Roman Technology and Art
(or How to Think Like the Romans)
Topics in Greek and Roman Art and Archaeology
CLAS/FA 145
Syllabus

Brandeis University, Spring 2008
Tuesday and Friday, 10:40 a.m. – 12:00 p.m., Block H, Abelson, room 131

Instructors:

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This course satisfies requirements for both for the Schools of Creative Arts (CA) and Humanities (HUM). It also fulfills the general university requirement for a course in quantitative reasoning (QR).

If you are a student with a documented disability on record at Brandeis University and wish to have a reasonable accommodation made for you in this class, please see either Professor Koloski-Ostrow or Professor Meyer immediately.

Rationale of Course:

This course investigates a selection of the most famous monuments and cultural institutions of the ancient Roman world in order to understand the impulse for the technologies that created them and the technologies themselves. The material covered in the course is by no means a full survey of ancient Roman art and architecture, although the monuments and topics covered are firmly placed in their historical and cultural contexts (such as Roman bridges and ships and transportation, baths and thermal technology, temples, arches, amphitheaters, theaters, aqueducts, and more.) We consider numerical estimation from simple problems to the more complex, sea and land transportation, arch and bridge construction, Roman weights, measures, and

their calendar, architectural engineering and construction of the Colosseum (and other amphitheaters), Roman baths and how to heat them, the Pantheon (a unique Hadrianic temple), aqueducts and hydraulic issues, and Roman military machinery and defenses.

To a lesser extent, we shall consider small-scale technologies used in food production, metallurgy, sculpture, and painting. Students will be required to assess Roman technologies through the application of modern physics. While the chronological dimensions of the course encompass broad parameters from the 8th c. BCE to the end of the Roman Empire in 4th century CE in order to cover a variety of technological achievements over a long period of time, we shall pay particular attention in the course to the world of Roman Italy in the imperial period (1st c. BCE to about the 3rd century CE).

Some of the more philosophical questions we shall consider in the course of the semester follow: What needs and desires of the Romans could be fulfilled through their understanding and manipulation of nature? By what standards should we judge the value of natural knowledge systems that appear to bear so little resemblance to modern science? Has technological sophistication historically depended on scientific sophistication, and vice versa? What are the causes of technological change?

Required Texts:

1. Rabun Taylor, *Roman Builders: A Study in Architectural Process* (Cambridge Univ. Press, 2003) (hard cover ISBN: 0521803349; paperbk. ISBN: 0521005833) abbrev.: Taylor

2. Paul MacKendrick, *The Mute Stones Speak* (W.W. Norton & Co. 1983 or latest) (paperbk. ISBN: 0-393-30119-2) (price: $14.95) abbrev.: MacKendrick (**posted on LATTE and in Library Reserve**)

3. Frank Sear, *Roman Architecture* (Cornell Univ. Press, 1992) (paperbk. ISBN: 0-8014-9245-9) out of print, but on reserve, abbrev.: Sear (**posted on LATTE and in Library Reserve**)

4. Additional readings focused on particular aspects of Roman technology to be posted in LATTE throughout the course of the semester.

Recommended Texts:

5. Fred S. Kleiner, A History of Roman Art (Thomson Wadsworth, 2007) (paperbk. ISBN: 0-534-63846-5) abbrev.: Kleiner

6. JoAnn Shelton, *As the Romans Did* (Oxford Univ. Press 1988 or latest) (paperbk. ISBN: 0-19-508974-X) (price: $43.95) abbrev.: Shelton

7. Nancy and Andrew Ramage, *Roman Art, Romulus to Constantine* (Prentice Hall 2000) (ISBN: 0-13-440702-4) (price: ca. $72.00) abbrev.: Ramage and Ramage

Most of the required and recommended texts are also on RESERVE (indicated with **R** below) in the library along with other suggested reading material for the course to be updated from time to time.

Course Requirements:

1. **ATTENDANCE**: You should be present (in mind and body) and participate as actively as you can during lectures, discussions, and any out-of-class activities or fieldtrips. Questions are always welcome and encouraged. Names of students will be read from the student roster for class attendance for the first few classes so that your professors can get to know you. For the rest of the semester, there will be attendance sign-in sheets, so attendance is very important. Please note that it quickly becomes apparent who is present and who is not, especially from the sign-in sheets.

2. **READINGS**: You must complete all assigned readings (from required texts and from books on reserve or articles posted on LATTE). Your appreciation and understanding of lectures, discussions, and experiments (both in-class and in our lab) will be greatly enhanced if you complete reading assignments by their due date. This syllabus contains assignments from your required texts and from various books on reserve for the semester. Since lectures (by both of your professors) are original creations, you are advised *not* to miss them. Many points made in them cannot be found in the required or reserve reading.

3. **QUIZZES**: The course will not have a midterm exam. Instead, two short quizzes involving short identifications of key persons, dates, places, terms, and/or monuments or discussion of images before you will be administered during the term. In addition, on some Fridays three or four students in the class will come to the front of the class and perform an experiment under the guidance of Professor Meyer on the Roman topic of the week. The rest of the class will also be given the data and expected to analyze findings as homework for that week. These assignments are required of everyone in the class, must be submitted each week, and in total will serve as a large part of your term grade (40%). You will lose one grade step for every day that your homework is late (A+ to A to A- to B+--unless you have a medical or other truly valid excuse, presented IN ADVANCE, if at all possible).

4. **LABS AND WRITTEN HOMEWORKS**: In the course of the semester you will compete **four "labs"** (to be arranged by sign-ups for Tuesdays, Wednesdays, or Thursdays) and **six written homeworks**. These assignments are indicated on the full syllabus below.

5. **FINAL PROJECT**: The course also will not have a final exam. Instead, you will complete a **term project** (which includes a written description and quantitative analysis of about 5-6 pages total) related to a Roman technology of your choice. In partial preparation for this final project, **a prospectus** (directions forthcoming) will be due on **Friday, March 28, 2008**. You will, of course, also receive a full explanation of the final project as well. To complete the final project successfully your work will require a sustained effort over many weeks, close attention to class problems and discussions, and much initiative on your part. The final project is due on the last day of class, **Tuesday, April 29, 2008 (a Brandeis Friday).** You will have ample opportunities to consult with your professors and the TA before the final project is due. You will lose one grade step for every day that your final project is late (A+ to A to A- to B+--unless you have a medical or other truly valid excuse, presented IN ADVANCE, if at all possible).

Course Requirements with Approximate Grade Determination:

1) Class attendance (taken regularly), participation in experiments and discussions, completion of reading assignments. (10%)
2) Four Labs and Six Quantitative Reasoning assignments (10 altogether for the term) (40%)
3) Two short quizzes consisting of short ids from readings and lectures or image identification and discussion (20%)
4) Prospectus for the Final Project (10%)
5) Final Project—Designing and Solving a Problem involving Quantitative Reasoning in Roman Technology (due Tuesday, April 29—Brandeis Friday) (20%)

Total: (100%)

An optional short research paper (2-3 pages) can replace one of the quantitative reasoning homework assignments or one of the two Roman archaeology quizzes in the event that you have to miss the discussion and class experiment related to a particular homework (but ONLY if you have special permission from your professors for a valid reason) or if for some valid reason you had to miss one of the quizzes. There are NO MAKE-UP quizzes. You may also write a short research paper to replace one quantitative reasoning homework assignment if you received a poor grade on an assignment (B- or lower, again, ONLY with permission from your professors).

Academic Honesty (last, but hardly least!):

You are expected to be honest in all of your academic work. Brandeis University policy on academic honesty is contained in your *Student Handbook* in section 5 under "Rights and Responsibilities." Instances of cheating, plagiarism, or other alleged dishonesty will be reported to the Office of Campus Life for possible referral to the Student Judicial System. The adjudication process is also outlined in your *Handbook*. Potential consequences of academic dishonesty include (in addition to an "E" on the assignment)

failure in the course, disciplinary probation, and suspension from the University. A record of any offense will remain in a student's disciplinary file in the Office of Student Affairs throughout his or her career at Brandeis. Please know that we take this code very seriously. If you have any questions about our expectations, please ask us.

Lecture topics with reading assignments for the entire semester are listed by date below, along with due dates for assignments.

Days marked with an * are quiz days or days when important work is due.
Course Syllabus by topic for Semester (subject to some modification):

JANUARY:

Tues., Jan. 15 Introduction to the World of the Romans, their Technologies, and their Art and Architecture (AOK-O)
Introduction to the Science of the course (RBM)
Required: Buy books. Familiarize yourselves with LATTE materials.

Please contact your professors or the TA with any questions about the readings.

Fri., Jan. 18 The City of Rome, Issues of Urban Infrastructure and City-Planning across a 1000 years (AOK-O)
Introduction to Numerical Estimation with example (RBM)
Required Reading: Taylor, Introduction, 1-20; MacKendrick chs. 1-4, 1-140 (LATTE).
Recommended Reading: Kleiner ch. 1, 1-16; Sear ch. 1, 10-28 (LATTE); Shelton ch. 1, 6-17 and ch. 2, 18-36; Ramage and Ramage Intro. chs. 1-2, 8-85 (R).

_____end of week 1

Tues., Jan. 22 Pompeii and Herculaneum: An Archaeological Laboratory for Ancient Small-Scale Technologies (AOK-O)
Required Reading: K.D. White, *Greek and Roman Technology*, ch. 6 "Food Technology," 63-72 (LATTE); Sear ch. 2, 29-48 (LATTE); Robert J. Forbes, *Studies in Ancient Technology*, 1958, ch. 7, "Fire and Food," 57-61.
Recommended Reading: Kleiner ch. 2, 16-29 and ch. 3, 30-45; Shelton ch. 4, 59-80 and ch. 5, 81-103.

Fri., Jan. 25 Pompeii and Herculaneum: Daily Life in the Shadow of Vesuvius cont. (AOK-O)
Presentation of a problem on numerical estimation on bread consumption. (RBM)
Homework #1 distributed--on estimation of quantities of oil and/or wine. (Due on Fri., Feb. 1.)

Required Reading: MacKendrick ch. 8, 244-281 (LATTE);

Sear ch. 6, 103-133 (LATTE).
Recommended Reading: Shelton ch. 7, 127-167 and ch. 8, 168-189; Kleiner ch. 10, 138-151.

_____end of week 2

Tues., Jan. 29 Romans as Movers and Shakers: Economics, Trade, Transportation and Ships (AOK-O)
Required Reading: MacKendrick chs. 5-7, 141-243 (LATTE); Horace *Satire* I.5 on trip to Brindisi (LATTE); K.D. White, *Greek and Roman Technology*, ch. 10 "Land Transport," 127-140 (LATTE).
Recommended Reading: Kleiner ch. 4, 46-59, ch. 5, 60-77, ch. 7, 88-101; Ramage and Ramage chs. 3-4, 86-133 (R); Shelton ch. 14, 325-331.

FEBRUARY:
***Fri., Feb. 1** Presentation on Roman cargo ships: speed and capacity (RBM)
Homework #1 due (estimation of quantities of oil/wine).
Homework #2 distributed--on importation of grain to Rome. (Due on Fri., Feb. 8.)
Required Reading: review MacKendrick ch. 7, 222-228 (LATTE); K.D. White, *Greek and Roman Technology*, ch. 11 "Ships and Water Transport," 141-156 (LATTE).
Recommended Reading: review Shelton ch. 14, 325-331; review Kleiner ch. 5, 60-77.

_____end of week 3

Tues., Feb. 5 Nature of Roman Architecture and Engineering (AOK-O) Concrete Revolution: Roman Bridges, Roads, Sewers, Viaducts, and Public Buildings.
Required Reading: K.D. White, *Greek and Roman Technology*, ch. 8 "Civil Engineering and Surveying," 91-100 (LATTE).
Recommended Reading: review Kleiner ch. 7, 88-101.

***Fri., Feb. 8** Discussion about buoyancy. (RBM)
Homework #2 due (importation of grain to Rome).
Lab #1 preparation problems distributed--on buoyancy--to be brought to lab in week of Feb. 12.
Required Reading: K.D. White, *Greek and Roman Technology*, ch. 7 "Roman Building Technology," 83-90 (LATTE).
Recommended Reading: review Kleiner ch. 7, 88-101, especially 92-96.

_____end of week 4

Tues., Feb. 12 Roman Architecture and Engineering in Relation to How the Romans Understood their Universe (AOK-O)

Required Reading: Kleiner ch. 6, 79-87 and ch. 15, 216-229.

Recommended Reading: Shelton ch. 6, 104-126.

***Between Tuesday and Friday:**
Lab #1--on buoyancy, including ship capacity and experiment about weighing in air and water. (Please bring completed preparation problems from Feb. 8 to class.)

Fri., Feb. 15 Introduction to Ropes and Pulleys (RBM)
Lab #2 preparation problems distributed--on ropes and pulleys--to be brought to lab in week of Feb. 26.

Required Reading: review K.D. White, *Greek and Roman Technology*, ch. 6 "Food Technology," 63-72 (LATTE).

Recommended Reading: review Kleiner ch. 6, 79-87; review Shelton ch. 7, 152-167.

_____end of week 5

Saturday, February 16 to Sunday, February 24, 2008
MIDTERM RECESS: NO CLASSES
Tues., Feb. 19 No class, Midterm Break
Fri., Feb. 22 No class, Midterm Break

_____end of week 6

Tues., Feb. 26 The Roman Amphitheater and its Blood Sports (AOK-O)
Scene from *Gladiator*

Required Reading: Taylor ch. 1, 21-58 and ch. 3, 92-132; MacKendrick ch. 9, 282-313 (LATTE); review Sear ch. 2, 29-48 (LATTE); Sear chs. 3-5, 49-102 (LATTE).

Recommended Reading: K.D. White, *Greek and Roman Technology*, ch. 7 "Roman Building Technology," 83-90 (LATTE); Kleiner ch. 8, 102-119 and ch. 9, 120-137.

***Between Tuesday and Friday:**
Lab #2--on Ropes and Pulleys. (Please bring completed preparation problems from Feb. 15 to class.)

Fri., Feb. 29 Lecture on Arches (RBM)
Homework #3 distributed--on arches and vectors.
(Due March 11.)

Required Reading: Taylor ch. 4, 133-173; Sear ch. 7, 134-153 (LATTE).

Recommended Reading: review Kleiner ch. 8, 102-119 and ch. 9, 120-137.

_____end of week 7

MARCH:

***Tues., Mar. 4** **Quiz #1** (ca. 30 minutes of class time)
Engineering Large Building Projects and the Roman Crane
Required Reading: MacKendrick ch. 10 314-341 (LATTE); Taylor, ch. 2 59-91 (LATTE).
Recommended Reading: review Kleiner ch. 9, 120-137; Ramage and Ramage ch. 6, 162-179 (R).

Fri., Mar. 7 Lectures on Cranes (RBM)
Homework #4 distributed--on building the Colosseum and cranes.
(Due March 18.)
Nova Program on Amphitheater.
Required Reading: see Ramage and Ramage ch. 5, Fig. 5.16 (R).

_____end of week 8

***Tues., Mar. 11** Decorating Roman Buildings—Paintings, Mosaics, and Sculpture (AOK-O)
Homework #3 due (on arches and vectors).
Required Reading: Required Reading: review Kleiner ch. 10, 138-151 and ch. 13, 186-201
Recommended Reading: Ramage and Ramage ch. 5, 134-161 (R).

***Between Tuesday and Friday:**
Lab #3—on Making a Mosaic

Fri., Mar. 14 Roman Baths/Bathing Culture: an Introduction (AOK-O)
Required Reading: Taylor ch. 3, 92-132; Robert J. Forbes, *Studies in Ancient Technology*, 1958, ch. 5, "Roman Hypocausts," 36-43, and ch. 6, "Speculations and Experiments," 43-57; Janet DeLaine, *The Baths of Caracalla*, 1997, 103-194 (LATTE).
Recommended Reading: Kleiner ch. 11, 152-169; review MacKendrick ch. 10, 314-341 (LATTE).

_____end of week 9

***Tues., Mar. 18** How to Heat a Roman Bath (RBM)
Nova Program on Building a Roman Bath.
Homework #4 due (on building the Colosseum and cranes).
Homework #5 distributed--on heating a Roman bath.
(Due on Tues., March 25.)
Required Reading: Janet DeLaine, *The Baths of Caracalla*, 1997, 195-226 (LATTE).

Fri., Mar. 21 **NO CLASS, Good Friday**

_____end of week 10

***Tues., Mar. 25** Hadrian's Architecture: His Villa at Tivoli, the Pantheon, and the Roman Dome (AOK-O)

Homework #5 due (on heating a Roman bath).

Required Reading: Taylor ch. 5, 174-211 (LATTE); MacKendrick ch. 11, 342-373 (LATTE); Sear ch. 8, 154-184 (LATTE).

Recommended Reading: Ramage and Ramage ch. 7, 180-207 (R).

***Fri., Mar. 28** The Science of the Domed Architecture. (RBM)

Prospectus for Final Paper due.

Lab #4 preparation problem distributed on domes--to be brought to lab in week of Apr. 1.

Required Reading: review Taylor ch. 5, 174-211 and read ch. 6, 212-255.

Recommended Reading: Kleiner ch. 12, 170-185; review MacKendrick ch. 11, 357-373 (LATTE).

_____end of week 11

APRIL:

Tues., Apr. 1 Hydraulics and Watering the Roman City
Introduction to Roman Aqueducts (AOK-O)

Required Reading: K.D. White, *Greek and Roman Technology*, ch. 12 "Hydraulic Engineering," 157-173 (LATTE); Deane Blackman and A. Trevor Hodge, *Frontinus' Legacy*, 2001, Intro, ch. II, and ch. III, 1-24 (LATTE).

Recommended Reading:, W.F. Jashemski, "The Use of Water in Pompeian Gardens," 51-57 and Paul Kessener, "Incrustations at the *Castellum Divisorium*, at Nimes," 169-177 in N. De Haan and Gemma Jansen, *Cura Aquarum in Campania*, *BABESCH*, 1996 (LATTE); review Kleiner ch. 7, 88-101, especially 91-96.

***Between Tuesday and Friday:**

Lab #4—on making domes.

Fri., Apr. 4 Lecture on water flow with lab demonstration of aqueduct model. (RBM)

Homework #6 distributed--on water flow.
(Due on Fri., April 15.)

Required Reading: Jan B.M. Wiggers, "The Urban Water Supply of Pompeii," 29-32 in N. De Haan and Gemma Jansen, *Cura Aquarum in Campania*, *BABESCH*, 1996 (LATTE).

_____end of week 12

Tues., Apr. 8 Roman Military Strategies, Defenses and Machinery (AOK-O)
Required Reading: Kleiner ch. 16, 230-245 and ch. 17 246-261.
Recommended Reading: Ramage and Ramage chs. 8-10, 208-267 (R).

***Fri., Apr. 11** **Quiz #2** (ca. 30 minutes of class time)
Nova Film on Catapults.
_____end of week 13

***Tues., Apr. 15** Lecture on catapults with demonstration outside. (RBM)
Homework #6 due (on water flow).

Fri., Apr. 18 The Big Picture of Roman Life and Technology: Slavery, Plagues, Wars, and the End of Empire (AOK-O)
Required Reading: MacKendrick chs. 12-13, 374-445 (LATTE).
Recommended Reading: Kleiner ch. 18, 262-277, ch. 19, 278-289, and ch. 20, 290-306; Ramage and Ramage chs. 11-12, 268-304 (R); Sear chs. 9-11, 185-254 (LATTE); review Shelton ch. 8, 168-189 and read ch. 9, 190-205.
_____end of week 14

Saturday, April 19 to Sunday, April 27, 2008
PASSOVER/ SPRING RECESS: NO CLASSES
Tues., Apr. 22 No class, Passover Spring Break
Fri., Apr. 25 No class, Passover Spring Break
_____end of week 15

***Tues, Apr. 29 Brandeis Friday**
Final Research Project due

Course Wrap-up—Concluding Thoughts from a Humanist and a Scientist
Discussion of what was accomplished in a quantitative sense in the Roman world and how much was done by sheer manpower.
Required Reading: review Janet DeLaine, *The Baths of Caracalla*, 1997, 195-226 (LATTE).
Recommended Reading: Sear ch. 12, 255-276 (LATTE).
_____end of week 16