

History of Metal Casting

Prof. Dr. Altan Turkeli

MSE-432

Foundry Technology

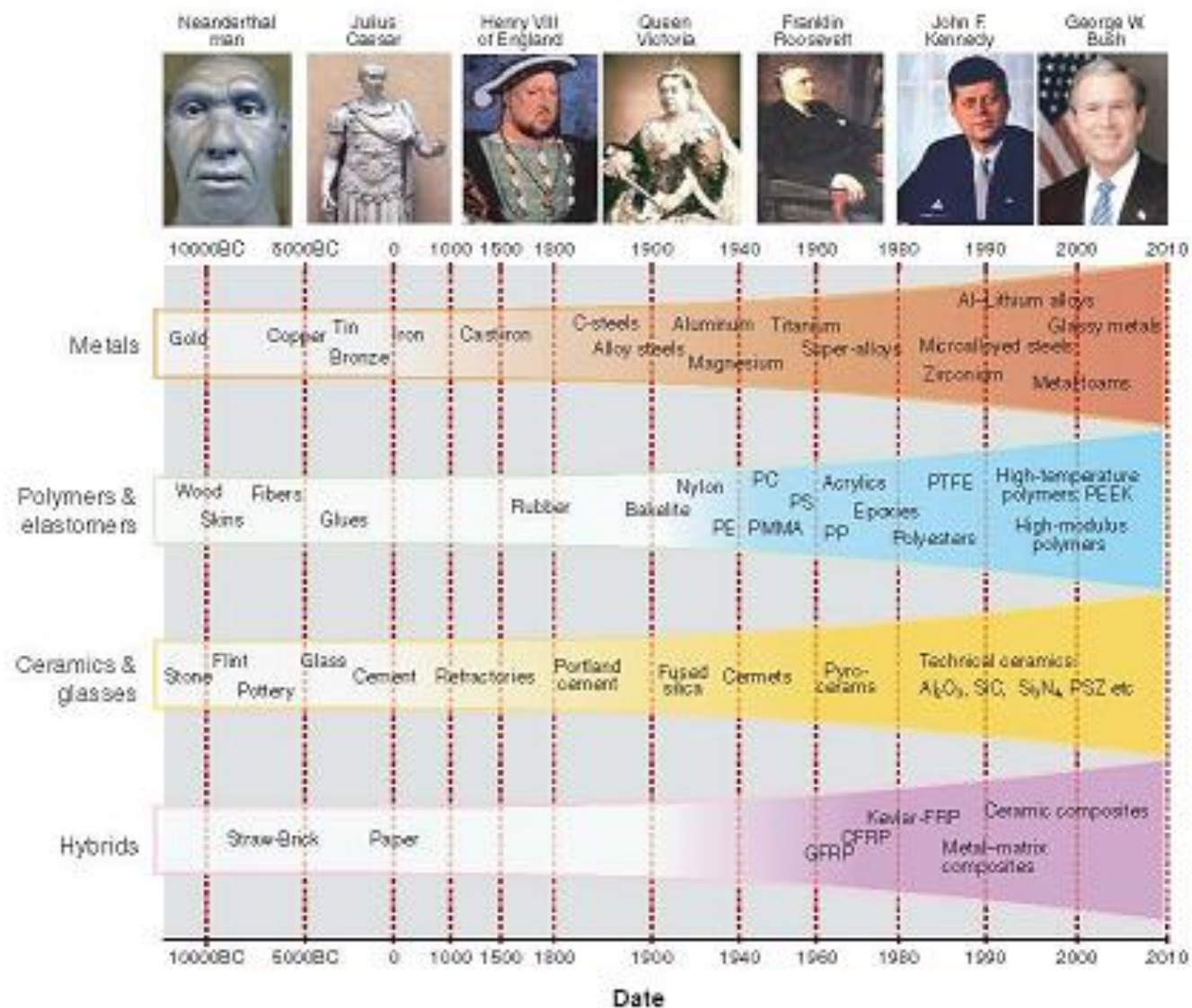
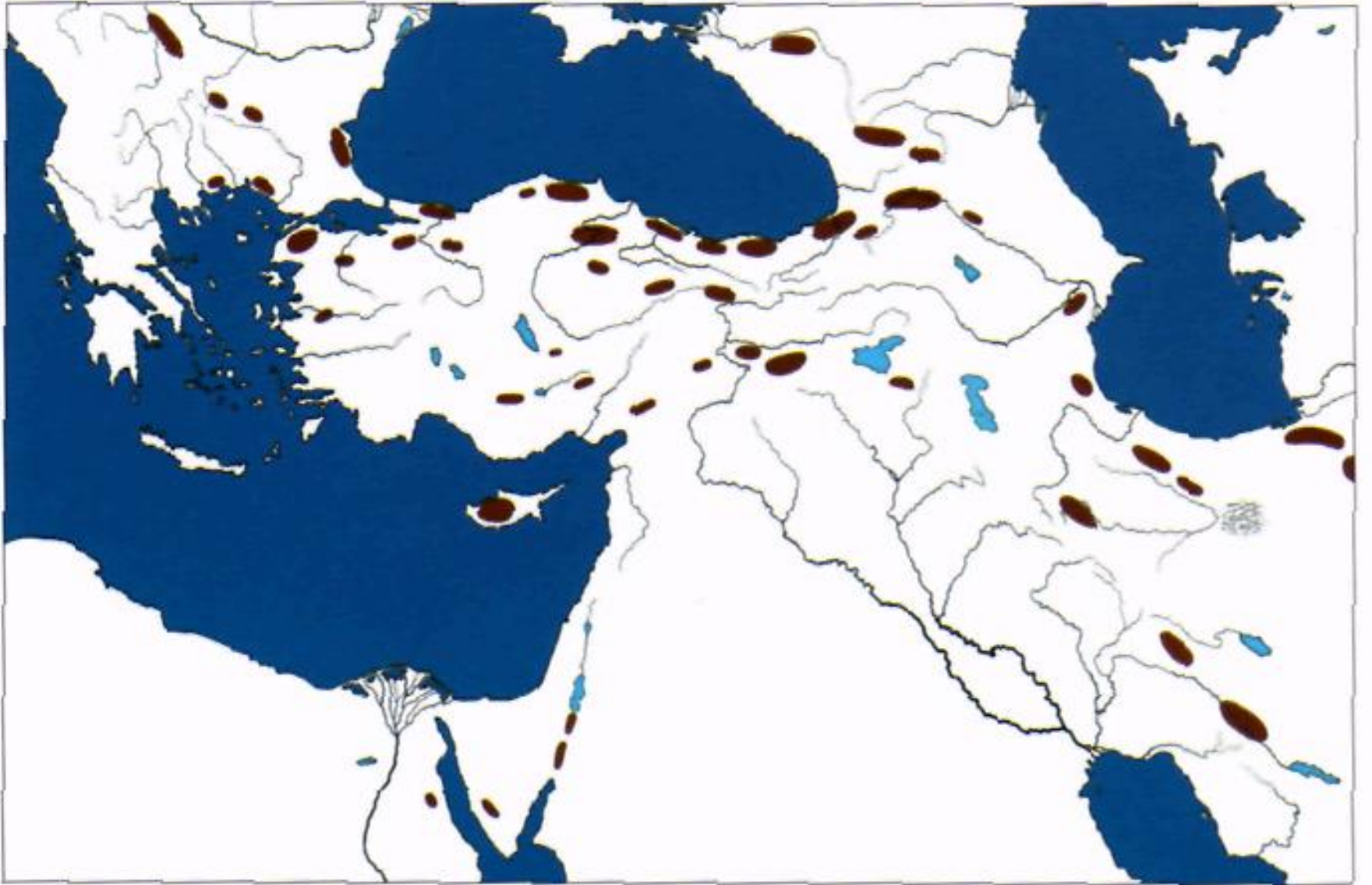


Figure 1.1 The development of materials over time. The materials of pre-history, on the left, all occur naturally; the challenge for the engineers of that era was one of shaping them. The development of thermochemistry and (later) of polymer chemistry enabled man-made materials, shown in the colored zones. Three—stone, bronze and iron—were of such importance that the era of their dominance is named after them.



Copper deposits in Anatolia and neighboring regions /
Anadolu ve komşu bölgelerde Bakır madeni yataklarının dağılışı



Figure 1.1 Stone mould for casting of axes, dating from 3000 BC.

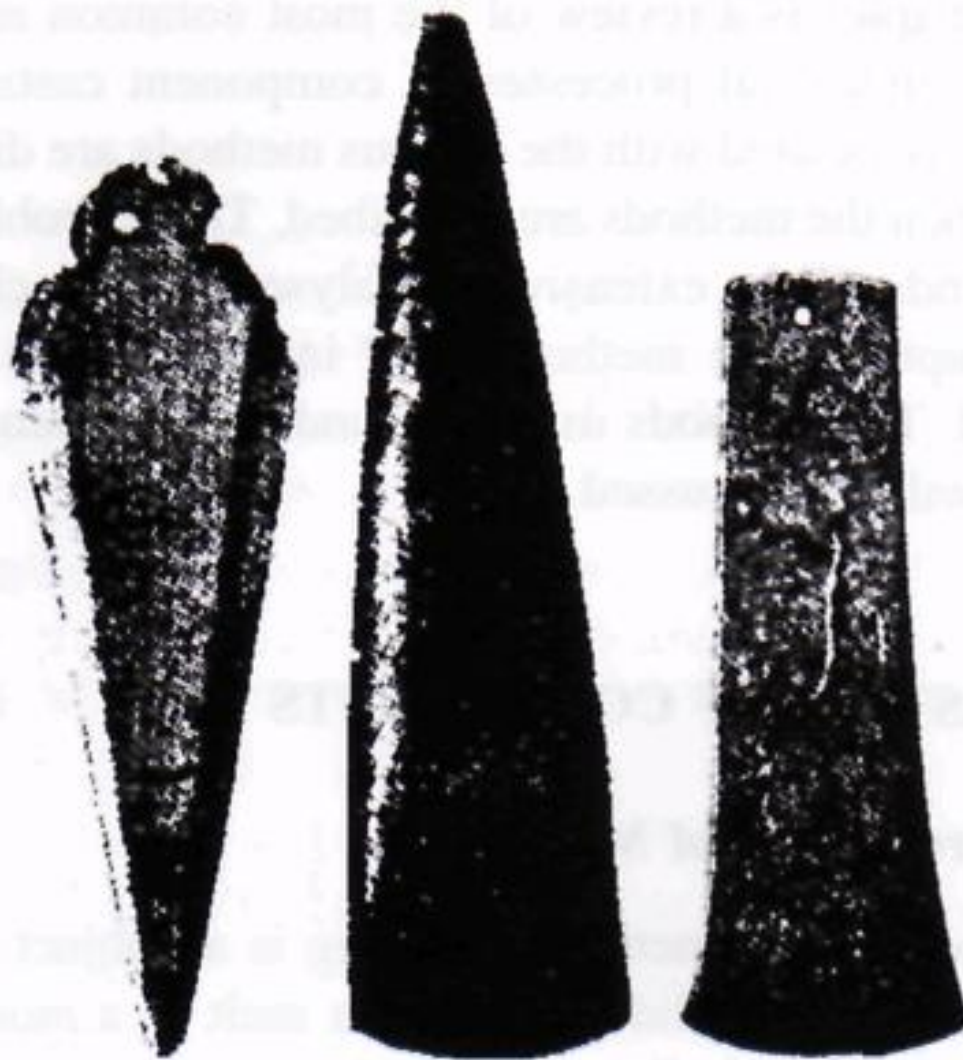
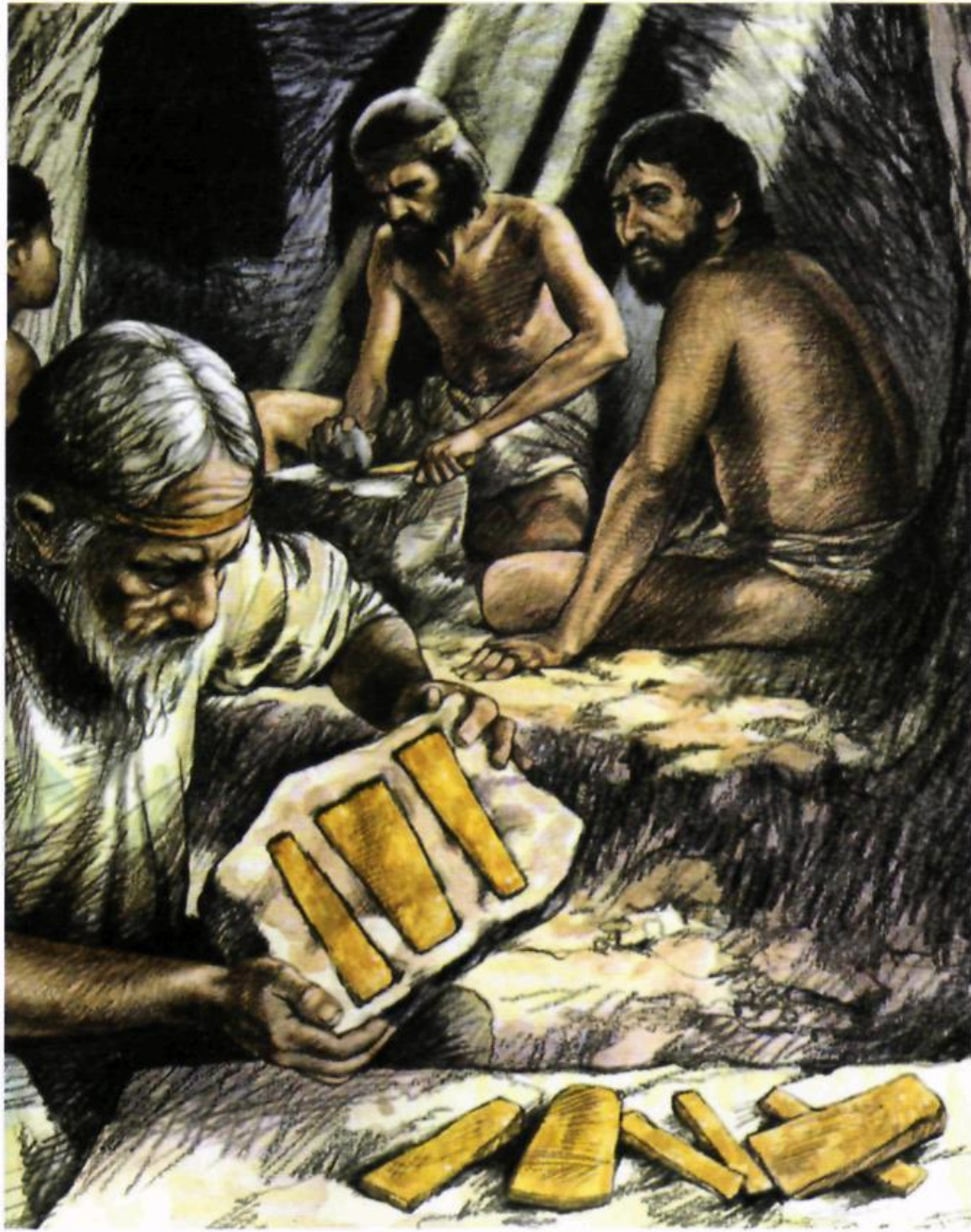


Figure 1.2 A knife and two axes of pure copper, cast in stone moulds of the type illustrated in Figure 1.1.



Early Bronze Age foundrymen / İlk Tunç Çağı dökümcü ustaları





Dagger casting in the Early Bronze Age / İlk Tunç Çağında hançer dökümü



Deer statuette / *Geyik heykelciđi*
Arsenical copper / *Arsenikli bakır,*
H / Y 45.5, Alaca Höyük-Çorum 25th c. BCE / MÖ 25. yy,
Anadolu Medeniyetleri Müzesi-Ankara



Bull statuette / *Bođa heykelciđi*
Arsenical copper / *Arsenikli bakır,*
H / Y 48, Alaca Höyük-Çorum 25th c. BCE / MÖ 25. yy
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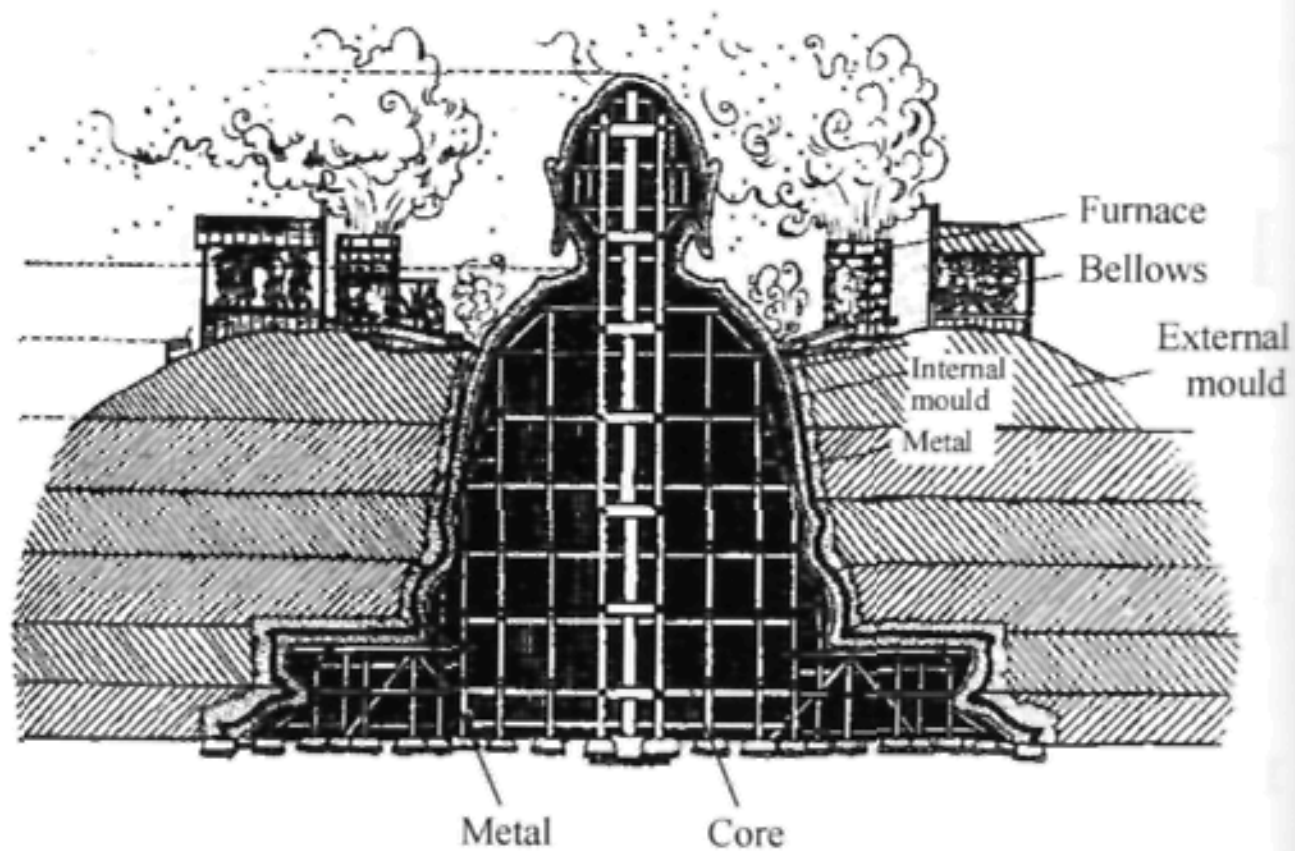
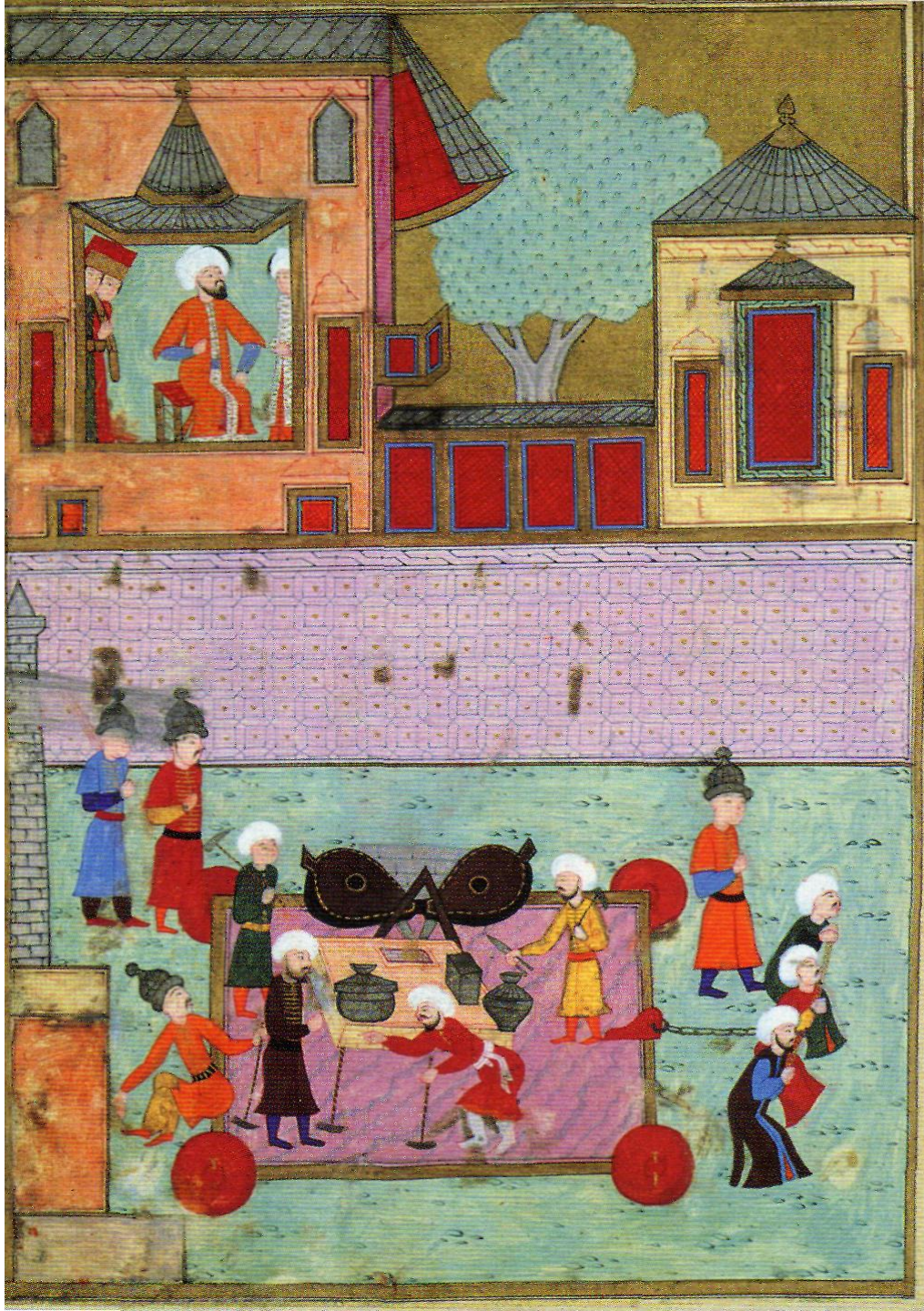


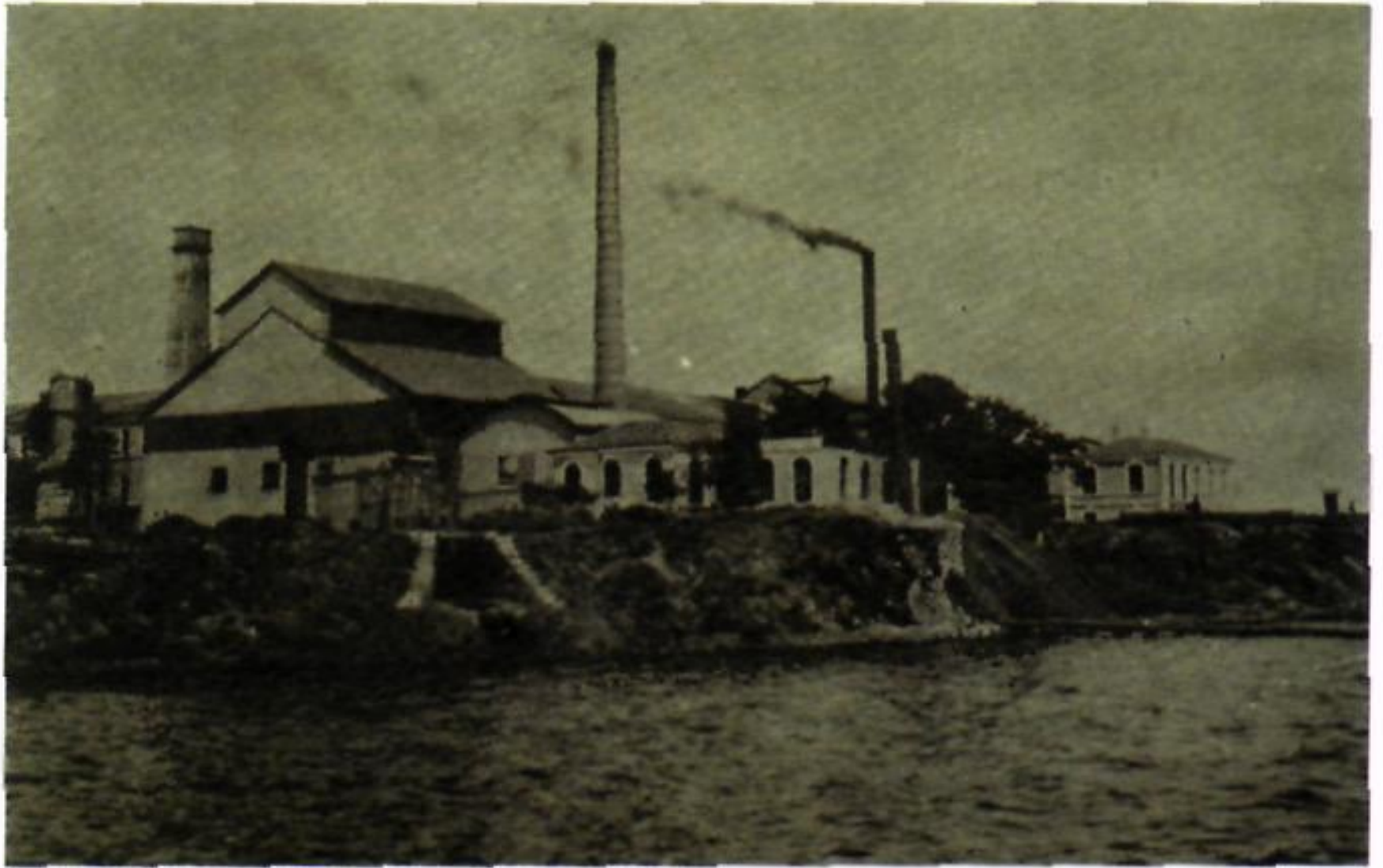
Figure 1.3 Picture of a cast bronze Buddha statue, which is more than 20 m high. The statue was cast in the Eighth century AD. Its weight is 780×10^3 kg. A very special foundry technique was used in which the mould production and casting occurred simultaneously. The mould was built and the statue was cast in eight stages, starting from the base. The mould was built around a framework of wood and bamboo canes. Each furnace could melt 1×10^3 kg bronze per hour. Reproduced with permission from Giesserei-Verlag GmbH.



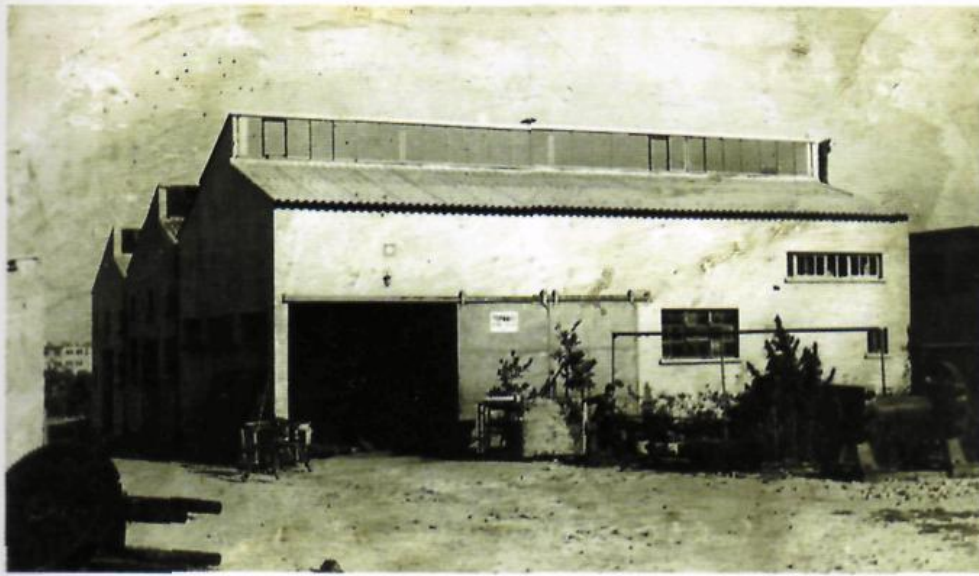




Cannon Foundry in the 18th century / *Tophane-i Amire'nin 18. yüzyıldaki görüntüsü*



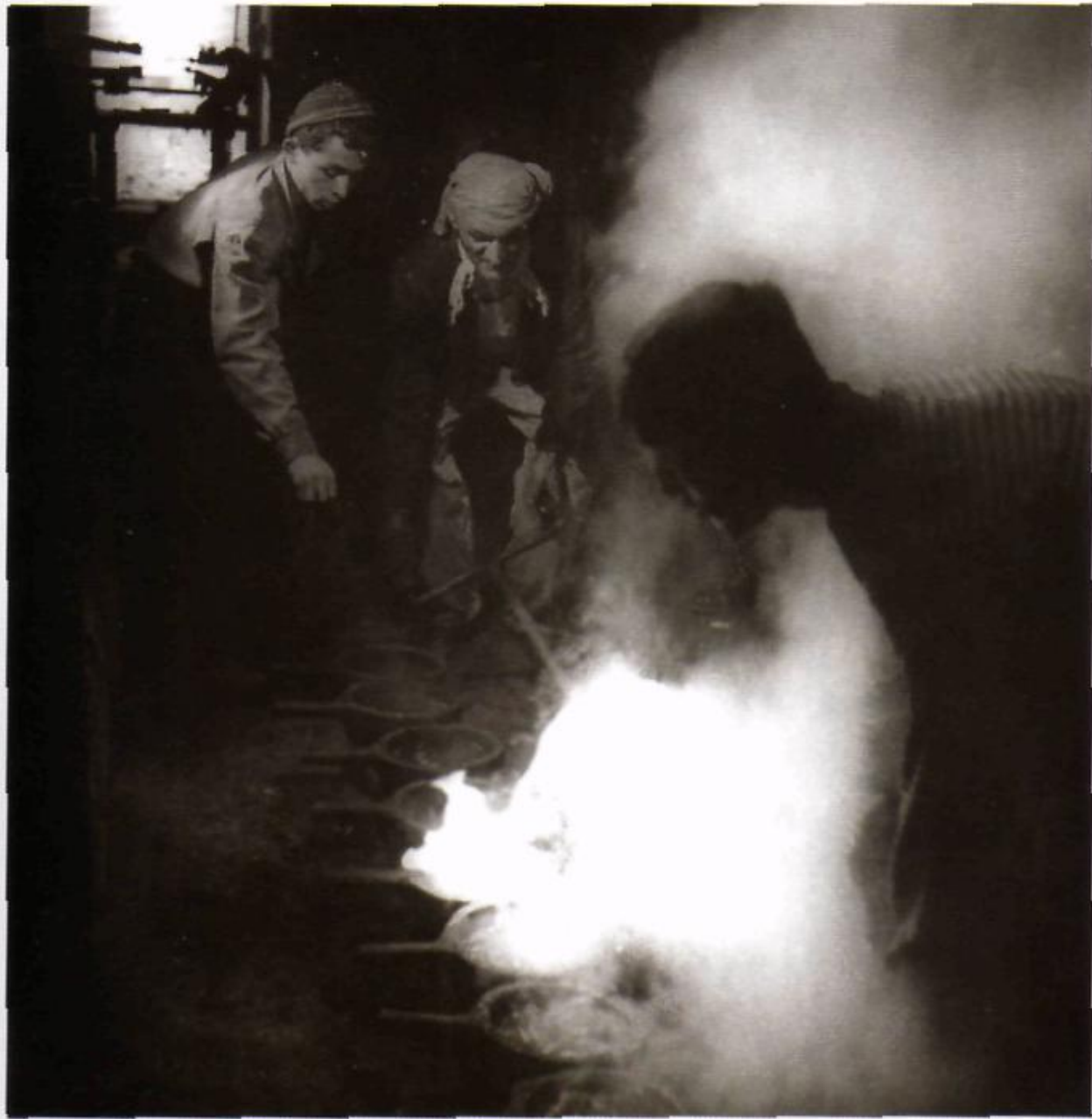
Zeytinburnu iron casting plant / *Zeytinburnu döküm fabrikası*, 1833 Istanbul



Mikael Zilciyan, bell and cymbal foundry / *Zil ve çan döküm fabrikası*,
Samatya-İstanbul



Mikael Zilciyan (on the right), owner of Zilciyan bell and cymbal foundry /
Mikael Zilciyan (sağdaki) ve fabrika tabelası



Casting cymbals / *Zil dökümü*, Zilciyan-Istanbul

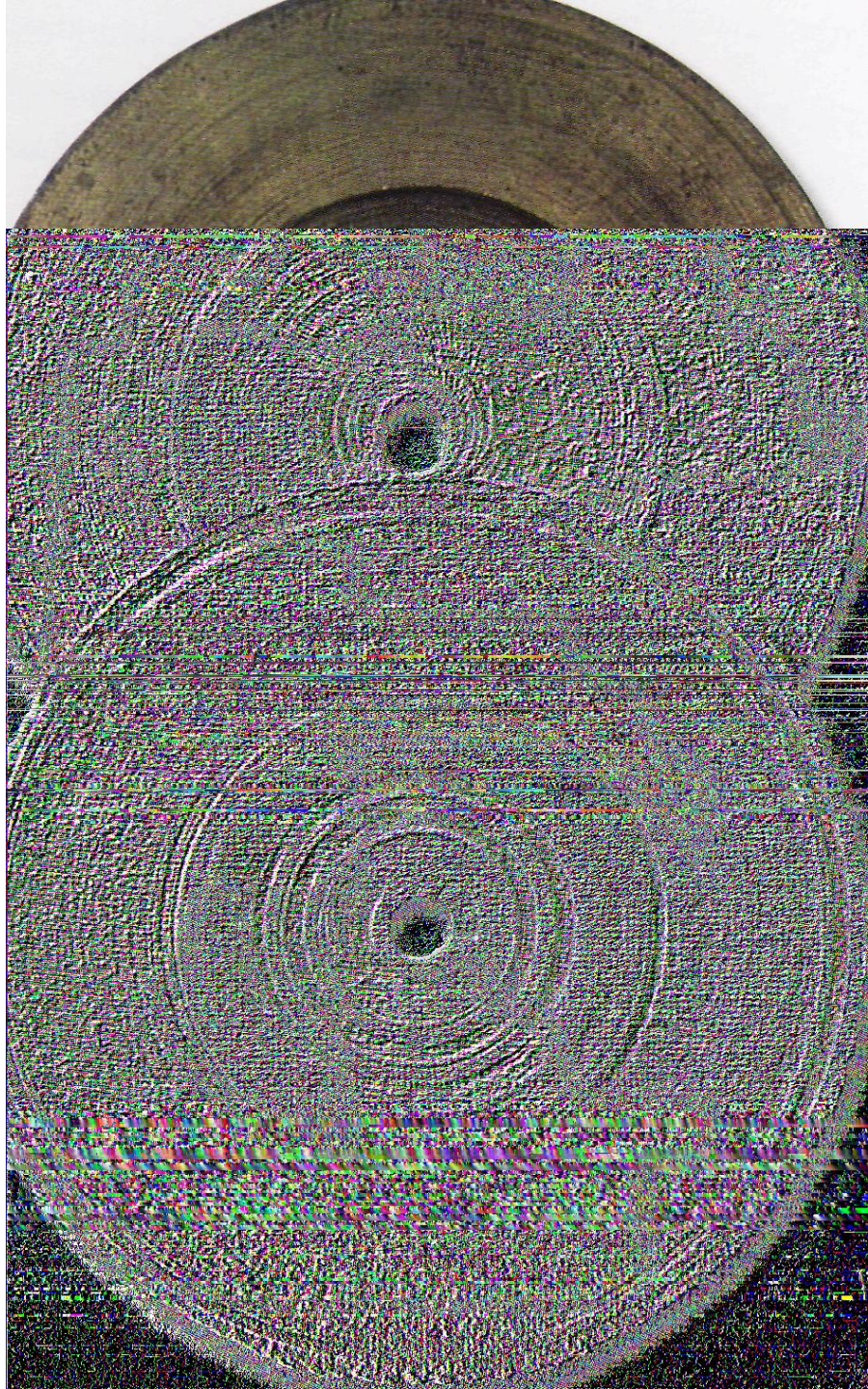








Table 1 Chronological list of developments in the use of materials

Date	Development	Location
9000 B.C.	Earliest metal objects of wrought native copper	Near East
6500 B.C.	Earliest life-size statues, of plaster	Jordan
5000–3000 B.C.	Chalcolithic period; melting of copper; experimentation with smelting	Near East
3000–1500 B.C.	Bronze Age: arsenical copper and tin bronze alloys	Near East
3000–2500 B.C.	Lost wax casting of small objects	Near East
2500 B.C.	Granulation of gold and silver and their alloys	Near East
2400–2200 B.C.	Copper statue of Pharaoh Pepi I	Egypt
2000 B.C.	Bronze Age	Far East
1500 B.C.	Iron Age (wrought iron)	Near East
700–600 B.C.	Etruscan dust granulation	Italy
600 B.C.	Cast iron	China
224 B.C.	<i>Colossus of Rhodes destroyed</i>	Greece
200–300 A.D.	Use of mercury in gilding (amalgam gilding)	Roman world
1200–1450 A.D.	Introduction of cast iron (exact date and place unknown)	Europe
<i>Circa</i> 1122 A.D.	Theophilus's <i>On Divers Arts</i> , the first monograph on metalworking written by a craftsman	Germany
1252 A.D.	<i>Diabutsu</i> (Great Buddha) cast at Kamakura	Japan
<i>Circa</i> 1400 A.D.	Great Bell of Beijing cast	China
16th century	Sand introduced as mold material	France
1709	Cast iron produced with coke as fuel, Coalbrookdale	England
1715	Boring mill for cannon developed	Switzerland
1735	Great Bell of the Kremlin cast	Russia
1740	Cast steel developed by Benjamin Huntsman	England
1779	Cast iron used as architectural material, Ironbridge Gorge	England
1826	Zinc statuary	France
1838	Electrodeposition of copper	Russia, England
1884	Electrolytic refining of aluminum	United States, France

- **Metal casting is a technology which reaches back almost 5000 years. We will probably never know when or how the first casting was produced because man made castings before he left a written record of this achievement.**
- **Gold, which occurs in nature in pure nugget form, and certainly would have attracted the attention of men, undoubtedly was the first metal recognized. Prehistoric man probably hammered gold** ornaments out of the nuggets that he found. We can only conjecture, but it's likely that it was around 8000 BC or shortly thereafter.
- **Silver also could have been found in relatively pure form and could have been treated similarly.**

- **Copper most likely was the next metal put to use by mankind. It is entirely possible that a campfire may have been banked with copper-bearing ore and that beads or droplets of solidified copper were found in the ashes,, perhaps around 4500 BC, although the discovery may have come as much as a 1000 years earlier.**
- **It would have been natural to hammer the copper into a shape, as gold had been formed. Unlike gold, however, the copper became harder when it was hammered, opening the door to new uses for metal — such as weapons.**

- **Long before, Man had discovered refractory materials and had used them for thousands of years to make pottery, With the discovery that copper could be melted, it should have been a natural step to melt it by design and form it into desired shapes in sand, clay and stone molds.**
- **In reality , however, forging of copper apparently was the accepted method of metal forming for a period of from 1000 to 2000 years — until about 3500 BC.**
- **Forged copper necessarily was limited to simple shapes, restricting the utility of the process involved. It was casting, the essential foundation of all civilization, that unlocked the future and placed man on the path to conquering his environment.**

- **Although we don't know who made the first casting, or exactly where, most historians believe that this great step forward was made in ancient Mesopotamia (roughly modern Iraq) in the period 4000-3000 BC.**
- **The oldest casting in existence is believed to be a copper frog cast in Mesopotamia probably around 3200 BC.**

- **Progress in casting necessarily was slow. From pure copper, early man moved to bronze castings when he learned, sometime around 3000 BC and again perhaps by accident, that the addition of tin to molten copper produced a much more useful material. Bronze was harder than copper and could be hardened more easily.**
- **The discovery of tin as a separate element did not take place until the 16th century, but by then Man had already used its ores for 4500 years in combination with those of copper.**
- **Brass (copper plus zinc) was developed many centuries before the Christian era, although precisely when or where is debatable. Like tin, zinc was used as an alloying metal before it was recognized as a separate element.**

- **The first production-of iron castings usually is attributed to the Chinese at a time shortly after 1000 BC, but certainly by the 6th century AD. Iron had been known much earlier — as far back as 4000 to 2000 BC.**
- **Since iron does not occur on earth in native form and could hardly have been smelted 6000 years ago, its origin has been attributed to meteorites in which it is found unoxidized, but this contention has also been debated.**

- **Developments in metal casting came swiftly in the 14th and 15th centuries.**
- **By 1500, cast iron — a brittle but still useful engineering material — was extensively used in the West.**
- The new era of foundry development which opened with the end of the Dark Ages was well underway by the close of the 15th century.
- **The blast furnace had been established and pig iron introduced pointing the way to iron and steel molding.**
- **It was in the 18th century that Reaumur developed the first malleable iron — European whiteheart — in France. Seth Boyden produced the first blackheart malleable in the U.S.A. in the year 1826.**

- ***In 1800, the practice of casting metal in green sand molds and "even in molding boxes" was recognized as an advancement in our metallurgical world.***
- **It was also in late 1800 that cast steel took its own place as a commercially available material.**

Some Foundrymen Societies

- **AFS**
- **NADCA**
- **SFSA**(Steel Founder's Society of America)
- **AMC** (America Metalcasting Consortium)
- **Ductile Iron Society**
- **The Institute of British Foundrymen**
- **World Foundrymen Organization**
- **German Foundrymen's Society (VDG)**
- **TUDOKSAD**

- **Metal Casting Plants**
 - **Casting Alloys**
- **in some countries**

A MODERN CASTING Staff Report

Number of Operating Metalcasting Plants By Nation—2006

COUNTRY	IRON	STEEL	NONFERROUS	TOTAL
Austria	12	4	35	74
Belgium	17	9	10	36
Brazil	609	186	577	1,372
Canada	55	28	83	166
China ^A	17,000	4,700	4,300	26,000
Croatia	15	3	25	43
Czech Republic	89	28	59	176
Denmark	8 ^B	n/a	10	18
Finland	15	6	15	36
France	110	37	322	469
Germany	212	53	354	619
Great Britain	203	46	210	459
Hungary	42	27	143	212
India	n/a	n/a	n/a	4,750
Italy	170	27	974	1,171
Japan	454	78	1169	1,701
Korea	501	140	210	851
Lithuania	8	3	5	16
Mexico	n/a	n/a	n/a	1,500
Netherlands ^C	16	0	5	21
Norway	7	3	11	21
Poland	185 ^D	n/a	245	430
Portugal	49	10	40	99
Romania	72	54	84	210
Russia ^E	n/a	n/a	n/a	1,900
Slovenia ^E	16	4	33	53
Slovakia ^E	12	7	32	51
South Africa	87	51	117	255
Spain	65	34	57	156
Sweden	38	15	85	136
Switzerland	17	3	38	58
Taiwan ^E	520	45	350	915
Thailand ^E	230	26	220	476
Turkey	890	66	306	1,262
Ukraine ^E	400	233	437	960
U.S.	564	239	1367	2170

A) 2005 data B) 2004 data C) only association members D) includes steel casters E) 2002 data

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Denmark	8 [†]	n/a	10	18
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Germany	212	53	354	619
Great Britain	203	46	210	459
Hungary	42	27	143	212
India	n/a	n/a	n/a	4,750
Italy	170	27	974	1,171
Japan	454	78	1,169	1,701

Korea	501	140	210	851
Lithuania	8	3	5	16
Mexico	n/a	n/a	n/a	1,500
Netherlands ^{BC}	16	0	5	21
Norway	7	3	11	21
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Russia ^E	n/a	n/a	n/a	1,900
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41st Census of World Casting Production—2006 (metric tons)

Country	Gray Iron	Ductile Iron	Malleable Iron	Steel	Copper-Base	Aluminum	Mag.	Zinc	Other Nonferrous	TOTAL
Austria	49,080	138,383 ^a	n/a	19,671	2,691	107,576	6,534	14,031	2,691	340,657
Belgium	81,200	10,700 ^a	n/a	46,800	1,049	24,545 ^b	n/a	740	n/a	165,034
Brazil	1,760,376	750,432	21,014	325,113	20,306	198,042	5,279	6,483	n/a	3,087,045
Canada	483,000 ^{***c}	n/a	n/a	117,600 ^{***}	18,585 ^{***}	282,200	n/a	n/a	n/a	901,385 ^{**}
China	13,928,086	6,843,019	517,214	3,811,210	470,189	2,310,350 ^e	n/a	214,100	n/a	28,094,168
Croatia	30,971	18,243	50	2,000	825	17,301	n/a	363	n/a	69,753
Czech Republic	293,026	51,006	3,900	113,878	1,760	89,824 ^e	n/a	2,712	285	556,391
Denmark	36,500	42,100 ^a	n/a	n/a	813 ^d	n/a	n/a	n/a	5,601	85,014
Finland	46,780	67,250	n/a	19,816	4,328	11,743	n/a	495	n/a	150,412
France	874,022	1,071,145	1,358	116,583	25,476	291,377 ^e	n/a	23,538	4,742	2,408,241
Germany	2,582,539	1,661,189	56,103	215,303	98,057	772,700	30,556	64,453	n/a	5,480,900
Great Britain	421,000	335,000	10,000	112,000	13,000	185,000	2,000	20,000	2,000	1,100,000
Hungary	48,950	20,112	31	6,033	4,338	93,630	n/a	2,012	n/a	175,106
India	4,870,000	762,000	62,300	914,000	n/a	571,000 ^f	n/a	n/a	n/a	7,179,300
Italy	931,400	549,300 ^a	n/a	83,000	92,000	897,100	12,000	71,200	1,400	2,637,400
Japan	2,834,185	2,035,845	56,401	281,190	105,830	1,556,316	1,014,837	35,788	7,234	7,927,626
Korea	987,600	576,500 ^g	46,600	150,400	23,600	173,100	n/a	n/a	10,500 ^{h,i}	1,968,300
Lithuania	12,500	200 ^a	n/a	90	2	60	n/a	n/a	n/a	12,852
Mexico	899,712 ^{a,c}	n/a	n/a	79,200	n/a	696,300	n/a	n/a	n/a	1,675,212
Netherlands [*]	63,100	78,241	6,209	438	n/a	n/a	n/a	n/a	n/a	147,988 ^h
Norway	17,971	53,199	n/a	3,346	5,271	21,163	n/a	n/a	n/a	100,950
Poland	431,000	129,400	24,400	60,400	7,300	185,400	n/a	11,120	n/a	849,020
Portugal	28,025	80,694	n/a	14,171	10,800	21,400	50	750	120	156,010
Romania	61,540	14,753	898	35,616	3,356	30,982	2,800	540	3	150,488
Russia ^{***}	3,480,000	720,000	280,000	1,200,000	160,000	920,000	70,000	20,000	50,000	6,900,000
Slovenia	79,000	28,800	n/a	30,000 ^a	n/a	32,610 ^e	n/a	n/a	7,413 ^{f,i}	177,823
Slovakia ^{***}	41,520	8,760	n/a	4,300	2,160	26,260	n/a	1,800	5	84,805
Spain	440,600	623,000	17,300	87,700	9,102	135,999 ^e	n/a	15,785	515	1,330,001
South Africa	14,700	86,000	n/a	184,000	3,000	77,000	n/a	4,000	n/a	368,700
Sweden	193,600	67,800	n/a	24,100	11,900	48,400	2,400	5,800	n/a	354,000
Switzerland	38,886	28,225	n/a	n/a	3,120	20,846 ^e	n/a	1,859	n/a	92,936
Taiwan	840,203	227,527	n/a	86,568	40,899	273,339	5,177	83,013	n/a	1,556,726
Thailand ^{***}	170,000	70,000	30,000	30,000	28,600	100,000	n/a	16,900	n/a	445,500
Turkey	586,000	368,000	6,500	132,000	17,500	82,500	n/a	17,000	n/a	1,209,500
United States	4,255,604	4,128,598	n/a	1,366,220	288,484	2,003,971	105,233	306,628	n/a	12,454,738
Ukraine ^{****}	626,610	40,000	10,000	266,060	11,000	20,500	n/a	n/a	n/a	974,140
TOTALS	42,539,286	21,685,421	1,150,278	9,938,806	1,485,341	12,278,534	1,256,866	941,110	92,509	91,368,121

^{*} 2004 tonnage ^{**} some tonnage from 2004 ^{***} 2005 tonnage ^{****} 2002 tonnage

A) includes malleable iron

D) gunmetal alloys

G) includes ductile iron

B) includes magnesium

E) includes all nonferrous

H) includes only ferrous

C) includes zinc

F) includes pipe castings

I) includes copper

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B) includes magnesium

E) includes all nonferrous

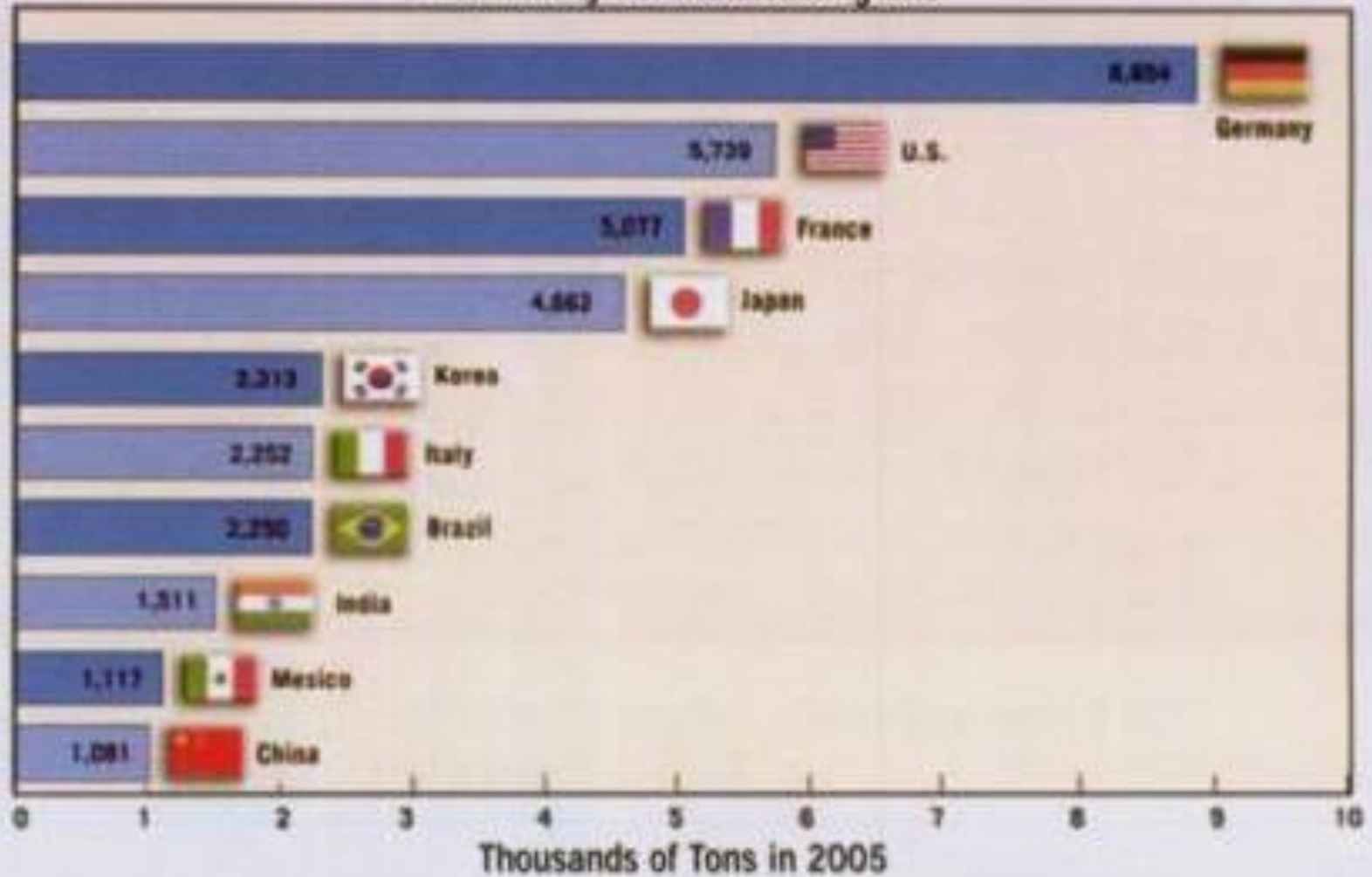
H) includes only ferrous

C) includes zinc

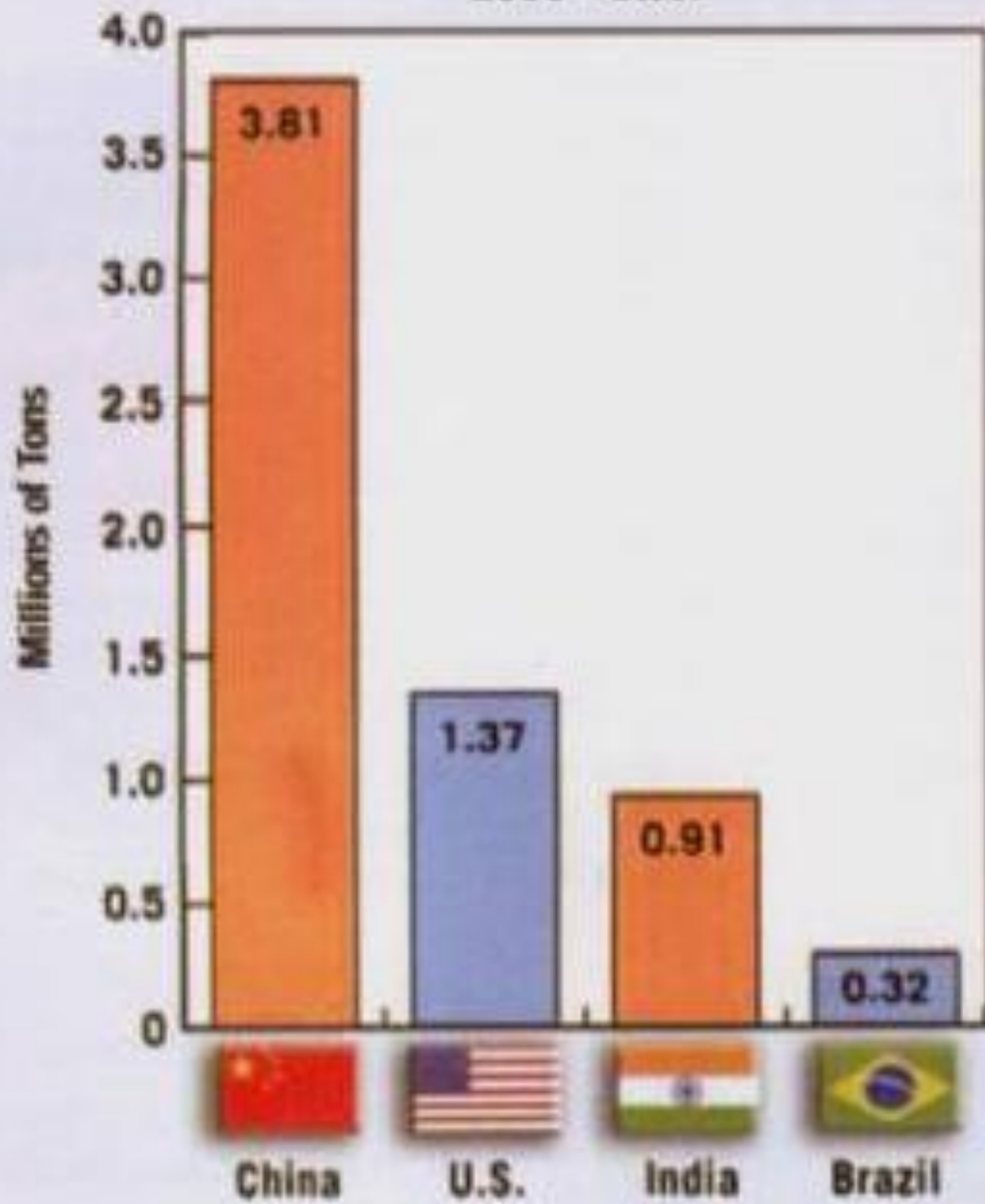
F) includes pipe castings

I) includes copper

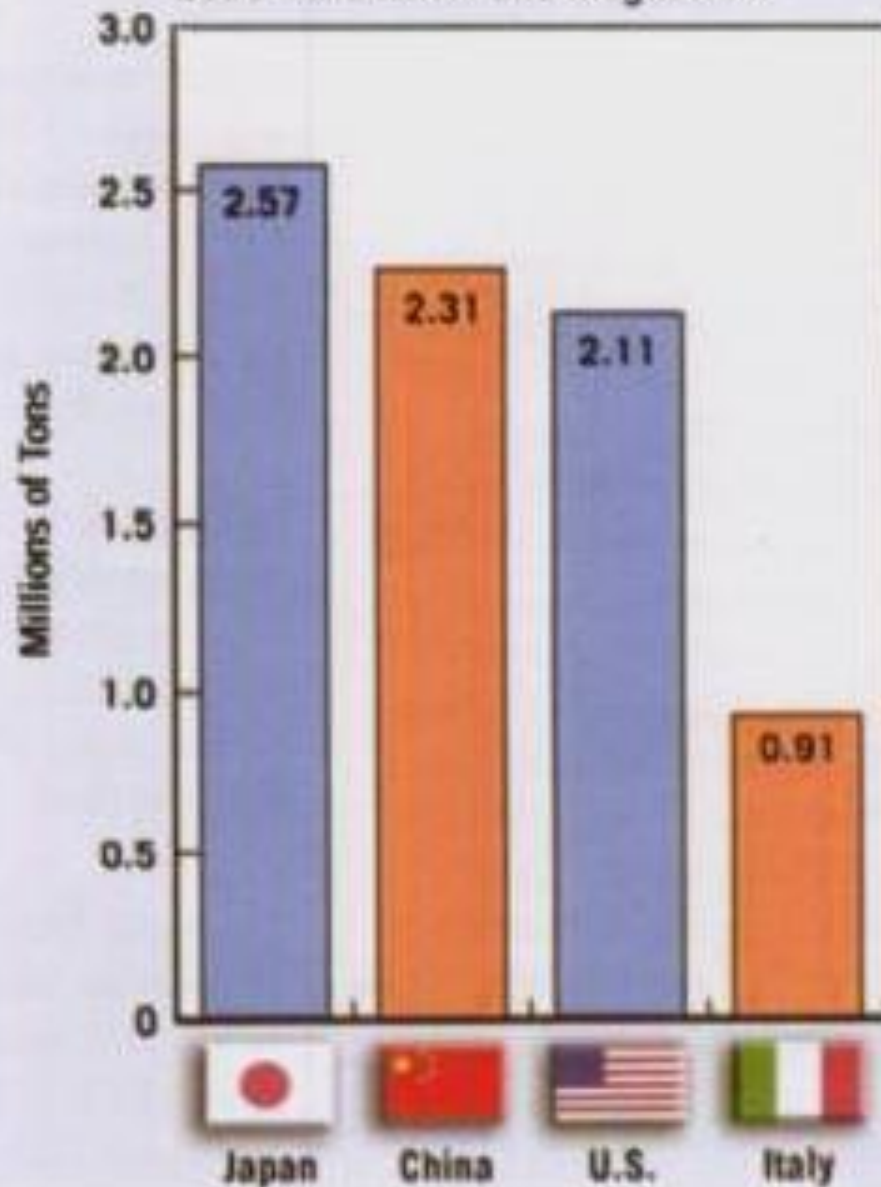
Productivity Per Metalcasting Site



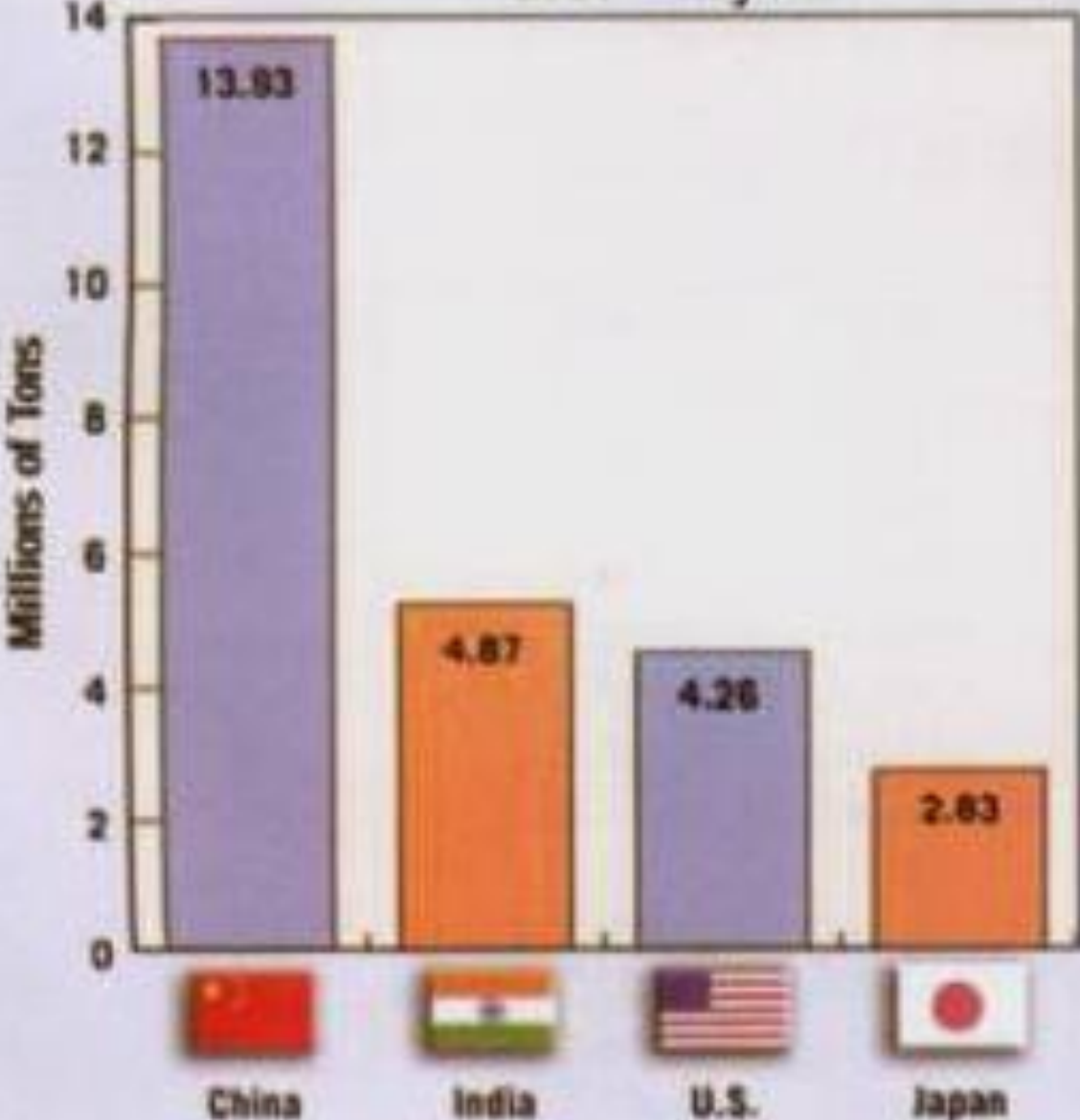
2006—Steel



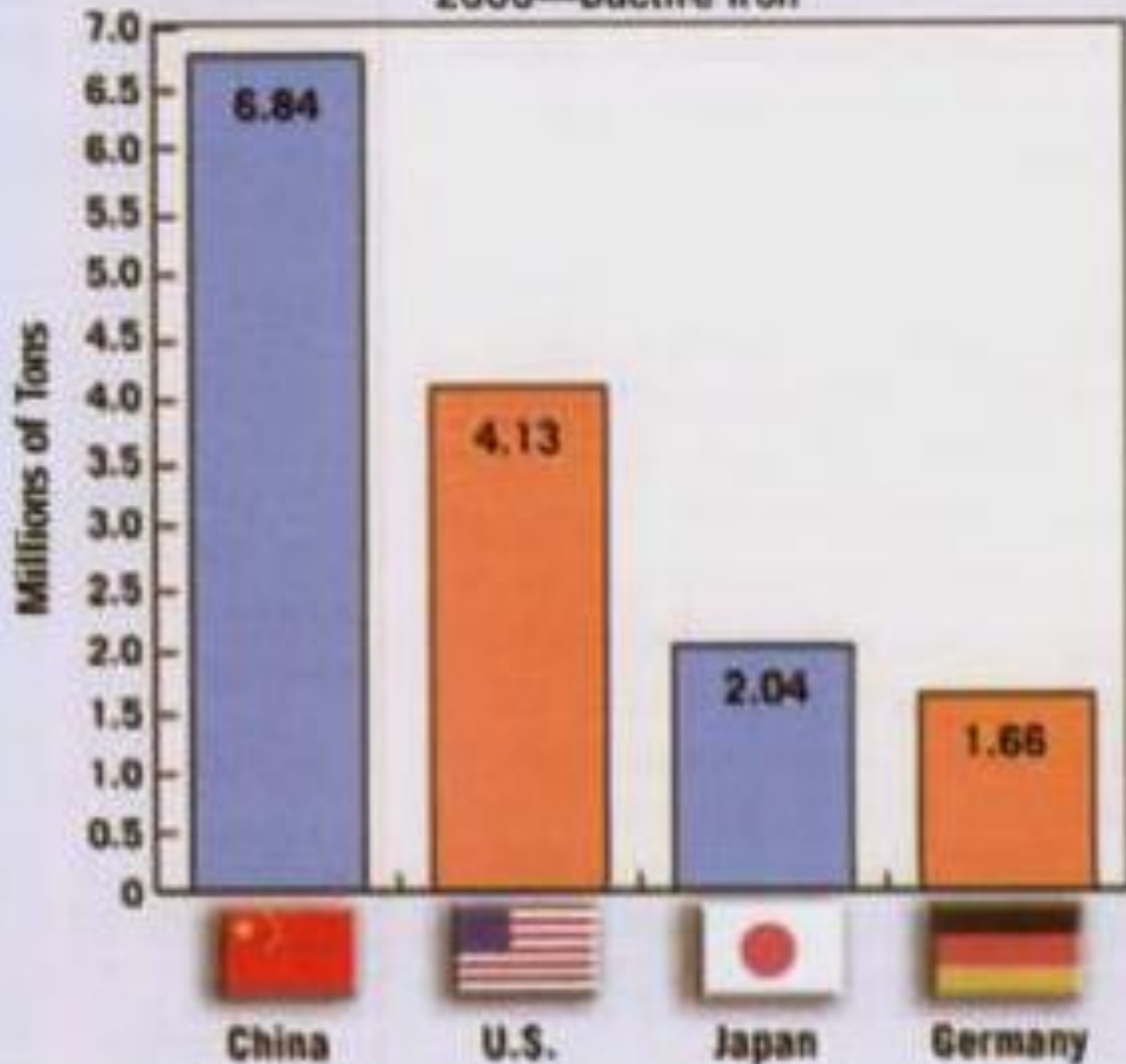
2006—Aluminum and Magnesium



2006—Gray Iron



2006—Ductile Iron



Toplam üretim 1000 t- Demir, çelik ve temper döküm

Tablo 1

Ülkeler	2004	2005	2006	2005:2004	2006:2005
				(+)/(-) %	
Avusturya	194,1	196,0	207,0	1,0	5,7
Çek Cumhuriyeti	443,4	433,1	466,8	-2,2	14,1
Finlandiya	120,3	126,5	133,8	5,1	5,8
Fransa	2.058,5	1.968,4	2.063,1	-4,4	4,8
Almanya	4.088,4	4.269,4	4.515,1	4,4	5,8
İtalya	1.507,5	1.517,6	1.563,7	0,7	0,3
Polonya	620,3	622,1	645,2	0,3	3,7
Portekiz	93,2	109,2	122,9	17,2	12,6
İspanya	1.141,8	1.143,8	1.080,9	0,2	-5,5
Türkiye	910,0	1.027,0	1.092,5	12,9	6,4
İngiltere	1.046,0	1.017,0	878,0	-2,8	-13,7
CAEF toplam	13.214,9	13.440,7	13.565,4		

Döküm Endüstrisinde İstihdam-Demir, çelik ve temper döküm

Tablo 2					
Ülkeler	2004	2005	2006	2005:2004	2006:2005
				(+) / (-) %	
Avusturya	2.853	2.860	3.027	0,2	5,8
Çek Cumhuriyeti	2.025	1.676	1.831	-17,2	9,2
Finlandiya	2.045	2.286	2.420	11,8	5,9
Fransa	21.377	19.915	19.300	-6,8	-3,1
Almanya	42.303	43.073	44.217	1,8	2,7
İtalya	17.690	15.680	15.150	-11,4	-3,4
Polonya	19.250	17.500		-9,1	
Portekiz	2.255	2.260	2.337	0,0	-1,7
İspanya	12.601	13.549	13.013	7,5	-4,0
Türkiye		20.068	22.023		9,7
İngiltere	17.000	17.000	15.700	0,0	-7,6
CAEF toplam	168.825	190.173	169.106		

Dökümhane sayısı (üretim tesisi) - Demir, çelik ve temper döküm

Tablo 3

Ülkeler	2004	2005	2006	2005:2004	2006:2005
				(+) / (-) %	
Avusturya	35	33	34	-5,7	3,0
Çek Cumhuriyeti	138	186	142	0,0	-3,7
Finlandiya	19	22	21	15,8	-4,8
Fransa	161	153	147	-5,0	-3,9
Almanya	265	265	265	0,0	0,0
İtalya	237	207	197	-12,7	-4,8
Polonya	185	185		0,0	
Portekiz	60	60	59	0,0	-1,7
İspanya	101	102	99	1,0	-2,9
Türkiye	973	932	955	-4,3	2,5
İngiltere	280	264	249	-5,7	-5,7
CAEF toplam	1.669	2.605	2.290		

Ülkeler bazında döküm tonajları 1000 ton

Tablo 4

Ülkeler	Demir döküm	Sfero ve temper döküm	Çelik	Demir dışı metal
Avusturya	49,1	138,4	19,7	130,8
Çek Cumhuriyeti	296,3	56,6	113,9	94,5
Finlandiya	46,8	42,1	19,8	20,7
Fransa	921,5	1.025,0	116,6	345,1
Almanya	2.582,5	1.717,3	215,3	972,6
İtalya	931,4	549,3	83,0	1.073,7
Polonya	431,0	153,8	60,4	217,7
Portekiz	28,0	80,7	14,2	33,1
İspanya	440,6	634,3	87,7	161,4
Türkiye	586,0	374,5	132,0	117,0
İngiltere	421,0	345,0	112,0	220,0
İsveç	204,3	57,1	25,5	68,5
CAEF toplam	7.193,8	5.573,0	1.080,3	3.587,1
Tayland	170,0	100,0	30,0	145,5
Ukrayna	626,1	50,0	266,1	31,5
ABD	4.457,6	4.316,0	1.287,3	2.834,9
Tayvan	170,0	100,0	30,0	372,5
G.Afrika	160,0	75,0	136,0	73,5
Hindistan	4.116,0	674,0	805,0	516,0
Brezilya	2.460,0		293,9	240,5
Kore	960,0	611,7	149,6	177,8
Rusya	3.480,0	1.000,0	1.200,0	1.220,0
Meksika	600,0	272,0	75,0	840,9

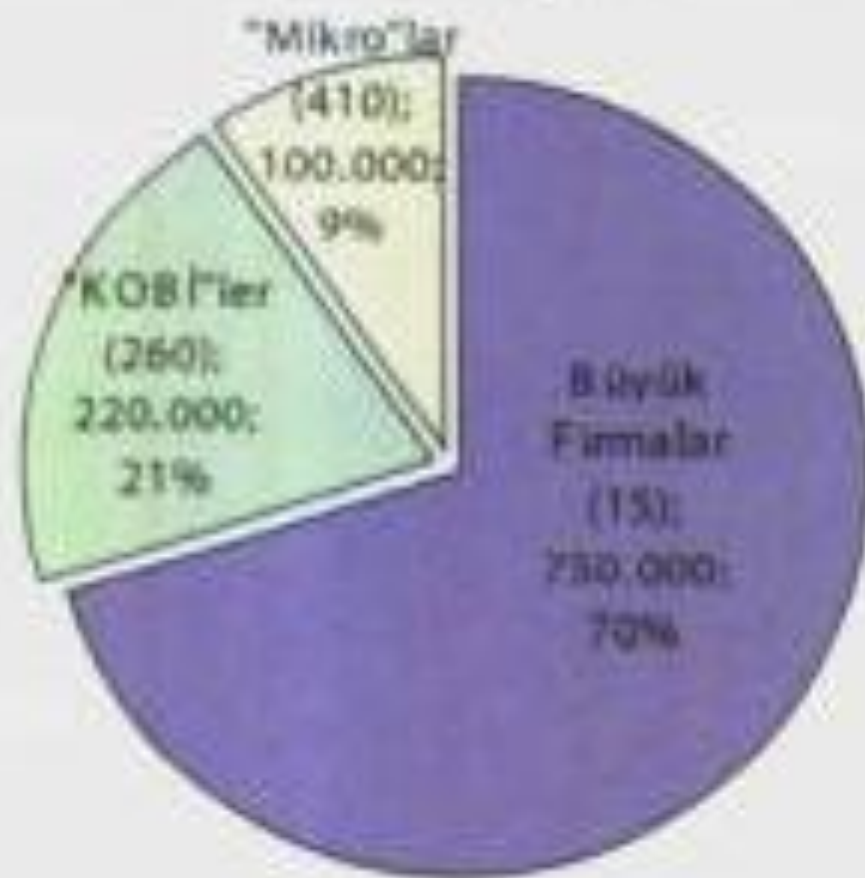
Tablo. 1. Döküm Sektörü Kuruluş Sayıları 2006

Üretim Cinsi	Özel Sektör			Kamu Askeri Tesisler	Toplam Kuruluş Sayısı
	Büyük	KOBİ	Mikro		
Pik/Sfero	16	208	467	11	702
Temper	1	1	2	-	4
Çelik	11	39	18	3	71
Alüminyum	18	47	122	2	189
Zamak	4	22	188	2	216
Bakar Ala.	2	9	18	5	34
TOPLAM	52	326	815	23	1216

Tablo.2. ISO 2006 Yılı 1. ve 2. 500
Büyük Firma Araştırması, Döküm
Firmaları

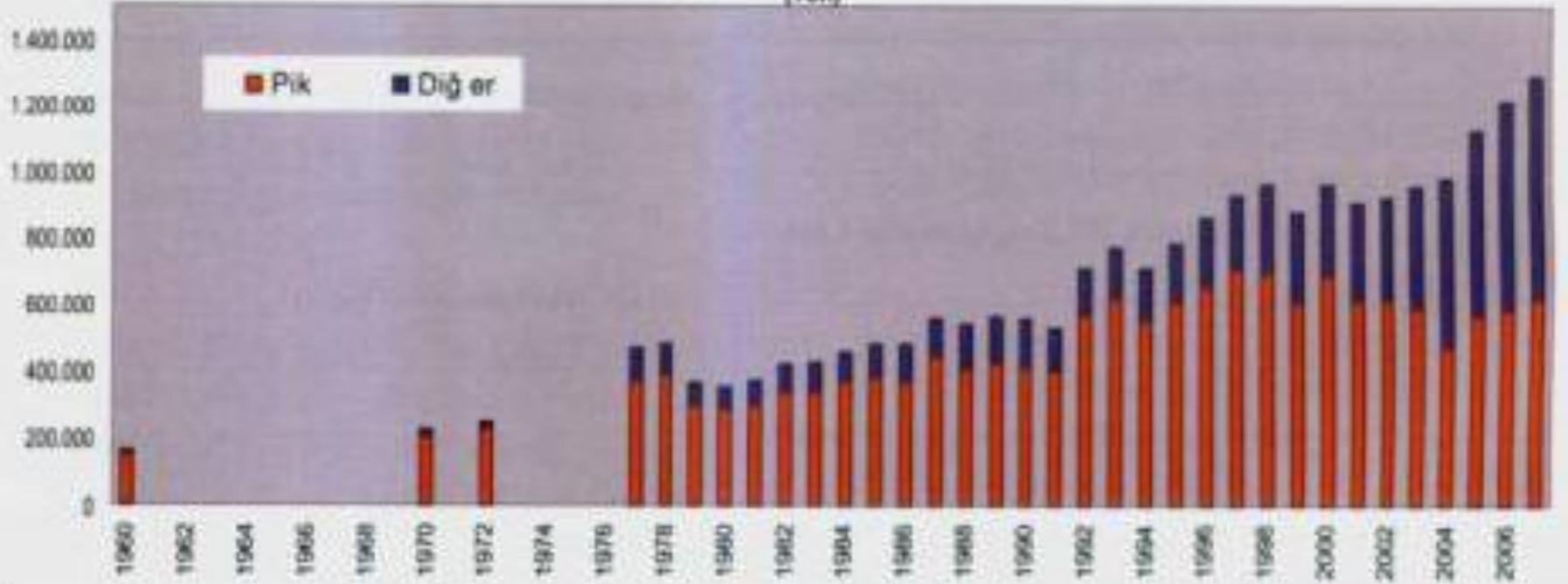
500 Sıra	Firma ve Müessese Adı
93	Componenta Döktaş Döküm.A.Ş .
166	Cms Jant Ve Makina Sanayii A.Ş .
316	Cevher Döküm Sanayii A.Ş .
369	Demisaş Döküm Emaye A.Ş .
394	Erkunt Sanayi A.Ş
397	Samsun Makina Sanayii A.Ş .
432	Çukurova İnşaat Mak. A.Ş .
436	Trakya Döküm San. Ve Tic. A.Ş .
473	Hisar Çelik Döküm San. A.Ş .
485	Cevher Jant Sanayii A.Ş .
İkinci 500 Sıra	Firma ve Müessese Adı
-	Ferro Döküm Sanayi Tic.A.Ş .
226	Erkunt Tarım Mak. San. A.Ş .
287	Akdaş Döküm San. Ve Tic. A.Ş .
292	Çelikel Alüminyum Döküm A.Ş .
336	Çukurova Kimya Endüstrisi A.Ş .

Piküfero Dökümhaneleri
Kapasite Dağılımı



Grafik.1. Kapasite dağılımı

Türkiye Metal Döküm Üretimi
(Ton)



Grafik.2. Türkiye Metal Döküm Üretimi

Toplam Döküm Üretiminde Avrupa Sıralaması (2006)

1	Almanya	5.484.246
2	İtalya	2.645.800
3	Fransa	2.408.241
4	İspanya	1.330.001
5	Türkiye	1.210.000
6	İngiltere	1.100.000
7	Polonya	849.820
8	Çek Cum	556.391
9	Avusturya	358.157
10	İsveç	354.000

Çelik Döküm Avrupa
Sıralaması (2006)

	Ülke	(Ton)
1	Almanya	215.303
2	Türkiye	132.000
3	Fransa	116.583
4	Çek Cum	113.878
5	İngiltere	112.000
6	İspanya	87.700
7	İtalya	83.000
8	Polonya	60.400
9	Belçika	46.800
10	Romanya	35.616

Alüminyum Döküm Avrupa
Sıralaması (2006)

	Ülke	(Ton)
1	İtalya	897.100
2	Almanya	772.700
3	Fransa	291.377
4	Polonya	185.400
5	İngiltere	185.000
6	İspanya	135.999
7	Avusturya	107.576
8	Macaristan	93.630
9	Çek Cum	89.824
10	Türkiye	82.500

Tablo .3. Türkiye Metal Döküm Üretimi (Ton)

Yıllar	Pik	Sfero	Temp	Çelik	Demir dışı	Toplam	Kıymeti 1000 €
1960	150.000	0	1.000	10.000	100	161.000	162.900 €
1970	200.000		2.000	15.000	5.000	217.000	242.500 €
1972	223.000		3.000	18.000	6.000	244.000	277.200 €
1977	371.500	2.500	2.500	85.000	7.000	461.500	584.100 €
1978	389.000	3.000	7.000	70.000	8.000	469.000	578.200 €
1979	300.000	2.500	7.000	50.000	9.000	359.500	451.500 €
1980	291.000	6.000	4.000	46.000	10.000	347.000	434.100 €
1981	299.500	5.500	5.000	50.000	10.000	360.000	453.650 €
1982	340.000	11.000	6.000	50.000	10.000	407.000	499.200 €
1983	345.000	13.000	7.000	51.000	10.000	416.000	511.100 €
1984	370.000	15.000	8.000	53.000	10.000	446.000	543.500 €
1985	385.000	18.000	9.000	56.000	10.000	468.000	570.600 €
1986	375.000	22.000	11.000	61.500	10.000	469.500	585.150 €
1987	442.000	32.000	13.000	59.500	10.000	546.500	657.450 €
1988	405.000	46.000	12.000	62.000	10.000	525.000	644.700 €
1989	428.000	48.500	13.200	61.500	10.000	551.200	670.150 €
1990	415.000	60.200	10.500	58.000	12.000	543.700	664.990 €
1991	400.000	55.000	10.500	53.000	10.000	518.500	624.750 €
1992	568.000	58.000	11.600	59.000	11.000	696.600	801.300 €
1993	620.000	69.500	11.600	56.000	12.000	757.100	858.400 €
1994	550.000	75.000	11.200	61.000	12.000	697.200	813.500 €
1995	606.000	79.700	12.960	65.690	14.000	764.350	893.665 €
1996	658.000	90.600	15.200	70.600	20.000	834.400	995.420 €
1997	706.000	86.500	14.000	94.400	24.350	925.250	1.107.600 €
1998	695.000	123.000	12.000	101.000	28.700	959.700	1.170.400 €
1999	605.500	136.000	7.550	88.350	36.720	874.120	1.094.780 €
2000	690.000	130.000	7.000	98.000	40.000	965.000	1.199.500 €
2001	615.000	132.000	7.800	107.000	44.000	905.800	1.174.900 €
2002	620.000	139.000	7.500	110.000	45.000	921.500	1.198.550 €
2003	592.000	187.000	6.000	112.000	58.000	955.000	1.284.200 €
2004	475.000	308.000	6.000	121.000	72.000	982.000	1.402.600 €
2005	567.000	327.000	6.500	125.000	95.700	1.121.200	1.614.250 €
2006	586.000	368.000	6.500	132.000	117.000	1.209.500	1.881.500 €
2007	623.000	394.000	6.500	144.000	127.000	1.294.500	2.022.000 €

**Tablo. 4. Döküm
Sektörü İstihdam
Durumu (kiş i)**

İş gücü	2007
Yüksek	5.400
Teknik	3.100
İdari	2.300
Orta	9.200
Teknik	6.700
Memur	2.500
İş ç i	19.900
Kalifiye	13.400
Düz	6.500
TOPLAM	34.500

2-SEKTÖRÜN S.W.O.T. - G.Z.F.T. ANALİZİ

Döküm Sektörünün Güçlü Yönleri

- 1,400.000 ton'luk kurulu kapasite,
- 1.200 Milyar \$ lık yatırım,
- Modern teknolojiye uyan tesisler,
- Genç ve yetişmiş insan gücü,
- Türkiye'deki coğ rafî dağ ılımın uygunluğ u,
- Ekonomik kriz dönemlerinde ayakta kalabilme gücü,
- Yabancı dil bilgisi ve bilgisayar kullanımının yoğ unluğ u,
- Kalite sertifikasyonlu tesis sayısının yaygınlığ ı,
- İhracat arzusu ve bilgisi.

Döküm Sektörünün Zayıf Yönleri

- Pazar dağ ılımının otomotiv sektörü yoğ unluklu olması,
- Yurt içi hammadde üretimi yetersizliğ i,
- Sermaye yetersizliğ i ve finansman maliyetlerinin yüksekliğ i,
- AR-GE faaliyetlerinin yetersizliğ i,
- Küçük iş letmelerin kırılğan yapısı,
- Orta ve büyük iş letmelerin büyüme zorunluluğ u,
- Ana sanayi, komponent ve alt sistem üretim yatırımlarının yetersizliğ i
- AB çevre standartlarına uyum konusundaki eksiklikler
- Yurt içi tesis, ekipman ve servis üretiminin yetersizliğ i

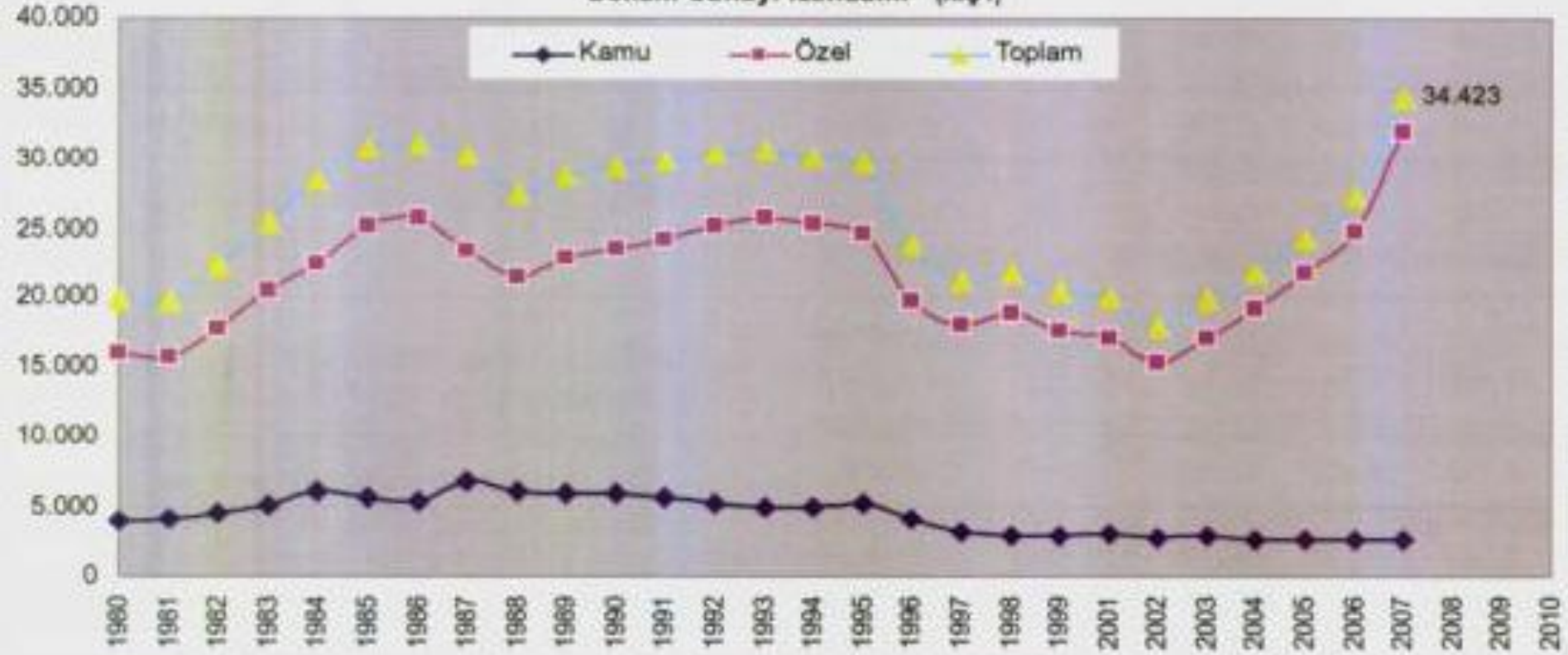
Döküm Sektörü İçin Tehditler

- Değ eri hızlı değ iş en ve yükselen Yeni Türk Lirası,
- Yüksek iş çilik ve enerji maliyetleri,
- Yetersiz çevre mevzuatı,
- Katı çalış ma mevzuatından kaynaklanan ilâve maliyetler.

Döküm Sektörü İçin Fırsatlar

- Geliş miş bilgi teknolojileri alt yapısı,
- Avrupa'ya coğ rafî yakınlık,
- Türkiye'nin, bölgenin otomotiv üretim üssü haline gelme eğ ilimi,
- Üretime hemen dönüş türülebilecek mevcut kapasite yapısı,
- Yetiş miş insan gücü fazlası.

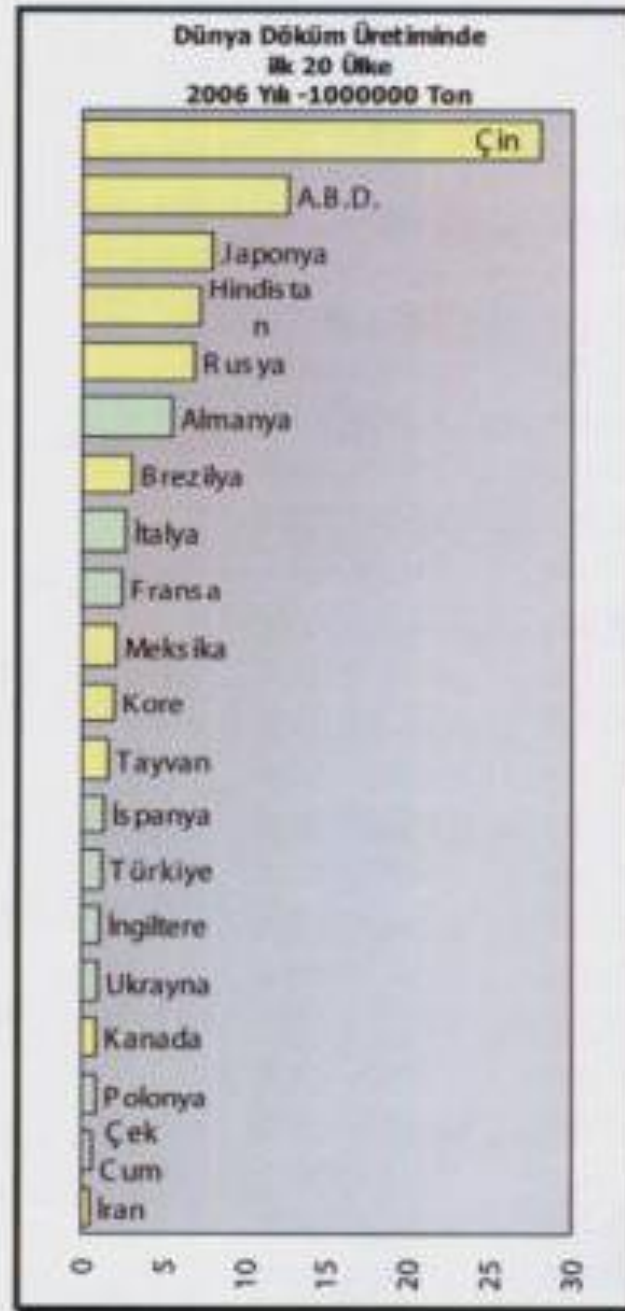
Döküm Sanayi İstihdamı (kiş i)



Grafik. 3. Yıllara göre Döküm Sanayi İstihdamı

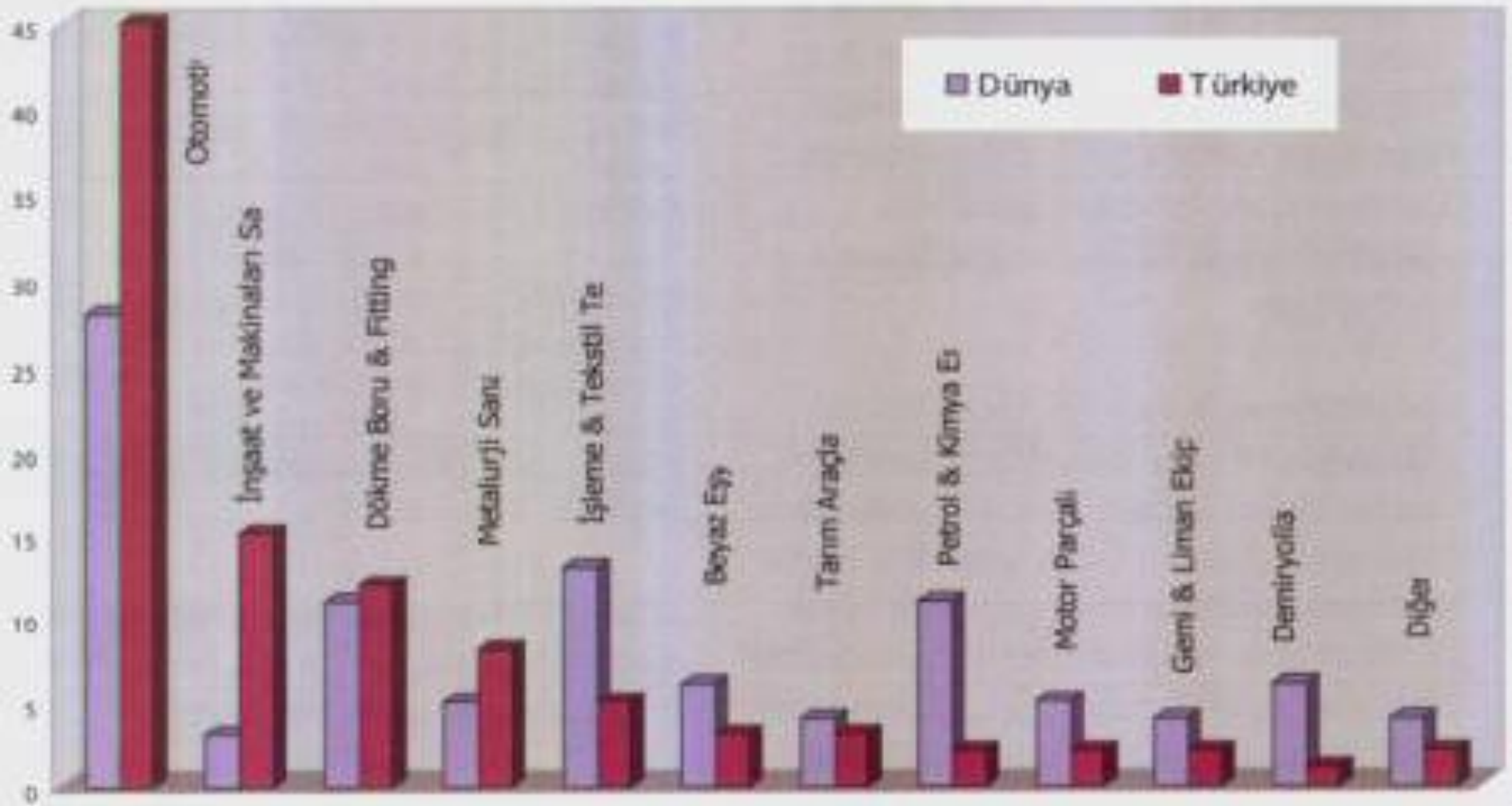
Tablo. 7. Döküm Türlerinin Dağılımı
(2006/1000ton)

Döküm Türü	Dünya		Türkiye	
	Miktar	Payı	Miktar	Payı
Pik	42.539	46,2%	586	48,4%
Sfero	21.955	23,9%	368	30,4%
Temper	1.263	1,4%	7	0,5%
Celik	9.939	10,8%	132	10,9%
Bakır Alas.	1.672	1,8%	18	1,4%
Aluminyum	12.283	13,3%	83	6,8%
Magnezyum	1.271	1,4%	1	0,0%
Zamak	941	1,0%	17	1,4%
Diğer	151	0,2%	0	0,0%
Totlam	92.016		1.210	



Grafik. 3. Dünya Üretiminde ilk 20

Döküm Sektörünün Çıktı Verdiği Alanlar %



Grafik 2. Döküm sektörünün çıktı verdiği endüstriler

Tablo. 5.

Türk Metal Döküm İhracatı

Yıl	Gri	Sfero	Temp	Çelik	Demir dışı	Toplam Ton	İhracatın Kıymeti
1979	3.845	0	0	680		4.525	5.160.500 €
1980	3.770	0	0	880		4.650	5.593.000 €
1981	5.100	0	0	1.300		6.400	7.840.000 €
1982	7.800	200	633	1.336		9.969	13.765.000 €
1983	7.540	322	335	1.270		9.467	12.022.400 €
1984	9.700	229	410	1.524		11.863	14.864.800 €
1985	8.400	232	540	1.935		11.107	15.375.900 €
1986	10.689	509	605	2.972		14.775	20.685.900 €
1987	18.234	705	657	2.198		21.794	26.036.600 €
1988	15.000	700	600	2.300		18.600	23.090.000 €
1989	17.189	2.200	711	2.500		22.600	27.915.100 €
1990	15.178	2.500	722	2.800		21.200	27.270.200 €
1991	14.420	2.400	780	3.900		21.500	29.508.000 €
1992	28.176	3.700	848	4.100		36.824	44.288.400 €
1993	28.176	6.072	1.097	3.813		39.158	47.662.300 €
1994	56.306	10.987	1.206	7.701		76.200	89.142.300 €
1995	61.900	14.870	1.302	8.006		86.078	100.079.000 €
1996	83.300	29.300	1.480	13.800		127.880	152.030.000 €
1997	98.000	39.000	1.840	21.000		159.840	196.700.000 €
1998	136.000	51.000	2.730	31.000	8.100	228.830	315.250.000 €
1999	153.000	55.000	3.210	41.000	9.200	261.410	368.250.000 €
2000	198.000	61.500	3.700	47.000	18.700	328.900	481.500.000 €
2001	211.000	72.000	3.000	49.000	22.000	357.000	523.800.000 €
2002	232.000	79.600	3.400	52.000	26.000	393.000	581.320.000 €
2003	251.500	87.000	2.500	59.000	35.000	435.000	665.750.000 €
2004	287.000	157.000	3.200	68.000	46.000	561.200	862.700.000 €
2005	295.000	190.000	3.300	70.000	75.000	633.300	1.114.800.000 €
2006	309.000	230.000	3.500	81.000	88.000	711.500	1.277.800.000 €
2007	340.000	260.000	3.500	90.000	95.000	788.500	1.508.500.000 €

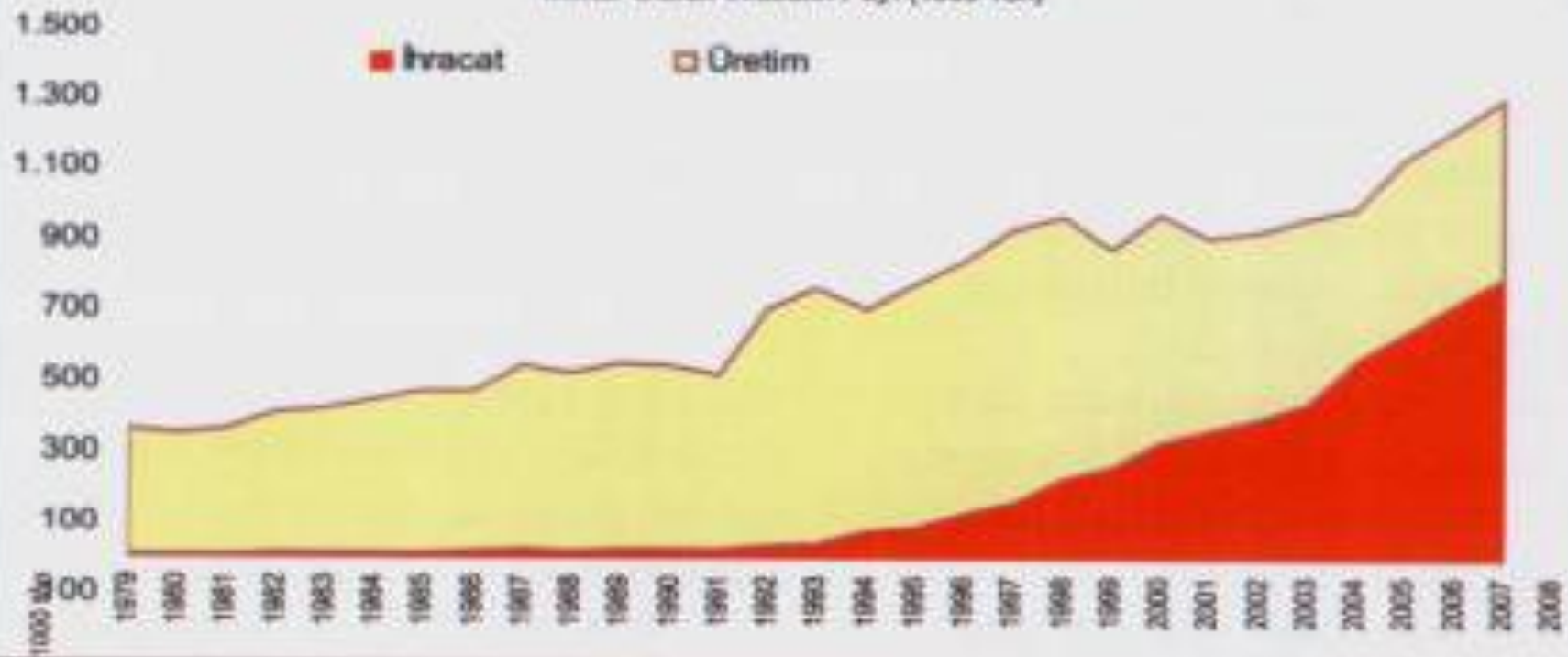
Tablo. 6. 2006 Yılı 1000 İhracatçı Listesi

Sıra	Firma Adı	Dış Satış Tutarı (ABD \$)
	TOPLAM	639.192.760
49	Componenta Döktaş Döküm A.S .	166.091.076
54	Cms Jant Ve Makina San. A.Ş .	140.445.446
175	Erkunt Sanayi A.S .	51.669.512
185	Cevher Döküm San. A.S .	50.163.319
192	Demisas Döküm Emaye A.S .	48.197.146
196	Hisar Çelik Döküm San. A.S .	47.888.338
345	Çukurova İnşaat Makinaları A.S .	29.291.239
409	Akdaş Döküm San. Ve Tic. A.S .	25.339.715
498	Erku Dış Tic.-Trakya DökümAS	21.787.596
592	Çelikel Alüminyum Döküm .Ş .	18.257.013
667	Ak Döküm Sanayi A.S .	16.300.253
842	Mopisan Motor Gömlek Pist.A.S .	12.861.468
987	Asçelik Döküm İşl.San. Ltd. S ti.	10.900.638

Türkiye Metal Döküm Üretimi ve İhracatı

Miktar Olarak İhracatın Payı (1000 Ton)

■ İhracat □ Üretim



Sorun	Açıklama	Çözüm	İlgili Kurum
Döküm fabrikası atıklarının atılabileceği alanların olmaması	Döküm kumu ve curufu katı ve tehlikesiz atık karakterinde olmasına rağmen, gerek belediye ve gerekse İzaydaş gibi atık toplama alanlarına atılmalarına izin verilmemektedir.	İzaydaş tipi atık toplama tesisleri kurulana ve devreye girene kadar, Belediye evsel atık sahalarına döküm kumu ve curuflarının atılması için özel izin veren genelge çıkartılması	Çevre ve Orman Bakanlığı
Atık depone alanlarının orman bölgelerinde kurulması	Kum ve curuf gibi tehlikesiz dökümhane atıklarının Orman Bölgelerindeki, kullanılarak terkedilmiş taş ve kum ocaklarının oluşturduğu çukur alanlara doldurulması, üstlerinin nebati toprakla kapatılarak ağ açlandırılması.	Bu gibi projelere Orman ve Çevre kanunları izin vermemektedir. Kullanılmış çukur taş ocaklarının doldurulup, ağ açlandırılmasına izin veren genelge yayınlanması.	Çevre ve Orman Bakanlığı
Çevre analizleri için akredite laboratuvar eksikliği	Sadece TÜbitak ve birkaç özel kuruluşta limitli analiz yapılabilmektedir.	Devlet Üniversitesi laboratuvarlarının akredite olana kadar ilgili Bakanlıklarca kabul edilmesi.	Çevre ve Orman Bakanlığı
Orta Kademe Eleman Eksikliği	Meslek liselerinin Döküm ve Modelcilik bölümleri kapanmaktadır.	Uzun yıllardır eğitim verilen Döküm, Makine Model, Döküm Modelcilik branşlarında eğitime devam edilmelidir	Milli Eğitim Bakanlığı
Yerli Üretimin Desteklenmesi Sosyal bir Sorumluluk olmalıdır.	Kamu ve resmi ihalelerde yerli üretim desteklenmelidir. İhale kanununun düşük teklif bağlayıcılığına son verilmelidir.	Tüm kamu ihalelerinde ve yatırımlarında, özelleştirme yatırımlarında yerli üretim ve yurt içinde istihdan yaratıcı yatırım şartları getirilmeli ve uygulamaya konmalıdır.	Sanayi ve Ticaret Bakanlığı

tonnes $\times 10^6$

