument for earthquakes recording has been installed.

The need for a seismic network was justified in the context of the intense seismicity recorded in Romania, both at crustal level, in many areas of the country, and at the intermediate depth, in the Vrancea area, sometimes with major destructive effects.

Even if at first, the seismic points of observation were few, the attention regarding enhancing the instruments to obtain better recordings was increasing. At first, the recordings were made on smoked paper, then on photographic paper, film and in the last part of the analogous era with ink on paper, the network has developed permanently reaching today over 200 stations, equipped with modern and high performance instruments.

Although though today the national seismic network is at its higher technical development, and seismic events can be detected and localised in a matter of seconds, we must always keep in mind the efforts made by the first researchers in Romania who laid the foundations for building the modern seismic network today.

REFFERENCES

Constantinescu L., 1977, Contributia lui Stefan Hepites la dezvoltarea geofizicii. Studii si cercetari de geofizica, tomul 15, Editura Academiei Romane

Curea I., 1940, Statiunea seismica a observatorului astronomic din Cluj. I. Curea, Ed. Cartea Romaneasca, Cluj

Curea I., 1942, Necesitatea organizarii unui serviciu seismic modern in Romania. Revista "Stiinta si Progres", pag 48-69

Curea I., 1944, Infiintarea unei statiuni seismice in Timisoara. Revista Banatului, vol 4-6

Curea I., 1944, Die horizontalseismometer der neuen Erdbebenwarte in Timisoara. Sonderdruck aus dem "Bulletin Scientifique de L`Ecole Polytechnique de Timisoara", band 11, heft 3-4

Curea I., 1969, Memoriu de activitate si date personale. Tipografia Universitatii Timisoara

Demetrescu G., 1937, Organizarea unei statiuni seismice la Observatorul din Bucuresti. Revista "Natura", nr 7

McComb H., West C., 1931, Bulletin of the National Research Council – List of the seismological stations of the world. National Academy of Sciences, Washington DC

Tőkés L., 1906, Természettudományi Füzetek – XXX Évfolyam – 1 Füzet, Temesvár

Rădulescu F., 2001, Romanian Seismology – historical, scientific and human landmarks. Rev. Roum. Geophysique, 52-53, p.101-102