

The Development of Science in the Turkish Republic

Erdal İnönü, Washington, TASSA Annual Meeting, February 19, 2005.

1. Introduction

Mr Chairman- MS Vice-President of George Washington University
Mr Ambassador of the Turkish Republic
Members of the Turkish-American Scientists and Scholars Association

It is a great pleasure for me to address your distinguished association here in Washington and I thank your governing board for having given me this opportunity. I wish great success to TASSA in the coming years.

I shall try to summarize in an hour the development of science in the Turkish Republic. That is to say from 1923 to the present covering roughly eighty years, which also coincides with my lifetime.

2. The Ottoman Legacy

To begin with I must say something about the period prior to 1923, The Ottoman period. Unfortunately, the Republic did not inherit a scientific tradition from the empire. In fact it is my conviction that the fundamental reason behind the continuous weakening and decline of the Ottoman Empire in the eighteenth and nineteenth centuries is their lack of understanding of the meaning and importance of the scientific revolution which took place in central and western Europe during the sixteenth and seventeenth centuries. The Ottoman case is a striking example of what happens to a country if scientific research is neglected for many years. The Ottoman rulers and their advisors did not attach any importance to the revolutionary advances made by people like Copernicus, Vesalius, Galileo, Descartes, Kepler, Newton, Leibniz, Harvey and others in the sixteenth and seventeenth centuries. The Ottoman scholars did not try to participate in developing the new fields opened up by scientific research, based on observation, experimentation and mathematical formulation of theories. The result was a continuous loss of power and general decline. When the disastrous consequences of this incredible neglect appeared on the battle field or in economic competition, the Sultans realized that something, some knowledge is missing. But since already two centuries of advances had taken place, they did not dare to go at the roots and tried to catch up in a hurry by transferring the new knowledge, first through hiring foreign military experts and next by establishing schools of engineering and medicine. No research was carried out in these educational institutions. In the rush of trying to obtain the existing knowledge, the administrators did not allow sufficient time to teachers to work actively and creatively in these new fields. They were satisfied by translating the available textbooks and teaching according to them. The idea that research is an essential and integral part of university training was not realized by the Ottoman educational system, almost to the end.

There are a few individual exceptions to this picture. One way to see them is to look at the list of the first Turkish scholars who have received Ph. D. degrees at universities in Europe before 1923. This list is shown in *table 1* below.

PEOPLE HOLDING PHD DEGREES IN SCIENCE IN TURKEY IN 1923

Name	Degree Giving University	Year	Field
JOSEPH ZANNI	HEIDELBERG UNIV.	1876	CHEMISTRY
HALİL ETHEM ELDEM	BERN UNIV.	1885	CHEMISTRY
MEHMET ARİF	HALLE-WITTENBERG.	1891	CHEMISTRY
MUSTAFA AZMİ SUMEN	MUNIH TEKNİK UNIV.	1917	CHEMISTRY
OSMAN NURİ SOMER	BERLIN UNIV.	1918	CHEMISTRY
A. REFİK KADIZADE BEKMAN	BERLIN UNIV.	1918	CHEMISTRY
KERİM ERİM	ERLANGEN UNIV.	1919	MATHEMATICS

Tables 2 and 3 show the first pages of doctoral theses of Halil Ethem Eldem and Kerim Erim. Unfortunately, most of the people indicated in this table did not continue to do research after they received their degrees. Only Kerim Erim on his return to Turkey joined Istanbul University when it was still called the Darülfünun and pursued his mathematical research there. Another scholar, Halil Ethem Eldem, after his return, accompanied the foreign geologist Toula in his study trips in Turkey, attaching his name to two fossils they discovered together and later specialized in numismatics, becoming the director of Istanbul Archaeological Museum. A. Refik Bekman joined the Educational Establishment, preparing textbooks for high schools, working at the Teacher Training Institute in Ankara and finally becoming professor of chemistry at the Ankara Science Faculty in 1943. The other people shown in the table, after they returned to Turkey, occupied administrative positions in various State and private sector institutions. I have two more tables, which show some research done in the fields of geology, medical and veterinary science.

Table 2.

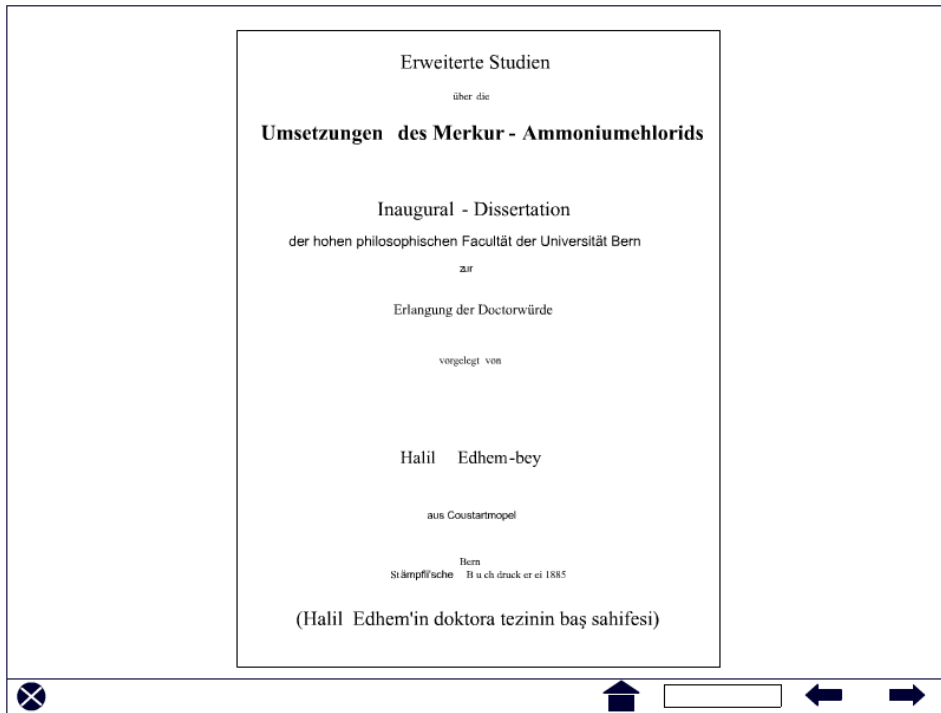


Table 3.

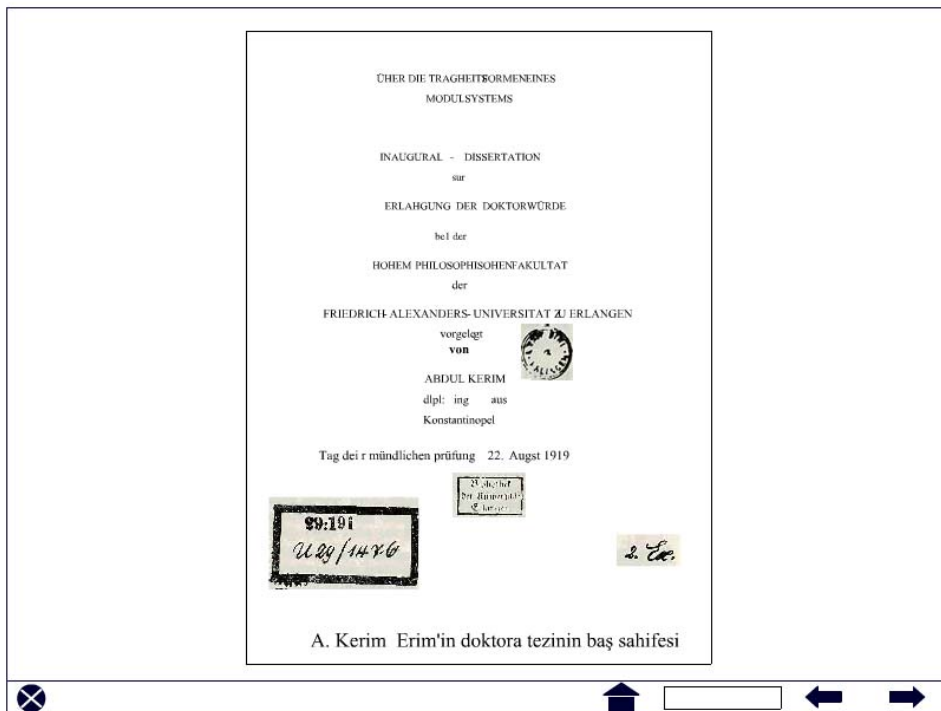


Table 4.

RESEARCH PRODUCTS IN GEOLOGY PRIOR TO THE REPUBLIC YEARS	
Source: R. Brinkman - Oğuz Erol, Türkiye Yer Bilimleri Bibliyografyası 1825-1975, Bölüm 1, TÜBİTAK, 1981	
Abdullah bey, Note relative a une collection des fossiles recueillis dans le terrain devonien du Bosphore CRA, Sc, 64,914, Paris, 1867.	
Abdullah bey, (Hammerschmied)Bemerkungen über die Pefrefakten der devonischen Formation des Bosphorus, Verh GR 1868,416-417, Wien	
Abdullah bey, Die Umgebung des See's Kütschüchtschekmetche in Rumelien, Verh GR 1869, 263-265, Wien.	
Abdullah bey, Remarques géologiques sur le calcaire dévionien du Bosphore, Bolletino Comitato Geologico d'Italia I, 187-189, Firenze, 1870.	
Abdullah bey, Offerte au Muséum d'une collection des roches et fossiles du terrain dévionien du Bosphore, BSGF (2), 24, 621, Paris, 1867.	
D'Archiac et al Trilobitardea, 1867, Cryphaeus abdullahi De Verneuil.	
De Verneuil,Appendice, Trilobitardea, 1869, Cryphaeus abdullahi De Verneuil.	
Fosiller	Toula., Muscheikaikauna, 1896; Rhynchonella Edhemi Toula Toula. Muschelkalkfauna. 1896: Acrochor diceras Halili Toula
Von Arthaber, Bithynien,1915, Rhynchonella edhemi var. plana von Arthaber. Rhynchonella edhemi var. robusta von Arthaber.	
Böhm 1927: Echinocorys Edhemi Böhm.	

Table 5.

RESEARCH PRODUCTS OBTAINED IN THE YEARS PRIOR TO THE REPUBLIC	
Hasan Reşat Sığındım: Reshad, H, Schilling-Torgau, V: Ueber eine neue Leukmie durch echte Ueberganz formen (Splenozytenleukamia) und ihre Bedeutung für die Selbstandigkeit dieser zellen. München med. Wohnschr. 1913,60:1981.	
Akil Muhtar Özden: 1896 yılında Cenevreye tıp tahsili için gitmiş, İsviçrede doçentlik sınavı geçerek 1904 te privat doçent unvanı almıştır. Kobay cilt refleksinin lokal anestetiklerin araştırmasında kullanılabilecek bir refleks olduğunu göstermiştir. Klasik farmakoloji literatüründe Muhtar refleksi olarak geçmektedir.	
(Özden) Akil, M: Strophantin und Digitalis bei Herzschwäche. 13. Karlsbader Fortbildungskurs, November 1926.	
Anday, Kadri Raşit (Paşa), Paris'te 1917 öncesinde "Organizmada klorür ile ilgili değişiklikler" konulu tezi ile fizyoloji doktoru unvanı almıştır,	
(Örensoy) Tevfik Recep: 1900 yılında Histoloji ve Embriyoloji tahsili için Almanyaya gönderilmiş, Würzburg Üniversitesi Tıp Fakültesinde Doktora sınavını vererek 1904 te İstanbula dönmüş.	
Adil Mustafa: Veteriner hekim bakteriyolog. 1902 de Fransız Dr. M. Nicolle ile sığır vebasası etkeni üzerindeki araştırma ve buluşları tüm dünyada ilgi uyandırmıştır. (Erk, N., 1968, İlk Türk bakteriyologlarından Adil Mustafa. A. Ü, Veteriner Fak. Dergisi 15: 24-28)	

There are also the archaeological excavations of Osman Hamdi in **Lebanon** of which the findings were published in France, an original mathematics book on “Linear Algebra” by Vidinli Tevfik Pasha, published in 1882-1892. Solutions of some Diophantine equations by Mehmet Nadir, published in a French Journal in the years 1908-1911 and a few more articles on various subjects.

These scattered individual efforts did not suffice to create a scientific tradition. When the Republic was created and its leaders, beginning with Atatürk, decided to embark on a development course based on the best use of advances in science and technology, they realized the inadequacy of the existing system. They had to start from scratch. The start was given by creating, in 1933, two new institutions of higher education where research would be an integral part of the academic activity. This is the famous University reform of 1933. In Istanbul, Darülfünun was abolished altogether and Istanbul University was created in its stead. In Ankara, the Higher Institute of Agriculture was created replacing the old school of Agriculture.

This was a radical reform. The majority of the teaching staff of Darülfünun were discharged and put on pension. The new staff composition was made up of young Turkish scholars who had just returned from Europe with doctoral degrees, some distinguished members of the old institution who did carry out research and refugee German scientists who had left Germany to escape political pressure of the Nazi regime. At the Ankara Agriculture Institute also, the new staff had a similar structure with the only difference that there, the visiting German staff had come officially through a cooperation agreement between the two governments.

Tables 6-12 list the Turkish scientists who received the first doctoral degrees in various sciences and joined Istanbul University after the Reform. With them about fifty German scientists joined the new institutions in Istanbul and Ankara and research activity started immediately.

Table 6.

THE FIRST DOCTORAL DEGREES OBTAINED BY TURKISH SCIENTISTS	
In Mathematics	
Abdül Kerim (Erim):	(Erlangen Üniversitesi, 1919): Über die Trägheitsformen eines Modulsystems.
A. Ratip Berker:	(Lille Üniversitesi, 1936): Sur quelques cas d'intégration des équations du mouvement d'un fluide visqueux incompressible.
Orhan. Hamdi Alisbah:	(Berlin Üniversitesi, 1936): Das Koeffizienten Problem des beschränkten Analytischen Funktionen.
Nazım Terzioğlu:	(Münih - Ludwig - Maximilian Üniversitesi, 1936): Über Finslersche Räume.

Table 7.

THE FIRST DOCTORAL DEGREES OBTAINED BY TURKISH SCIENTISTS	
In Astronomy	
Tevfik Okyay Kabakçiođlu:	(Müniđ - Ludwig - Maximilian Üniversitesi, 1934) Über die mehrfachen Kommensurabilitä-ten im System Planetoid - Jupiter - Saturn.
Nüzheth Gökdođan:	(İstanbul Üniversitesi, 1937): Contribution aux recherches sur l'existence d'une matiére interstellaire homogéne autour du soleil.
Paris Pişmiş:	(İstanbul Üniversitesi, 1937): On the interpretation of the K-term.

Table 8.

THE FIRST DOCTORAL DEGREES OBTAINED BY TURKISH SCIENTISTS	
In Physics	
Fahir Yeniçay:	(Paris Üniversitesi, 1930): Films monomoléculaires sur l'eau et sur le mercure.
Sait Ali Ankara:	(Berlin Technische Hochschule, 1931): Über Liot-rope Eigenschaften des Thallions.
Müniđ Çelebi:	(Ankara Yüksek Ziraat Enstitüsü, 1937): Amorf kömürün kristalin haline geçmesine dair tecrübeler.

Table 9.

THE FIRST DOCTORAL DEGREES OBTAINED BY TURKISH SCIENTISTS	
In Chemistry	
Halil Edhem (Eldem): (Bern Üniversitesi, 1885): Erweiterte Studien über die Umsetzungen des Merkur - Ammonium-chlorids.	
Tahsin Rüştü Beyer: (Lyon Üniversitesi, 1932): Sur la constitution des solutions organo-magnésiennes.	
Mecit İbrahim Okay: (Berlin, Landwirtschaftlichen Hochschule, 1932): Untersuchungen über Geschiebemergel als Me-liorations-mittel. (Tarım Kimyası)	
Turan Şeşbeş: (Dresden Technische Hochschule, 1932): Über Feigen, Feigenmöste, Wein und Wein brände. (Kimya Mühendisliği)	
Saffet Rıza Alpar: (Hamburg Üniversitesi, 1932): Die Synthese des Rubans.	
Remziye Hisar: (Paris Üniversitesi, 1933): Contribution à l'étude des acides métaphosphoriques et de leurs sels.	





   

Table 10

THE FIRST DOCTORAL DEGREES OBTAINED BY TURKISH SCIENTISTS	
In Botany	
Hikmet Ahmet Birand: (Bonn Üniversitesi, 1933): Untersuchungen über Tracheomykosen.	
Lütfiye İrmak: (İstanbul Üniversitesi, 1938): The Lyotropic effect of ions on the sugar permeability of living plant cells.	
Mehpare Heilbron: (İstanbul Üniversitesi, 1938): Les caractères secondaires sexuels de Bryonia discica.	





   

Table 11.

THE FIRST DOCTORAL DEGREES OBTAINED BY TURKISH SCIENTISTS	
In Zoology	
<p>Mithat Ali Tolunay: (Münih Üniversitesi, 1932): Experimentelle Untersuchungen über den Einfluss von Temperatur und Luftfeuchtigkeit auf die Entwicklung des Schwammspinners Porthetria disper L.</p>	
<p>Yusuf Kemal Bayrakçı: (Hamburg Üniversitesi, 1935): Die Schuppen - entwicklung bei Susswasserfischen und ihre örtlichen Verschiedenheiten.</p>	
<p>Melahat Çağlar: (Berlin Friedrich - Wilhem Üniversitesi, 1936): Das thermotaktische Verhalten einiger Reptilien.</p>	

Table 12.

THE FIRST DOCTORAL DEGREES OBTAINED BY TURKISH SCIENTISTS	
In Geology	
<p>Şevket Ahmet Birand: (Berlin, Landwirtschaftlichen Hochschule, 1933): Über die Methode einer petrografisch-morpholo-gischen Kartierung Anatoliens, unter Berücksichtigung der natürlichen Verhältnisse dieses Landes.</p>	
<p>Ahmet İbrahim Can Okay: (Berlin, Preussisch-Geologische Landesanstalt, 1932): Sporenformen des Aegirhorizonts des Ruhr-Reviers.</p>	
<p>Suat Erk: (Istanbul Üniversitesi, 1938): Géologie de la region de Gemlik.</p>	
<p>İhsan Ketin: (Bonn Friedrich-Wilhelm Üniversitesi, 1938): Über die Tektonik und den Vulkanismus der Gegend von Bad Bertrich.</p>	

Table 13-15 show the research output in physics, mathematics and chemistry in the period of 1933-1966 by indicating the variation in the number of research articles averaged over three years. These articles were written by the Turkish or foreign staff.

One can see in these tables a steady increase up to the middle of the fifties, with a slowing down period in the forties, which was caused by a fire, which in 1942, burned down the building of the science faculty of Istanbul University. There is a more important slowing down in the middle of the fifties caused by adverse economic conditions.

Table 13

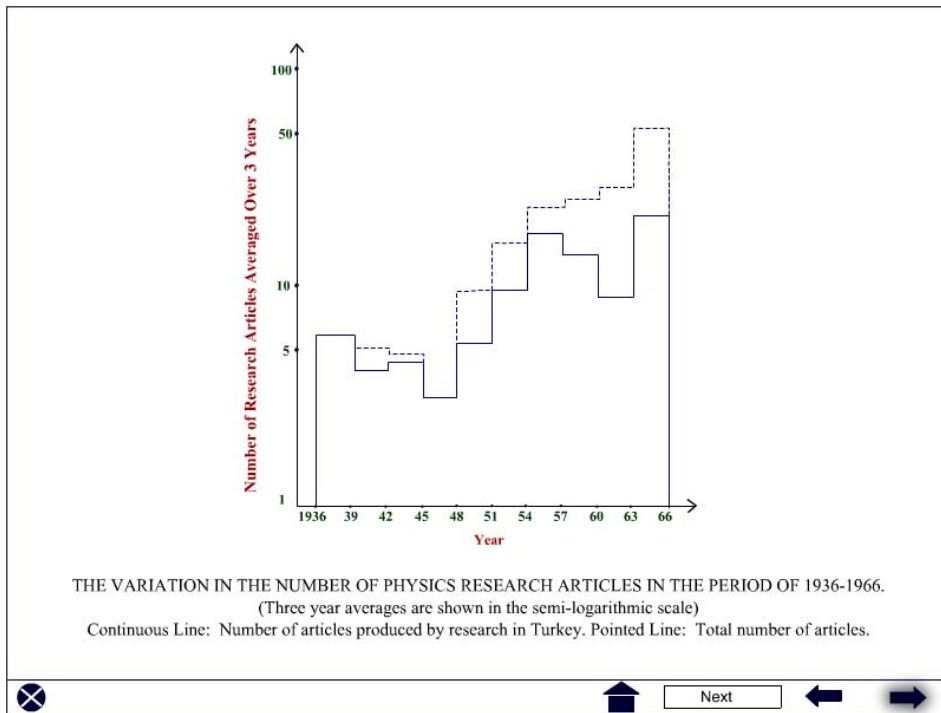


Table 14.

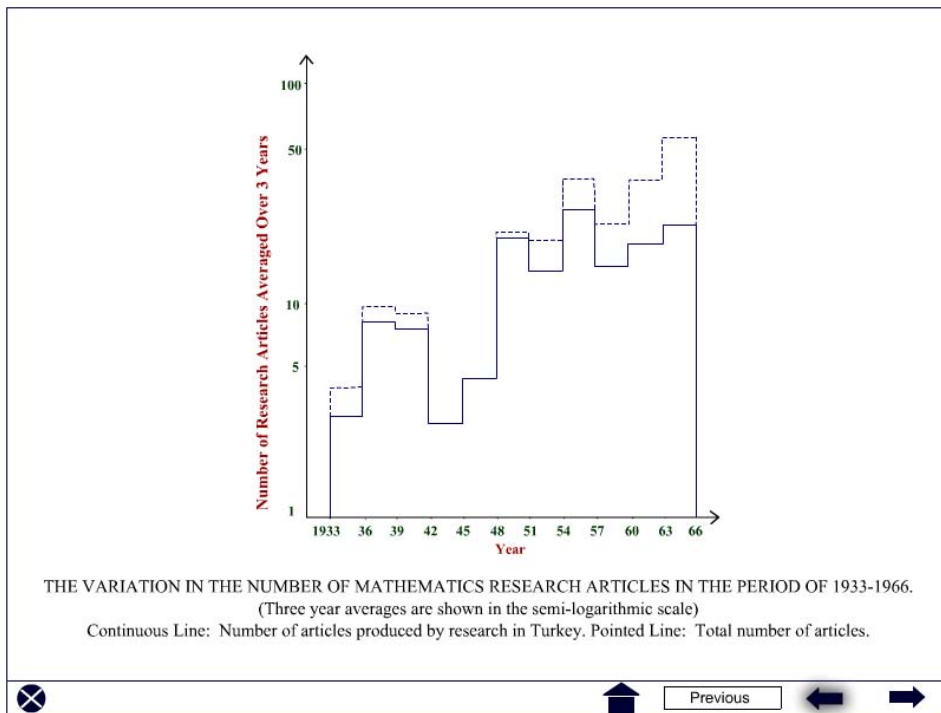


Table 15.

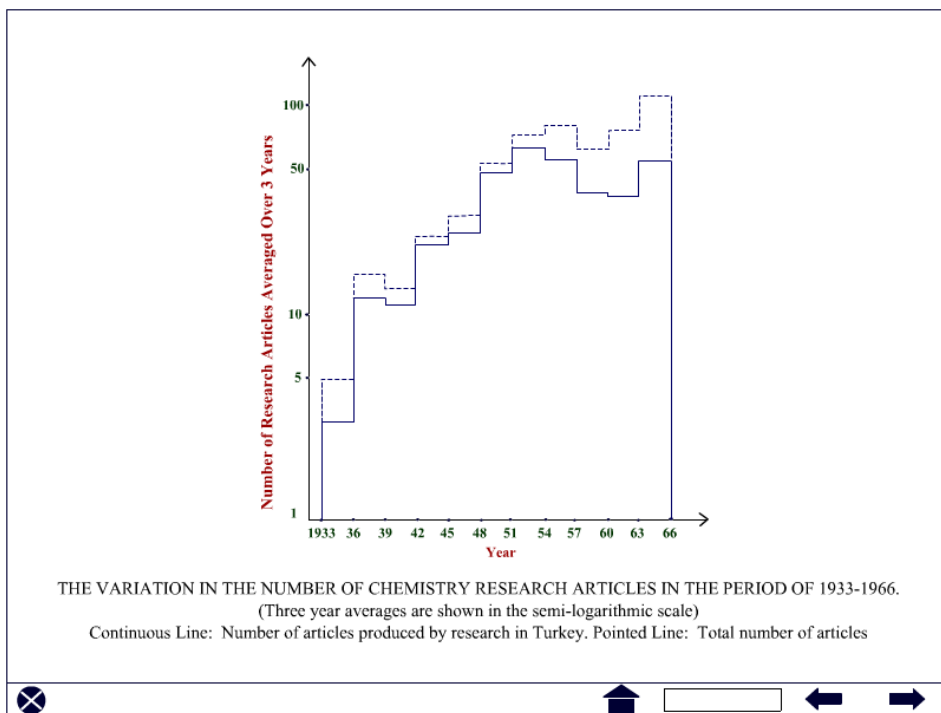
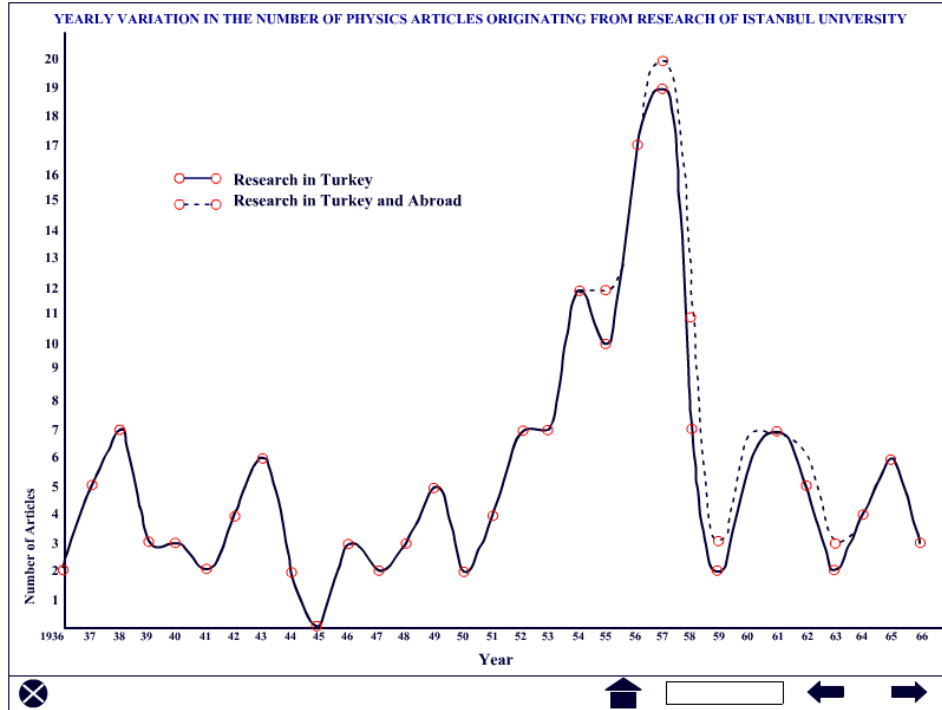


Table 16 shows the yearly variation in the number of articles in physics, produced by the members of Istanbul University in the period of 1936-1966, where one sees clearly that the research activity goes through a maximum in the fifties and then goes down to previous levels.



Before continuing with the story of the development, I want to make a general observation. In the period of 1933-1945, research activity in all fields of pure and applied science was continued vigorously at Istanbul University, under the leadership of some outstanding scientists. Many articles were published bringing appreciable contributions, in particular, in such fields as mathematics, mechanics, and medicine. However no major discoveries were made, leading for instance to a Nobel Prize. One cannot escape the impression that something was missing in all this activity.

I believe what was missing was the required cultural background for scientific research. The visiting professors did not find a sufficient number of talented young assistants who would help them develop new ideas. A competition for producing important results was absent. The foreign scientists enjoyed good living conditions but they were scientifically isolated. The conclusion I derive from this observation is that a change was needed in the cultural attitude in Turkey, before achieving important results in a large scale. When you start from a background devoid of scientific tradition and wish to engage in ambitious research, the development usually proceeds through the following steps, taking several generations to achieve the intended results:

1. In the first generation a few highly talented young people appear. They follow the call of the leaders for science and manage to achieve world fame with their findings. These are the stars of the first generation, who are in the case of Turkey, people like Cahit Arf, Ratip Berker, Hulusi Behçet, İhsan Ketin. They make important contributions, but they are only a few people and can not influence the public understanding of science.

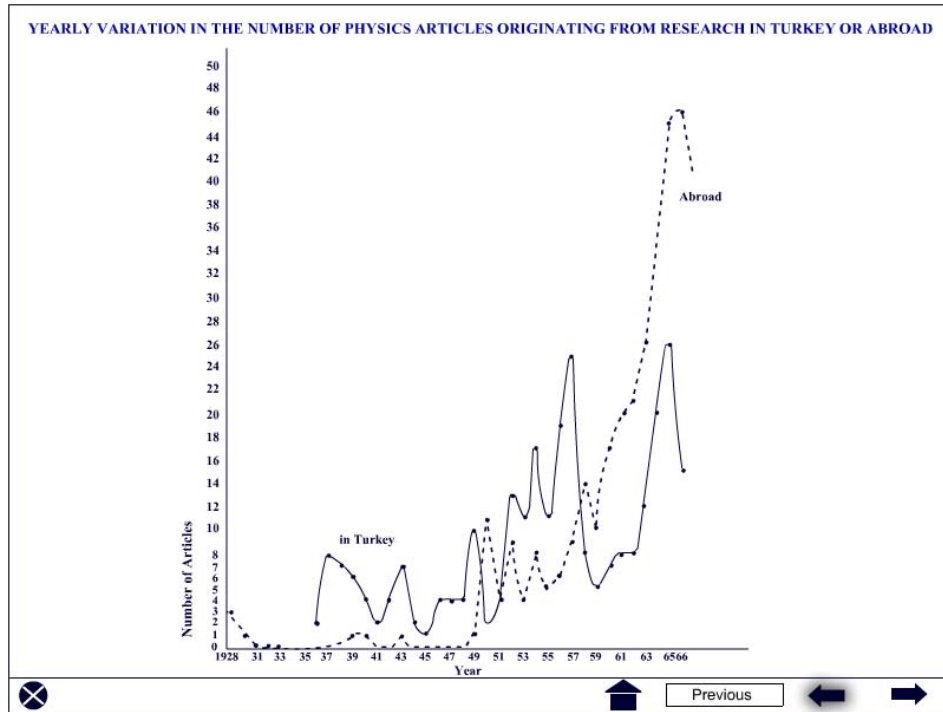
2. In the second generation, more young people appear who intend to follow the example of the first stars. They also realize that some new infrastructure is needed to enlarge the community interested in scientific advances. They spend time to create new universities, Research Councils, Research Institutes.
3. In the third generation one can expect to see the beginning of a new cultural attitude in a large scale. There are now institutions to supply the necessary men and women power in sufficient numbers. There exist brilliant local examples to emulate and appreciable material and moral support from private and state sources. As a result large-scale advances become highly probable only in the third generation and after, i.e., about 75-80 years from the beginning, which in our case means the twenty first century.

Let me go back to my story. The period of stagnation in the mid fifties was overcome through an impulse which came from the U.S. President Eisenhower announced in 1953 a worldwide programme, called "Atoms for Peace", in which American firms were going to set up research reactors in countries, who were willing to sign cooperation agreements with the U.S.

With these agreements, knowledge accumulated in the U.S. during the war effort would be available for pacific uses of atomic energy. Turkey became one of the first countries who answered positively the proposal of Eisenhower. More than that, the Turkish Government asked for and obtained a three-year research programme in fields related to atomic energy to be carried out by Turkish scientists in the U.S. before the establishment of a research reactor in Istanbul.

This programme was implemented successfully and the result was a new growth trend in the research production of Turkey. This can be seen in the following tables.

Table 17 shows the yearly variation of the number of physics articles produced by research done in Turkey and abroad in the period of 1928-1966. Here we see the first appearance of a new trend. The number of articles produced by research outside Turkey (chiefly in the U.S.) becomes larger than the number of articles produced by local research.



Tables 18-19-20 show the yearly variation of the number of articles produced in Turkey in physics, or in physics, mathematics, and chemistry, or in all sciences in the periods indicated.

Table 18.

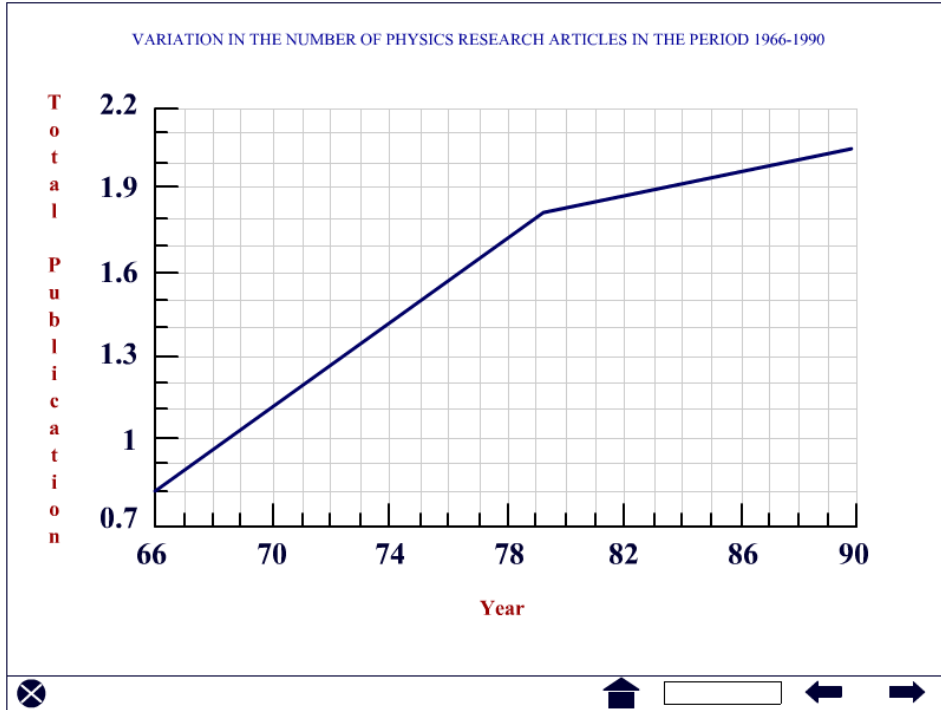


Table 19.

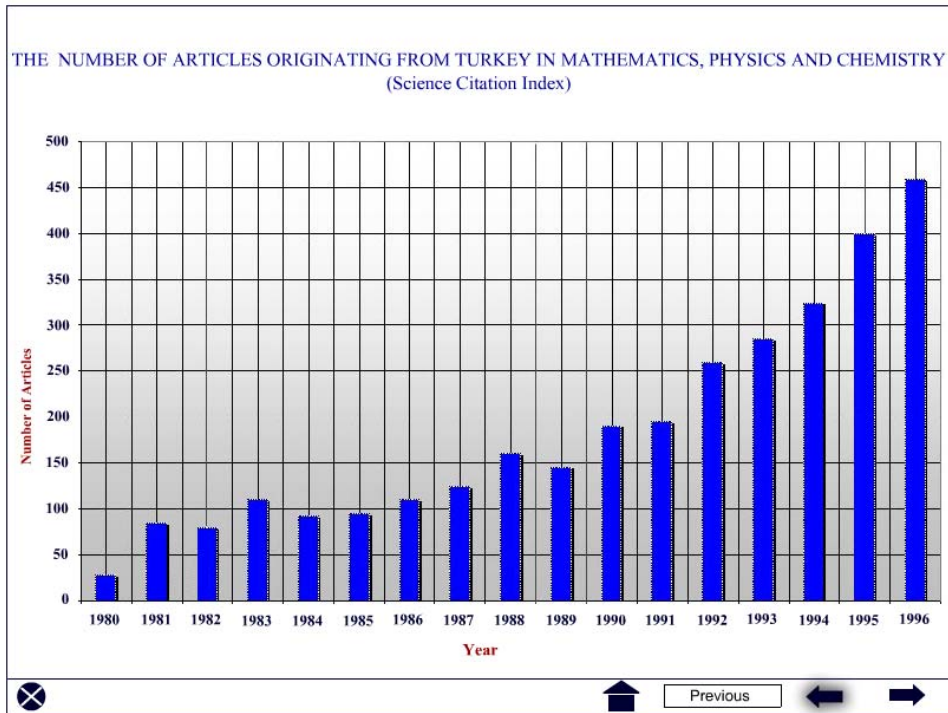
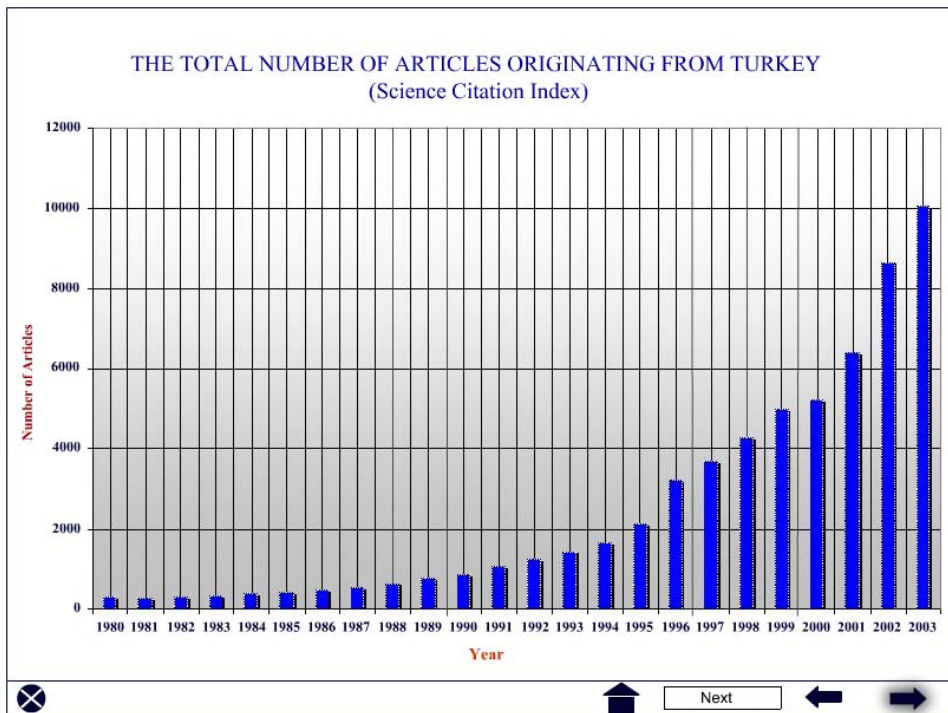


Table 20.



What about the contents of these articles?

Tables 21-25 show the number of citations received in the period of 1961-71 by Turkish mathematicians, physicists, chemists working in Turkey and abroad. One can see that some scientists like Gürsey, Barut, Arf, Erginsoy, Kurşunoğlu, Baysal, Erben, Ergun, Sinanoğlu and others have received many citations. On the other hand most, if not all, of these citations were received for work done outside Turkey. In this respect the results of a selection citation analysis indicated in Table 26 are quite interesting. In this study only articles, which have received more than ten citations, are considered and the two periods of 1961-71 and 1994-2000 are compared in this respect and only for physicists.

Table 21.

NUMBER OF REFERENCES TO RESEARCH ARTICLES IN MATHEMATICS (Science Citation Index)										
	1961	1963	1964	1965	1966	1967	1968	1969	1970	1971
Akçoğlu, Mustafa						3	1		10	2
Ar, Ergun						4		2		1
Arf, Cahit		1	1	4	2	3	4	4	5	2
Arman, Teoman							6	12	7	8
Atabek, Bülent		1		1		3	12	13	4	20
Berker, Ratip			11	3	3	4	2	7	11	6
Çınlar, Orhan						5	2	2		9
Çıray, Cahit							1		1	
Dikmen, Murat										1
Dizioğlu, Bekir					1	1	1	5	2	3
Ebcioğlu, İbrahim				1			1	1	1	
Erdogan, M. Emin			1		1	1	2	7		2
Erdogan, Fazıl			2	11	6	6	25	15	25	34
Eringen, A. Cemal	3	3	11	16	27	85	96	118	114	147
Gürel, Okan				1	3	2	4	10	14	14
İçen, Orhan						1	1			1
İkeda, Gündüz		1			8	5	5	5	6	3
İnan, Mustafa									1	1
Kapıano, İzak				1						
Körezlioğlu, Hayri				1						
Kuran, Ülkü					4	2	1	4	5	8
Oğuztöreli, Namık				1	1	6	17	18	35	17
Ölcaylar, İsmet										1
Onat, Turan	2	1	2	12	16	15	21	15	13	11
Ölçer, Nurettin			1	2	3	6	16	6	7	8
Özkan, Asım					1	1		1		
Özoklav, Hasan				1						3
Sarpkaya, Turgut			2	2	7	4	9	22	10	15
Şemin, Ferruh							1	1		1
Şuhubi, Erdoğan			1	3	5	20	17	31	14	22
Tameroglu, Sacit							1			
Tekinalp, Bekir			2							1
Ütku, Şenol						1	8	4	6	1

Table 22.

NUMBER OF REFERENCES TO RESEARCH ARTICLES IN PHYSICS (Science Citation Index)								
	1961	1964	1965	1966	1967	1968	1969	1970
Z. Akçasu	0	0	4	9	16	13	22	35
Z. Aydın	0	0	0	0	0	0	2	0
R. Akpınar	0	0	1	0	0	0	0	0
S. Akpınar	2	1	3	4	2	2	2	0
M. Ataç	0	0	0	0	3	4	10	7
K. Bardakçı	0	13	143	72	33	40	144	264
S. Barkan	1	0	2	0	0	0	2	2
A. Barut	7	52	98	97	149	231	250	174
E. Baş	1	1	16	6	15	9	10	5
H. Benel	0	0	1	1	0	0	0	0
H. Budak	0	0	1	0	0	0	0	0
A.F. Cesur	0	0	0	1	2	4	2	1
F. Domanıç	1	2	2	2	1	3	1	1
C. Ener	0	0	1	1	0	0	0	0
E. Erdik	0	1	0	1	0	0	0	0
M.E. Erdoğan	0	1	0	1	1	2	7	0
C. Ergunsoy	10	23	41	74	74	78	48	36
Ç. Ertek	0	0	1	1	1	0	1	1
A. Ferendeci	0	2	1	2	2	4	6	0
A. Erarslan	0	0	0	1	2	4	3	2
F. Gürsey	0	70	355	227	121	97	117	70
E. İnönü	2	3	19	25	26	26	16	23
K. Emre	0	1	6	2	3	4	8	9
A. Işın	0	0	2	5	7	8	4	3
C. Karadeniz	0	0	0	1	0	3	0	0
B. Kurşunoğlu	3	12	34	20	45	47	21	19

Table 23.

NUMBER OF REFERENCES TO RESEARCH ARTICLES IN PHYSICS (Science Citation Index)								
	1961	1964	1965	1966	1967	1968	1969	1970
R. Nasuhoğlu	1	0	0	0	0	1	1	3
H. Ögelman	0	0	0	4	4	4	9	7
F. Öktem	0	0	0	1	0	0	0	0
T. Oğurtanı	0	0	0	1	2	2	4	2
Y. Özemre	0	0	3	1	1	1	0	0
İ. Özdoğan	0	0	0	1	0	0	0	0
E. Özizmir	0	0	0	1	1	0	0	1
T. Salgır	0	0	0	0	0	1	0	1
A. Sokollu	0	0	0	0	0	2	2	1
A. Sümer	0	2	1	1	1	2	1	1
A. Şaplakoğlu	3	2	7	1	1	3	2	1
N. Tarımer	0	0	1	2	1	0	0	0
B. Tanyel	0	0	1	0	0	0	0	0
N. Taşköprülü	0	0	1	1	2	0	1	0
S. Tunakan	0	0	0	0	0	0	2	0
İ. Usseli	0	0	0	0	0	2	0	2
İ. Sakmar	0	1	1	1	3	8	9	3
C. Yalçın	0	0	1	0	0	0	0	1
B. Yaramış	1	0	0	1	0	2	2	3
N. Zengin	0	1	0	0	0	3	1	1
K. Zuber	0	0	0	2	0	1	1	0
Y. Yafet	18	31	29	45	52	62	84	73
H. Yılmaz	1	1	3	7	6	14	7	3
M. Yıldız	0	2	2	3	1	0	0	0
A. Yıldız	0	3	4	8	4	5	4	2

Table 24.

NUMBER OF REFERENCES TO RESEARCH ARTICLES IN CHEMISTRY
(Science Citation Index)

	1961	62	63	64	65	66	67	68	69	70	71
S. Akalan					1		2	1	1		
G. Akovalı								2	1	3	12
A.M. Aksoy					2		2	1		3	3
S.R. Alpar			1			1					1
O. Alpaut					1	1	2	1	7	3	2
H. Amal											1
V. Amirhanian									1		
N.K. Aras					4	11	16	9	11	11	11
M. Arnaki			1	3	2	1				1	1
S. Aybar					1	2					
E. Ayça		2						1	1	2	
T. Balkaş						1	2	3	4		2
F. Baykut		4	1	2	1			1	1	3	4
S. Baykut								1			
B. Bayşal		5	8	11	10	19	15	23	31	24	13
T. Baytop			3		1	1	1		1	4	
B. Berköz		2	3	6	20	20	10	14	5	3	9
A.R. Berkem		2	1				1			3	1
H. Bodur		1	1	1		2					
F. Arat (Bursa)									1		
L. Capuano	1	1			2	1	3	8	5	9	8
H. Civelekoğlu		1	1								
S.N. Ege	2	1	2	1	2	1	3	2	8	2	9
O. Ekiner					3	2	1	3		5	2
B.V. Enüstün	2		4	2	2	5	5	7	4		3
B. Erdem				3	2	2	2	1	1		1
N. Ergenç								1	1		
L. Ergener		2			1						
S. Ergun	6	7	3	11	23	27	41	39	32	67	64
S. Erhan					3	3	1	1	1	6	11
H. Erkut						1	1	1			
S. Geçgil							2				
D. Gücer			1	1	1				2	3	2
E. Gülbaran									1		
K.C. Güven	1	6	8	11	8	5	7	18	7	20	

Table 25

NUMBER OF REFERENCES TO RESEARCH ARTICLES IN CHEMISTRY
(Science Citation Index)

	1961	62	63	64	65	66	67	68	69	70	71
N. Güven					1			6	1	3	10
R. Hisar				1		7					
H. Keskin	2	4	2	1	5	2	1	2	2	4	3
M.I. Okay						2			1		1
İ. Öksüz									4	9	12
A. Olcay		1	3	1	1	8	1	2	1	1	1
P. Özand			4	5	13	13	17	8	11	4	4
S. Özeriş				3	4	5	1	2	5		1
B. Özsöz				1	2		1				1
A.N. Payza	7	2	5	1	2	4	1	9	11	11	9
B. Pekin											1
M. Seyhan				1	1		7	12	3	5	2
O. Sinanoğlu	4	34	55	67	94	155	156	192	154	124	99
T.G. Somer					1	2		2	3	1	1
C.B. Şenvar	4	2	3	7	4	8	6	5	3	2	
M. Talat-Erben	7	27	4	10	12	14	11	17	7	8	13
M. Tanker				1	3		2				1
M.R. Tek		1	1	6	3	4	1	1	1	5	3
E. Tekin							4	7	12	12	7
Y. Tekiz							1				1
Ş. Tekman	1	1	1		1	1			1	2	1
H.N. Terem	1	6	1	3	1	3	2	5	7	5	1
R. Tolun					1	1		2		4	2
M. Tuğtepe					1						
R. Tulus		1	2	3	2	3	3		1	2	4
E.T. Türkođođan	3	9	13	17	25	28	61	63	79	88	69
C. Tüzün					1				1		
A. Utubelen		1		1	3	3	2	1	1		5
E. Ulusoy			1			1				1	2
E. Ünseren		2	2	4	1	3	2	1	3	2	1
M. Vardar				2							
M. Yenson		3			1			1			
A. Yıldız								2	5	6	5
M. Zafrı	1					1					1

Table 26.

RESEARCH OUTPUT OF TURKISH PHYSICISTS
By E.İnönü & L.Kurnaz

Table 1. Quantitative information obtained from the SCI for the periods of 1961-71 and 1994-2000.
where the papers and books cited may have been written within or before the period mentioned

	1961. 1963- 1971	1994-2000	Growth factor
No. of papers and books with at least 10 citations	114	864	7.6
No. of corresponding authors	23	228	9.9
No. of papers and books with at least 100 citations	7	20	2.9
No. of corresponding authors	4	19	4.7
No. of papers and books based on work done in Turkey	4	91	22.7
" No. of corresponding authors	4	117	28.2

Table 2. Quantitative information obtained from the SCI for the periods of 1961, 1963-71 and 1994-2000.
where only the papers and books written in the same periods are included

	1961. 1963-1971	1994-2000	Growth factor
No. of papers and books which have received at least 10 citations	85	494	5.8
No. of corresponding authors	18	169	9.4
No. of papers and books which have received at least 100 citations	6	19	3.2
No. of corresponding authors	4	14	3.5
No. of papers and books based on work done in Turkey	3	61	20.3
No. of corresponding authors	4	87	21.7

E. İNÖNÜ, L. KURNAZ: Research output of Turkish physicists

Two important conclusions can be derived from the figures in **Table 26**:

1. The number of physics articles with more than ten citations based on research done in Turkey has increased in the thirty years from 1961-71 to 1994-2000 much more than the total number of articles with more than ten citations. The ratio is 23 to 1 or 20 to 1 (counting only the citations received in the same period in which the articles were written.)
2. The number of experimental articles due to research done both in Turkey and abroad has also increased appreciably.

To my mind both of these consequences indicate a cultural change toward a scientific tradition in Turkey.

Now let us look at some general statistical data in order to evaluate Turkey's science performance with respect to other countries.

Table 27 shows the classification of countries with respect to the yearly production of their research articles in science in the year 2003, as prepared by the Institute of Scientific Information (ISI). Turkey stands in the 21st line, in front of several countries in Europe.

Sıra	Ülke İsimleri	Aranılan Nitelikteki Yayın Sayısı (V)
1	USA	228889
2	Japan	73942
3	Germany	63633
4	United Kingdom	60733
5	France	46363
6	China	45606
7	Italy	34330
8	Canada	32700
9	Spain	24294
10	Russia	23872
11	Australia	20551
12	India	20081
13	South Korea	19952
14	Holland	18504
15	Sweden	14466
16	Switzerland	13753
17	Brazil	12938
18	Taiwan	12254
19	Poland	11769
20	Belgium	10427
21	Turkey	10065

Table 28 shows how this rank of Turkey has changed in the last twenty three years, indicating a rapid increase after 1990. I must point out however that this high rank is obtained for the total population of the country. If we make a comparison after dividing the number of articles by the population, our rank would fall down quite a bit, remaining behind all the countries in Europe. Therefore we must continue vigorously to increase output.

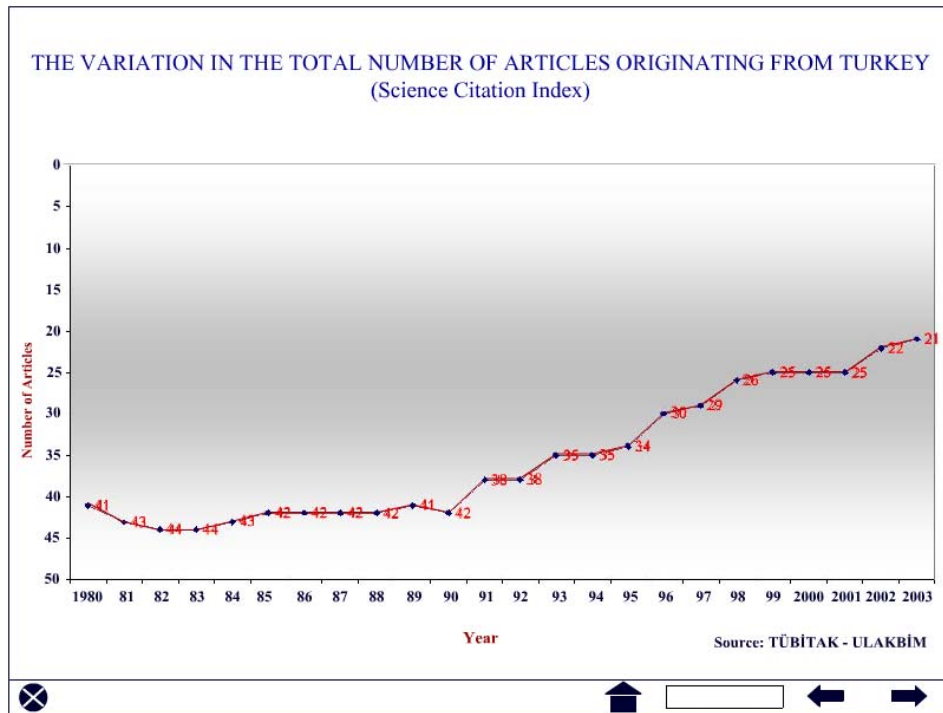


Table 29 considers another way of determining in a comparative ways, the scientific value of the research articles. It gives the yearly variation in the ratio of number of citations over the number of articles. We see that in the period of 1973 to the present, this ratio fluctuates around the value 7 to 9 citations per article. Then in the very last years, drops down quite rapidly. This drop is undoubtedly caused by the rapid increase in the number of articles. Many young researchers came into the picture and some time is needed for their articles to get some recognition in the world. However, it is also a warning to take a more critical attitude to the contents of the new articles.

YEARLY VARIATION OF THE RATIO OF CITATIONS / ARTICLES FOR TURKEY			
Year	Number of Articles	Number of Citation	Number of Citation / Number of Articles
1973	220	1.601	4.82
1974	249	1.688	6.78
1975	251	2.297	9.15
1976	255	2.118	8.31
1977	311	2.238	7.20
1978	352	2.854	8.11
1979	333	3.008	9.03
1980	425	3.434	8.08
1981	386	3.531	9.65
1982	429	3.101	7.23
1983	471	2.918	6.20
1984	532	4.295	8.07
1985	580	3.712	6.40
1986	633	4.188	6.62
1987	739	5.982	8.09
1988	879	6.242	8.79
1989	1.008	7.717	7.66
1990	1.152	7.687	6.67
1991	1.394	9.456	6.78
1992	1.709	12.735	7.45
1993	1.965	15.289	7.79
1994	2.339	16.483	7.04
1995	3.093	19.710	6.37
1996	3.927	21.520	5.48
1997	4.582	23.113	5.04
1998	5.385	23.362	4.34
1999	6.198	22.591	3.64
2000	6.424	20.882	3.25
2001	7.812	16.789	2.15
2002	10.309	10.771	1.04
2003	11.990	3.357	0.27

Table 30 gives the yearly variation of the ratio of R-D expenses over GNDP for Turkey. The increase of 0.0032 to 0.0067 over a period of thirteen years is another indication of the slowly changing cultural attitude toward research. Every government in the past thirty years has announced its aim to bring this ratio up to at least 0.01. But the aim has not been reached. The present government has allocated a comparatively larger fund to TUBITAK for financing new research projects with the aim of reaching a figure of 0.02 in the year 2010. We shall see whether this government will be more successful.

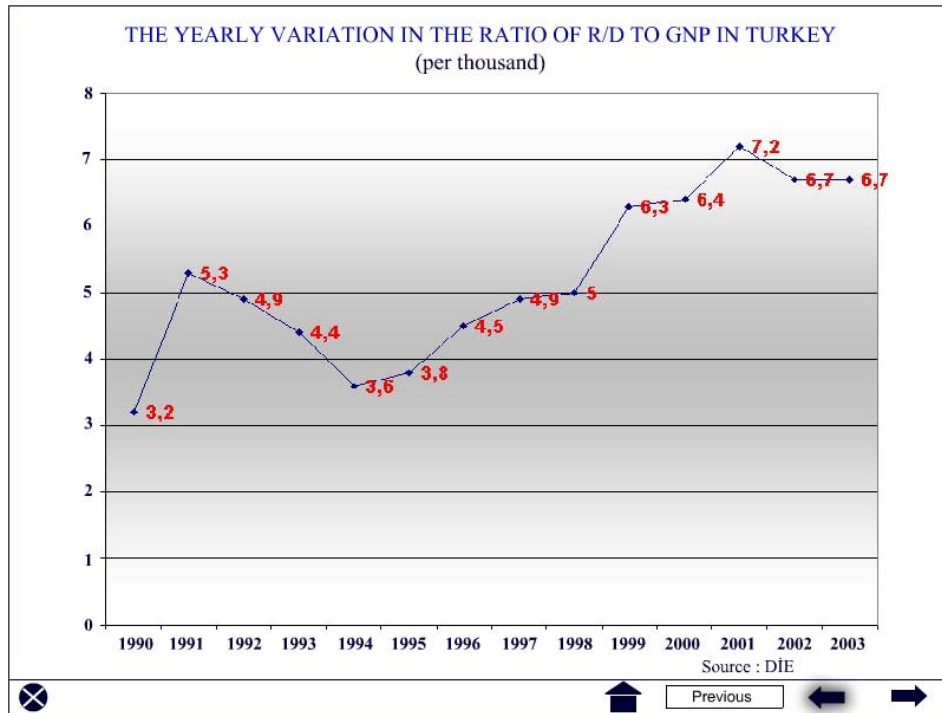


Table 31 indicates the financial contribution of the commercial or private sector to the R-D activities. It is also increasing slowly and I believe has reached a figure in the region of 35%. You know that in Western Europe and United States it is around 70%, largely above the figure for the universities.

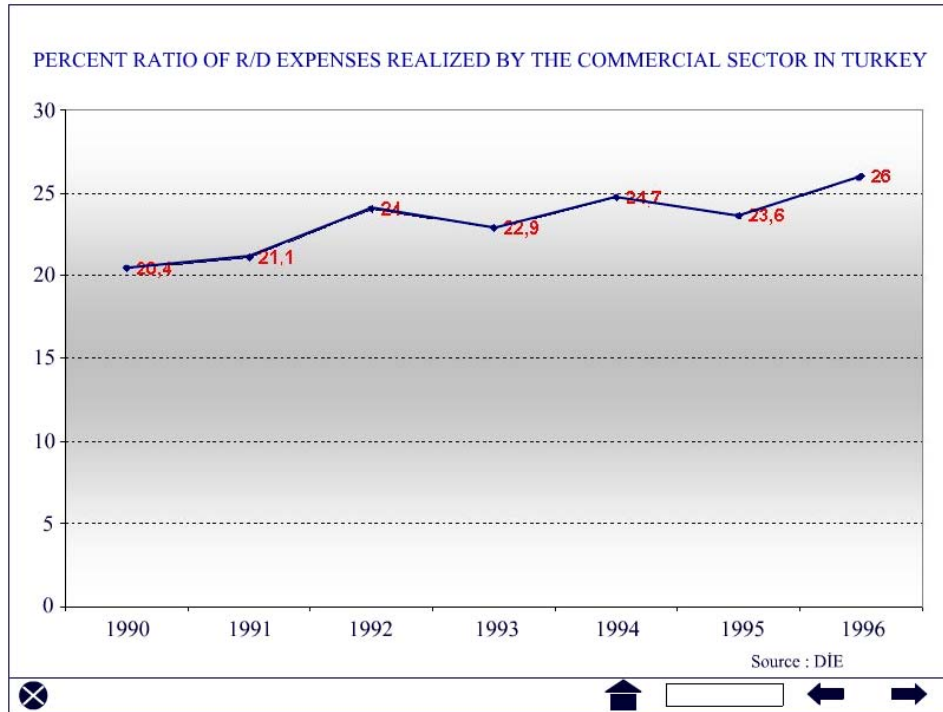
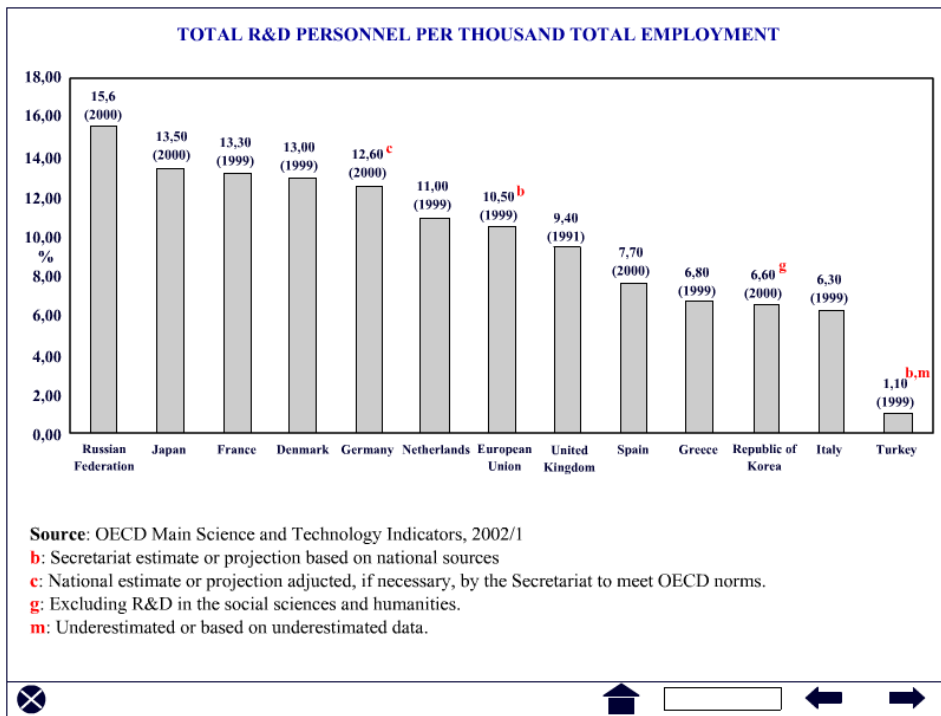


Table 32 is a comparison of the ratio of R-D expenses over GNDP among the OECD countries. The figure for Turkey is the lowest one.

Another figure used in such evaluations is the ratio of the number of R-D personnel over the number for the total working population.

Country	1998	1999	2000
Australia	1.51	.....	.....
Austria	1.79	1.83	1.80
Belgium	1.89	1.96	.....
Canada	1.79	1.80	1.84
Czech Republic	1.24	1.25	1.35
Denmark	2.06	2.09	.....
Finland	2.89	3.22	3.37
France	2.17	2.19	2.15
Germany	2.31	2.44	2.48
Greece	.....	0.67	.....
Hungary	0.68	0.69	0.81
Iceland	2.03	2.33	.....
Ireland	1.26	1.21	.....
Italy	1.07	1.04	.....
Japan	2.94	2.94	2.98
Korea	2.55	2.47	2.68
Mexico	0.46	0.40	.....
Netherlands	1.94	2.02	.....
New Zealand	.....	.....	.....
Norway	.....	1.70	.....
Poland	0.72	0.75	0.70
Portugal	.....	0.75	.....
Slovakia	0.82	0.68	0.69
Spain	0.89	0.88	0.94
Swiss	.....	3.78	.....
Switzerland	.....	.....	2.64
Turkey	0.50	0.63	0.64
UK	1.80	1.88	1.86
USA	2.61	2.66	2.70
EU	1.81	1.86	1.88
Total OECD	2.17	2.21	2.24

Table 33 gives the values of this ratio for the OECD countries. Again the figure for Turkey, one in ten thousands is the lowest figure.



Yet another aspect of the state of advance of a country in science and technology is the number of patents received by the citizens of that country.

Table 34 gives an indication about the number of patents received every year by citizens of some countries.

SOME INFORMATION ABOUT PATENTS		Country	2000
Number of patent applications to the EPO (priority year)	Switzerland	2666	
	Turkey	41	
	United Kingdom	5748	
	United States	29587	
	Japan (adj)	.....
	Total OECD	108194	
	EU-25	50632	
	EU-15	50322	
Number of patents granted by the USPTO (priority year)	Switzerland	1321	
	Turkey	14	
	United Kingdom	4111	
	United States	95140	
	Japan (adj)	.....
	Total OECD	170707	
	EU-25	28178	
	EU-15	280007	
Number of patent applications to the EPO in the ICT sector (priority year)	Switzerland	6666	
	Turkey	5	
	United Kingdom	2146	
	United States	11501	
	Japan (adj)	.....
	Total OECD	38069	
	EU-25	14926	
	EU-15	14861	
European Commission	.....	

Source: OECD Main Science and Technology Indicators, 2002.

Table 35 shows the variation in the number of patents in Turkey, in the last ten years. Clearly there is a great lack of interest for obtaining patents, which is again a sign of non-scientific cultural background.

PATENTS GIVEN IN TURKEY

Number of Patent Applications			Number of Approved Patents		
Year	Local	Foreign	Year	Local	Foreign
2001	299	2920	2001	44	2092
2000	268	3178	2000	26	1151
1999	270	2795	1999	28	1114
1998	214	2280	1998	32	774
1997	210	1329	1997	7	451
1996	187	719	1996	47	554
1995	178	1520	1995	64	703
1994	148	1244	1994	61	1138
1993	168	1071	1993	52	740
1992	190	1062	1992	54	621
1991	136	1073	1991	60	632
1990	138	1090	1990	48	438

⊗
⬆
Previous
⬅
➡

In this talk, I do not have time to give you a description of the Turkish scientists in person who have been the main actors of the development of science in Turkey. What I can do is to show a list of the scientists who have received the science prize of the Turkish Research Council (TUBITAK) in the past forty years.

Tables 36 and 37 give this information

Table 36

PEOPLE WHO HAVE RECEIVED "THE SCIENCE PRIZE" OF THE TURKISH RESEARCH COUNCIL (TÜBİTAK) 1966 - 2004	
MATHEMATICS	CAHİT AREF, ORHAN İÇEN, ERDOĞAN ŞUHUBİ, GÜNDÜZ İKEDA, HİLMİ DEMİRAY, TOSUN TERZİOĞLU, SELMAN AKBULUT, ATILLA AŞKAR, ALİ ÜLGER
PHYSICS	CAVİT ERGİNSOY, FEZA GÜRSEY, BEHRAM KURŞUNOĞLU, ERDAL İNÖNÜ, NEJAT VEZİROĞLU, ASIM BARUT, MİTHAT İDEMEN, SALİM ÇIRACI, NİHAT BERKER, YAVUZ NUTKU, NAMIK KEMAL PAK, HAKKI ÖGELMAN, REFİK KORTAN, ERGİN SEZZİN, TEKİN DERELİ, MEHMET ERBUDAK, AYŞE ERZAN, ÖNDER PEKCAN, TURGAY UZER, RAHMİ GÜVEN, AKİF BAHA BALANTEKİN, ATAÇ İMAMOĞLU
CHEMISTRY	TALAT ERBEN, OKTAY SİNANOĞLU, BAHATTİN BAYSAL, NAMIK ARAS, HASAN ERTEN, METİN BALCI, ŞEFİK SÜZER, AYHAN ULUBELEN, MERAL DİZDAROĞLU, YUSUF YAĞCI, SAİM ÖZKAR, ÖZER BEKAROĞLU, BEKİR ÇETİNKAYA, LEVENT TOPPARE, İSKENDER YILGÖR
BIOLOGICAL SCIENCES	GÖNÜL BARA, SEMAHAT GELDİAY, ATIF ŞENGÜN, YUSUF VARDAR, ENGİN BERMEK, TURHAN BAYTOP, AZİZ SANCAR, EMEL ARINÇ, GÖKHAN HOTAMAÇLIGİL
ASTRONOMY AND SPACE SCIENCES	DİLHAN EZER ERYURT
EARTH SCIENCES	İHSAN KETİN, CELAL ŞENGÖR, YÜCEL YILMAZ, ARAL OKAY

Table 37

PEOPLE WHO HAVE RECEIVED "THE SCIENCE PRIZE" OF THE TURKISH RESEARCH COUNCIL (TÜBİTAK) 1966 - 2004	
ENGINEERING SCIENCES	TURAN ONAT, BEKİR DİZİOĞLU, RATİP BERKER, ADNAN ÇAKIROĞLU, KAZIM ÇEÇEN, NECATİ ÖZİŞİK, YILMAZ TOKAT, NEJAT İNCE, MEHMETÇİK BAYAZIT, ÖZAY ORAL, CENGİZ DÖKMECİ, TUNCER CEBECİ, TARIK OĞURTANI, İZZET ŞAHİN, FUAT PASİN, BURAK ERMAN, MUTLU SÜMER, ZİYA AKÇASU, ERHAN ÇINLAR, TAMER BAŞAR, ZEKÂİ ŞEN, ABDULLAH ATALAR, FİKRET KARGI, VEDAT ARPACI, DERİN ORHON, HALDUN ÖZAKTAŞ, ERHAN BİŞKİN, İLHAN AKSAY, AYŞE ERDEM ŞENATALAR, YAMAN ARKUN, YAVUZ ÇORAPÇIOĞLU, MURAT TEKALP
HEALTH SCIENCES	MUZAFFER AKSOY, ORHAN ULUTİN, KAZIM TÜRKER, ALAATTİN AKÇASU, AYHAN ÇAVDAR, TAHSİN GÜRSON, İSMET KARACAN, ÜNER TAN, NACİ BOR, ALİ CUMHUR ERTEKİN, OĞUZ KAYAALP, SEVİM ERCAN, ATILLA ERTAN, MÜNCİ KALAYOĞLU, HASAN YAZICI, İZZET BERKEL, ÇİĞDEM ALTAY, FATİH UÇKUN, SÜMER BELBEZ TEK, MUSTAFA İLHAN, EMİN KANSU, AYTEN ARCASOY, GÖNÜL VELİÇELEBİ, GÖNÜL HIÇSÖNMEZ, İSMAİL HAKKI ULUS, GAZİ YAŞARGİL, İHSAN ÇALIŞ, FERİDUN CAHİT TANYEL, TURGAY DALKARA, TANER DEMİNER, AYTEMİZ GÜRGEY, HALUK TOPALOĞLU
VETERINARY SCIENCES	MAHİR BÜYÜKPAMUKÇU
FORESTRY	HARZEMŞAH HAFIZOĞLU, İSMAİL ÇAKMAK

Table 38 indicates the names of four scientists who have received the science prize of Tubitak and the Third World Academy of Sciences (TWAS).

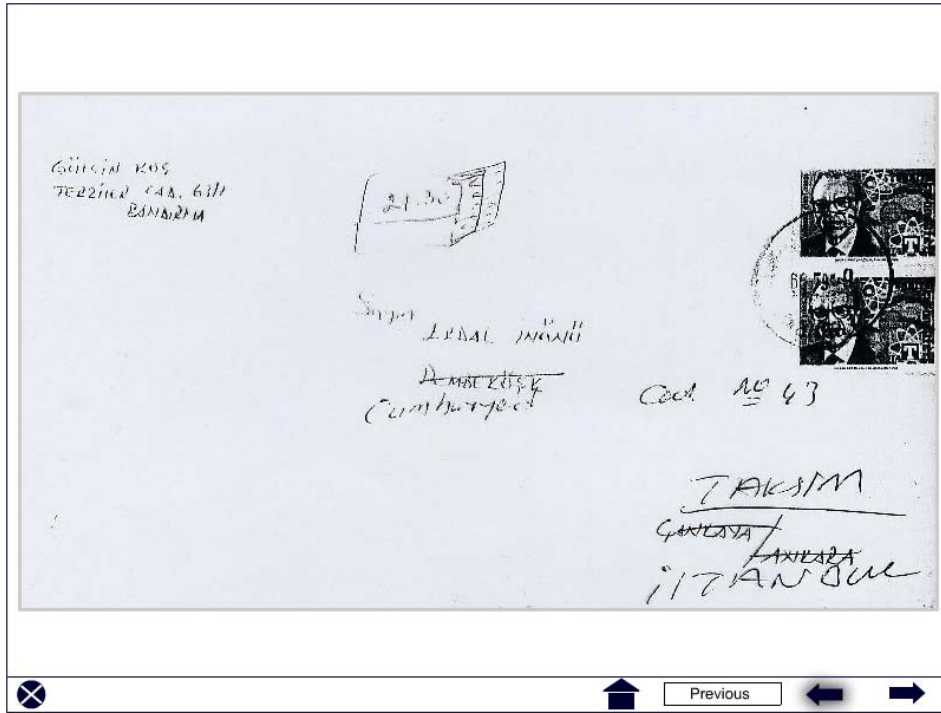
PEOPLE WHO HAVE RECEIVED "THE SCIENCE PRIZE" OF THE TURKISH RESEARCH COUNCIL (TÜBİTAK) - THIRD WORLD ACADEMY OF SCIENCE PRIZE (TWAS) 1966 - 2004		
MATHEMATICS	HALİL METE SONER	2002
PHYSICS	MEHMET ALİ ALPAR	1992
CHEMISTRY	İVET BAHAR	1995
BIOLOGY	MEHMET ÖZTÜRK	1996

Finally, just to indicate that the public interest in science is increasing gradually, *tables 39-40* show some stamps issued in connection with physics. In table 39 we see the stamps commemorating the meeting of the European Physics Society in Istanbul in 1981. In table 40 there are stamps issued to honour Feza Gürsey, our best-known physicist.

Table 39



Table 40.



Conclusion

After 80 years of efforts in the Republic, we are now at the threshold of making really important contributions to science and technology in the world. We have in Turkey the personnel with the required talent, education and ambition, who are supplied in various institutions with the necessary hardware. What is still needed, is more emphasis on research at universities, more support from the State and from the private sector and more collaboration with Turkish scientists working abroad. I am confident that the third and fourth generations of Turkish scientists will achieve the Republic's aim of reaching the contemporary level of civilization in science.

Let me end my talk by thanking you for your interest and acknowledging the precious help of Sabancı University's Information Center Course Material Support Unit 2005 and its director Mr Hilmi Çelik.

Sources for the Tables

1. Tables 1, 19-20 (originally prepared by Serhat akır) and 30-38 are taken from the article:

E. İnönü; “ Cumhuriyet döneminde Türkiye’de bilime toplu bir bakış ve gelecek hakkında beklentiler”, published in “Türkiye Cumhuriyetinin 75. yılında Tüba konferansları I”, Tüba, Ankara, 1999.

2. Tables 2, 3 and 6-12 are taken from the article:

E. İnönü; “Temel bilimlerde Türk bilim adamlarının yaptığı ilk doktoralar”, published in the book: “Prof. Dr. Tevfik Okyay Kabakçiođlu anısına”, İTÜ, İstanbul, 1974.

3. Table 4 is taken from the book:

R. Brinkman- Ođuz Erol; “Türkiye Yer Bilimleri bibliyografyası, 1825-1975”, Tübitak, 1981.

4. Table 5 has been prepared for this talk.

5. Tables 13- 16-17 are taken from the book:

E. İnönü; “ 1923-1966 döneminde Fizik dalındaki arařtırmalara Türkiye’nin katkısını gösteren bir bibliyografya ve bazı gözlemler”, ODTÜ, Ankara, 1971.

6. Table 14 is taken from the book:

E. İnönü; “1923-1966 dönemi Türkiye Matematik Arařtırmaları Bibliyografyası ve bazı gözlemler”, ODTÜ, Ankara, 1973.

7. Table 15 is taken from the book:

E. İnönü; “ 1923-1966 dönemi Türkiye Kimya Arařtırmaları Bibliyografyası ve bazı gözlemler”, Bođaziçi Üniversitesi, İstanbul, 1982.

8. Table 18 is taken from the Ph. D. Thesis:

Mehmet Sancar; “Relation between scientific productivity as measured by bibliometric indicators and individual, social and academic characteristics of Turkish physicists working in Turkey during the period 1966-1989”, ODTÜ, Ankara, 1992.

9. Tables 21-25 are taken from the paper:

O. Birgöl, S Gürsey, E. İnönü; “Türkiye kökenli arařtırmaların matematik, mekanik, astronomi, fizik, jeofizik ve kimya dallarındaki makaleleri içinde 1961 ve 1963-71 Citation Index yıllıklarına göre 9 veya daha fazla referans almış olanların listesi”, communicated to the IV. Tübitak Science Congress, Ankara, 1973.

10. Table 26 is taken from the article:

E. İnönü, L. Kurnaz; “Observations on the growth characteristics of the research output of Turkish physicists based on a selective citation analysis”, Scientometrics, Vol. 55, No:3, 2002.

11. Table 27 is taken from the Internet, as prepared by the Institute of Scientific Information (ISI), U.S.A.

12. Table 28 has been prepared for this talk, on the basis of data provided by ISI and Tübitak-Ulakbim.

13. Table 29 has been prepared for this talk, using the data given in the article:

Bahattin Baysal, Hasan Seçen; “Türkiye’nin bilimsel yayın ve atıf bakımından dünyadaki yeri”, Cumhuriyet Bilim-Teknik eki, 5 Şubat 2005.

14 Tables 39-40 have been prepared for this talk.