I'll accumulate in this file some informal suggestions for paper topics. I'll add to and may edit it as I prepare classes. *Its content will change occasionally without notice*.

You'll choose your own topics, with my approval. The latter should ensure that your choices lie properly within the history of mathematics, are reasonably formulated, and that sufficient source material is available to support your inquiry.

You must beware of sensationalist materials posted on the Internet that appear to the naive to be about mathematics, but that really have other agendas. Here are two embarrassing examples. (1) A student in one of my classes, training to become a teacher, thought she was reporting on mathematics used in church design and other religious contexts, but cited only Internet materials composed to further the sale of various trinkets and counterculture pamphlets. (2) A professional colleague cited what seemed to be a scholarly report on the Internet about Gauss's doctoral dissertation. Gauss criticized some contemporaries' assumptions about complex roots of polynomials. The report wildly inflated the import of his remarks. On further inspection, it turned out to be a screed by the Lyndon LaRouche political movement. My colleague was dismayed at seeming to support that group.

This list will be somewhat random in origin: topics I'd like to hear about. For most of them sufficient material should be available in English. For a few, I'll indicate other languages that would be required. When you search for topics, you should spend some effort yourself, perhaps consult a librarian, and talk with me. I can often point you to materials that neither you nor a librarian would find by yourself.

Our library, under reconstruction, is difficult to use in some respects. But its service to me in recent years has been splendid, far beyond what I'd ever expected. During the semester I will present many guidelines for finding mathematical information there and on the Internet.

1. Some people I'd like to know more about
   a. Dirk J. Struik. You *must* find appropriate material about his work in geometry, in history, and about his politics.
   b. One or more of the Danish scholars Heiberg, Hjelmslev, Petersen, Zeuthen. I know a bit about Zeuthen because there's a good English biographical article and some of his work was related to some of Pieri's. I don't know about his best friend Petersen or about Hjelmslev: their material is probably in Danish and German. Heiberg was the philologist on whose translation modern versions of Euclid are based.
   c. Prof. Vazquez mentioned to me recently that one of the mathematicians who founded her field, knot theory, was Max Dehn, whose review of Struik [1949] 1987 was described in class. I know about Dehn because he was also an early

worker in my own research field, foundations of geometry. I told her that Dehn had narrowly escaped Germany in the late 1930s, then found his way to Black Mountain College in North Carolina. Prof. Vazquez then reported that she had just attended a seminar on the work of Ruth Asawa, a noted contemporary San Francisco artist. (The sculptured facade of the police station on 24th Avenue just north of Taraval Street is hers.) Prof. Vazquez noted that Asawa attended Black Mountain as a student around the same Dehn was there, and that Asawa's sculpture has a certain knotted quality. Could Dehn have influenced Asawa? A paper about these people and that college would be welcome. (Buckminster Fuller is also involved in this story, and I believe there is a connection from Asawa to Maya Lin.) I have some references to get you started.

2. Arithmetic
    a. Report on the relationship between commerce and the development of arithmetic. Starter resource: a book by Swetz.
    b. Compare and contrast what arithmetic students were expected to learn in the late 1800s and now. Resources: old books (I have some), mathematics-education faculty.
3. Algebra
    a. Report on F. K. C. Smith 1996—a study of an algebra problem that evidently originated in the 1300s in Italy. Include a discussion of the algebra involved, which should be vaguely familiar from precalculus, but not at all trivial. I have a copy of the paper.
    b. Report on Dold-Samplonius 1996—a study of the occurrences of a particular high-school algebra problem in Italian Renaissance texts and much older Arabic and Indian works. Perhaps find additional material on these contexts. Describe in general the *regula falsi* method that is used here. I have a copy of the paper.
4. Geometry
    a. Compare and contrast Euclid's ancient geometry text, [1908] 1956, with Legendre's or Playfair's or others before 1895 (these are available in various editions online or in my library).
    b. Compare any of those with common more recent approaches. Where did the latter stem from? Are they substantially different in this country and in others? Why? Resources: me, mathematics-education faculty.
    c. Compare these with Tarski et al [1935] 1946. I have a copy. This requires Polish. The historical question afoot is whether this book warrants translation into a western European language.
    d. Geometry in the religious designs by the ancient Hindus, perhaps also in contemporary floor designs. Resource: papers by Seidenberg in *Archive for History of Exact Sciences*.
    e. Elite education in Victorian England relied on Euclidean geometry to an extreme degree. Report on this practice and its effects. Resource: a book by Joan Richards. Also Bertrand Russell's autobiography.

f. What's in Leibniz' 1679 *Characteristica Geometrica*? The mathematics is probably quite easy. This question is related to my work on Pieri and to an inquiry I'm pursuing with Prof. Ovchinnikov. I have a copy of the work, in Latin, and one of a recent French translation.

g. Development of perspective drawing in Renaissance art. This would make a rather good paper topic, especially if particular examples were pursued in detail. There are several good works on the subject. Caution: most books on perspective drawing aimed at contemporary art students hardly begin covering the subject. You need to look at books addressed to advanced mathematics students, some architects, some engineers, and some computer-graphics-software developers.

h. Research the claim that Euclid's goal was not an *axiomatic* presentation, but a manual of methods for carrying out geometric constructions.

i. What can you construct with a noncollapsing compass, without using a straightedge? What, with a straightedge but no compass? This was a major study in the 1800s.

5. Trigonometry

a. I took trigonometry in high school and taught it at SFSU for years. What was in the course? When was that material put into standard form? When did it start as a course? Why? When did it stop? Why? (I have a lot of trigonometry books.)

b. I never covered spherical trigonometry, but it was included in some courses. What was that material? When was it developed? Who used or uses it? Where do you learn it now if you need it? Starter resource: van der Waerden's *Science Awakening*.

c. Struik mentioned the connection between surveying and geometry. Explore it. Surveying is a fascinating subject!

6. Calculus

a. Some calculus books departed greatly from the standards of their time. Why? Where did their approaches come from? How did they fare? Resources: SFSU faculty, the Harvard calculus text, texts by Kline, Menger, Keisler (non-standard analysis), Lorenzen, Toeplitz, Peano. The Peano book would require Italian.

b. For what problems did von Neumann develop the first stored-program computer? Where did they come from and how did they develop?

7. General

a. Make an overview report of the mathematics presented at the world's fair in Paris in 1900. Not just Hilbert's famous paper—that's getting a bit overdone. Include both the mathematics and the philosophy meetings. Note connections with more recent mathematics, as well as with Peano. There are easily accessible survey articles in English about the meetings. They are featured in the recent novel Michaelides 2008.

b. What did the School Mathematics Study Group do and what traces of its influence remain?

8. Combinatorics and number theory
    a. (Contributed by Prof. Matthias Beck) "Report on the possibly oldest reference to the coin-exchange problem…posed by J.J. Sylvester in the *Educational Times* in the 1880s, and a solution by C. Sharp." Google some terms in these quotes to find Beck's write-up. I suspect that all the sources required are accessible and that the level of mathematics required is appropriate for this course.
    b. Pursue historical questions, ancient or modern, connected with Egyptian fractions. The treatment in Burton 2007 alludes to 1881 work of Sylvester on vulgar fractions. The text of Anatole Beck, Bleicher, and Crowe leads to more recent stuff. (Caution: I am not familiar with this area and cannot be much of a guide.)