B01.1 History of Mathematics
Course Context Session 2

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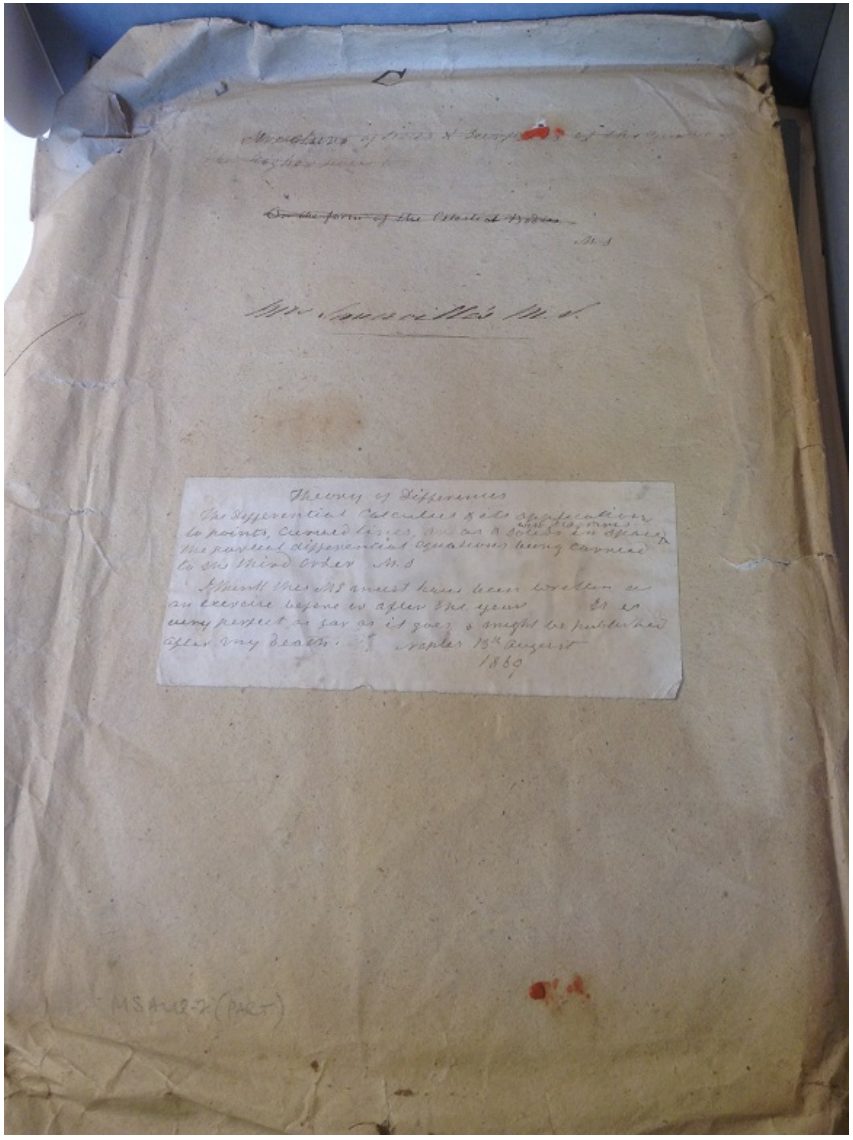
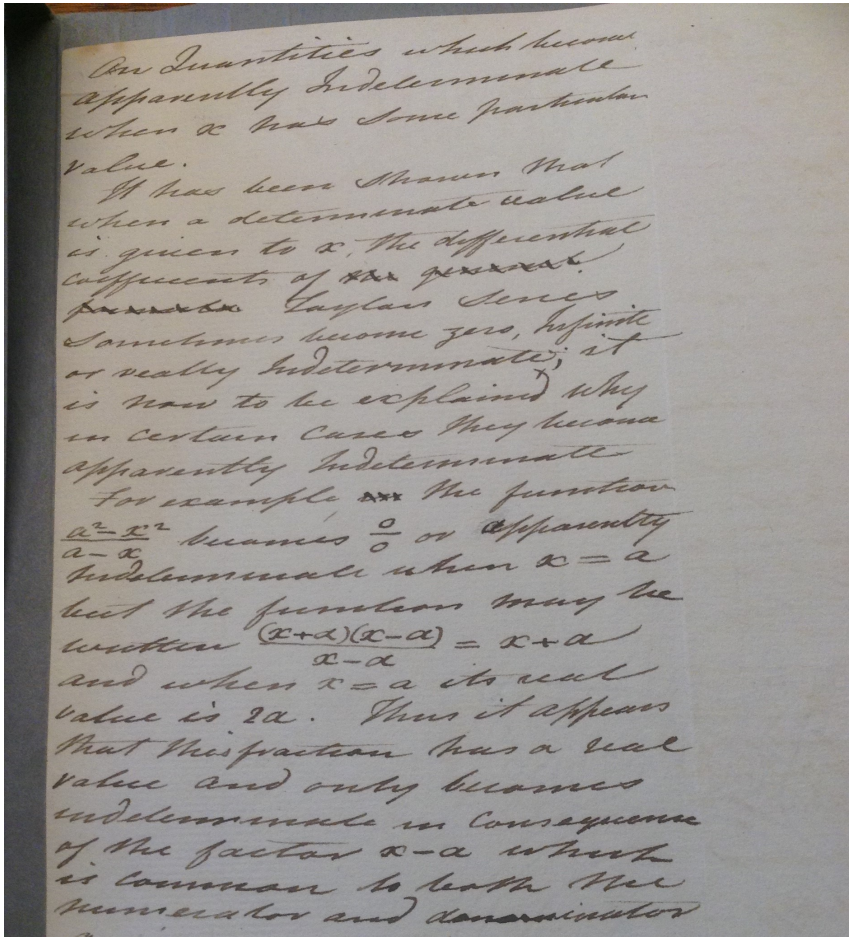
Mary Somerville (1780–1872)

Figure: Self-Portrait by Mary Somerville

- Known as a mathematician for her solutions published in *The Mathematical Repository*, through involvement in London 'polite society', and an 1831 translation of Laplace's *Mécanique Céleste*.
- Published experimental results on light and magnetism in *The Philosophical Transactions*.
- Went on to publish highly acclaimed books in Physical Sciences (1834) and Physical Geography (1848).

Mary Somerville's Theory of Differences





L'Hôpital's Rule

On Quantities which become apparently Indeterminate when x has some particular value.

For example the function $\frac{a^2-x^2}{a-x}$ becomes $\frac{0}{0}$ or apparently Indeterminate when $x = a$ but the function may be written $\frac{(x+a)(x-a)}{x-a} = x + a$ and when $x = a$ its real value is 2a. Thus it appears that this fraction has a real value and only becomes indeterminate in consequence of the factor $x - a$ which is common to both the numerator and denominator.

Again the expression $\frac{x^3-ax^2-a^2x+a^3}{ax^2-a^3}$ becomes Indeterminate when $x = a$, but the fraction is the same with $\frac{x-a}{a} \times \frac{x^2-a^2}{x^2-a^2} = \frac{x-a}{a}$ and when $x = a$ it is $\frac{0}{a}$ or zero.

L'Hôpital's Rule ctd

The quantity $\frac{ax^2-a^3}{x^3-ax^2-a^2x+a^3}$ becomes $\frac{0}{0}$ or Indeterminate when $x = a$, but it may be written $\frac{x^2-a^2}{x^2-a^2} \times \frac{a}{x-a} = \frac{a}{x-a}$ and when $x = a$ this quantity becomes $\frac{a}{0}$ or Infinite.

Hence it appears that a quantity which is apparently Indeterminate may have a finite value, or it may be infinite, or zero, when a particular value is given to x; but in every case its true value is to be found by expunging the factors that are common both to the numerator and denominator. This may be accomplished by the following method.

L'Hôpital's Rule ctd

Let $\frac{fx}{Fx}$ be a function of x which becomes indeterminate when x has some particular value as $x = a$. So that $fx = 0,\ Fx = 0$. Now let $x + h$ be put for x, then the function becomes

$$\frac{fx + f'x \cdot h + \frac{1}{2}f''x \cdot h^2 + \&c}{Fx + F'x \cdot h + \frac{1}{2}F''x \cdot h^2 + \&c}.$$

But when $x = a$ then $fx = 0$ and $Fx = 0$ by hypothesis, therefore this function is Divisible by h and hence is reduced to

$$\frac{f'x + \frac{1}{2}f''x \cdot h + \&c}{F'x + \frac{1}{2}F''x \cdot h + \&c}$$

but h may be taken so small that $f'x$ and $F'x$ shall exceed the remaining parts of their respective series and therefore the last expression is reduced to $\frac{f'x}{F'x}$ which is the value of the function when $x = a$.

L'Hôpital's Rule ctd

Hence the following rule for obtaining the true value of a fraction which becomes indeterminate when x has some particular value, as $x = a$.

Rule 17

Find the differential coefficients of the numerator and of the denominator the same number of times, till one or other is no longer zero.

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- We learn which people had authority as textbook writers

Witnessing failure

> *I had, and still have, determined perseverance, but I soon found that it was in vain to occupy my mind beyond a certain time. I grew tired and did more harm than good; so, if I met with a difficult point, for example, in algebra, instead of poring over it till I was bewildered, I left it, took up my work or some amusing book, and resumed it when my mind was fresh.*

(Somerville and Somerville, 1873, 65)

Witnessing failure

> *After this, every time I went to Paris, I carried my work of typographical revision, and presented it in person to M. Laplace. He received it always with kindness, examined it, discussed it; and that gave me an opportunity to submit to him the difficulties which too frequently baffled my weakness. His condescension to remove them was without bounds. But he himself could not always do it... That happened usually in places where, to save himself from the details of a too expanded exposition, he had employed the expeditions formula, Il est aisé de voir... Once I saw him pass almost an hour trying to seize again the chain of reasoning which he had concealed under this mysterious symbol.*

(Biot, 1850, 67), translation from (Lovering, 1889, 197–8), attributed to 'a lady'.

Witnessing exclusion

> *To a few, celibacy is a necessity... There are women... too passionately fond of a wild independence to be passionately fond of any mate; and to such single life may spare the endurance and the infliction of much misery...*
>
> *Lastly, there are women who are really almost epicene; whose brains are so analogous to those of men that they run nearly in the same channels, are capable nearly of the same toil, and reach nearly to the same heights; women not merely of genius (for genius is often purely and intensely feminine), but of hard, sustained, effective power; women who live in and by their intelligence alone, and who are objects of admiration, but seldom of tenderness, to the other sex. Such are rightly and naturally single; but they are abnormal and not perfect natures.*

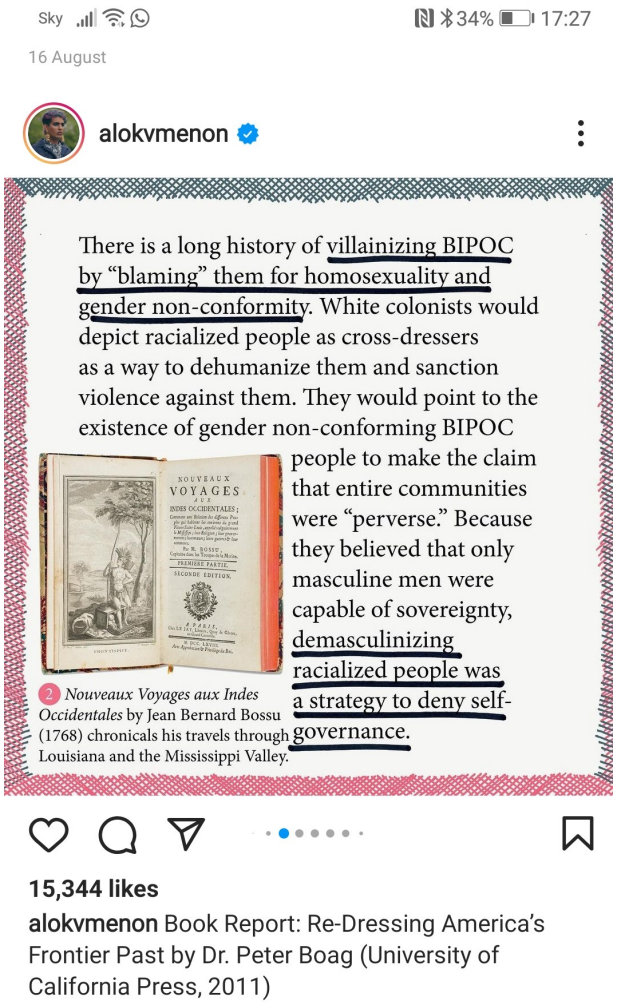
'Why are women redundant?', W.R. Greg, 1877
Read at Hathi Trust

Witnessing exclusion

> *In the seventeenth century, the English natural philosopher Margaret Cavendish spoke for many when she wrote that women's brains are simply too "cold" and "soft" to sustain rigorous thought. The alleged defect in women's minds has changed over time: in the late eighteenth century, the female cranial cavity was supposed to be too small to hold powerful brains; in the late nineteenth century, the exercise of women's brains was said to shrivel their ovaries. In our own century, peculiarities in the right hemisphere supposedly make women unable to visualise spatial relations.*

(Schiebinger, 1991, 2). Further reading: (Kaufholz-Soldat and Oswald, 2020).

Witnessing exclusion



White colonists would depict racialized people as cross-dressers as a way to dehumanize them and sanction violence against them. . . Because they believed that only masculine men were capable of sovereignty, demasculinizing racialized people was a strategy to deny self-governance.

Instagram post by alokvmenon, a book report on (Boag, 2011).

Witnessing exclusion

> *The cultural values associated with the establishment of a large community of technically expert mathematicians and mathematical physicists can also be explored at the level of everyday undergraduate experience. The private anguish expressed by Ellis, Smith, and Galton makes visible the painful process by which student sensibilities were slowly fashioned to the needs of industrialized learning. In the process, athleticism became an adjunct to competitive study and mathematics became a manly pursuit that selected and shaped the minds of the intellectual elite. Conversely, the mathematics prized in Cambridge came to reflect the ideals of competition, examination, and fair play prevalent in the coaching room and on the playing field.*

Exercising the Student Body: Mathematics, Manliness, and Athleticism: in (Warwick, 2003).

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Extract from Somerville's *Theory of Differences* is from Bodleian Library, Mary Somerville Collection, Dep. b. 207, MSAU2–7, folios 108–109.