

Janus in the Mathematics Library

Foundations, communities,
meaning and scale in the
mathematics literature

Michael J. Barany

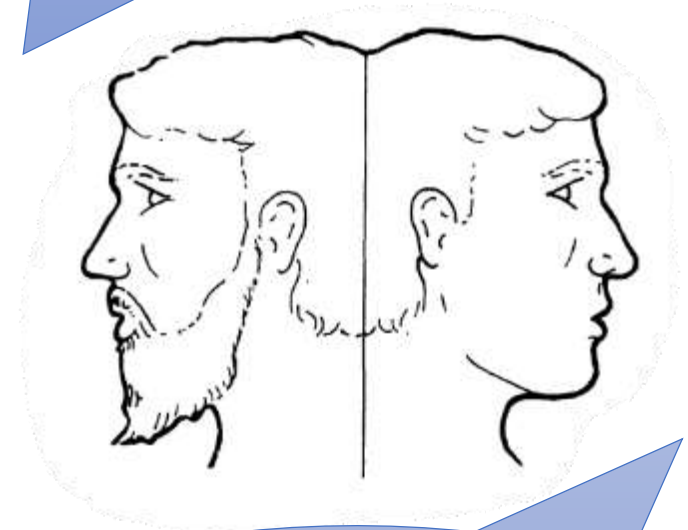
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The mathematics literature
is a stable repository of
settled claims.



The mathematics literature
is a dynamic instrument of
unsettling relations.

André Weil, 1959



Weil, 1956, Oberwolfach Photo Collection



Shelby White and Leon Levy Archives Center, Institute for Advanced Study

André Weil, 1959



“the School of Mathematics ... found the large reading room an agreeable room, and considered it of great importance that they **should be as close as possible to their books.**”

E.L. Woodward
Draft Minutes, IAS Faculty Meeting
25 March, 1959

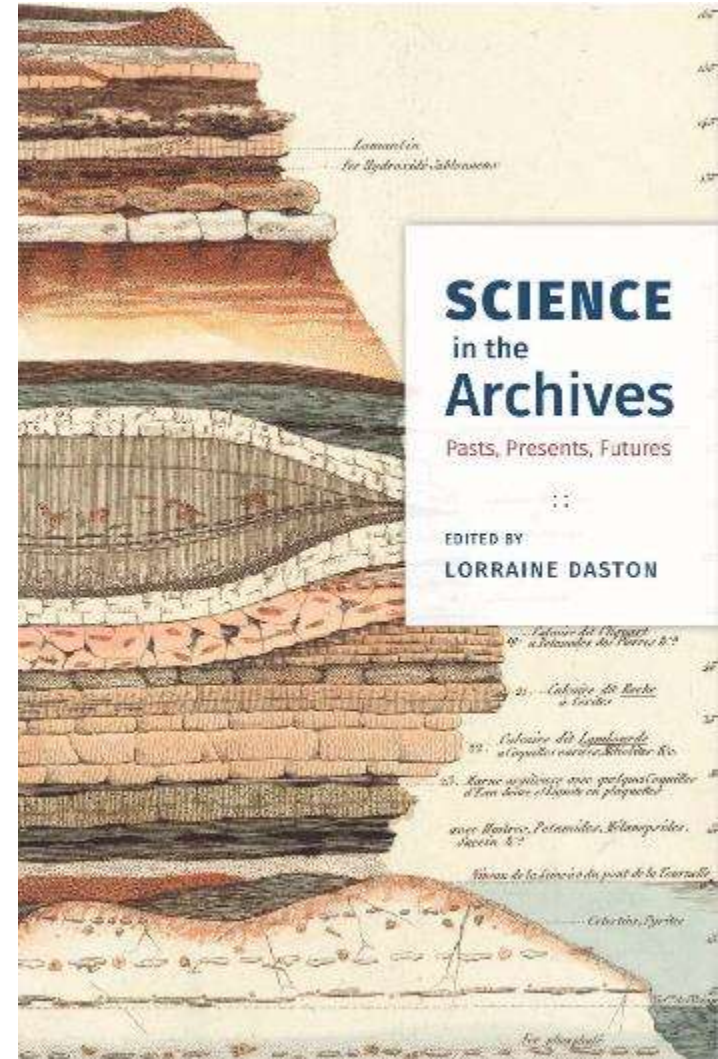
Outline

- Prologue: Weil's Books
- Introduction: Janus in the Mathematics Library
- I. Ethnography of Mathematical Media
- II. History of Mathematical Media
 - A. Mathematics for PoWs
 - B. Mathematics for Travelers
- Conclusions

Mathematics of the Archive

“For reasons and in ways that remain obscure to me, the sciences destroy their past more thoroughly than do mathematics or the arts.”

T.S. Kuhn (1980), quoted in Daston (2012), “The Sciences of the Archive”



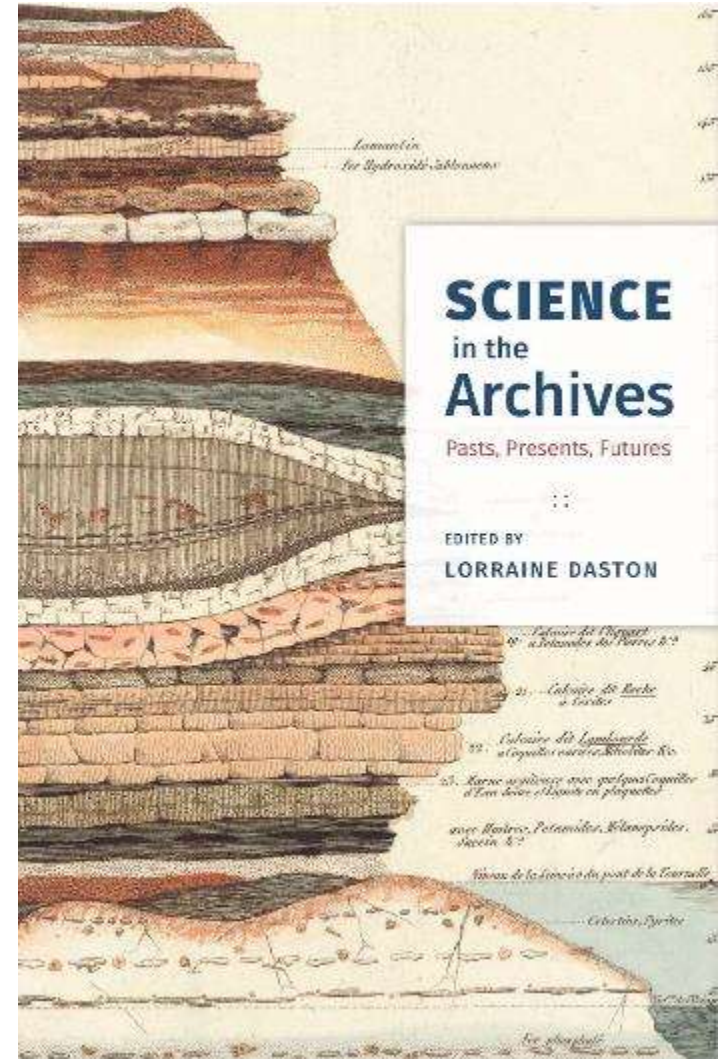
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What are mathematics libraries for?

What do mathematics libraries do?



Janus in the Mathematics Library

Bruno Latour, *Science in Action*, 1987



Figure I.1

Janus in the Mathematics Library

Bruno Latour, *Science in Action*, 1987

“If you take two pictures, one of the black boxes and the other of the open controversies, they are utterly different. They are as different as the two sides, one lively, the other severe, of a two-faced Janus.”

Ready Made Science

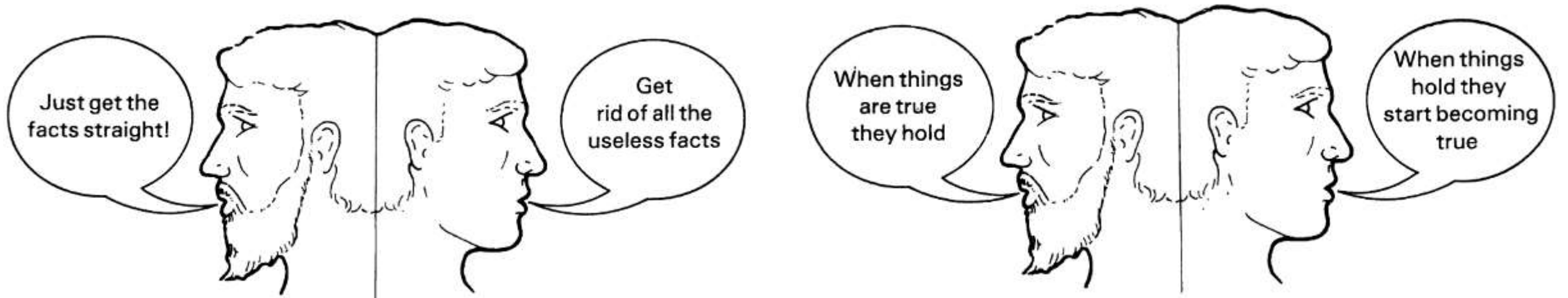


Science in the Making

Figure I.1

Janus in the Mathematics Library

Bruno Latour, *Science in Action*, 1987

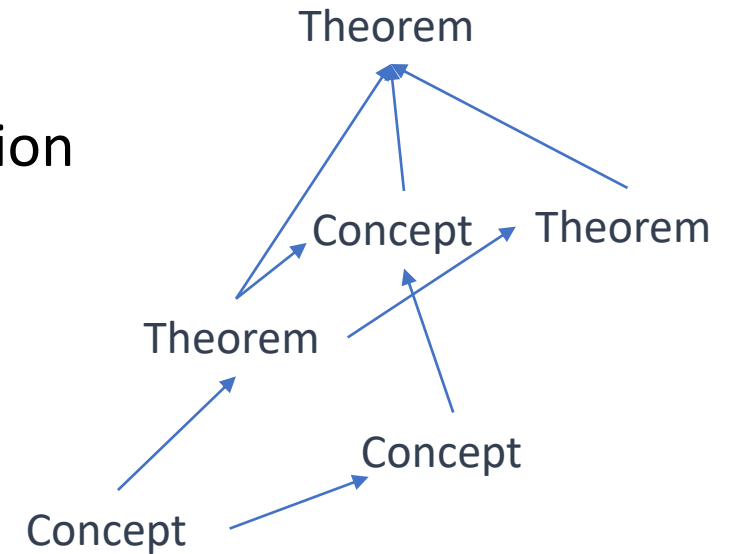


As scientific claims enter and circulate in the literature, they acquire modalities that shift from the perspective of “science in the making” to “ready-made science”

The Historicity of Mathematical Concepts

Static Mathematics

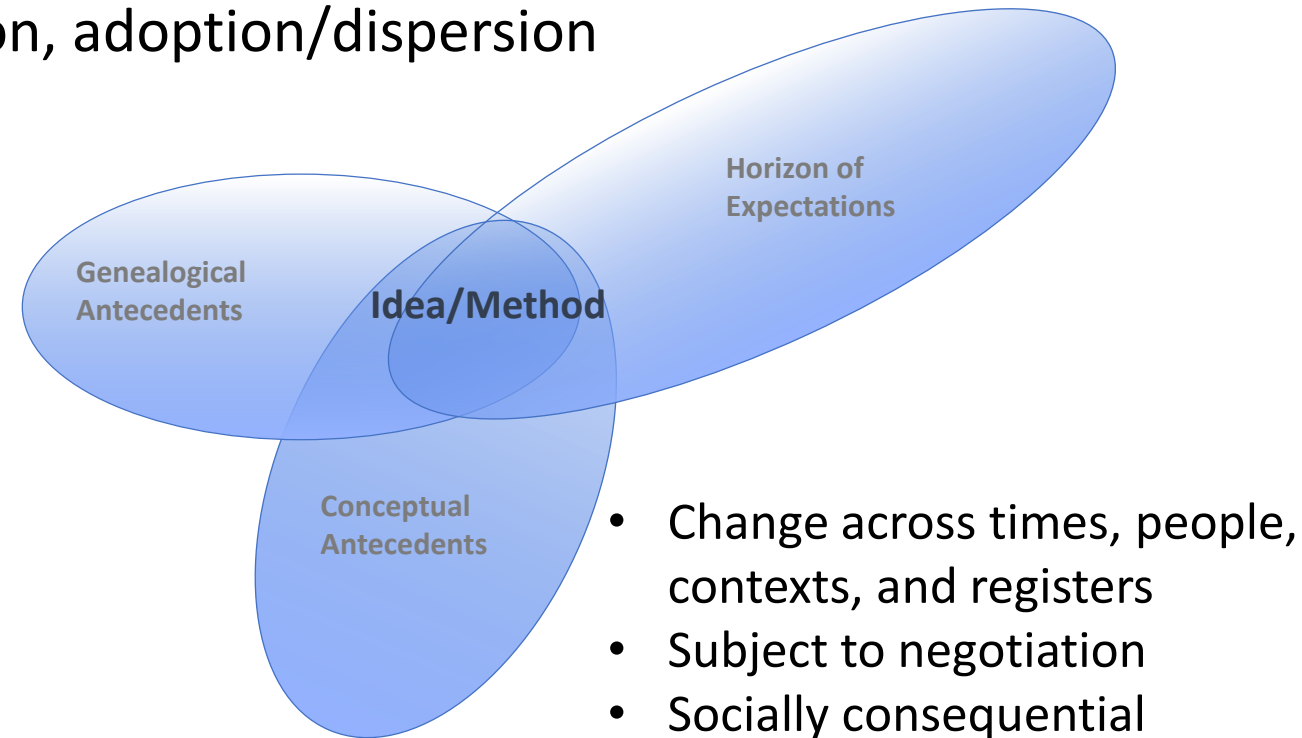
- *Concepts* and *Theorems* manifest as *events* in uniform time
- Philosophy: ontology, epistemology, logical relations, cognition
- History: historical epistemology, genealogical relations, discoveries/inventions



The Historicity of Mathematical Concepts

Dynamic Mathematics

- *Ideas* and *Methods* manifest as shifting antecedents and horizons
- Philosophy: fruitfulness, significance, heuristics and analogies
- History: communities, habits, inspiration, adoption/dispersion



Outline

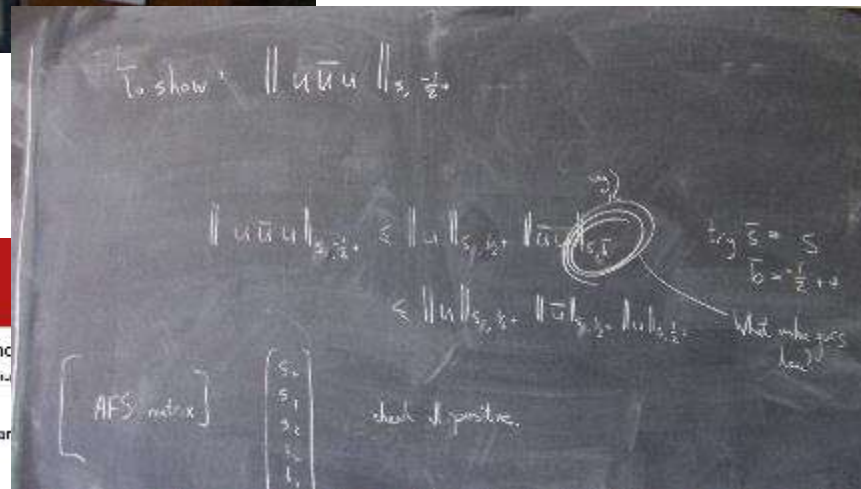
- Prologue: Weil's Books
- Introduction: Janus in the Mathematics Library
- **I. Ethnography of Mathematical Media**
- II. History of Mathematical Media
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Ethnography of Mathematical Media



Mathematicians actually have a pretty good sense of how they work and reason, but this is rarely reflected in how they characterize their work when asked to do so directly (philosophically, logically, etc.).

A screenshot of the arXiv.org website. The top part shows the arXiv.org logo in white on a red background. Below it, there is a navigation bar with links for "Open access to 1,093,250 e-prints in Physics, Mathematics, Computer Science", "Subject search and browse:", "Physics", "Search", "Form Interface", and "Contact". A date notice reads "30 Oct 2015: 2015 holiday scheduled announced" and "See cumulative 'What's New' pages. Read robots beware before attempting ar". At the bottom, the word "Physics" is written in bold.



Ethnographic methods can make this informal working knowledge visible and available.

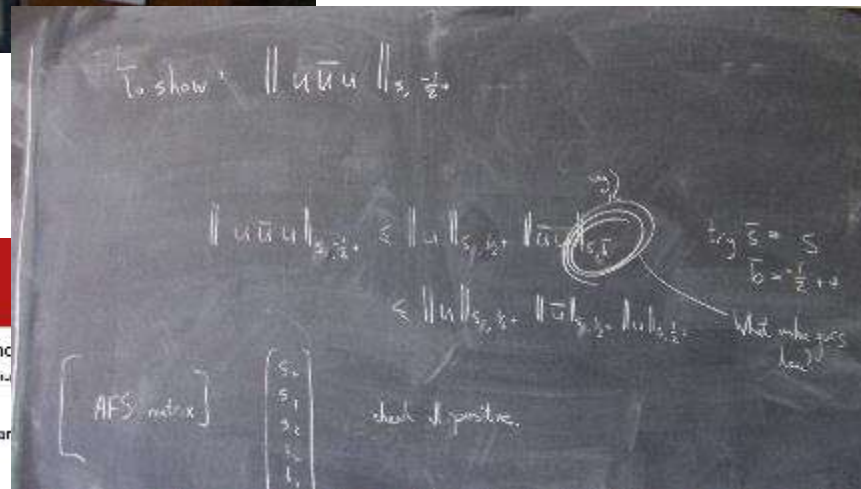
- **Astrophysics (astro-ph new, recent, find)**
includes: Astrophysics of Galaxies; Cosmology and Nongalactic Astrophysics; Earth and Planetary Astrophysics; High Energy Astrophysical Phenomena; Instrumentation and Methods for Astrophysics; Solar and Stellar Astrophysics
- **Condensed Matter (cond-mat new, recent, find)**
includes: Disordered Systems and Neural Networks; Materials Science; Mesoscale and Nanoscale Physics; Other Condensed Matter; Quantum Gases; Soft Condensed Matter; Statistical Mechanics; Strongly Correlated Electrons; Superconductivity

Ethnography of Mathematical Media



Desks, computers screens, notepads, notebooks, scrap paper, office blackboards, seminar blackboards, websites, blogs, social media, repositories, databases, journals, offprints, print-outs, textbooks, monographs, articles, abstracts, letters, emails, catalogues, indices, forms,...

A screenshot of the arXiv.org website. The top part shows the arXiv.org logo in a red bar. Below it, there is text about open access to e-prints and subject search options. The date '30 Oct 2015' is visible. The 'Physics' category is selected. At the bottom, there is a list of physics sub-fields with 'Astrophysics' and 'Condensed Matter' highlighted.



Not all part of mathematics libraries, but all part of what mathematics libraries do.

Ethnography of Mathematical Media

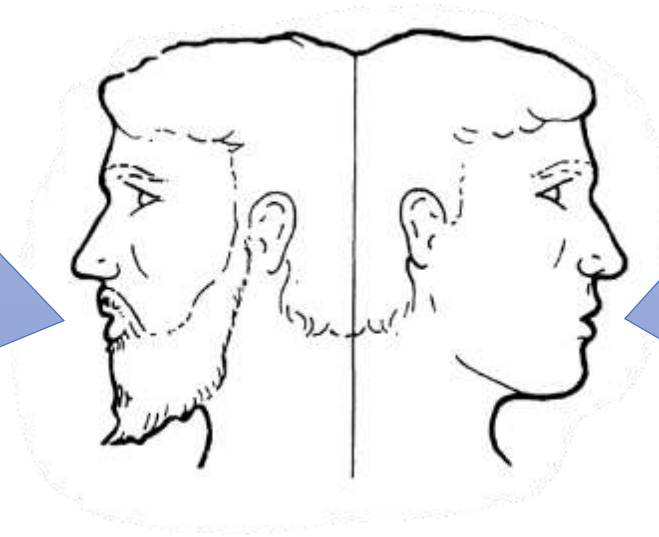
Mathematicians use different kinds of media to different ends:

- *Stabilized* (written up) media circulate abstractions that are mobile but incomprehensible.
- *Situated* (read down) media mobilize abstractions as workable but spatiotemporally constrained productions.



Ethnography of Mathematical Media

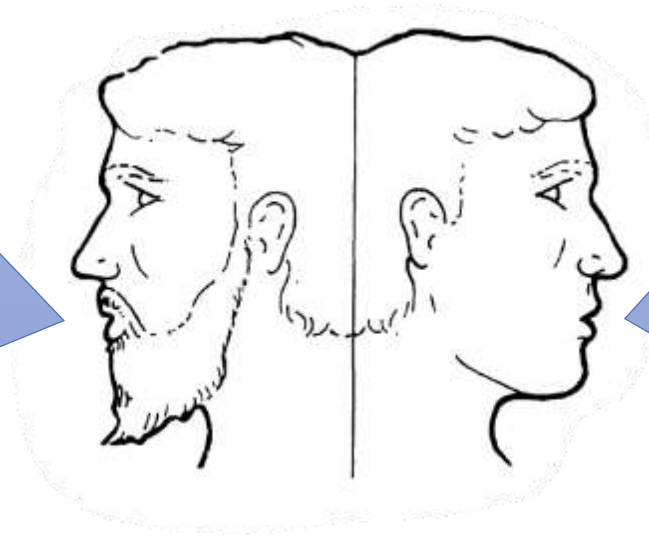
Mathematicians
“write up” stable
conclusions to make
them available to each
other as literature.



Mathematicians
“write up” unstable
conclusions to stabilize
them for circulation.
They must
subsequently be “read
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“Immutable Mobiles” (Latour)

“Immobilized Mutables”

Ethnography of Mathematical Media

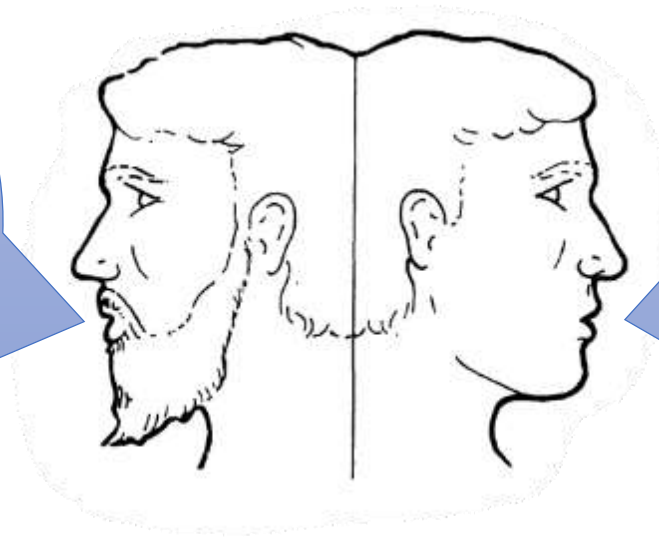
- “I don’t tend to look back very much”
- “I do a lot of stuff in my head”
- “I’m going to keep doing the calculations again, only now trying to look for terms of this form... I have an ocean of terms like this, and the problem in some sense is how do you put them together so that they make some sense.”
- “[you] see sort of which ones [factors] are ones that are helping you prove your result and which ones are the obstacles”
- ‘writing up’ generally viewed as secondary labor, not conceptual

$$\underbrace{\sum_{jk} \partial_j a_{jk}(x) \partial_k u}_{Lu} = \sum_{\substack{j \\ \in S_{j,0}}} \partial_j \underbrace{a_{jk}(x) \partial_k u}_{L^* S_j^1}$$

probably need symbol smoothing, not clear how to invert.

Ethnography of Mathematical Media

Mathematicians use the literature as an established foundation to support new results.



Mathematicians manipulate and destabilize the literature to upset the obstacles to new results.

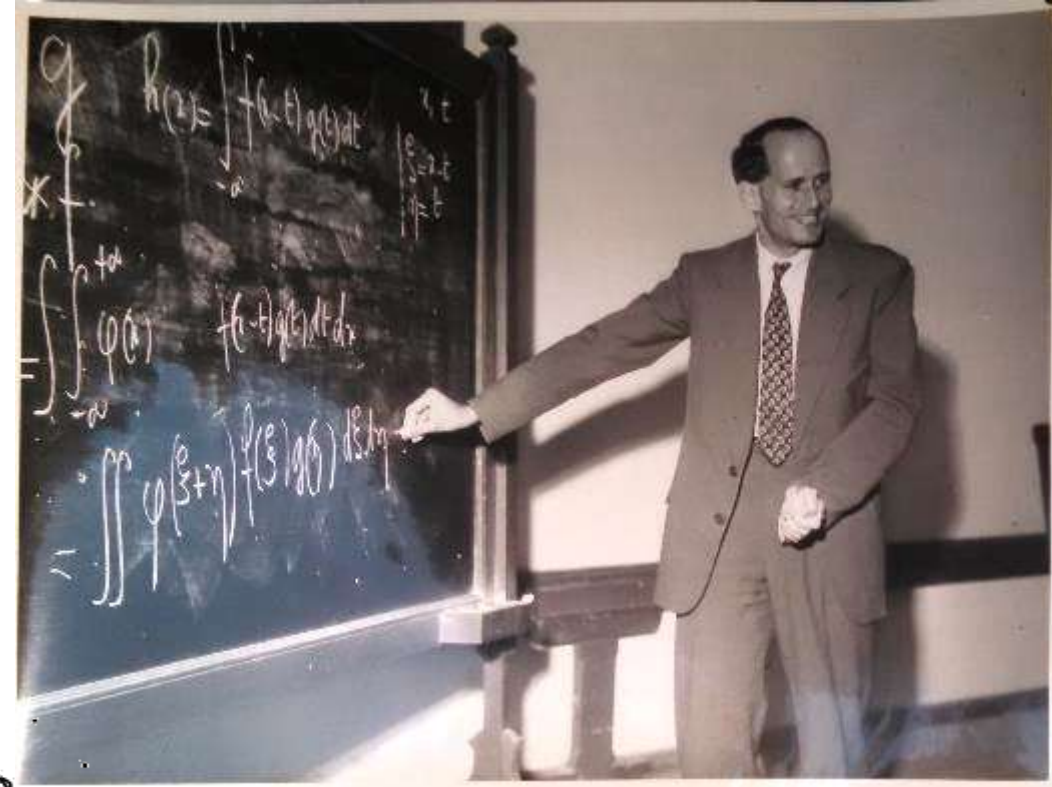
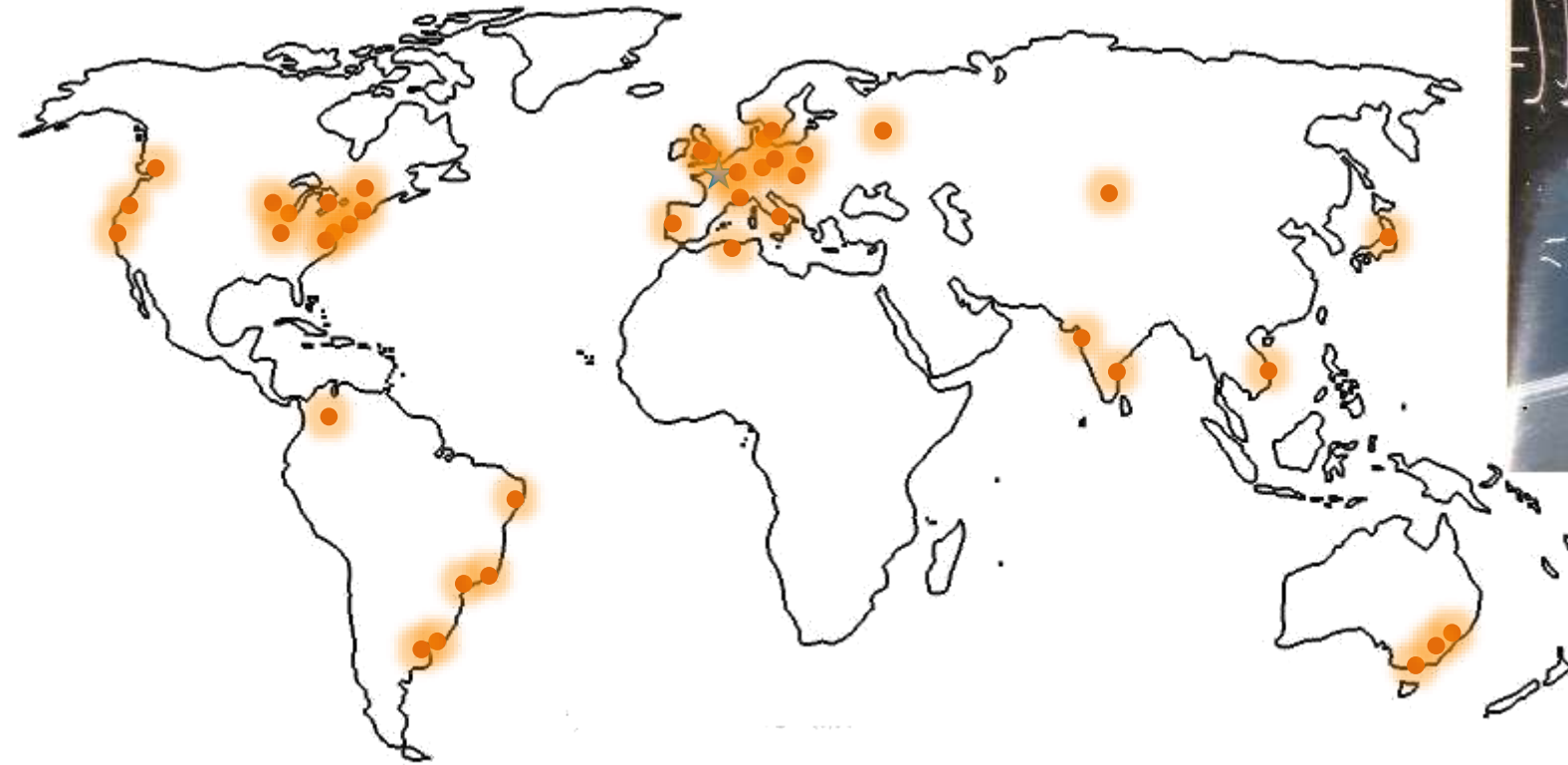
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History of Mathematical Media



History of Mathematical Media



See, e.g. Barany, "Distributions in Postwar Mathematics";
Steingart, "A Group Theory of Group Theory"

History of Mathematical Media

- Ferdinand Rudio, 1897 International Congress:

“... I would like to draw your attention to one point, perhaps **the most important** of all. The most important because it concerns a searing question whose solution requires energetic initiative: the **question of mathematical bibliography.**”

“In our epoch of enormous production where the works are so dispersed, a rapidly and continually functioning bibliographic repertoire is essential.

“Such a repertoire must, among other things, give the means of knowing by titles everything that has appeared in a given domain not just in the last years, but also in the last months or even in the last weeks.

“The repertoire of a given science can only be established by an international institution.”

Mathematics for PoWs

“My mathematics work is proceeding beyond my wildest hopes, and I am even a bit worried – if it’s only in prison that I work so well, will I have to arrange to spend two or three months locked up every year?”

André to Eveline Weil, 1940

Mathematics for PoWs

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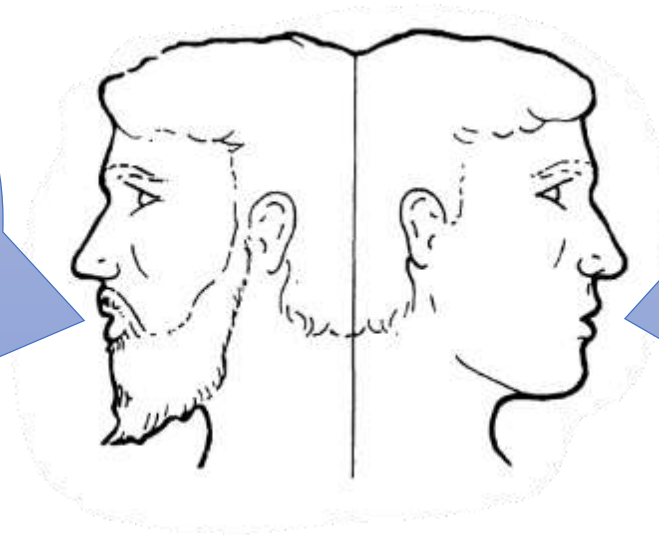
André to Eveline Weil, 1940

“**Ayant, dans cette nouvelle situation, assez de confort pour poursuivre mes recherches scientifiques**, recourant quelques colis de vivres de collègues dévoués habitant la France non occupée, je vous demande de bien **vouloir m'envoyer et me faire envoyer** (en particulier de Princetown) **des tirages à part** concernant: équations aux dérivées partielles, topologie, groupes et quanta; quelques autres mathématiciens de ce camp (Roger, Ville, etc.) en profiteront avec moi.”

Leray to Lewy, 19 January 1941

Ethnography of Mathematical Media

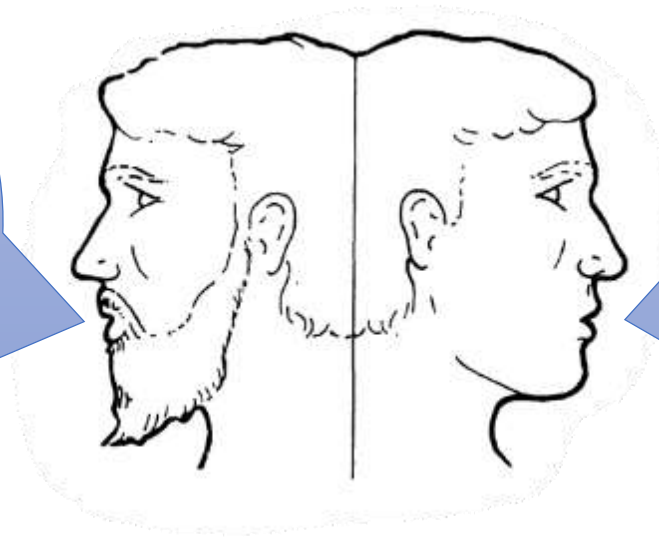
Mathematicians read journals to find out what each other has done.



Mathematicians read journals and abstracts to find out what each other is doing.

Ethnography of Mathematical Media

Mathematicians share articles to publicize relations among concepts.



Mathematicians share articles to establish and maintain relations among researchers.

Mathematics for Travelers

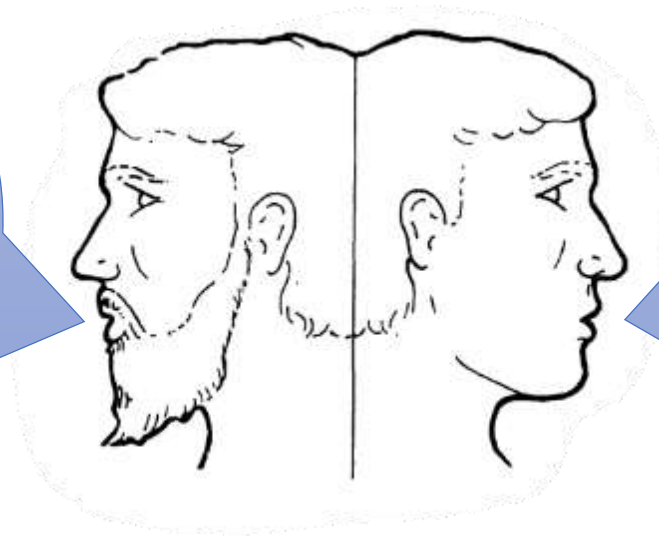
“Mr. Ehresmann has confirmed Mr. Kahane’s impressions concerning the library of the Mathematics Centre, whose collection is not worthy of an institution set up to attract students from all over Latin America. For a start, a sum of two to three thousand dollars would be required to purchase books for the library.”

UNESCO Memo BMS/TA22.595

18 December 1959

Mathematics for Travelers

Mathematical libraries
support access to past
mathematics.



Mathematical libraries
nucleate institutions
and mobilize
resources for creating
future mathematics.

Mathematics for Travelers

ZENTRALBLATT FÜR MATHEMATIK

9. Band, Heft 1

UND IHRE GRENZGEBIETE

S. 1—48

Mathematical
Reviews

EDITED BY
*The American Mathematical Society &
The Mathematical Association of America*

January, 1960 TABLE OF CONTENTS Vol. 1, No. 1

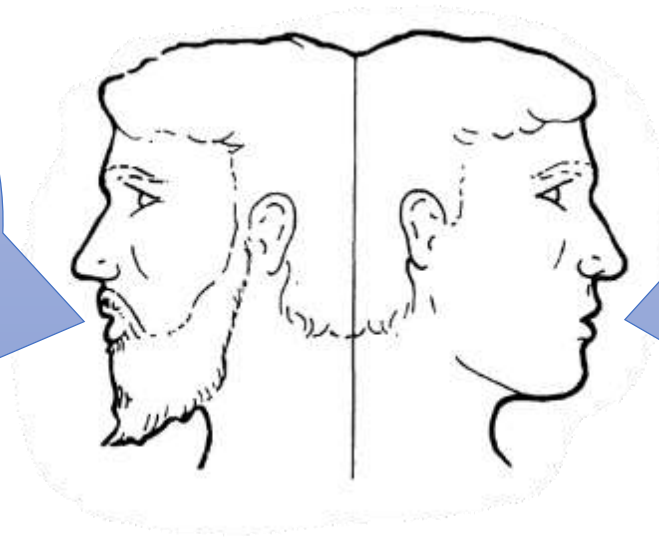
Algebra	1	Algebra: abstract varieties, algebras	20
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Analysis of systems of integral equations	1	Analysis of systems of integral equations	20
Analysis of systems of matrix equations	1	Analysis of systems of matrix equations	20
Analysis of systems of vector equations	1	Analysis of systems of vector equations	20
Analysis of systems of tensor equations	1	Analysis of systems of tensor equations	20
Analysis of systems of differential equations	1	Analysis of systems of differential equations	20
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Analysis of systems of matrix equations	1	Analysis of systems of matrix equations	20
Analysis of systems of vector equations	1	Analysis of systems of vector equations	20
Analysis of systems of tensor equations	1	Analysis of systems of tensor equations	20

**РЕФЕРАТИВНЫЙ
ЖУРНАЛ**

13. МАТЕМАТИКА

Mathematics for Travelers

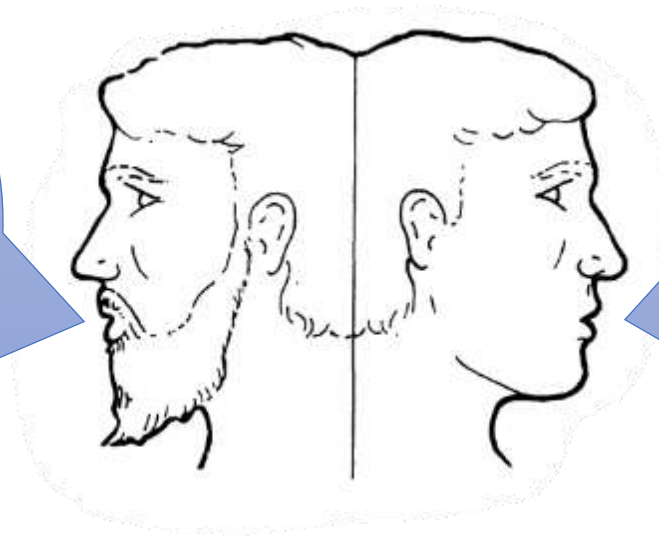
Reviews and abstracts summarize results and relations in the literature.



Reviews and abstracts propose possible relations among research communities and conceptual programs.

Mathematics for Travelers

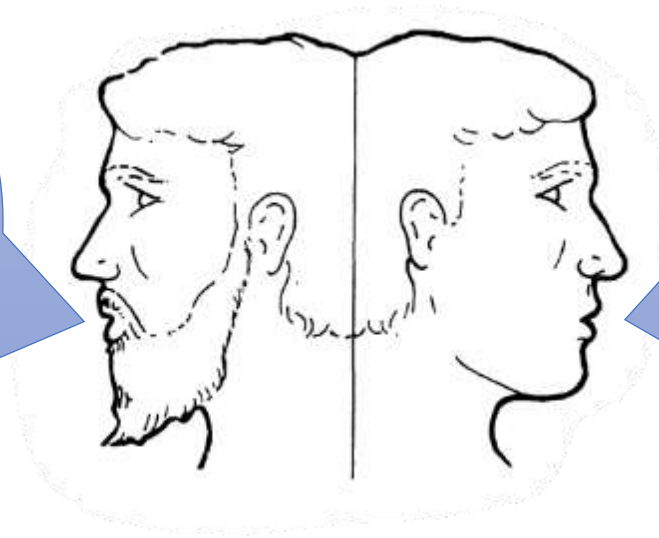
Citations and references connect new mathematics to past mathematics.



Citations and references relate new mathematics to recognizable horizons of possibility.

Mathematics for Travelers

Mathematicians
organize in
communities to
produce mathematical
concepts.



Mathematicians
organize concepts to
produce mathematical
communities.

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Janus in Big Proofs

- Not myth/reality: both Janus perspectives are co-produced through mathematical research.
- Systems based on the “ready-made” view may account well for ready-made mathematics (textbooks?) but may not work as directly for mathematics in the making.
- Both the *past* (antecedents, foundations, etc.) and the *future* (validity, understanding, fruitfulness, etc.) of a mathematical concept/proof/theorem/program are constantly negotiated through mathematical work.

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