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Bu nüshada yazı işlerini fiilen idare edenler - Editors :  
*M. Rasim MUTUK - Sehavet MERSİNOĞLU*

## BRIEF ACCOUNT OF THE WORK DONE BY THE MINERAL RESEARCH AND EXPLORATION INSTITUTE OF TURKEY (M. T. A.) DURING THE PERIOD 1935-1960

It can duly be stated that the Mineral Research and Exploration Institute (M. T. A.) has been somewhat of a symbol of economic development in Turkey, which it successfully pioneered with many a contribution to its credit. Even the very foundation of the Institute may be regarded as a first sound step toward that end.

While previously the Ministry of Economics was having difficulties in finding suitable jobs for technical men at hand, including those trained in Europe, soon after the start of the M.T.A. operations, need for such qualified personnel became sufficiently pressing to necessitate signing up of foreign experts to fill the gaps, which naturally led to the application of regular training programs kept up to date.

It can clearly be noticed that at the very beginning of its foundation in June 1935, the functions to be performed by the Institute had been given a definite direction. The first objectives were to explore the raw material resources much needed for the country's future industrial development, to evaluate their reserves and to lay out groundwork preliminary to exploitation.

In all these activities, natural course of an organic development is clearly noticed. Both the Gold Exploration Administration, set up in the same period, and the previously founded Petroleum Exploration Administration were turned over to and incorporated in the M.T.A.

in order to centralize all of the controlling power toward a definite goal.

A successful achievement of the task depended, of course, on strenuous efforts, long-term programs and substantial financial backing, but above all, an idealistic spirit.

### GEOLOGICAL MAPS

To explore the underground resources in the country, geological maps were needed, right at the start, but none was available to suite the purpose. Consequently, it became necessary to set to work on various scale geological maps which was to be done at any cost. This has successfully been achieved by the Institute. First, a 1/800,000 scale map was prepared followed by an other at a scale of 1/100,000, comprising 444 sheets or map-sections. Later, a 1/500,000 scale map of the country was also completed in addition to several other regional ones of various scales (1/50,000, 1/10,000, 1/5,000, 1/2,000, 1/1,000 or larger) to cover mining districts and the like.

To make the study of the country from a hydrological viewpoint and especially to provide for the water requirements of villages as well as various cement, sugar and other factories set up in different parts of the country, hydrological maps of a great number of regions were also drawn up at 1/25,000 or larger scales.

In carrying out these activities, M. T. A. simultaneously took up petrol-

eum exploration on one hand and the surveys of the old existing mines on the other, so as to complete geological mapping, before going into mineral prospecting. These mines were already exploited years ago during the reign of the Ottoman Empire and were in completely abandoned condition at the time when M. T. A. was founded.

#### **PETROLEUM EXPLORATIONS AND PETROLEUM INDUSTRY OF TURKEY**

Petroleum exploration in the Republic of Turkey was initiated on October 13, 1934, with the first well drilled at Basbirin.

As a result of the petroleum explorations conducted in different parts of the country, including Thrace (European Turkey), the Institute was led to think that to concentrate on Raman and Garzan would prove more to the point. Thus the drilling soon began in those regions followed, in due time, by production and development work.

The Institute is then responsible for the discovery of oil in Turkey (Raman and Garzan fields), going into construction of the first sizable refinery (Batman) and also the pipe line (linking Raman and Garzan fields to Batman Refinery). Since early 1955 these fields, installations and equipment are turned over to and operated by the TPAO (Turkish Petroleum Co.).

In view of the fact that the entire exploration had cost the Institute no more than 53 million Turkish Liras and the value of the oil now produced by the TPAO annually reaches 81 million Turkish Liras (\$ 9,000,000) the contribution of the M. T. A. to the Turkish Petroleum Industry becomes well ascertained.

#### **TURKISH IRON AND STEEL INDUSTRY**

Turkish Iron and Steel Industry initiated with the discovery by the M.T. A. Institute of the Divriği iron ore reserves (1937) were estimated and then transferred to the Etibank for exploitation.

From the high-grade ore extracted from these deposits at the rate of 500,000 tons a year, pig iron and steel are produced at the Karabük Iron and Steel Works to meet the basic requirements of the country for those products.

The producing capacity of the said works, equipped with two blast furnaces and 4 Siemens - Martin ovens, increases from year to year. In 1958, the production of pig iron amounted to over 200,000 tons in addition to 160,000 tons of steel and about the same amount of other rolled products. In 1961, however, the production of pig iron and bulk steel is expected to rise to 600,000 tons yearly with the addition of a third larger blast furnace and two new Siemens-Martin ovens, the four older ones being also expanded.

Taking due account of the fact that the Turkish Iron and Steel Industry is being improved to meet the country's requirements for those products at an ever-increasing extent, the fortunate part the Institute played in the Turkish Iron and Steel Industry through discovering the Divriği iron reserves, estimated over 30 million tons, can be seen clearly. The Divriği deposits are sufficiently rich to provide for many years ore requirements of a second steel center, as large as Karabük itself.

In addition to this, the Institute discovered, estimated reserves, and appraised exploitation potentialities for many other iron ore deposits in different regions of the country, including the Hasaңcelebi deposits with more than 20 million tons of visible ore. These reser-

ves may in due time turn into new centers as justified by future needs and possibilities.

Since 1960 the exploration program of the Institute also includes airborne prospecting of magnetic iron ore in several areas of the country not yet explored by any other method. Thus, M. T. A. feels confident to continue to play its worthy part in the future development of the Turkish Iron and Steel Industry whose first stage was initiated by the Institute itself, as previously mentioned.

## **TURKISH COPPER INDUSTRY**

### **Kuvarshan Copper Mine**

One of the first problems treated by the Institute soon after its foundation had been the study of the Kuvarshan (Çoruh) Copper Mine. As the result of the surveys made by the Institute within the period 1935-36 on the mine which was exploited by Germans before the First World War, 250,000 tons of ore with a 5-% copper content, was ascertained and the mine was then transferred to the Etibank for exploitation.

During the 1937-1945 exploitation period a total of 11,475 tons of ore were produced of which 1,800 tons were sold in the country, the balance being entirely exported. The sum total of the proceeds amounted to 8 million Turkish Liras, of which 6,973,000 Liras were derived from export sales.

### **Murgul Copper Mine**

The geological study of this mine, financed with the British capital until 1917 and then ruined during the First World War, was made by the Institute in 1937, although it was assumed then that it had a lower grade. Analyses and flotation tests made on over 500

samples proved it to be worth operating and it was subsequently transferred over to Etibank for this purpose. Visible reserves amount to 10,300,000 tons, as estimated by the Etibank in 1959. With a 2.05 - % copper content, these deposits contain about 211,000 tons of copper. As for the possible reserves, they amount to 3,700,000 tons, which means a copper content of about 69,000 tons.

Etibank installations in Ergani and Murgul — which incidentally represents the bulk of the copper industry in Turkey — helped the country's foreign exchange stock a good deal. As the Murgul Mine appears to be one of the largest copper deposits in the country, second to Ergani, the importance of the part played by the M. T. A. in the development of the Copper Industry in Turkey becomes self-evident.

Moreover, copper occurrences in different parts of the country, especially those in the eastern regions, were studied one by one by the Institute, giving further attention wherever justified.

Furthermore, through surveys and mining operations carried out during the period, 1935-1945 at the Küre Pyrite Mine, associated with copper, the Institute located 1,600,000 tons of ore, containing 1.92% of copper and 47.9% of S. This ore is now used chiefly by the paper industry.

During the recent years, M. T. A. studied copper occurrences, under the guidance of Prof. Maucher of the University of Munich, covering especially those in northwestern Anatolia, along the Black Sea coastal region.

### **Tirebolu Copper Deposits**

Two occurrences near Tirebolu (Vilayet of Giresun) were investigated at length from 1956 on, with the one at Lahanos already showing promising re-

suits. 70 drill-holes proved considerable amount of pyrite (about 8,600,000 tons) within an area 500 x 300 m, roughly 27 % of which containing 3 % Cu and 2 % Zn, also a little Pb. Sulphur content changes between 30 - 44 %. Although portions of it could be mined in open-casts, the bulk of the deposit appears to lie deep, 860-900 feet below surface. The work still is on.

### CHROME ORE EXPLORATION

Turkey is one of the richest countries in the world with respect to her chrome ore reserves.

It might be noted that the production of chromium ore from the Fethiye and Köyceğiz mines only totalled 200,000 tons even in the period prior to the First World War. The production level which did not exceed 8,000 tons a year in the early years of the Republic, noted an unprecedented remarkable rise during the Second World War and also in the period of cold war which followed, owing to the then prevailing political tension which influenced the increase of chrome production in Turkey as well as in the rest of the world. The annual outputs, according to the records, reached the levels to 500,000, 600,000, 800,000 and finally 900,000 tons. The importance of the Turkish chrome production in the world market can best be recognized by considering that the total chrome ore output in the world did not exceed 3 million tons in 1955. This was also one of the main incentives that led the Institute to include in its program extensive technical and scientific investigations with a view to add newer deposits to the existing ones.

Long before the increase of our chrome ore production, as described above, the M. T. A. Institute had done

considerable exploration work on the Guleman chrome occurrences. The Guleman Mine together with the Soridağ chrome ore occurrences were surveyed by the Institute as early as 1935 and transferred to the Etibank, after their reserves were estimated. The output today from chrome deposits at the Guleman and Soridağ areas in the province of Elazığ, exploited now by the Eastern Chromite Mine, reaches as high as 350,000 tons a year. It is to be inferred then that an average of 20 to 30 % of the total chrome ore output of Turkey is supplied by Guleman and Soridağ mining exploitations whose surveys were made by the M. T. A. Institute. As estimated by the Eastern Chromite Mine in 1959, the existing ore reserves appear to exceed — in spite of continued exploitation carried on for years — 1,300,000 tons; 800,000 tons of which as visible and 500,000 tons probable reserves.

The Institute has also investigated many chrome outcrops reported from the different chrome areas in the country. Mention should also be made of Üçköprü (Muğla) and vicinity where M.T.A. discovered an estimated total of 95,000 tons of chrome ore (45-47 % Cr) using drilling and mining methods. These too were turned over to Etibank.

Chrome mining however has never gone beyond certain limits in Turkey. In fact, chrome ore deposits now known and exploited are only those showing occasional outcrops at or near the surface resulting from regional uplifts. With the exception of a few number of spots mining operations reach depths of 100-150 m, work carried on may very well be stamped as superficial. Therefore it is worth-while to tackle the chrome problem of such high economic importance at its principles, especially when there exists in Turkey huge ophiolitic masses waiting to be looked

through which probably contain many times more chrome deposits than what we have laid our hands on up to date.

Getting to the bottom of this problem, both in theory and application, should be given first priority as it is essential for the country to hold its near leading place on the world market.

With this in mind, each year, mineralization zones are systematically prospected for chrome, according to a special program.

### LEAD PROSPECTIONS

Lead was mined in Turkey since early days, one of the most important deposits being the one at Keban.

#### **Keban Argentiferous Lead Mine (Elazığ)**

This was one of the first mines M.T.A. investigated soon after its foundation in 1935. The work ended in 1938 with an estimate of 87,000 tons of ore that analysed as follows: 11 % Pb, 12.6 % Zn and 350 g/t Ag.

Etibank completed necessary installations and started production in 1953. New installations are capable of yielding 3,000 tons of lead and as much zinc, annually.

#### **Bolkardağ Mine (Niğde), lead associated with gold and silver**

The M.T.A. Institute also began studies at this mine situated at an altitude of 1800 to 2800 m, and in spite of the extremely unfavorable climatic conditions, 280,000 tons of ore with 5.8 % Pb, 8.9 % g/t Au and 333 g/t Ag were located in 1936 when investigations ended and the mine was turned over to Etibank for exploitation. During this study more than 1,000 samples were, closely examined and analyzed in the laboratories of the Institute.

#### **Gümüşane Argentiferous Lead Mine**

Through underground excavations and drillings carried out by the Institute during (1935-1939), 230,000 tons of ore were found at Hazine Mağara with mineral content as follows: 3.3 % Pb, 3.2 % Zn, 21.6 % S, 2 g/t Au, and 89 g/t Ag.

Smaller lead deposits were also located by the Institute in different parts of the country, without however much of an economic value.

#### **Turhal (Tokat) Antimony Mine**

In the period 1936-1938, the Institute located a 54,000 ton ore deposit with 12.05 % Sb content, using drifts, shafts and cross-cuts totalling 4,000 m. 54,000 tons of ore thus located were inter turned over to Etibank for exploitation.

Investigations were also carried out on Çamlıca (Tokat) occurrences, but the reserves of 20,000 tons, with a 4.5 % Sb content, abandoned as not suitable for exploitation.

### TUNGSTEN PROSPECTIONS

Tungsten explorations were handled by the Institute with great interest. Considerable prospection work was carried on in different parts of the country, especially at Kaman.

#### **Uludağ Tungsten Mine**

Uludağ tungsten studies were taken up by the Institute in 1951 and successfully terminated in 1954. Because of the high altitude, working period was limited to a few summer months only. In addition to the wells drilled from the surface totalling 1791 m, cross-cuts, winzes and raises aggregated 334 m. Preliminary studies here have shown the presence of 10 million tons of tungsten ore (scheelite) with an average content of 0.43 % WO<sub>3</sub>.

### **Keçiborlu Sulphur Mine (Isparta)**

Large deposits of sulphur were shown to exist by the M.T.A. in the neighborhood of Değirmendere, near Keçiborlu, as a result of exploratory drilling conducted in 1944 (1695 m) and 1945 (1815 m).

Visible reserves in the portion now exploited by Etibank, were estimated in 1959 to run over 500,000 tons (60 % S). The fact that sulphur, largely consumed for vinicultural purposes, is obtained from the country's own resources, enables the country to save considerable foreign exchange. Production in 1958 amounted to 13,000 tons.

### **MERCURY ORE EXPLORATIONS**

Investigations made in different parts of the country gave the following results :

#### **Haliköy Mercury Mine**

80,000 tons of reserves were located through geological surveys and investigations made by the Institute in Haliköy Mercury Mine (İzmir, Ödemiş) have shown the content of the ore to be 0.44 % Hg.

#### **Sızma (Konya) Mercury Mine**

Only 15,000 tons of ore with a 0.32 % of Hg content could have been located here.

### **EXPLORATIONS FOR MOLYBDENUM**

Among a great number of molybdenum outcrops occurring in different areas in the country, the M.T.A. Institute focused its attention on the deposits at Keskin (Ankara), which offered the greatest economic possibilities.

#### **Keskin Molybdenum Mine**

Although the geophysical studies and other mining operations made on these

deposits in 1936 indicated the presence of 4,500 tons of ore (2.2 % MoS<sub>2</sub>) further investigation was stopped by 1937, as the mineralization seemed to discontinue towards the lower levels.

### **EMET COLEMANITE OCCURRENCE**

In the course of the prospections made by the M. T. A, Institute, colemanite occurrences were encountered at Emet, in the vicinity of Kütahya which, during the first survey, showed to contain a visible reserve of 3,000,000 tons. According to drillings carried out in this mine, actually exploited by Etibank, reserves appear to rise to 5,000,000 tons. Probable reserves to be checked later through drills are evaluated today at 5,000,000 tons.

### **EXPLORATIONS FOR BARITE**

Prospections for barite were conducted by the Institute in different parts of the country. The most important of the deposits located was the one at Bilir (Muş), with 900,000 tons of visible reserves, while probable reserves of the same deposits are estimated to run into 3,000,000 tons.

### **BAUXITE EXPLORATIONS**

The Institute has for quite a while concentrated on bauxite deposits, abundant throughout the country. But as they all were of rather low grade and their export during the World War II could not be possible, M. T. A. also conducted a number of laboratory tests on the side to see if aluminum could be obtained from emery, instead of bauxite. Although the results came out positive, production cost was calculated to run too high for going into actual operations.

The more important bauxite deposits in Turkey are the following :

#### . Akseki (Antalya) Bauxite Ore

As a result of the geological surveys and investigations by the Institute 5,000,000 tons of bauxite were located in this area.

Subsequent investigations aimed at selecting sections of these deposits, with sufficiently low SiO<sub>2</sub> content, to permit an economic exploitation.

#### .Cebbardağ ( Gaziantep - İslahiye ) Bauxite Occurrence

Visible and probable reserves of this occurrence are estimated at 5,000,000 tons, and the detailed study of this area postponed to a later date.

#### . Kokaksu (Zonguldak) Bauxites

Investigations made on those deposits indicated the presence of reserves with smaller tonnage.

#### . Çan (Çanakkale) Occurrences

Visible and probable reserves of the occurrences in this area are estimated at 3,000,000 tons.

### RAW MATERIAL PROSPECTION FOR FINE CERAMICS INDUSTRY

For years, the Institute has been carrying out studies on raw material resources in the country for use in fine ceramics industry. In addition to considerable studies made in the ceramics laboratories of the Institute on samples shipped from various localities of the country, detailed geological surveys and different exploratory work have been conducted on various raw material deposits in the country.

Among kaolin occurrences, that constitute the main raw material for fine ceramics, mention can be made chiefly of the Arnavutköy (Istanbul) kaolin deposits formerly estimated at 30,000 tons. Further investigations brought this

figure up to 400,000 - 500,000 tons. Likewise, the reserves of Beykoz (Istanbul) plastic kaolin deposits are estimated around 100,000-200,000 tons.

The Institute surveyed feldspath occurrences and ran a number of laboratory tests on samples. Quartz is also suitable for the purpose and found in many places, some of them near industrial centers, such as Istanbul. 5 to 10 million tons of it was reported from Yalıköy, near Podima and another 300,000 tons from Kabakça (Thrace).

### COAL INDUSTRY AND EXPLORATIONS FOR COAL RESERVES

The Institute has also taken on to task of finding out the location, grade and size of all the coal deposits throughout the country, ranging from semi-bituminous to low-grade lignite. Working on this vitally important subject, special efforts were made to determine true extent of the sub-bituminous coal reserves scattered all over Turkey, together with tentative methods for their most economical exploitation as well as utilization. It was in this connection that the M. T. A. thought of and designed as new type of stove, which even the peasants could build themselves if necessary, suitable both for heating and cooking. One such stove, using lignite as fuel, was actually built in the M. T. A.'s workshop and even exhibited for a while during the Second World War.

#### Bituminous Coal

**Short History:** Bituminous coal was first discovered in Turkey by «Uzun Mehmet» in 1829, in the Ereğli-Zonguldak District, on the Black-Sea coast. Exploitation had started as early as 1848, but only a total of 50,000 tons of coal were produced in the course of 17 years



that followed. Later the Navy took over the administration of the collieries, setting up organized operation as a result of which production suddenly reached 60,000 tons in 1865. Annual run-of-mine output was about 900,000 tons in 1910, but was to decline during the war, to 300,000 tons in 1917. The figure was once again up at 994,000 ton level in 1924, following the proclamation of the Republic, to go over the million ton mark by 1926. Following the nationalization of the coal district, the production tripled in 1940 and gradually increasing reached 6,500,000 tons by 1958 (with only 4 million tons of which marketable).

It is almost impossible substantially to rush the increase of coal production in underground mines anywhere. So, in the years that followed the Second World War, the production level could not adequately be boosted to cope with the ever-increasing consumption figures.

## EXPLORATION FOR BITUMINOUS COAL

**1. West of Filyos River.** — After the nationalization of the Ereğli-Zonguldak Coal Basin the Institute conducted a series of studies in the district with a view to determine true value of the known reserves there, both visible and probable. A portion aggregating 300-350 million tons was thus investigated using various methods, including drilling. It appears that the calculated reserves would substantially increase if the vicinity of the said portion, comprising some of the best-known sections only, were also included. The amount of known reserves, along with our knowledge, will naturally be expanding as the mining progresses and more exploratory wells drilled.

**2. East of Filyos River.** — In order to check for coal the area extending to

the East of the Zonguldak Coal Basin, investigations were conducted in such places as Pelitovaşı, Sögütözü and Kırmacı plateau with outcrops of coal-bearing formations. A total of 7,765 meters of bore holes, together with the geological and geophysical work carried out, showed the area to be highly disturbed, but nevertheless a portion of reserves amounting to some 40 million tons of coal was proven to be located in the Amasra syncline, East of Filyos River.

## EXPLORATION OF THE LIGNITE DEPOSITS

Lignite deposits encountered in many places throughout Turkey are gaining more and more importance in regards fuel requirements for all purposes. The bulk of the lignite deposits in the Western Anatolia is presently controlled and operated by the Western Lignite Exploitation.

Early studies made by the Institute having shown sufficient reserves in Soma, Tunçbilek and Değirmisaz to justify government operation, Etibank started to exploit these deposits of which the extents appear greatly increased through subsequent investigations.

The present visible reserves are estimated as high as 83 million tons in Tunçbilek and 88 million tons in Soma. Lignite deposits in Seyitömer were evaluated at 80 million tons of which 50 million tons were actually explored by the Institute.

If required in the future, the Institute will be conducting further investigations to cover probable reserves in the region.

M.T.A. has also contributed to the success of private sector by investigating such lignite concessions as those in Dordurga (Çorum) and Çan (Çanakkale)

with visible reserves of 30 and 41 million tons respectively in addition to three others in the vicinity of Soma estimated to be of 6, 19 and 20 million tons. Apart from the above, 40 million tons of lignite were found near Yenisaray (Tekirdağ) which goes to show that after valuable work on petroleum carried through to success, the Institute has concentrated on the lignite problem with 460 million tons of proven and over 200 million tons of probable reserves to its credit.

In the coal laboratories of the Institute, tests are carried out to determine characteristics of various coals from different parts of Turkey, such as briquetting tests made on fine lignite, which incidentally gave favorable results.

The activities briefly mentioned above have been rather limited to larger occurrences only.

The fact that in addition to 5689 technical reports filed away at the Institute there are 4864 records of reported occurrences of which 4321 were examined in place, goes to show how careful and steady a support is given by the M.T.A. to the matter of mineral resources in the country.

The Institute may well be proud of its accomplishments in the past (although the work was carried out within a relatively small budget) and can rightfully look forward to greater achievements in the industrial development of Turkey.