THE SIGNIFICANCE OF TIN IN TURKISH MINING HISTORY AND ITS ORIGIN

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ABSTRACT. — The major discovery of the ancient mining industry of Asia Minor is bronze, in the production of which tin was also used. It is highly probable that tin, used in copper-base alloys in certain amounts for the manufacture of various bronze tools, in prehistoric times, had been supplied from a number of small tin deposits presumed to have occurred in Asia Minor. It should however be born in mind that tin exploited from such deposits, had been insufficient to meet the demands of the ever-expanding bronze industry and had therefore been imported from foreign sources since the beginning of the second millenium B.C. Cuneiform texts on clay tablets discovered in the course of excavations conducted at Kültepe provide information on the ore trade between the occupants of Asia Minor and Mesopotamia. These tablets further indicate that the occupants of Asia Minor, sold copper, gold, silver and argentiniferous lead to the inhabitants of Mesopotamia in exchange of tin imported for the purpose of bronze production.

First information on the tin deposits presumed to occur in Turkey is mainly hearsay and date back to 1868. Earliest research work on the subject, on the other hand, was carried out in the period between the end of 19th, and the beginning of the 20th centuries. In Turkey, the first tin mineralization has been discovered in 1979-1980 in Keles-Sogukpinar area of Bursa Province. This discovery holds an important place in the mining history of Turkey.

INTRODUCTION

Research and exploration activities aimed to the discovery of tin minerals and mineralization as well, still hold significance. In epochs B.C. also, tin was an important and a rare mineral used extensively in the alloyg. Various research work carried out regarding the source of tin used by the indigenous civilizations of Asia Minor, also failed to illuminate the source of supply of tin consumed extensively in Anatolia. It has only been determined that tin had been supplied through imports from Mesopotamia in the form of bars ready for use in the alloys. Although it is known that a rich variety of mineral resources occurring in Asia Minor had been used since prehistoric times, the presumed occurrence of tin minerals still remains unresolved.

The earliest find offering evidence regarding the use of tin in alloys, has been discovered in the course of excavations conducted at Yümüktepe, 3 km northwest of Mersin. This material made of a copper + tin alloy (2.6 % tin), dates back to 4300 B.C. Although the tin content is too low, for a true bronze production and thus the material in question has been considered to be a primitive sample of its kind, it is, for the time being, the earliest material made of copper +tin alloy.

It is a known fact that early civilizations settled in Asia Minor used tin extensively in the production of bronze, in the years 3000-1200 B.C., thus labelling a new cultural epoch, the Bronze Age. Best examples of this epoch were found at Alacahöyük (Çorum-Sungurlu) and Horoztepe (Tokat-Erbaa). For example, among the finds discovered in the Alacahöyük tombs (B.C. 2400-2100), are bronze and copper materials and gold, silver and gold+silver objects (Koşay, 1966). The fact that the surface of some bronze objects, which had been used for religious purposes, were plated and inlayed with electrone (gold+silver), indicates the perfection of the technical skill achieved by the smiths of the age. Analyses of the bronze materials discovered at Alacahöyük were first carried out in 1937 at the MTA Laboratories and these were found to contain 9-17 percent tin;

as no other minerals, however in trace amounts, were detected the materials analyzed were considered to be perfect copper+tin alloys (Koşay, 1938). It therefore seems reasonable to conclude that Alacahöyük is the first known representative of an advanced mining industry in Asia Minor in the second half of the 3rd millenium B.C., since in the objects discovered tin had been used intently as an additive in copper-based alloys and has duly led the techniques of metallurgy and treatment to an advanced level. The source of tin supply, however still remains unresolved.

At the beginning of the second millenium B.C. several rich cities familiar to the valuable mineral resources and having advanced level of mining industry, dominated Asia Minor. It should also be noted that, in the same period also, the Central and Central-Northern Anatolia, was familiar with the underground mining techniques and metallurgy as well; and the region in question is one of the rare and exceptional areas in terms of earliest recorded systematic and organized production of processed metallic materials. Such potential possessed by the Asia Minor, has been a factor in the development of trade relations between the occupants of Anatolia and Mesopotamia (most part of Iraq territory of today), mainly in the form of minerals and lasting for more than two centuries. And such trade relations were first initiated by the Assyrian merchants coming from Mesopotamia and forming trade colonies in the rich cities of Asia Minor. The era described here is labelled as the «Age of Assyrian Trade Colonies in Asia Minor» (1950-1750 B.C.) in history. Assyrian caravans, starting their journey from Mesopotamia, brought cloths, perfumes and other ornaments and tin bars ready for use in the alloys to the «Kharum»s (big market places) set up in the cities, and took back to Mesopotamia gold, silver, copper and various precious stones in exchange (Bilgiç, 1948) (Fig. 1). Trade relations thus starting between the inhabitants of Asia Minor and Mesopotamia and mainly aimed to the utilization of the underground riches of the first, is known as the date when Asia Minor was first became a source of an organized and systematic exploitation in the history.

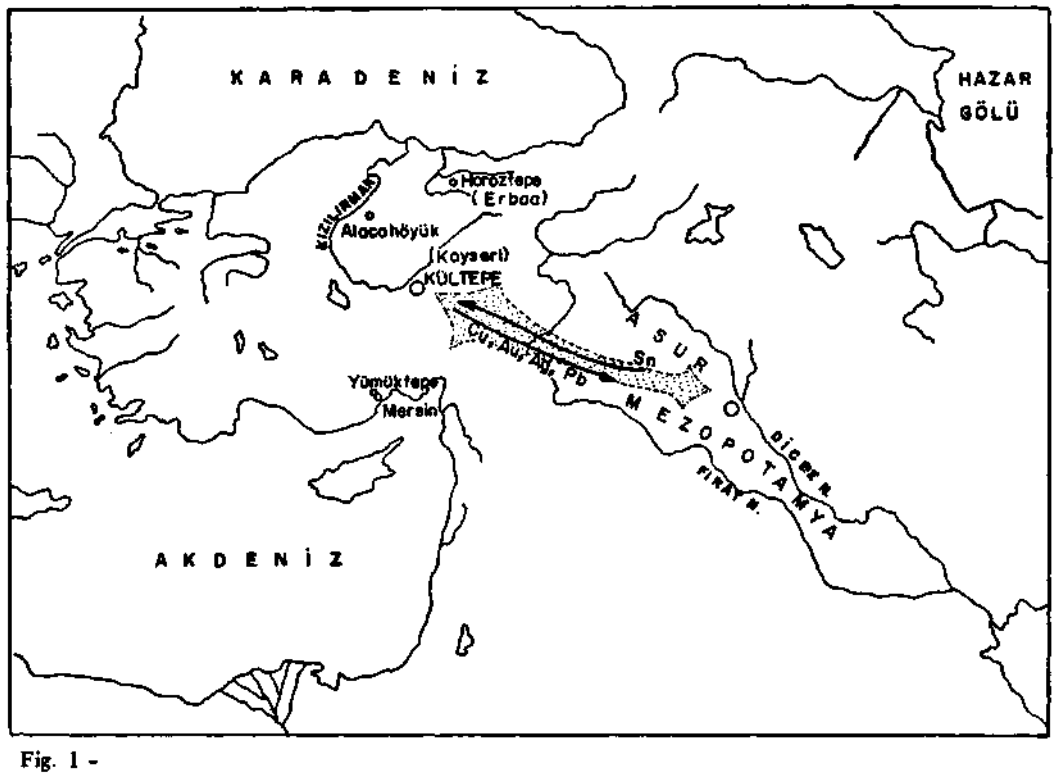

Fig. 1 -

A number of cuneiform texts written in Assyrian language, and found during the excavations carried out in Kayseri-Kültepe (Karahöyük) area provide evidence that tin had been an import item in Asia Minor.

TIN IN ANATOLIA IN SECOND MILLENIUM B.C.

AN. NA (anakum) = Tin

Through various research work carried out, it has been determined that the ideogram AN. NA inscribed on the clay tablets discovered during the excavations at Kültepe (Kayseri) means tin and is read «anakum» in Assyrian language; and that the tin required by the smiths of Asia Minor for the production of bronze, had been imported from Assyrians (Bilgiç, 1943). Assyrian merchants, about four thousand years ago, sent tin, exploited in Mesopotamia and in the form of bars bundled together and weighing about 300 kgs along with other merchandise. It has been estimated that the share of tin in the total merchandise shipped to Asia Minor, was about 40 percent (Özgüç, 1950). In a business letter discovered in the course of excavations conducted at Kültepe and illuminating the mineral-based trade relations between the inhabitants of both countries, the following has been deciphered: «Tell-Puzur-Assur that 1 sent 115 mine* free tin, packed 75 best quality tin, 57 1/2 mine free tin, 10 black donkeys and sets, that is everything to you, sealed with Assur-imiti and İli-sutu stamp. Sarra-Su'en brought his gold and silver to me. Among them 1 sent, 28 mine tin and 4 good quality cloths to you. Sarra-Su'en shall send the rest of merchandise to you.»

Merchandise brought to Anatolia by the Assyrian merchants, were exchanged with the by then valuable minerals and ores. Tin on the other hand, had a very particular place among the imported goods; although the customs tax levied on imported goods was 5 %, tax levied on tin bars, ready for use in the alloys was only 2-3 %. The difference between the taxes levied, is another indication of the importance attached to tin imports. Furthermore several clay tablets giving evidence regarding the prohibition of taking tin out of Asia Minor have also been discovered.

In Anatolia tin had been sold on the basis of 1/10-1/5.5 silver value to the inhabitants. And it is also highly probable that tin had been imported, levied and sold on the basis of different silver values in different cities. Furthermore various writers believe that tin had also been used as coins (Özgüç, 1950).

Through decipherement of cuneiform texts inscribed on clay tablets, it has also been determined that two qualities of tin had been imported to Asia Minor: viz.,

a. Perfect quality tin (anakum damqum vatrum)

b. Good quality tin (anakum damqum)

Similarly in some of the cuneiform documents, complaint and resentment had been inscribed regarding the quality of tin; for example: «Your tin is not good. Please send good quality tin, since people are not willing to buy inferior quality. I commissioned four men, and opened the merchandise in front of them, your tin (AN. NA) is low quality. «Through decipherement of other cuneiform texts, it has been established that tin bars bundled together and called riksum in Assyrian language, had been enveloped in a bandage termed livitum in Assyrian and following stamping, were exported as

anakum zakum=tin ready for export (Landsberger, 1965). The purpose of enveloping tin bars in wool or cloth sacks or skinhide bags before shipment to Asia Minor could not have been made solely to facilitate transportation. The journey of the caravans carrying the goods called «suqlum» on the clay tablets, to Anatolia, did take seasons, going through winters and summers, thus being subject to seasonal changes. Tin bars, had therefore, to be protected against moisture and damp weather, since they were easily be oxidized. Even today experts call tin impaired due to oxidation as «plagued tin». It should therefore be considered that the use of cloths or sacks or skinhide bags to protect tin bars about four thousand years ago, from atmospheric effects, had been a reasonable precaution.

Tin ready for use in the alloys and imported from Mesopotamia, had never been used alone in the manufacture of tools and implements, or for tinning purposes of kitchen utensils, due to its low melting point (232°C) and softness. Spectral analyses carried out on the bronze tools discovered during the excavations have shown that tin had been used in amounts varying between 5-10 percent.

Sources of tin supply to Anatolia

Various research work carried out regarding the origin of the tin used in the production of bronze, the major discovery of the Bronze Age (3000-2000 B.C.) in ancient Asia Minor, presume that tin had been supplied from a variety of small deposits, scattered throughout Eastern Anatolia. Should such a presumption, i.e. the occurrence of tin deposits in Eastern Anatolia is accepted to be true (as it has been the case regarding the gold deposits which had been depleted throughout the history by the indigenous civilizations of the region in question) then it may be logical to assume that the small tin deposits had been exploited to depletion by the first bronze manufacturers within a relatively short period of time. It should further be noted that whatever the source may have been, tin had not been sufficient to meet the requirements of the ever increasing bronze production of the period. It is therefore concluded that tin had been supplied from the Assyrians in lots weighing 300 kgs since the beginning of the second millenium B.C. It does however remain to resolve, the problem from which resource the Assyrians supplied tin in amounts sufficient for exportation also to the Asia Minor. In various research work carried out in this respect, it has been stated that a number of antiquities have been discovered in Caucasia and Azerbaijan (Western Asia) in particular, giving evidence that tin had been exploited in these regions; and it is also known that tin is still produced in these areas. It should also be noted that in Baluchistan (Southern Asia) however located at a considerable distance, compared to the above referred areas, important tin reserves have been discovered. It would however not be reasonable to conclude that tin had been supplied to Asia Minor from Caucasia or Azerbaijan, on the basis of data given here in the period between 3000-2000 B.C.; otherwise the same sources would have continued their supply in the following eras. Furthermore, the trade relations developed between the Assyrians and the inhabitants of Asia Minor principally aimed to the utilization of a variety of underground riches of the latter in exchange of tin and lasting for more than two centuries, would not have found the grounds necessary.

During the reign of the Hittites and the following centuries tin had been supplied to Asia Minor from such sources as England (Cornwall), Spain, Portugal, Bohemia (Central Europe), and Northern Italy via Dardanellas (Werhime, 1973).

Tin problem of Asia Minor-Today

Earliest research work regarding the determination of tin deposits assumed to occur in the country, were carried out at the turn of the century.

Gümele (Eskişehir). — The first exploration concession has been granted by the government of the Ottoman Empire to M.M. Halagian and his son in 1899 for the area located in Bursa Province, Ertuğrul subdivision, within the boundaries of Söğüt and Mihalgazi Counties, covering the vicinities of Tozman, Demirciler, Bozaniç and Bunaklar (Sarıoğlan) Villages. Today, however, the area in question is located in Eskişehir Province, within the boundaries of Mihalgazi (Gümele) County, Sarıcakaya (Fig. 2).

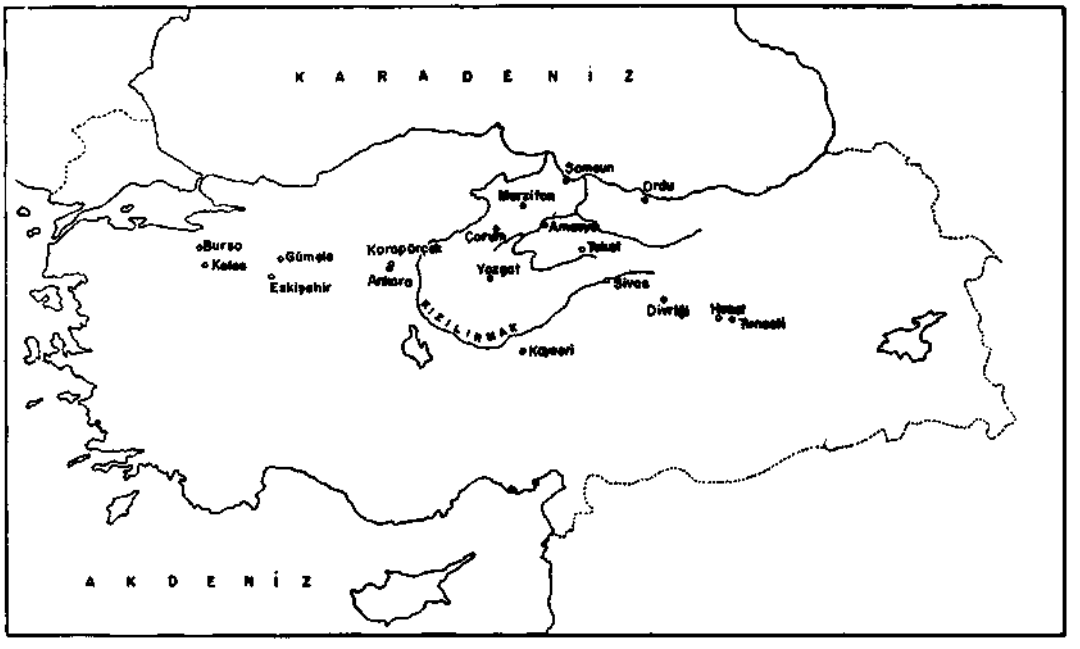

Fig. 2 -

The first official report entitled «Gümele Tin Deposit» and giving the results of the activities carried out in the concession area was prepared by the Chief Engineer of the Empire on 30/8/1900; the report in question, however, does not give the writer's name (MTA Rep.) and further states that a tin oxide (SnO_2) deposit occurs in the Gümele (Mihalgazi) area and that the average tin content of the samples collected varies between 0.25 % - 0.35 % and 1.75 %. The report further states the occurrence of alluvial deposits containing 3 % cassiterite and 12 % magnetite.

The second research work regarding Gümele area, has been conducted during the Republican period. The work in question has been carried by E. Zimmer, on behalf of the MTA Institute. This work, which was primarily carried out based on the results stated in the report prepared by the Chief Engineer of the Ottoman Empire, has been conducted in the same region and concludes that tin does not occur even in trace amounts, as indicated by the results obtained from the spectral analysis of the samples collected (Zimmer, 1940).

The third research work on the Gümele area, has also been carried out on behalf of the MTA Institute by V. Stchepinsky. Within the framework, of this work, which was primarily aimed to bring a solution to the varying results obtained from the previous works, 0.1 % tin has been determined in the samples taken from the area and spectrally analyzed. Furthermore, V. Stchepinsky collected new samples from an exploratory drill hole opened 1 km north of Gümele and pre-

viously sampled by Zimmer, and determined that tin occurs in the range of 0.05 % on the basis of spectral analyses. It has thus been concluded that the area investigated cannot be entirely sterile (Stchepinsky, 1941).

Tillek Village-Dojik Mt. (Tunceli Province). — The earliest information regarding the occurrence of tin deposits in Asia Minor, however legendary, has been reported by J.G. Taylor in 1868 at the «Royal Geographical Society»; Mr. Taylor has claimed that tin occurs in Sarp Garabet locality of Dojik Mt., situated N of River Munzur flowing through Tillek Village (Taylor, 1868) (Fig. 2).

However limited, M. Lucius also gives information on the possible occurrence of tin on Dojik Mt., Tillek Village (Tunceli-Hozat) in his work dated 1932. In this work M. Lucius states that tin occurs in trace amounts in the copper ore, which is found at the granitic intrusions in the metamorphic schists developed on the southwest flank of Dojik Mt. (Fig. 2) (Lucius, 1932).

Detailed information obtained from a research work carried out in Tunceli, with a purpose to determine the tin deposits assumed to occur on Dojik Mt., may also be found in the report submitted by A. Helke. A. Helke conducted his activities not only in the near vicinity of Tillek Village, but also in the surroundings of Mamlis with a purpose to prove the reliability of the data and information supplied by J.G. Taylor. Analyses of samples collected however, did not yield any tin, even in trace amounts. Furthermore, in his report, A. Helke particularly emphasizes that the occurrence of tin would be highly improbable in this locality due to the calcareous structure of Dojik Mt. (Helke, 1939).

Karapürçek-Bayamlı Hill (Ankara). — Spectral analyses of the samples collected during the course of research work carried out by H. Kleinsorge in the area between Karapürçek (Hüseyingazi) and farther to northwest, have shown trace amounts of tin. It is particularly interesting to note that in one of the samples analyzed, tin occurs in the range of 0.24 % The same research work, however, further states that the area investigated, has no importance regarding possible tin occurrences (Fig. 2) (Kleinsorge, ,1940).

Divriği Efendi Brook-Karakeban (Sivas). — Ulvi Denkel conducted research work in the area between Divriği Efendi Brook and Karakeban on copper, bismuth and tin occurrences. Denkel reports the occurrence of chalcopyrite, bismutine, lollengite and cassiterite in the area investigated. Copper, fluorite and bismuth occur in substantial amounts and their respective proven reserves have been calculated. Reserve calculations of tin deposits, however had not been made since tin occurs in trace amounts, i.e. 0.02 % (Denkel, 1961).

Exploration for tin in Central and Central-North Turkey. — Based on the information provided by the historical documents, and with a purpose to contribute to the activities aimed to the discovery of tin deposits in the country, a research work has been undertaken at the ancient waste dumps found in Central,and Central-Northern Turkey.

The fact that the ancient civilizations inhabiting Asia Minor manufactured bronze since 3000 B.C. and that such production did keep pace with the ever increasing demands, multiplies the chance ofencountering waste dumps resulting from ancient tin metallurgy.

More than two hundred ancient waste dumps have been found in Turkey, and only 43 of them are dated within the framework of the present work. It should however be noted that no mine dumps have been eucountered containing tin waste. Furthermore, results obtained from the optical spectrographic-semi quantitative analyses of the samples collected from these dumps, show that tin is not present even in trace amounts. Analyses of the samples taken from waste heaps found in Sakapınarı locality (Bakırçay Valley, Merzifon), reknown for the discovery of a number of waste dumps dating back to Roman-Early Byzantine period (A.D. 400-600) has shown the presence of tin in very minor

amounts, i.e. 0.07 % (Kaptan and Jesus, 1974). It is very interesting to encounter tin in such amounts in the samples collected from waste heaps.

It may thus be concluded that no waste dumps have been encountered giving an indication of tin metallurgy, in the course of research work carried out in Anatolia. Furthermore, such general-purpose research work also shows that tin minerals should be explored for in the sediments, and it is therefore emphasized that research work for cassiterite should be carried out in the river placers developed in areas abandoned by stream waters and in areas lying between upstream and downstream of Kızılırmak. This is mainly due to the reason that ancient settlement centers of Bronze Age civilizations are mostly located within the arch of Kızılırmak, thus leading to the conclusion that, tin minerals should be searched for in the Çorum-Yozgat-Kayseri, Ordu-Samsun-Amasya and Tokat areas (Fig. 2) (Kaptan, 1976).

Keles-Soğukpınar Madenbelenitepe (Bursa). — The first tin mineralization of Turkey has been discovered in Madenbelenitepe area, located in the vicinity of Handere Valley, Soğukpınar, Keles County (Bursa Province) (Çağatay, Altun and Annan, 1980) (Fig. 2).

It is also interesting to note that in the present area characterized by the exposures of Madenbelenitepe tin mineralization, in addition to a number of adits and trenches dating back to near past, several slope galleries were found belonging to ancient times.

Tin mineralization discovered in the area described here, is very important since it illuminates the problem awaiting solution for a long time.

CONCLUSIONS

The major discovery of the mining industry of ancient civilizations inhabiting Asia Minor, dhas been bronze, for the production of which 5-10 percent tin has been added to copper. The solidity of bronze, compared to other metallic materials used in the manufacture of various tools and implements, has also been a factor for the continuation of the production of bronze tools for thousands of years in Asia Minor and this had thus led to label a major age, the Bronze Age (B.C. 3000-1200). It may also be concluded that the small tin deposits occurring in Asia Minor had been explored for the manufacture of bronze in the third millenium B.C. It should also be born in mind that, such tin deposits, as it has been the case in terms of gold deposits, must have been consumed to depletion by the indigenous inhabitants of Asia Minor in the period between 3000-2000 B.C. to meet the demands of ever-increasing bronze production. Tin required by the later civilizations had therefore been supplied through imports, in the form of bars ready for use in the alloys.

Although the first official research work aimed to the discovery of tin deposits presumed to have occurred in Asia Minor was carried out at the end of 19th century, the earliest information, however legendary, on the subject, dates back to 1868. It should also be noted that technological and scientific developments recorded lately, have also influenced the research work aimed to the discovery of tin minerals; and within the framework of such activities, the first tin mineralization of Turkey is found in Bursa Province.

Tin occurrence discovered in Bursa Province (Madenbelenitepe, Keles-Soğukpınar Village) has a very important place in the mining history of Turkey. Whether this occurrence had any substantial influence on the mining industries of the civilizations settled in Asia Minor in times Before Christ, however, can only be determined by additional research work, since it is possible that deposition of tin minerals in the sedimentary rocks has resulted from erosional effects of streams and that

ancient miners extracted the mineral in question from cassiterite occurring in placer deposits. Additional research work is therefore considered necessary to search for findings which can illuminate ancient culture on tin metallurgy.

Geological and mineralogical research work aimed to the determination of tin deposits presumed to have occurred in Turkey and archaeological works based on historic data and documents and conducted in line with the former are thought to contribute, as it is the case in other countries, substantially to the determination of ore deposits occurring in Turkey.

ACKNOWLEDGEMENTS

The writer particularly wishes to thank to Mr. Veysel Donbaz, expert at the İstanbul Archaeology Museums and to Mr. Münip Özben, painter at the Mineral Research and Exploration Institute, for their careful and ardent efforts to take the old of a clay tablet discovered at Kültepe, Kayseri during the excavations and illuminating the trade of tin, gold and silver between Asia Minor and Mesopotamia, and who has also led to the acquisition of the tablet in question following its transcription to the Section of Turkish Mining History at the Natural History Museum of the MTA Institute.

Manuscript received April 3, 1981

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