

Ottoman science and education

ENG 151 · Lecture 5

Science, technology and institutions

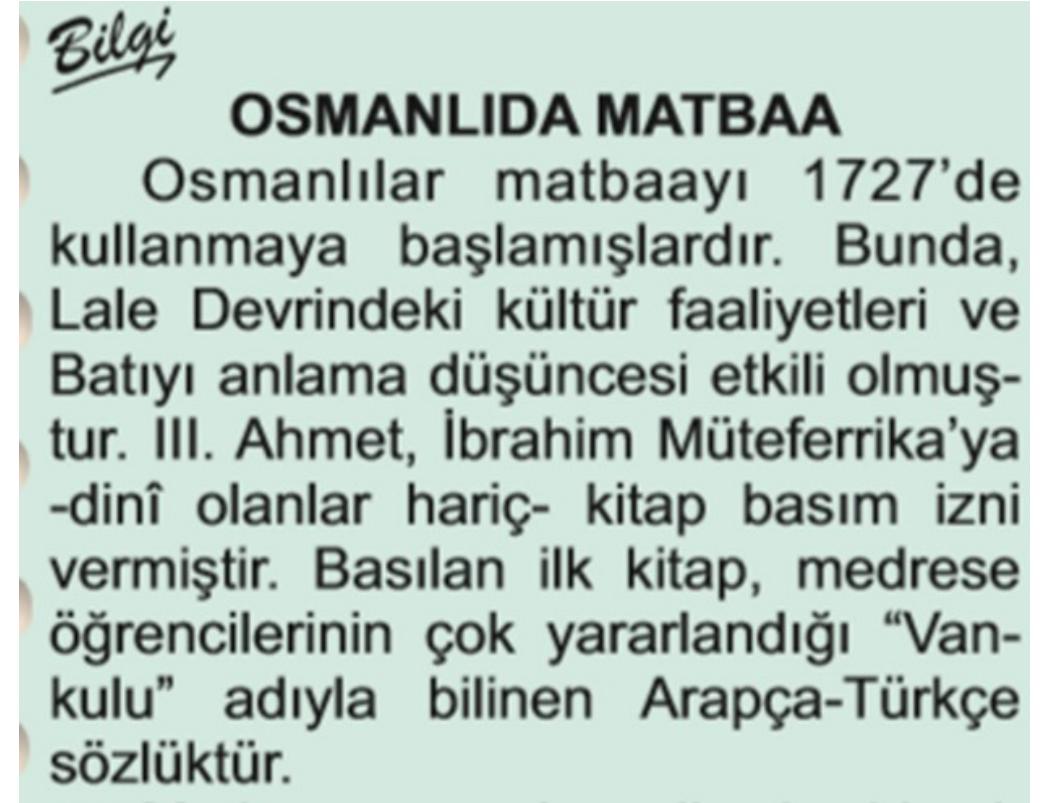
Mehmet Göktürk

Printing: why did it take so long?

Gutenberg: mid-fifteenth century.

Müteferrika's Ottoman Turkish press: 1727.

What happens when access to knowledge expands slowly?



Printing and the Müteferrika press

A press needs more than machinery

Type, paper, ink and trained workers.

Authors, translators, readers and distribution.

Permission to print—and reasons to read.



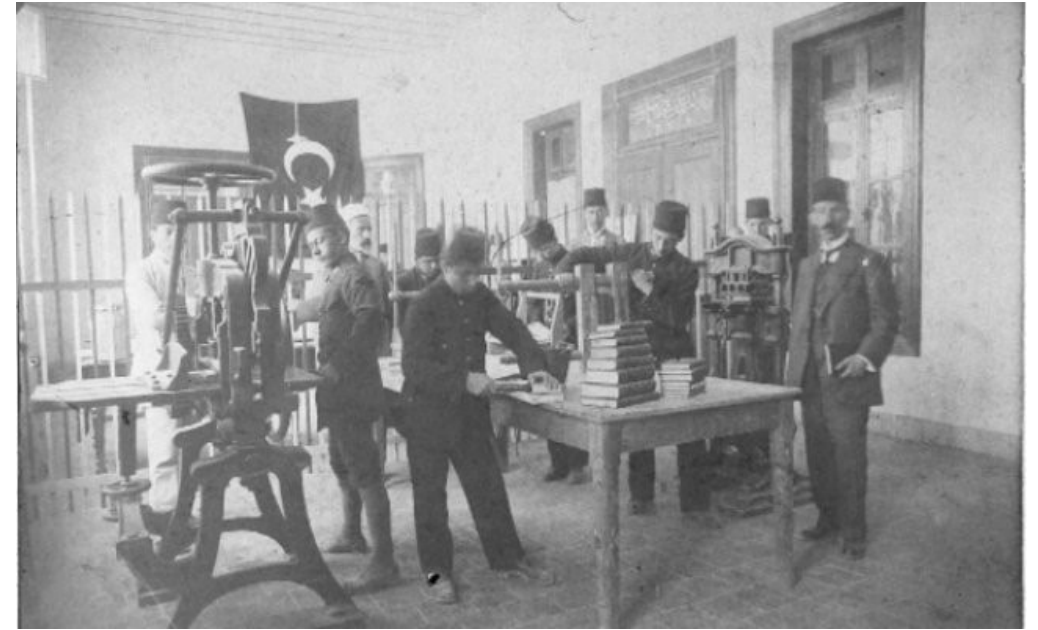
Printing as coordinated work

Who can turn knowledge into public life?

A machine makes copies. Institutions make repeated use possible.

Schools create readers; publishers connect them with ideas.

Leadership can open a door—or keep it closed.



People, equipment and books in a printing workshop

Sultans, learning and patronage

Selected sultans · reign dates and developments

Fatih Sultan Mehmed

1444–46; 1451–81

- Sahn-ı Seman medreses; patronage of Ali Kuşçu and mathematical learning.

Bayezid II

1481–1512

- Edirne hospital and medical teaching complex (1488).

Süleyman I (Kanuni)

1520–1566

- Süleymaniye: endowed teaching, medicine and hospital care.

Murad III

1574–1595

- Taqi al-Din's Istanbul observatory (1577–1580): support, then closure.

Ahmed III

1703–1730

- Lale Devri (1718–1730): translation, diplomacy and Müteferrika's press (1727).

Sultans and institutional reform

Selected sultans · reign dates and developments

Mustafa III

1757–1774

- Naval engineering education: the 1773 foundation in İTÜ's institutional history.

Selim III

1789–1807

- Nizam-ı Cedid reforms; land engineering school (1795).

Mahmud II

1808–1839

- Janissaries abolished (1826); medical school (1827), military academy (1834).

Abdülmecid I

1839–1861

- Tanzimat (1839); teacher training and new educational institutions.

Abdülaziz

1861–1876

- Galatasaray (1868); public education regulation (1869); vocational schools.

Abdülhamid II

1876–1909

- Expansion of schools, telegraph and railways; Darülfünun reopened (1900).

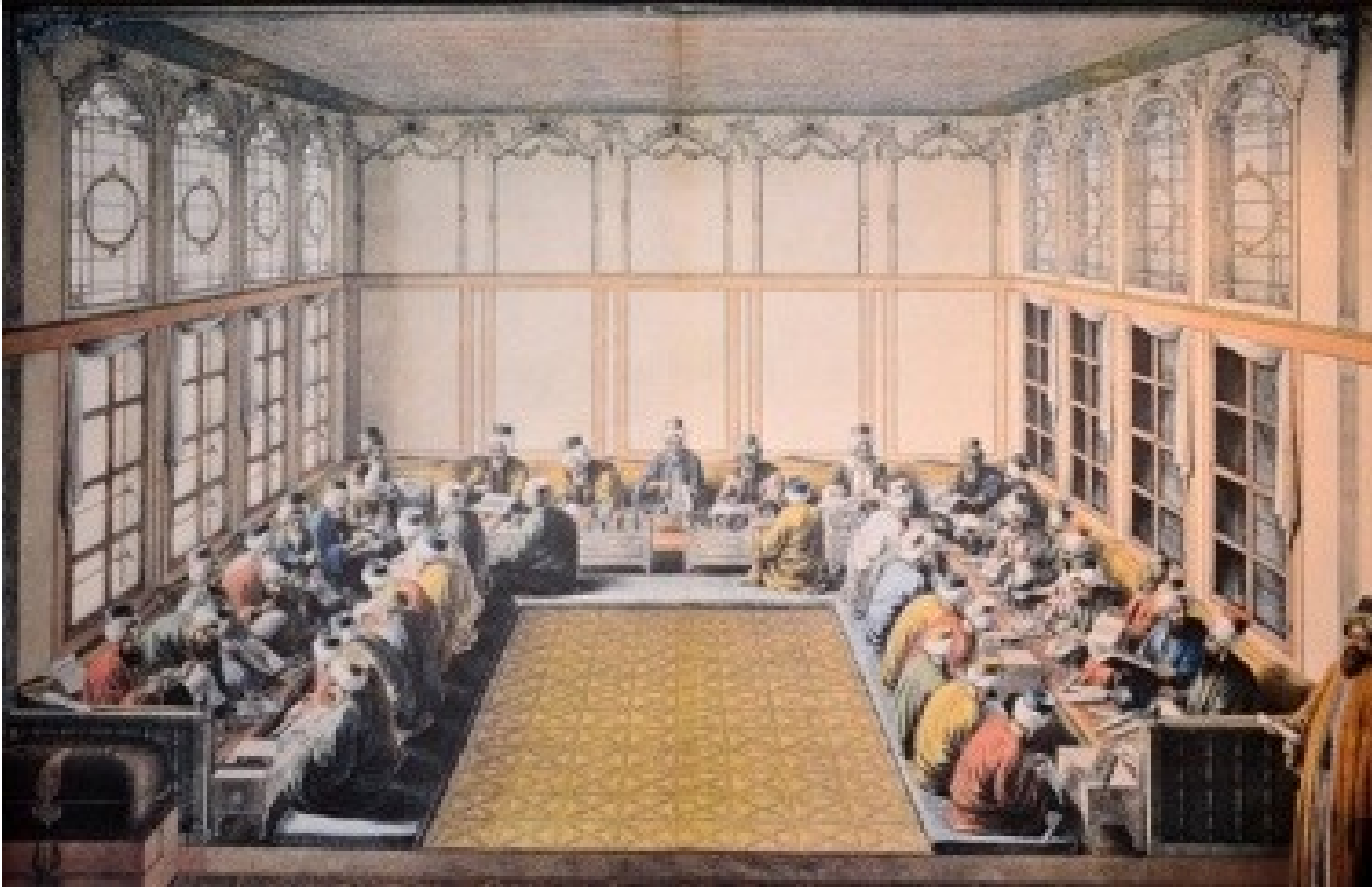
Fifteenth–sixteenth centuries

An expanding empire joined cities, courts, workshops and schools.

Astronomy, medicine, navigation and military engineering answered different needs.

Knowledge moved with people, books and patronage.

Classical time



Courts and learned institutions

Rulers and officials could recruit scholars and finance projects.

A patron's interest could create unusual opportunities.

Personal favor was a fragile basis for long-term work.

Medreses and scholarly careers

Teaching depended on texts, discussion and qualified teachers.

An icazet recognized a scholar's training and authority to teach.

Institutions and curricula varied across places and periods.



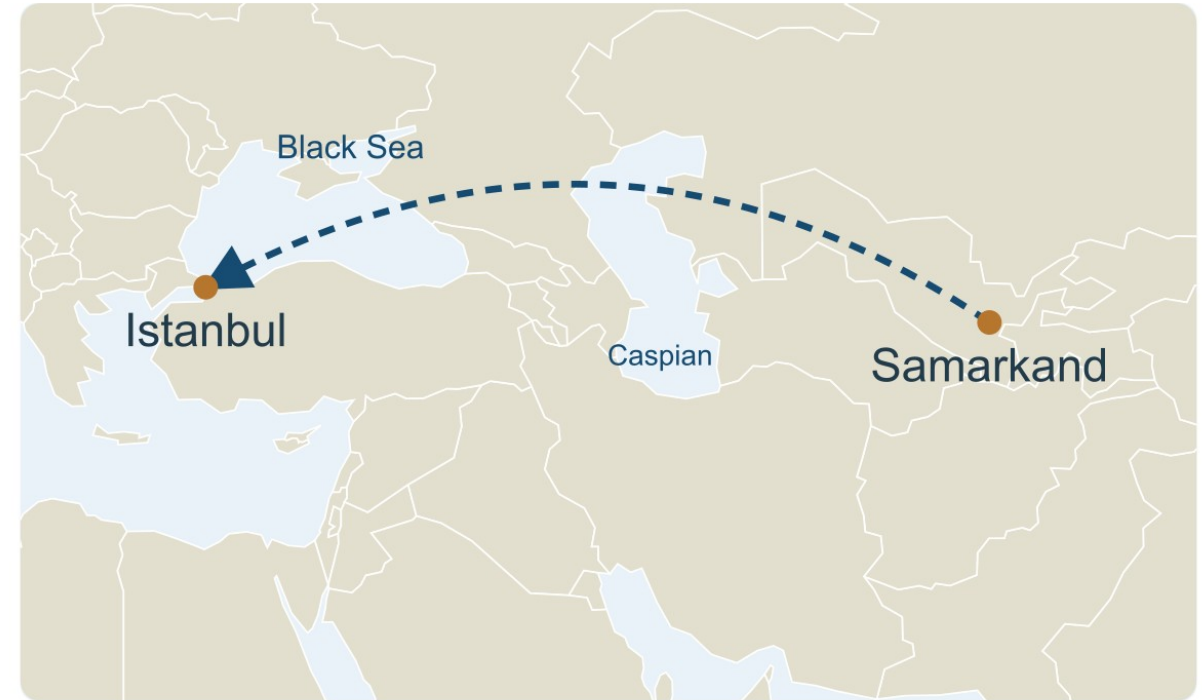
Medrese buildings and a schematic academic career sequence

Ali Kuşçu: knowledge travels with scholars

The Samarkand astronomical tradition reached Istanbul through people and texts.

Ali Kuşçu taught mathematics and astronomy under Mehmed II.

Recruiting a scholar could also bring methods, students and intellectual connections.



Ali Kuşçu · astronomy, mathematics and texts

Ali Kuşçu: Samarkand to Istanbul

1453 and the demands of artillery

A large cannon required metal, skilled casting, transport and gunpowder.

Military success depended on organizing all of them.

Mehmed II recruited expertise for the siege of Constantinople.



Ottoman bronze artillery; the pictured gun is a later example

The Dardanelles gun, 1464

Munir Ali's bronze bombard joined two large sections.

Its scale made transport, loading and positioning major tasks.

A powerful object belongs to a larger system of production and use.



The two-part Dardanelles bombard

Handguns and organized firepower

Matchlocks brought ignition and aiming into a portable weapon.

Reliable use required ammunition, training and maintenance.

Weapons and military expertise crossed political borders.



Illustration of a matchlock firearm

1465: surgery in words and pictures

Sabuncuoğlu's Cerrahiyyetü'l-Hâniyye explained surgery in Turkish.

It drew on an earlier surgical tradition, including al-Zahrawi.

Images made instruments, procedures and practitioners visible.



Illustrated surgery in Cerrahiyyetü'l-Hâniyye

Hospitals, care and endowments

A darüşşifa joined medical practice with organized care.

Vakıf income could support staff, buildings and supplies.

Food, surroundings and patient well-being formed part of treatment.

Medicine across languages

Physicians worked across linguistic and religious communities.

Musa ibn Hamun is associated with Ottoman dental writing.

Translation connected practical experience with wider medical traditions.



Musa bin Hamun'un diş tababetine ait Türkçe eserine kaynak teşkil eden Şerefeddin Sabuncuoğlu'nun Cerrahiyet ül-Hâniye eserinde diş tedâvi ile ilgili bir resim. Paris'teki Bibliothèque Nationale'deki nüshadan.

Dental treatment in illustrated medical literature

1513: Piri Reis maps a connected world

His surviving world-map fragment combines information from several sources.

Kitâb-ı Bahriye is a separate work on Mediterranean navigation.

A useful chart joins accumulated knowledge with a sailor's needs.



The surviving fragment of Piri Reis's 1513 world map

What makes a navigation guide useful?

Coastlines and harbors must be recognizable.

Distances, winds and hazards connect the page to a journey.

A guide improves when reports are compared with experience.

1577–1580: the Istanbul observatory

Taqi al-Din brought instruments and observers together under court patronage.

Accurate observation required careful measurement and calculation.

The observatory was destroyed in 1580.



Observers and astronomical instruments

What does an observatory produce?

Repeated measurements become records.

Records support tables and comparisons.

Better instruments are valuable when people can keep observing.

Patronage and vulnerability

Political support enabled the observatory to be built.

Court conflict and hostile judgments helped bring it down.

A scientific institution needs continuity beyond its first sponsor.

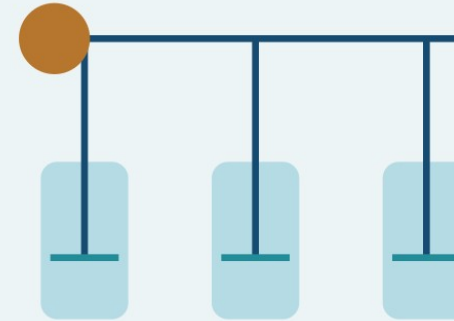
Sixteenth-century mechanical designs

Taqi al-Din described water-raising machinery and a steam-driven spit.

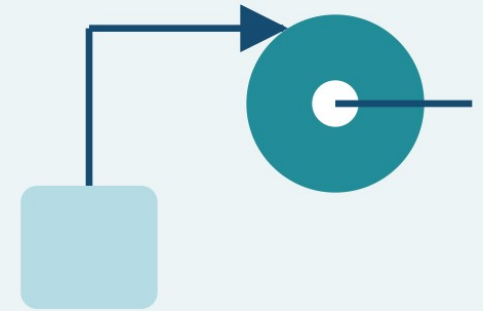
These designs connect motion, control and useful work.

Describing a mechanism is one step;
reliable widespread operation is another.

TAQI AL-DIN · MECHANICAL DESIGNS



Water-raising pump
rotation → reciprocation



Steam-driven spit
steam jet → rotation

Motion is directed toward a practical task.

Water-raising machinery and a steam-driven spit

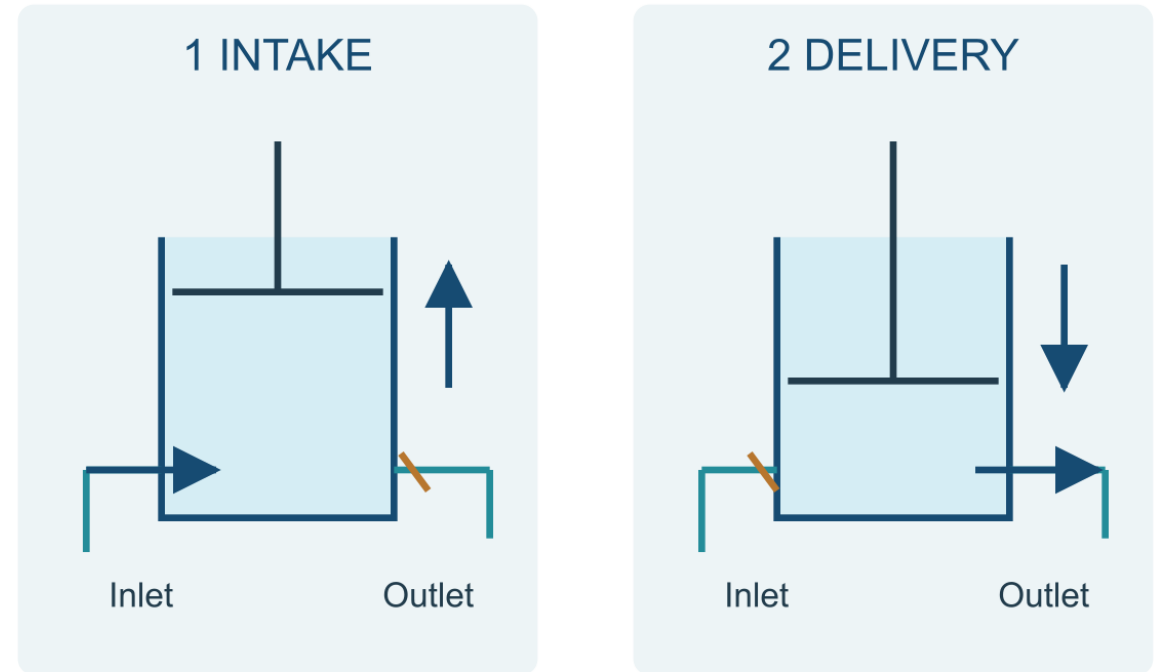
A reciprocating pump: the operating cycle

A rotating drive raises and lowers a piston.

One-way valves control entry and delivery of water.

Repeating the cycle turns motion into a steady service.

ONE CYLINDER · TWO STROKES



One-way valves make the water move forward.

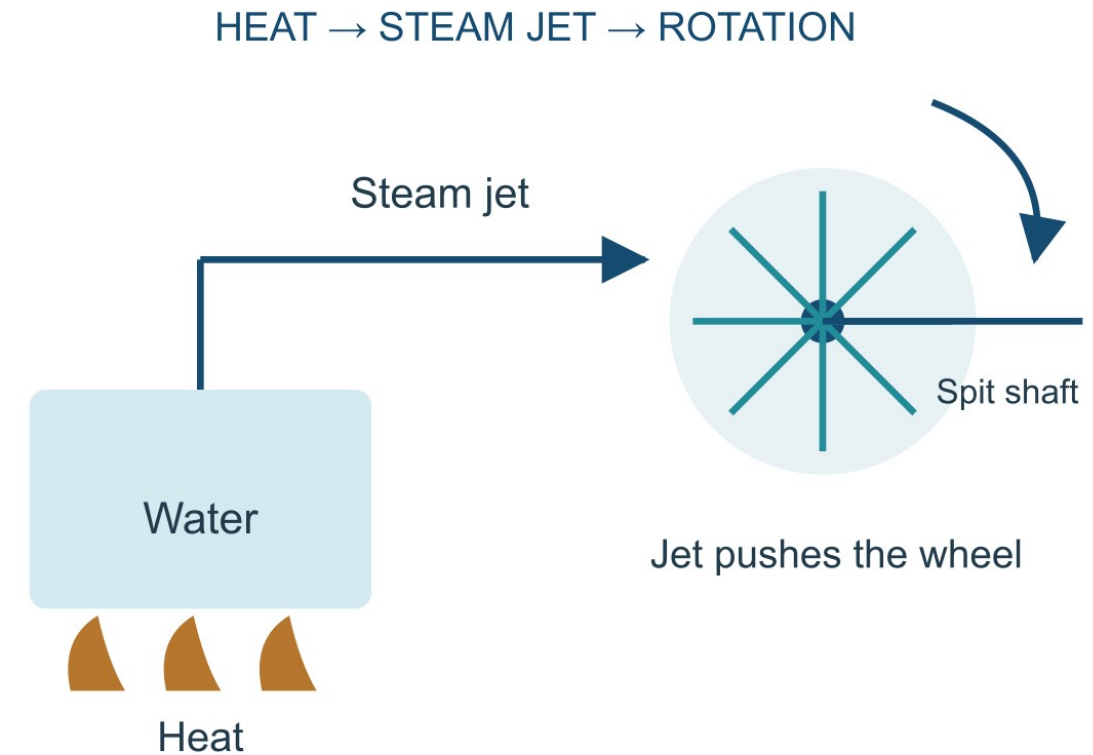
A reciprocating pump: intake and delivery

A steam jet can produce rotation

Heat produces steam.

A directed jet transfers momentum to a wheel.

Useful power also depends on fuel, materials, control and efficiency.



A steam jet converts heat into motion.

Steam jet, wheel and spit shaft

Kâtib Çelebi compared geographical traditions in Cihannümâ.

Working with a translator opened access to European maps and texts.

New information could require an existing account to be rewritten.



Cihannümâ, 1732 · Houghton Library, Harvard

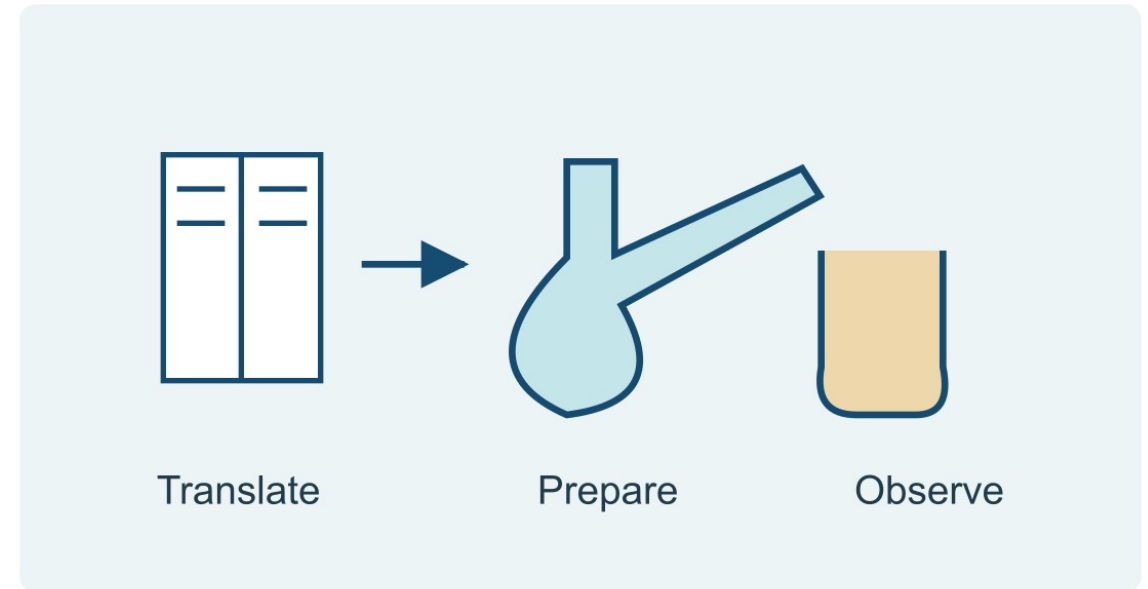
Medical knowledge also changed

Translations introduced new remedies and chemical approaches.

Older and newer explanations could coexist.

Access to a text did not remove the need to assess its claims.

NEW REMEDIES, NEW QUESTIONS



How was a remedy made? What did it do?

Translation, preparation and observation

Eighteenth century: print and reform

1727: authorization of Müteferrika's press.

1729: publication of the Vankulu dictionary.

Printed reference works could reach readers beyond a single teaching circle.



Vankulu dictionary · Müteferrika press

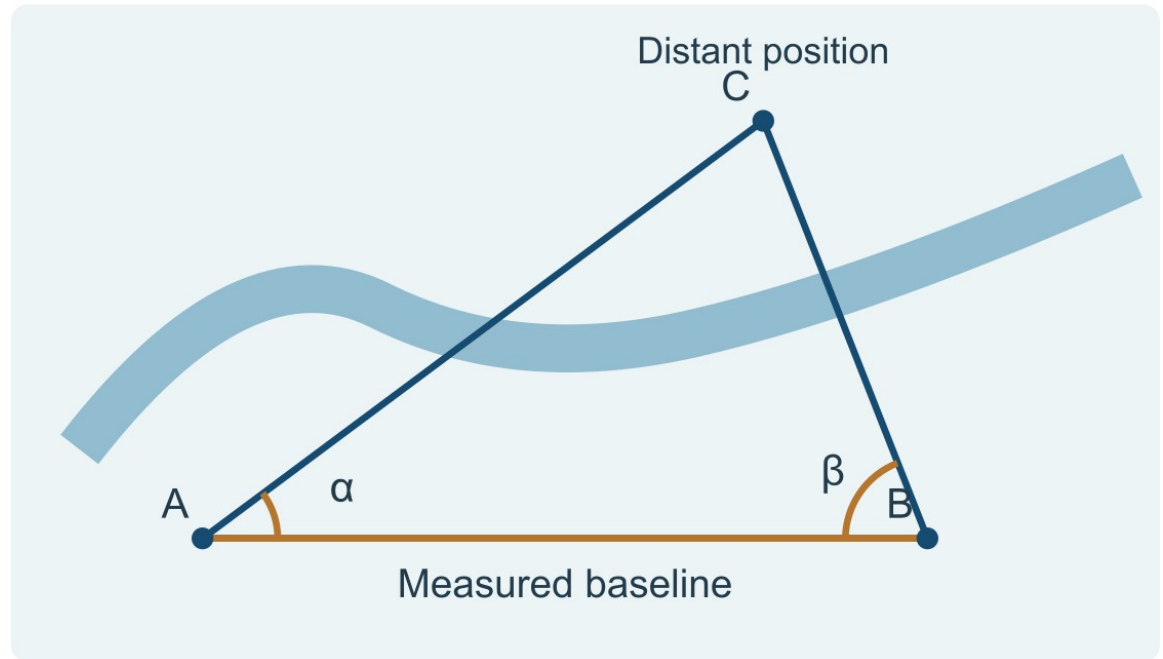
Military needs shaped technical education

Surveying, navigation and fortification required mathematical skills.

Foreign specialists could teach methods and help organize training.

Schools offered a way to reproduce expertise within the empire.

MATHEMATICS IN THE FIELD



Known distance + measured angles $\rightarrow$ a survey

Surveying: a baseline and two measured angles

1773 and 1795: engineering institutions

İTÜ traces its institutional roots to naval engineering education in 1773.

The land engineering school opened in 1795 under Selim III.

Naval and army training developed through distinct stages of reform.



Halıcıoğlu engineering schools · late Ottoman period

Training engineers for particular tasks

Geometry supports surveying and the design of fortifications.

Astronomy and calculation support navigation.

A task-focused curriculum can build competence without covering every field of inquiry.

Şânîzâde Mehmed Atâullah Efendi



Ömrünü ilme adayan Osmanlı âlimlerinden biriydi, Şânîzâde Mehmed Atâullah Efendi. Tıp tahsili alarak modern tıbbın öncüsü olmuş, yedi dil öğrenmiş ve ardından Osmanlı'da birçok görevi yerine getirmişti. Sultan II. Mahmud, Şânîzâde'yi bizzat seçip vak'anüvisliğe getirmiş; "Bektâşî" olduğu gerekçesiyle ise, görevinden azlederek sürgün etmişti. Böyle bir âlimin sürgünde bulunmasına gönlü razı olmayan Sultan Mahmud, bir süre sonra af fermanı yazdırdı. Ancak, bu fermanı ulaştırmak üzere yola çıkan elçi, bir yanlışlık yaparak elim bir olayın müsebbibi olacaktı...

Early nineteenth century: Şânîzâde

Şânîzâde connected medical learning, translation and anatomical explanation.

His work helped develop a language for newer medical knowledge.

Scientific ability did not protect a scholar from political insecurity.

Anatomy in a shared medical language

A drawing makes structures available for comparison.

Terminology allows teachers and students to discuss the same structure.

Translation becomes part of building a professional community.



Anatomical illustration and explanatory text

1826: exile and a fatal message

Şânîzâde was exiled amid the political upheaval of 1826.

An account of his death tells of a pardon announced with a terrifying verbal mistake.

A scholar's security can be as consequential as a scholar's talent.



An Ottoman historical scene accompanying the account

1827–1839: reorganizing medical education

1827: the Tıbhâne-i Âmire opened to train military medical personnel.

1839: reorganization at Galatasaray strengthened the modern medical-school model.

Languages, textbooks, collections and clinical work all mattered.

The Imperial Medical School at Haydarpaşa



Nineteenth-century medical institutions

Medical teaching required laboratories, collections and clinical settings.

Translation and Turkish terminology expanded access to professional learning.

Institutions needed a continuing supply of teachers and resources.

Egypt: the ambitions of industrial reform

Muhammad Ali's government promoted manufacturing and technical training.

Machinery needed fuel, skilled labor, finance and markets.

State ambition could start factories; sustaining them raised further problems.



Mahmoudiyah Canal, Alexandria · Léon Belly, 1868

Nineteenth century: organizing education

Age groups, subject teachers and examinations made schooling more standardized.

Students and teachers sent abroad could bring back expertise.

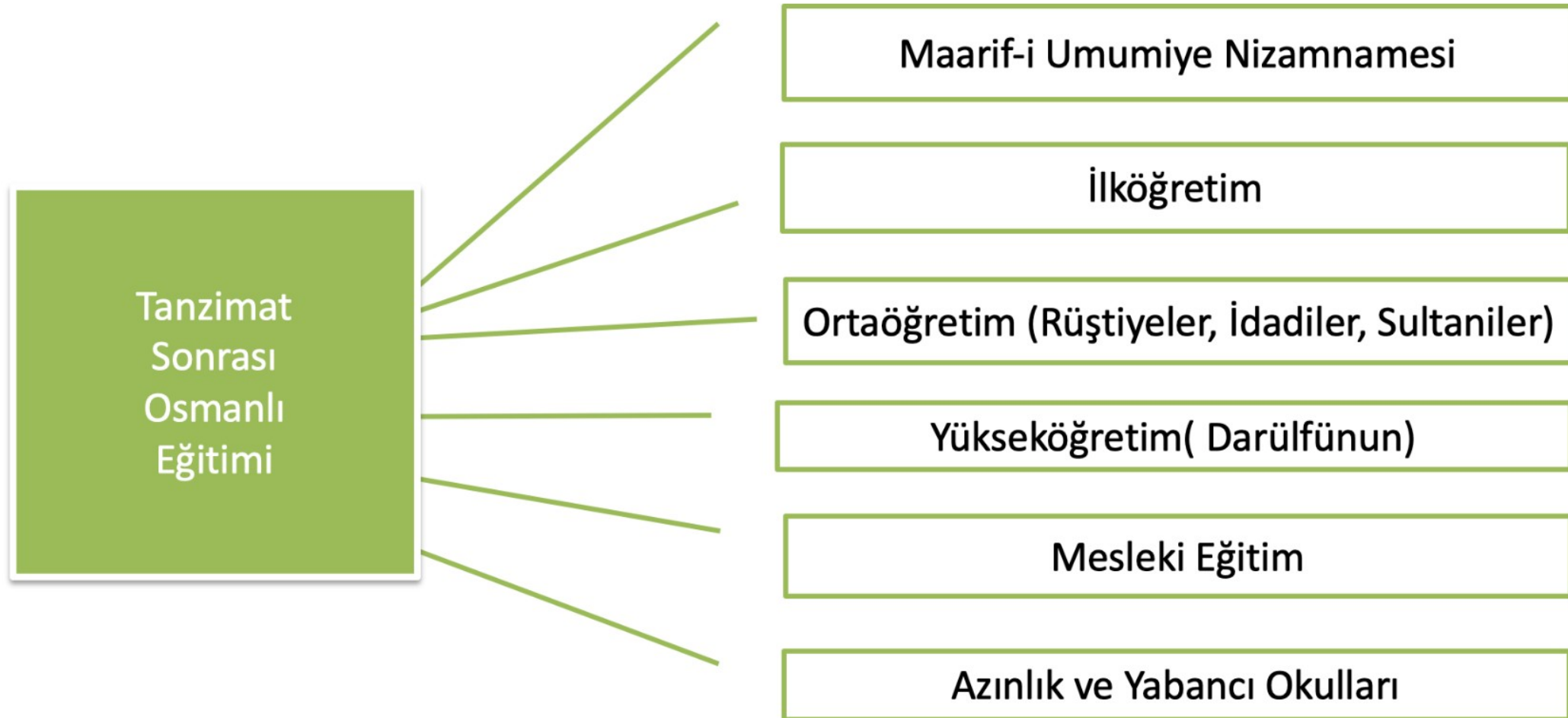
Military, civil, community and foreign schools developed alongside one another.



Ali Kemaleddin · studies abroad approved in 1894

Study abroad: Ali Kemaleddin, 1894

School system after Tanzimat



Primary and secondary schools formed routes to further study.

Professional schools trained people for particular occupations.

Darülfünun represented an ambition for higher learning across fields.

Schools and access, 1897

Community and foreign schools were a substantial part of educational life.

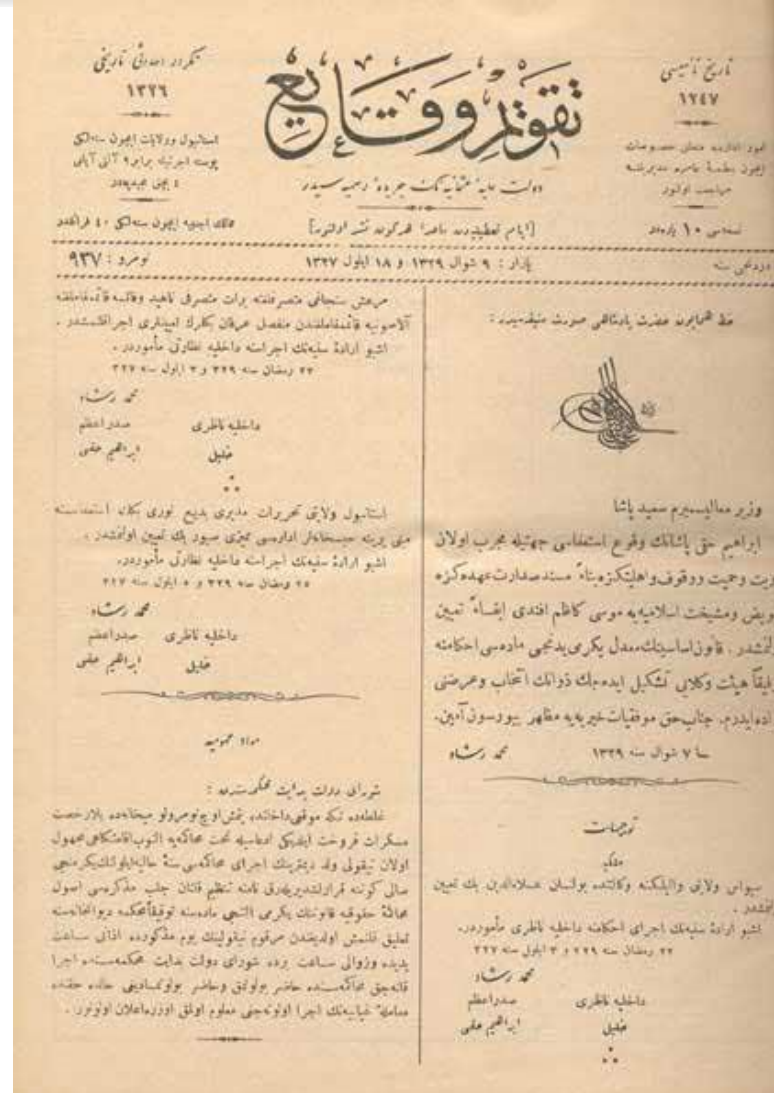
Language, resources and location affected opportunity.

The 1869 education regulation addressed an already diverse landscape.

1897'DE OSMANLI SINIRLARI İÇİNDE AZINLIKLARIN VE YABANCILARIN SAHİP OLDUKLARI OKUL SAYILARI			
AZINLIK OKULLARI		YABANCI OKULLARI	
MİLLET	OKUL SAYISI	MİLLİYET	OKUL SAYISI
Rum	4.390	Amerikan	131
Ermeni	851	Fransız	127
Bulgar	693	İngiliz	60
Yahudi	331	Alman	22
Sırp	85	İtalyan	22
Ulah (Romanya)	63	Avusturya	11
Katolik Rum	60	Rus	7
Katolik	50	İran	4
TOPLAM	6.523	TOPLAM	384

Prof. Dr. S. ARIBAŞ, vd., *Türk Eğitim Tarihi*, s. 154-156.

School counts for 1897, as presented in the cited educational-history table



Mecmûa-i Fünûn: science for a reading public

Published from 1862 by the Cemiyet-i İlmiyye-i Osmâniyye, with Münif Paşa as a leading organizer.

Physics, chemistry, geology and biology appeared beside history, education and economics.

Accessible explanations and new scientific vocabulary brought knowledge beyond specialist circles.

Mecmûa-i Fünûn: keeping publication alive

1862: publication begins. Cholera and financial difficulties later interrupt it at issue 33.

1866–1867: issues 34–47 appear; the society's dispersal brings another interruption.

1883: one revived issue appears before closure. A scientific public needs continuity.

Mecmûa-i Fünûn: readers become contributors

Articles connected science with everyday subjects: electricity, the telegraph, geology and education.

Translation and shared terminology helped readers discuss unfamiliar ideas.

Schools develop readers; journals connect them with writers, teachers and future contributors.

Adopting technology and sustaining inquiry

Acquisition: obtain a machine or a method.

Adaptation: make it work under local conditions.

Inquiry: investigate limits and develop new knowledge.

Acquire



Adapt



Investigate

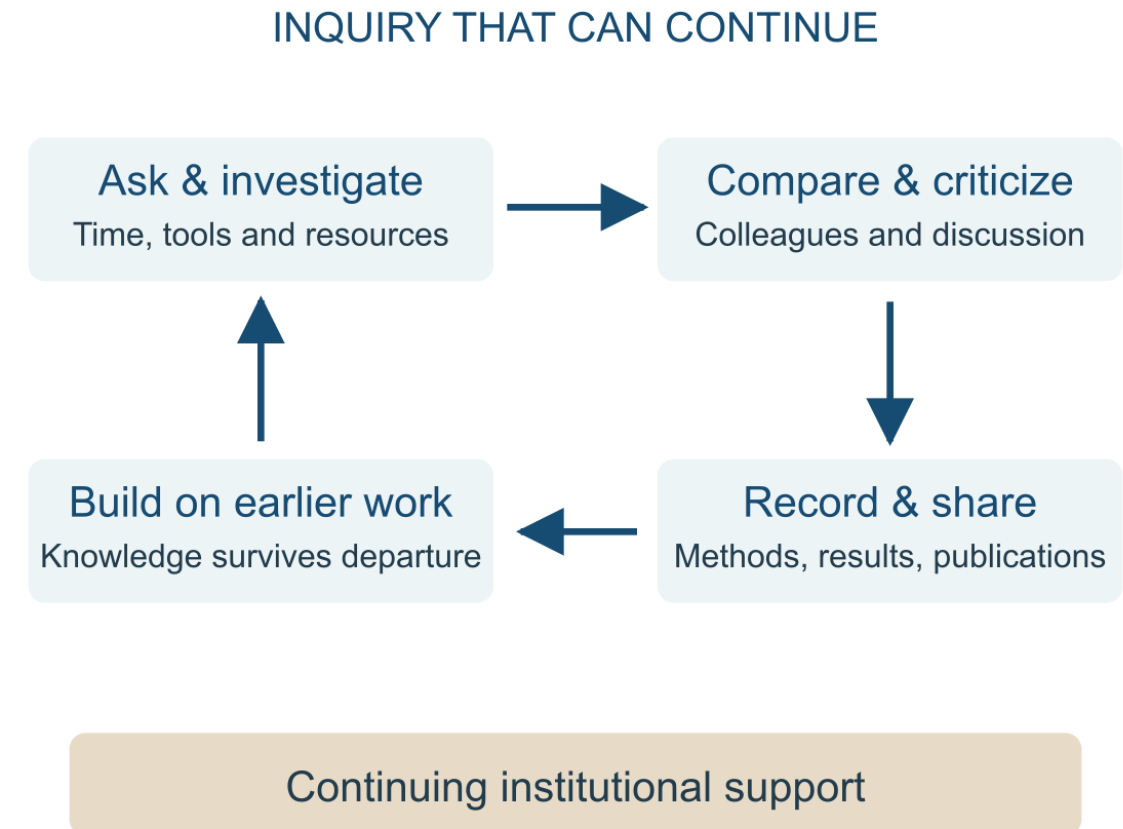
Each activity needs people, resources and continuing learning.

What would support a culture of research?

Time and resources for questions without immediate answers.

People who can compare, criticize and build on one another's work.

Institutions that retain knowledge when individuals leave.



Research depends on people and continuity

Leadership and continuity

Support can recruit talent, establish schools and make knowledge accessible.

Political insecurity can interrupt work even when talent is present.

The lasting achievement is a community able to continue and improve.

Discussion



Return to the printing workshop

Which conditions make this workshop useful to society?

What would let its readers become contributors?

Which responsibilities belong to leaders, institutions and individuals?

Review: explain with an example

How did patronage both enable and endanger scientific work?

Why does owning a technology differ from sustaining a capacity to improve it?

How could schools and journals reinforce one another?

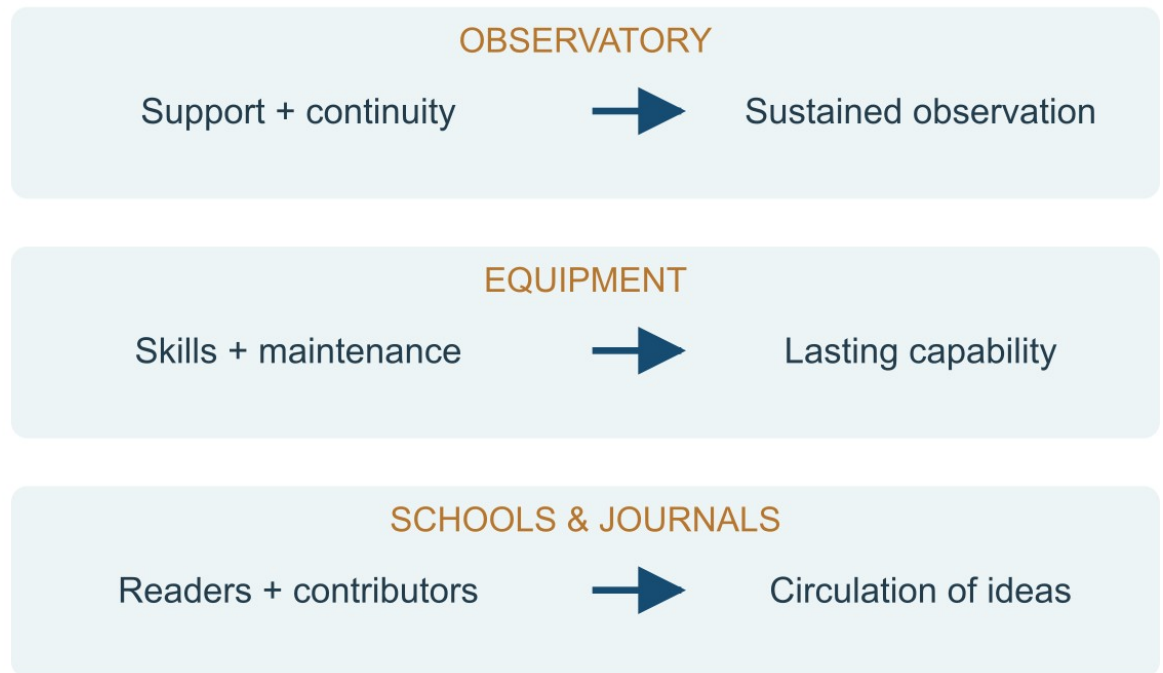
Model reasoning

The observatory needed court support, but its destruction interrupted organized observation.

Equipment becomes lasting capability through skills, maintenance, learning and further investigation.

Schools prepare readers and contributors; journals give their ideas a wider life.

FROM EXAMPLES TO LASTING CAPACITY



Three examples of lasting scientific capacity

Next: industrialization

Machines became parts of larger production systems.

Energy, labor, capital and transport changed together.

We will examine why some combinations became self-sustaining.

Sabuncuoğlu: memory and representation

A modern monument commemorates an earlier medical author.

The illustrated work offers different evidence from the later portrait.

Distinguish commemoration from a contemporary likeness.



A modern bust commemorating Sabuncuoğlu

Şânîzâde: the reported final episode

The Turkish account describes exile and a misannounced pardon.

Read the narrative alongside his medical and scholarly work.

The reported episode concerns vulnerability as well as personal tragedy.

ELÇİ, 'İTLÂK' YERİNE 'İTLÂF' DEYİNCE...

Şânîzâde, Beşiktaş Cem'iyet-i İlmiyyesi'ne mensuptu. Yeniçeri Ocağı'nın ortadan kaldırılması sırasında Bektaşîliğin de yok edilmesine girildiğinden Şânîzâde, 15 Haziran 1826'da "*Bektaşî*" olduğu ileri sürülerek, arpalığı olan Tire'ye sürgün edildi.

Böyle bir âlimin sürgünde bulunmasına gönlü razı olmayan Sultan II. Mahmud Han, bir süre sonra af fermanı yazdırdı.

Bu fermanı ulaştırmak üzere yola çıkan elçi, Şânîzâde'nin kaldığı konağa geldiğinde "*af*" anlamına gelen "*Şânîzâde'nin itlâkına ferman getirdim*" yerine; telâş içinde yanlışlıkla "*ölüm*" anlamına gelen "*Şânîzâde'nin itlâfına ferman getirdim*" dedi.

An account of Şânîzâde's exile and the messenger's words

Şânîzâde: remembrance

His death was followed by a long history of remembrance.

Monuments and biographical accounts kept his name in public life.

His medical writings also carried his work into later generations.

KATLEDİLECEĞİ KORKUSU İLE KALP KRİZİ GEÇİRDİ

İstanbul'dan her an kötü bir haberin gelmesini beklemekte olan Şânîzâde, olduğu yere yığıldı. Geçirdiği kalp krizinin ardından 5 Ağustos 1826'da vefat etti.

Kışla civarındaki mezarlığa defnedilen Şânîzâde'nin kabri, bu mezarlığın 1916 yılında kaldırılmasıyla kayboldu. Daha sonra mezarındaki taş, kasaba civarında tesadüfen bulunup Tire Müzesi'ne kaldırıldı.

Bugün Tire'de onun adını taşıyan bir meydan ve cadde; bu cadde üzerinde 1973 yılında yapılan modern çizgiler taşıyan bir anıt; hastanenin bahçesinde ise, 1950'de yapılan anıtın üstüne yerleştirilmiş bir büstü vardır.

The continuation of the account of Şânîzâde's death

Firearms: form and changing use

Stocks, barrels and ignition systems changed over time.

The object shows workmanship as well as military function.

An object's exact date and mechanism require a catalogue identification.



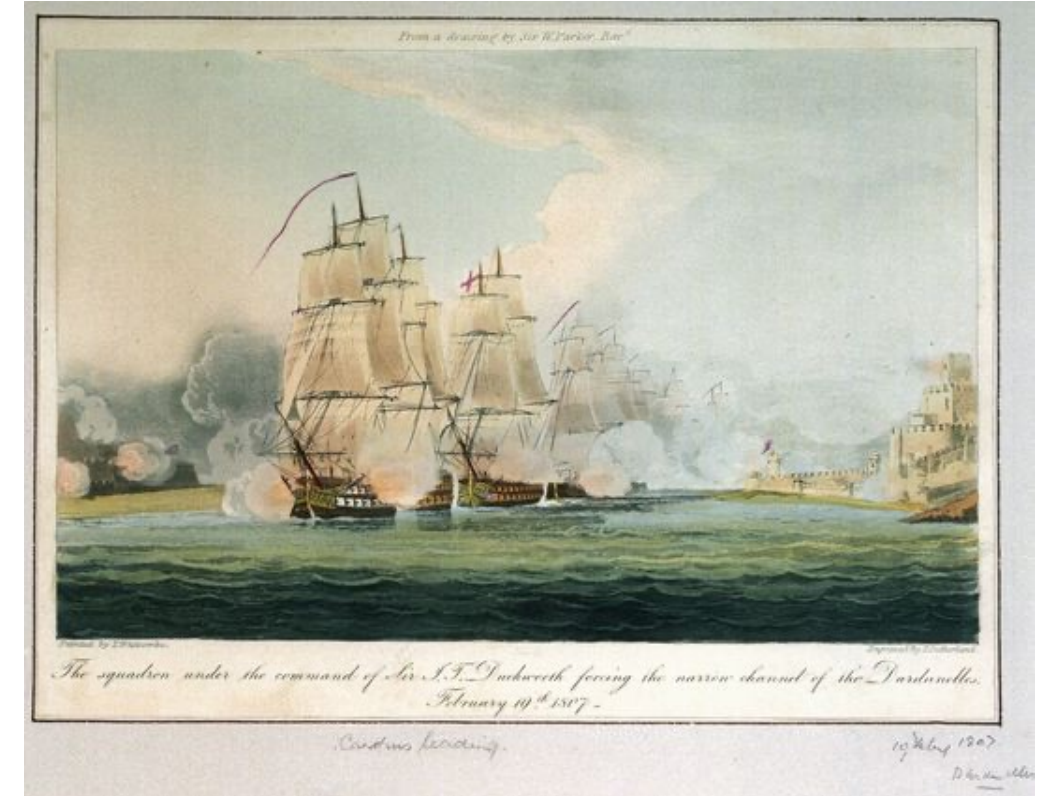
A long firearm with decorative detailing

1807: the Dardanelles expedition

Older artillery remained part of coastal defense.

Naval operations faced geography, fortifications and supply constraints.

A later conflict can reveal the long working life of earlier technologies.



A historical depiction of naval action in the Dardanelles

Reading a military summary

The table summarizes the 1807 expedition.

Separate losses in an entire operation from the effect of a particular gun.

Numbers need a defined scope before they support a comparison.

Date	19 February 1807	
Location	Dardanelles	
Result	Ottoman victory	
Belligerents		
 United Kingdom	 Ottoman Empire	
Commanders and leaders		
John Thomas Duckworth	Sultan Selim III	
Strength		
8 ships of the line, 2 frigates, 2 bomb ships, 1 transport	14 ships of the line, 9 frigates, a dozen brigs and gunboats, several hundred Ottoman siege cannons, and some modern bronze pieces	
Casualties and losses		
42 killed, 235 wounded, and 4 missing ^[1]	Unknown	

A summary table for the Dardanelles operation of 1807

1902: a rüşdiye curriculum

1902 YILINDA RÜŞTİYE OKULLARINDA OKUTULAN DERS PROGRAMI					
BİRİNCİ YIL		İKİNCİ YIL		ÜÇÜNCÜ YIL	
DERS İSİMLERİ	HAFTALIK SAAT	DERS İSİMLERİ	HAFTALIK SAAT	DERS İSİMLERİ	HAFTALIK SAAT
Kur'an-ı Kerim	1	Kur'an-ı Kerim	1	Kur'an-ı Kerim	1
İlimihal	2	İlimihal	2	Ulûm-ı Diniye	2
Türkçe	6	Türkçe	4	Ahlak	1
Arapça	2	Arapça	4	Türkçe	3
Hesap (Hendese)	2	Farsça	2	Arapça	3
Muhtasar Coğrafya	2	Ahlak	1	Farsça	2
Hüsn-ı Hat	2	Hesap	2	Hesap	2
Ahlak	1	Coğrafya	2	Tarih-i Osmani	1
		Muhtasar Tarih-i İslâm	1	Hendese (Hesap)	1
		Malumat-ı Ziraiye	1	Coğrafya	2
		Resim	1	Malûmat-ı Ziraiye (İdare-i Beytiye)	1
		Hüsn-i Hat	1	Hesab	1
		Fransızca		Resim	1
				Hıfzısıhha	1
				Fransızca	
Toplam	18		22		22

Yrd. Doç. Dr. Muammer DEMİREL, "Türk Eğitiminin Modernleşmesinde Rüştiye Mektepleri", Türkler Ansiklopedisi, C 15, s. 58.

1902: a rüşdiye curriculum

The timetable combines languages, mathematics, history and other subjects.

Weekly hours make educational priorities visible.

A school timetable describes planned teaching, not all learning that occurred.

Late-Ottoman engineering and weapons

Engineering education broadened toward civil infrastructure through later reorganizations.

Modern rifles connected procurement with foreign manufacturing and ammunition supply.

The M1903 Mauser belongs to the late-Ottoman army, after the Janissary corps had ended.



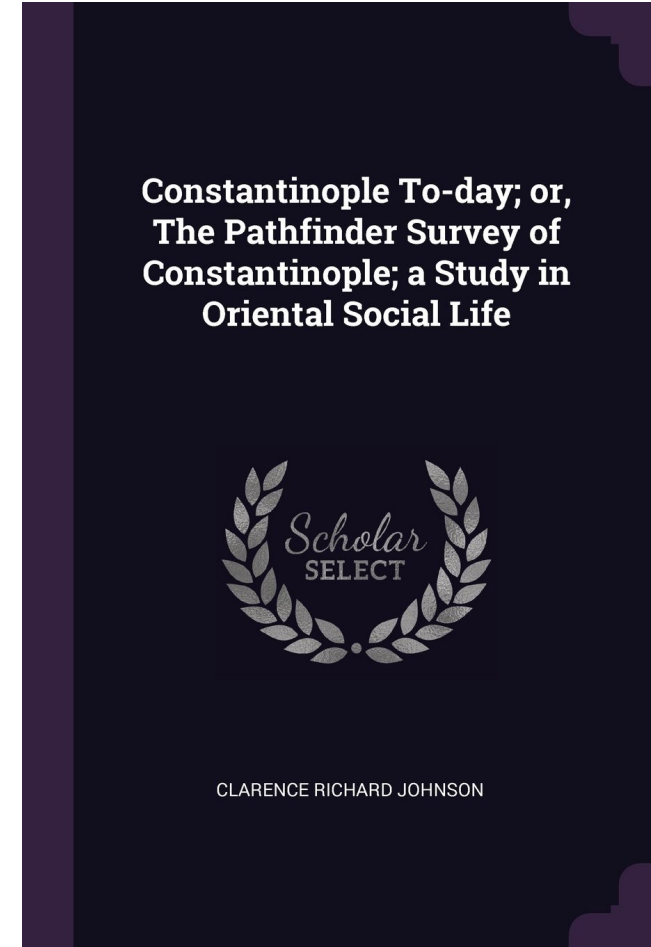
Ottoman Mauser M1903 · Morten Jensen, CC BY 2.0

Constantinople To-Day, 1922

A later social survey offers a different view of the city.

Ask who collected the information and which questions they considered important.

Read its categories in their postwar historical setting.



Constantinople To-Day: a social survey published in 1922

Sources and further reading

Osman Cengiz, “Osmanlı Döneminde Bilim,” in Bilim Tarihi (2024).

Miri Shefer-Mossensohn, Science among the Ottomans (2015); Turkish edition reviewed by Ahmet Keleş (2020).

Institutional histories, historical reference works and object studies are linked in the reading.