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Online Resources for Mathematics in the Scientific *Virtual Reference Desk*

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Abstract

The present work briefly describes the Virtual Reference Desk for mathematics elaborated during the time I worked at the CERN Library [\[1\]](#) (European Laboratory for Particle Physics or Laboratoire européen pour la physique des particules) in Geneva.

This instrument is dedicated to the CERN librarians, with whom I have shared important moments of my professional career. In particular, I would like to gratefully acknowledge their valuable co-operation and assistance during our time spent working together.

The Web metasource is comprised of three directories, annotated and interrelated with dual application:

The first is intended as a work tool for librarians working in mathematics libraries, but above all for librarians of high energy physics, who more often than not must turn to mathematics and the use of mathematical applications and models for the physical sciences and in particular particle physics.

The second is an on-line resource for mathematics; that is, a Virtual Reference Desk for the community of mathematicians, with whom I have been collaborating for some twenty years at the University of Padova.

The bibliographical instrument is born from the need to have at our disposal a scientific Virtual Reference Desk created according to the needs of those working in physics and mathematics libraries – a tool which is comprised of materials collected during years of work as much as material available on-line through the use of new technologies.

Introduction

The duality of this bibliographical instrument is reflective of a research methodology oriented towards the disciplines of physics and mathematics, but which is necessarily founded on the traditions of our profession as librarians.

Two components were necessary for the development of this scientific VRD:

- traditional and classical expertise gained through years of work in the field, especially as pertains to the selection of the resources;
- experience gained in the management and organisation of information through the use of technological tools available on line.

The research methodology employed allows the community of librarians, and above all the mathematicians, to benefit from a classic bibliographical instrument on a modern support, namely the Web.

The specific nature and significance of this discipline inevitably lead to the Galilean conception of mathematics as a unique language unlike any other form of human communication.

The language of mathematics applies to the natural world and permeates the mechanisms of physical phenomena. Nothing can elude its power of description through its combinations and variations.

The method and form of this bibliographic instrument are therefore suggested by the rationality inherent to mathematics. This characteristic is also implicit in the codified order and in the pre-established rules of our profession, fundamental to a rational organisation of knowledge.

The contents are selective yet reasoned. The selected resources consist of the essence of the informational category, as well as being parts of larger sets.

Mathematics is not a mere collections of facts or coincidences [2] nor a set of abstract formulas invented for the sole pleasure of the intellect. It is rather a way of thinking about numbers and models, which has evolved through the millennia and which transcends race and culture. It responds to practical needs as well as to aesthetic considerations.

Mathematics is a unique discipline which implicitly comprises its own logic and which carries with it a certainty of substance absent in other areas of study. Its sources are both of this world and out of this world; its formulation, however, is within the human mind.

On-Line Resources for Mathematics in the Scientific Virtual Reference Desk is imbued with this spirit of pragmatism.

Form and Structure of the *Mathematics Virtual Reference Desk*

The bibliographical instrument is comprised of three directories in three distinct but interconnected Web pages:

The home page is titled [Online resources for mathematics](http://library.cern.ch/derobbio/mathres/mathres1.html)

<<http://library.cern.ch/derobbio/mathres/mathres1.html>>

It contains approximately 80 references, subdivided by categories, with an index at the beginning.

The second directory is headed by [Reviews and Data Base Services](#) and contains a detailed description of about ten data bases for mathematics and related disciplines
<<http://library.cern.ch/derobbio/mathres/mathdatabase.html>>

[Mathematics and Physics Preprint and e-Print Servers](#) is found on the pre-print server page.
<<http://library.cern.ch/derobbio/mathres/preprint.html>>

Approximately forty mathematics, physics and computer science resources can be found in this directory.

The organisation of the resources within the instrument is as follows:

- **Mathematics Search Engines**
- **General Directories**
 - **Mathematics Department Web servers & People**
 - **Electronic Newsgroups and Listservs**
- **Guide to Mathematics Literature**
 - **History of Mathematics**
 - **Bibliographies**
 - **Miscellaneous**
- **Reference Works**
 - **Manuals, technical dictionaries, encyclopaedias**
 - **Classification schemes**
 - **On-line mathematics resources organised according to classification schemes or indexed by topic**
- **Data bases: Abstracting, Reviewing and Data base Services (second instrument, in an independent page)**
- **Mathematics Literature on the Web**
 - **Electronic periodicals**
 - **Digital monographs**
 - **Preprint Servers: Mathematics and Physics Preprint and e-Print Servers (third instrument, in an independent page)**
 - **Services**
 - **Virtual libraries**
 - **Specialised services for Document Delivery for mathematics**
- **Projects for Mathematics**

Contains descriptions of several of the most representative resources contained in the *Virtual Reference Desk for Mathematics*, to give a general idea of the structure of the instrument.

Search Engines for Mathematics

As with other disciplines, generic search engines are not ideal for the effective retrieval of information.

[MathSearch](#) is an on-line bibliographical search tool for mathematics:

<<http://www.maths.usyd.edu.au:8000/MathSearch.html>>

MathSearch is considered a specialised search engine for mathematics resources. It was developed

by the School of Mathematics and Statistics at the University of Sidney, and partly inspired by the descriptions of Brian Pinkerton on WebCrawler. MathSearch is a Web-Indexing Robot for searching and indexing of sections of the Web based on the Peregrinator application. MathSearch can retrieve over 200,000 English-language resources found on mathematics and statistics Web servers.

General Directories

This section is comprised of several general metasources, for example the Web server lists of mathematics departments and the co-ordinates of mathematicians throughout the world as compiled on Web sites of various mathematical associations.

One of the most comprehensive lists is the one compiled by Penn State University:

[Mathematics Department Web servers & People. Lists located at Penn State University](http://www.math.psu.edu/MathLists/)

<<http://www.math.psu.edu/MathLists/>>

Other resources in this category include lists of chat groups and newsgroups. The most complete among them is found on the site maintained by Mathematics Archives:

[Electronic Newsgroups and Listservs by MathArchives](http://archives.math.utk.edu/news.html)

<<http://archives.math.utk.edu/news.html>>

This site contains more than one hundred mathematics chat and newsgroups, subdivided by areas of interest, and with instructions for membership registration, listserv functionality and links to the lists themselves.

A list of mathematics software compiled by SINM (Sistema Informativo Nazionale per la Matematica) in Lecce can also be found.

Guides and Bibliographies

This section contains links of a historical nature, links to several bibliographies and lists of quotations, as well as a section containing miscellaneous resources.

[The MacTutor History of Mathematics archive](http://www-groups.dcs.st-and.ac.uk/~history/)

<<http://www-groups.dcs.st-and.ac.uk/~history/>>

is one of the most complete resources for the history of mathematics.

It contains an index of over 1300 biographies of famous mathematicians, an archive of some thirty full-text articles considered classics in the history of mathematics in different categories and a data base containing over sixty mathematical curves described within the context of their evolution and for their properties. The archives in the site are searchable by word or phrase via a built-in search engine.

The miscellaneous list contains general interest guides, FAQ links for mathematics and related disciplines.

[Quotations server at Furman University](http://math.furman.edu/~mwoodard/mqs/mquot.shtml) instead is an archive of quotations by famous mathematicians also searchable by key word

<<http://math.furman.edu/~mwoodard/mqs/mquot.shtml>>

This section also contains other resources such as a directory of documents and materials on the numbers of Fibonacci, a site dedicated to Leibniz, field mathematician and inventor of the calculus machine, and diplomat in the court of the Sun King. Mathematics in cinema is considered in A Guide to Major Motion Pictures with Scenes of Real Mathematics by A. G. Reinhold.

Reference Works

The reference works section is structured so as to contain a selection of material useful to mathematicians. Mainly, this section contains web versions of the reference works one might find on typical library stacks: dictionaries, manuals, encyclopaedias.

This section also contains considerable material relating to classifications schemes in mathematics and related disciplines.

Two logical subsections:

- **Classification Schemes**
- **Mathematics Resources Organised By Category Or Topic (Web Sites)**

Classification schemes for mathematics

The subsection titled Classification Schemes is comprised of four resources. The first contains various classification schemes, the other three instead focus on the international classification system par excellence, *Mathematics Subject Classification* (MSC).

This scheme constitutes the standard for a good deal of editorial activity, indexing and classification, in addition to library management and organisational activities.

MSC references the synthetic content indications of numerous books, articles and grey literature. One can also find the MSC scheme as a sector classification within preprint servers dedicated to mathematics.

It is the classification instrument par excellence also with respect to encyclopaedic works such as the Encyclopaedia of Mathematics [3], seminal work born on the shores of the Moscovia and now developed on ancient ferries under the guidance of M. Hazewinkel [4].

MSC is the classification compiled and updated by the editorial offices of the most important bibliographical directories for mathematical research, available on paper, CD-ROM, and on-line.

- *Mathematical Reviews and Current Mathematical Publications* (MR and CMP), produced and published (MR from 1940) by the American Mathematical Society
- *Zentralblatt für Mathematik und ihre Grenzgebiete / Mathematics Abstracts* (ZM/MA), was created in 1931, produced by Deutschen Akademie der Wissenschaften zu Berlin and (currently) by Heidelberg Akademie der Wissenschaften and Fachinformationszentrum Karlsruhe is published by Springer-Verlag, with the scope of the European Mathematical Association.

The current version, the MSC2000 scheme, is very comprehensive, comprising 5520 sections, among which 1742 have been updated or are completely new.

The principal sections are listed from 00 to 99, and denote an ample margin of "hospitality". In the current version of the MSC2000 only 63 first-level sections are occupied. The scheme is also being used by several digital libraries, among them the Networked Computer Science Technical Reference Library (NCSTRL) [5]. With respect to the Metadata, MSC is one of the classification systems falling under the DublinCore format in the MetaTag zone, also within the European EULER project for mathematics [6].

The first of the four resources within the VRD for mathematics is the one found on the AIB-WEB site:

[*AIB-WEB Classification Schemes. Scientific and Technical Disciplines: Computer Science, Engineering, Physics, Mathematics, Statistics, Geology*](#) [7]

This page is intended as a work tool for librarians, which brings together resources relating to classification schemes available on line. In it one can find a section for classifications relating to scientific and technical disciplines: (computer science, engineering, physics, mathematics, statistics, geology). Specialised classifications: refers to specific area schemes. This section was later subdivided into broad discipline areas, in as much as some classifications refer to interrelated or complementary topics, often comprising different sectors among them.

The specialised classifications correlated to mathematics, in as much as they refer to complementary disciplines and which have interactions with the MSC are:

- * **Physics and Astronomy Classification Scheme (PACS)**
- * **Computing Review by the Association for Computing Machinery (ACM-CR)**
- * **International Reviews on Mathematical Education. Zentralblatt fur Didaktik der Mathematik (ZdM)**

Many discipline schemes involving or relating to mathematics, such as PACS for physics and ACM/CR for computer science, have undergone structural modifications with respect to the way in which mathematics has evolved in the last few decades, rigorously recorded in the MSC updates. Thus, as MSC has taken account of the evolution of the other classifications, the development of structural links between schemes over time has lead to the creation of new and ever- expanding discipline areas which have, in turn, come to occupy an increasingly important role within the scientific schemes.

The other three resources of the Virtual Reference Desk for Mathematics in the classification schemes sections are:

[*The mathematics classification page: MSC2000 H-volume libraries*](#) (hypertextual editions MSC2000) by

Antonella De Robbio, Alberto Marini, Dario Maguolo [8]

<<http://www.math.unipd.it/~biblio/math/index.html>>

Comparison with preceding historical versions of the scheme. The site offers various instruments: various representations of the 2000 version accessible in different ways, an Italian version of the scheme, a bilingual version (English/Italian), a hierarchical tree structure with links from the

scheme to the on-line resources (guide page from which one can navigate on the Web in search of sites on mathematics).

[Expérimental: navigation dans MSC, avec interrogation de banques de données](#)

Cellule de Coordination Documentaire Nationale pour les Mathématiques

<<http://www-mathdoc.ujf-grenoble.fr/MS2000/db.html>>

MSC200 classification scheme with multilingual interface. It offers a multi-lingual version of the MSC2000: French, English, Italian. The English version uses original data on the AMS site

<www.ams.org/msc>. The Italian version uses our data from the Padova site

<www.math.unipd.it/~biblio/math/>.

[Connections between the classification schemes DDC21 and MSC2000](#)

<<http://www.math.unipd.it/~biblio/msc-cdd/index.html>>

A draft presentation for the EULER project for the connection between Dewey 21.ma ed. and MSC2000 on the site of the library of the mathematics seminary of the University of Padova.

Mathematics resources organised by classification or by topic

Several sites contain mathematics resources organised by classification or indexed by topic. Several fundamental collections have been inserted in the mathematics VRD for their selectivity, for the quality of the resources offered, or for the specificity of the digital collection.

[The Math Forum's Internet Mathematics Library](#)

<<http://forum.swarthmore.edu/library/topics/>>

The Math Forum's Internet Mathematics Library is an annotated catalogue of Web sites on mathematics and on the didactics of mathematics. The site is particularly aimed at educators, teachers, students and anyone involved in the teaching or learning of mathematics at all levels. Math Forum is a virtual community for mathematics education.

[Mathematical Atlas](#)

<<http://www.math.niu.edu/~rusin/known-math/index/index.html>>

The Mathematical Atlas site contains an important collection of articles on different aspects of mathematics at the university level, but not necessarily on scientific research. The goal of the collection is to introduce topics in different areas of modern mathematics, describing fundamental subjects and results, and offering key references from which one can delve more deeply on the different aspects.

Also noteworthy is the access mode via the map, which is organised in a hierarchical order according to discipline:

[Clickable Index Map of Mathematics](#)

<<http://www.math.niu.edu/~rusin/known-math/index/mathmap.html>>

Data Bases: Abstracting, Reviewing and Data base Services

This instrument is connected to the General Directory or the main page of the VRD, but it can also be used independently.

This page offers detailed descriptions of the principal international bibliographical data bases for

mathematics and for related disciplines, access modes, mirrors, covered periodicals and adjunct services.

The world of mathematics revolves around two data bases for international mathematics literature: **MATH** [9] e **MathSci** [10].

The first originated in Europe in contrast to the politics of monopoly, and more closely adhering to the rules of the intellectual property rights system in the *droit d'auteur* continental countries of Europe, and more accurately reflecting the needs of the Italian mathematics community.

The second is produced by the *American Mathematical Society* (AMS), and reflects the organisation of information in a typically American fashion, with a mechanism which regulates access and use clearly orientated to the regime of copyright.

MATH is the electronic version of the famous directory *Zentralblatt für Mathematik und ihre Grenzgebiete / Mathematics Abstracts* (ZM/MA), also known as *Zentralblatt MATH* found on the Web.

Zentralblatt für Mathematik, initially produced by the *Deutschen Akademie der Wissenschaften* zu Berlin, and later by the *Heidelberg Akademie der Wissenschaften* and the *Fachinformationszentrum* (FIZ) Karlsruhe, published by *Springer-Verlag*, replaced by ***Jahrbuch für die Fortschritte der Mathematik*** (JFM). MATH, European mathematics data base extant since 1931, is accessible via the Berlin-based site of the EMIS-EMS (European Mathematical Information Service - European Mathematical Society) and through other mirror sites: Strasburg, New York and the Italian SIBA site in Lecce.

MathSciNet, begun in 1940 by the American Mathematical Society (AMS), is the on-line version of the two paper directories *Mathematical Reviews* (MR) and *Current Mathematical Publications* (CMP) [11]. The bibliographical data base contains 60 years of international mathematics literature or over 1.4 million records (including 60,000 CMP quotations) and approximately 60,000 new additions every year. Articles are selected from some 2300 international mathematics journals (including 1600 current ones) in addition to 7500 monographs, proceedings, doctoral theses and annual technical reports.

Other mathematics data bases of interest are:

Mathematical Didactics MATHDI [12]

This is the on-line version of *Zentralblatt für Didaktik der Mathematik*, from 1976 to the present, bibliographical data base on the literature of mathematics education and related fields. All the relevant periodicals are covered in the field of mathematical didactics, some 500 titles. The references, almost all containing an abstract, are in English and German, and refer to periodicals (50%), textbooks and manuals (30%), reports and multi-medial material. The classification scheme used is the ZDM.

CompuScience [13]

Bibliographical data base produced by *Fachinformationszentrum* (FIZ) Karlsruhe. Department of Mathematics & Computer Science Berlin, new version for the Web, contains some 500,000 references (from 1976 to today for ACM's *Computing Reviews* and from 1977 to today for ACM's *Guide to Computing Literature*) in addition to Section 68 "Computer Science" by *Zentralblatt für Mathematik*. A careful analysis and evaluation of the individual reviews, in accordance with the ACM (ACM's *Computing Classification System*) classification scheme, ensures an accurate indexation for a high level of information.

The independent page connected to and integrated in the VRD, contains and describes the more important data bases of the mathematics sector

<http://library.cern.ch/derobbio/mathres/mathdatabase.html>

Mathematics Literature on the Web

The section is subdivided in three parts

- **Electronic periodicals**
- **Digital monographs**
- **e-preprints (separate instrument)**

Numerous lists for **electronic journals** in the mathematics sector are available on line through individual publishers or groups. It was determined that the list [*directory of the American Mathematical Society*](#) be included. It offers 500 web links to ToCs (Table of Contents) of periodicals, abstracts, general information on periodicals (editorial committee, subscription information, etc...) and when available, the direct link to the full-length text of the article.
<<http://www.ams.org/mathweb/mi-journals5.html>>

Other mathematics e-journals lists are:

[*The Electronic Library of Mathematics. E-journals*](#)

<<http://www.emis.de/journals/index.html>>

[*Mathematics Virtual Library. Journals*](#)

<<http://euclid.math.fsu.edu/Science/Journals.html>>

Collection maintained by Florida State University, Department of Mathematics.

[*e-journal list of interest to mathematicians*](#)

<<http://www.math.unipd.it/~biblio/seminario/biblioteca/e-jourmath.htm>>

This is the list found on the site of the Mathematics Seminary Library of the University of Padova.

This section lists, among others, the most important **collections of digital mathematics volumes** or digital libraries for mathematics.

I would like to mention that, in this section, I opted not to include the OPAC catalogues of the mathematics libraries.

Instead, I chose to create a wholly virtual collection, similar to what one can find on the Web with respect to digital monographs in physics and mathematics.

Some of the resources listed are sites which contain or effectively own the digital collection. Other sites, instead, are gateways which, through a selective index, connect to the volumes contained on other sites. Thus, some overlapping is inevitable.

The most important digital collection, for its historical relevance, is the one housed at **Cornell University**, created in Cupertino with the Xerox company.

The project saw the transfer of 571 mathematics texts, dating from the early part of the nineteenth century, to digital format, primarily in an effort to preserve the information from deterioration caused by acid contained in the paper used during that time, but also to make available an affordable service of print on demand for copies of the texts in question.

[Math Book Collection. Cornell University Library](http://cdl.library.cornell.edu/cdl-math-browse.html)

<<http://cdl.library.cornell.edu/cdl-math-browse.html>>

In Europe we have the collection of the Electronic Publishing Committee of the European Mathematical Monographs.

[The Electronic Library of Mathematics](http://www.emis.de/monographs/index.html)

<<http://www.emis.de/monographs/index.html>>

which contains some ten monographs, proceedings and general works.

The Catalogue général des documents numérisés lists only the documents available on [Gallica](#), on the site of the Bibliotheque Nationale de France. It offers 380 mathematics texts and 406 physics texts

<<http://catalognum2.bnf.fr/html/i-frames.htm>>

A typical gateway, which connects to digital books in other sites, is the one maintained by the University of Pennsylvania.

[The On-Line Books Page](http://digital.library.upenn.edu/books/), contains 302 mathematics and computer science volumes and 105 physics volumes <<http://digital.library.upenn.edu/books/>>

Preprint servers for mathematics, physics and computer science

This instrument, as well, is found on an independent page, though closely related to the general VRD. More than forty preprint resources or sites are described.

The directory is divided in four parts:

- **Directories and General Resources**
- **Main preprint data bases and Search Engine Interfaces**
- **Institute and Department Servers**
- **Other scientifics Preprint Web sites**

I will not describe the numerous and noteworthy resources found in this section. These require separate treatment, as much for descriptive aspects as for the contents, but also for the implications with respect to electronic publishing and scientific communication in particular.

Specialised Document Delivery Services for Mathematics

Here are listed several sites which offer services in Document Delivery. For mathematics, related to MathSciNet, is the [Canadian CISTI](http://www.nrc.ca/cisti/docdel/docdel_e.shtml) Canada Institute for Scientific and Technical Information <http://www.nrc.ca/cisti/docdel/docdel_e.shtml>

In Europe *GAUSS-/SSG-Document Delivery* (SUB Göttingen), *TIB in Hannover*, and *JASON-WWW* (Universitätsbibliothek Bielefeld) in German territory are connected to Zentralbatt

Virtual Bookstores for Mathematics

The section relating to services includes several virtual bookstores, among them the American meta-resource

The Mathematics Online Bookshelf and the virtual bookstore of the AMS, [AMS Bookstore](http://www.ams.org/bookstore/), specialising in mathematics monographs <<http://www.ams.org/bookstore/>>

Noteworthy for its originality is the [Virtual Bookstore of the CERN](http://library.cern.ch/acquisitions/amazon_de.html) <http://library.cern.ch/acquisitions/amazon_de.html>

The CERN's Scientific Information Service has subscribed to a program put forth by Amazon, which provides access to the library's catalogue from the pages of the CERN library. The program grants the CERN library 5% of proceeds of orders coming throughout this channel. The service is also available outside of CERN.

Mathematics Projects

In this site, for every project there is a table which describes objectives. I will mention the most important ones for the European context.

[EULER](http://www.emis.de/projects/EULER/)

European Libraries and Electronic Resources in Mathematical Sciences [14]

<<http://www.emis.de/projects/EULER/>>

The main objective of EULER is to be a "one-stop shop" for research on mathematics information resources such as books, pre-prints, Web pages, abstracts, collections of articles and reviews, periodicals, technical reports and theses. With this in mind, July 1999 saw the development of a Web meta-interface for parallel simultaneous querying, run by the EULER engine, with protocol z39.50, with a heterogeneous collection of data bases, in an effort to integrate data gathered from: bibliographical data bases, OPAC, electronic reviews produced by academic publishers, prepublication and grey literature servers, and on-line mathematics resources indices.

Within the scope of European projects on mathematics under EMIS is the [JFM Jahrbuch-Electronic Research Archive for Mathematics](http://www.emis.de/projects/JFM/) (ERAM) [15] <<http://www.emis.de/projects/JFM/>> project.

Founded in 1868 by mathematicians Carl Ohrtmann and Felix Müller, JFM is comprised of 68 volumes for the period 1868 to 1943 with over 200,000 reviews of mathematics publications of the period.

[LIMES](http://www.emis.de/projects/LIMES/)

Large Infrastructure in Mathematics Enhanced Services

<<http://www.emis.de/projects/LIMES/>>

The main objective of LIMES is to facilitate the integration of European data bases with the Zentralblatt data base at the integration centre, through a distributed system.

Other projects being undertaken in Europe include:

[Internet Information Services for Mathematicians](http://www.Math-Net.de/)

<<http://www.Math-Net.de/>>

This project comprises *MPRESS* which has to do with the European Mathematical Society and the

European bibliographical data base for mathematics MATH Zentralblatt [16].

Through MPRESS the following preprint servers are queried: the French Index national des prépublications et thèses en mathématiques, the Austrian JABaPub / Preprints, the Italian SINM-MPRESS / Preprints, the Swedish Preprints from Stockholm, the German MathN / D-MathNet.preprints, in addition to Topology Atlas (preprint servers relating to topology), the section on mathematics on the site of Augusta on the Los Alamos server ar.Xiv, Algebraic Number Theory Archives e K-theory Preprint Archives.

CARMEN

Content Analysis, Retrieval and MetaData: Effective Networking

<<http://www.mathematik.uni-osnabrueck.de/projects/carmen/index.en.shtml>>

is a project, which comprises a "sub-project", studying the interconnection of the different classification schemes.

Mathematics and Information

Numbers were born before writing, though the roots of their origin are lost in prehistory. If mathematical intuition, as John D. Barrow teaches us, did not exist in the ancient civilisations, it was even less evident in primitive ones.

What distinguishes an intellectual creation by a mathematician from that of another author in the arts or the human sciences is that a mathematical creation, as an original idea, can be formulated independently in the very same way by another mathematician somewhere else in the world – someone from a different culture and education, and living in a completely different economic and political system. For this reason, mathematical formulas are considered to be part of the human heritage and not subject to intellectual property rights protection.

It is very peculiar that different mathematicians, separated by time and space, should make the same discoveries and express these using identical "formulations". It is not possible in the field of arts and letters for two authors in different places and at different times to compose the very same work. This observation, as Barrow [17] reminds us, leads us to think of mathematics as something "completely or partly independent of human thought" with an objective foundation.

In the *Virtual Reference Desk for Mathematics* one comes across a curious resource:

Why is there no Nobel Prize in Mathematics?

There is a Nobel Prize for physics and chemistry, as well as for literature, medicine and peace. Why not a Nobel Prize for mathematics?

I will conclude this survey of information resource for mathematics with a pleasant anecdote currently making the rounds in mathematical circles, particularly in France and in the United States [18], and which involves two eminent figures of the last two centuries: the celebrated Swedish mathematician Magnus Gösta Mittag-Leffler [19] and Alfred Nobel [20], chemist and inventor of dynamite by which he amassed his enormous wealth and at the same time became world famous. The brilliant and ambitious mathematician was also known for his poetic genius and his uncommon intellectual allure. Younger than Nobel by thirteen years, he had studied complex analysis under K. Weierstrass. He was the founder of the *Acta Mathematica*, and exercised great influence in the cultural and academic life of his native Sweden until the end of the last century [21].

It is told that the famous mathematician won the heart of the woman with whom Nobel [22] had fallen in love. For this reason Nobel refused to create a category for mathematics, which would most certainly be won by his rival [23]. He thus omitted in his will [24] a prize for mathematics so that no mathematician would ever be awarded a prize bearing his name [25].

"The mathematician's best work is art, a high perfect art, as daring as the most secret dreams of

imagination, clear and limpid. Mathematical genius and artistic genius touch one another [26]. This quotation by Mittag-Leffler, drawn from the Quotation Server at Furman University, ends my presentation of the Virtual Reference Desk for Mathematics and underscores the beauty of this discipline which expresses itself as a fractal opening from within in increasingly smaller infinite universes and unfolding in spaces stretching to infinity in ever-expanding parallel universes.

Acknowledgments

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References

[1] Internship at the CERN Library from June to October 2000

[2] My epigraph was inspired by the first sentence in Gaisi Takeuti's "*Proof Theory*" (1975), "*Mathematics is a collection of proofs*".

[3] <http://www.wkap.nl/series.htm/ENMA>

[4] http://dbs.cwi.nl/cwwwi/owa/cwwwi.print_people?ID=472

[5] <http://www.ncstrl.org/>

[6] <http://www.emis.de/projects/EULER/>

[7] From the **AIB-WEB** site. The World of On-line Libraries. Classification "Classification Schemes" by Antonella De Robbio <http://www.aib.it/aib/lis/lpi16c.htm>

[8] For a more detailed accent of the MSC classification, see the "*2000 Draft version of the Mathematics Subject Classification (MSC): How is mathematics moving on?*" by Antonella De Robbio, Dario Maguolo, Alberto Marini <http://www.math.unipd.it/~biblio/math/analisi/2001.htm> published in an abridged version on the *Bollettino AIB*, March-June 1999 (Vol. 39, n. 1/2)

[9] Information: <http://www.zblmath.fiz-karlsruhe.de/zbl/index.html>

[10] Accessible through the official AMS site in Providence: <http://www.ams.org/mathscinet/> and five additional mirror sites

[11] In the original on-host version of *MathSci Online* are also contained the *Current Index to Statistics dell'ASS* (CIS), *Index to Statistic and Probability* della AMS (TUKEY), *ACM Guide to Computing Literature* (GCL), *ACM Computing Reviews*, *Technical report in Computer Science of the Stanford University*, and *Eugene Strens Recreational Mathematics Collections of the University of Calgary*

[12] Accessible through: <http://www.emis.de/MATH/DI.html>

[13] Accessible through: <http://www.zblmath.fiz-karlsruhe.de/cs/CS-cs.html>

[14] The EULER project which revolves around MATH, is cofinanced by the European Commission in the sector Telematics for Libraries; future documentation on the project is available on the EMIS sites. <http://www.emis.de/projects/EULER/> (main site); <http://emis.csi.it:8888/projects/EULER/> (EMIS mirror site in Torino); <http://opac.unifi.it/euler/> (EULER project on the site of the Florence University)

[15] At the present time JFM contains the following volumes already in digital format, with comprehensive bibliographical references and abstracts 1-20 (1868-1888); 25 (1893/94); 28-30 (1897-1899); 32-34 (1901-1903); 38-39 (1907-1908); 42 (1911); 45 (1914/1915); 50 (1924); 44, 46-49,51-56 (1913-1930): only references.

[16] The use of MetaData DC allows the identification of the preprints found on servers, or to reach other servers connected to gateways, as in the case of the Italian server.

[17] Barrow, John D. "*Perché il mondo é matematico*", Roma, Laterza, 1998

[18] For a documented answer to the question, refer to the article by L. Gårding e L Hörmander "*Why is there no Nobel Prize in Mathematics?*", Math. Intelligencer 7 (1985), 73-74

[19] 1846-1927

[20] 1833-1896

[21] Comoglio, Mauro "*La strana storia dei matematici e di un premio negato*" <http://matematica.uni-bocconi.it/news/nobel.htm>

[22] A variation of the story, though less credible, where the woman in question is supposed to be Nobel's wife, is found in an article which appeared in *La Stampa* on October 19, 1997, <http://www.mat.uniroma2.it/txt/conf/arch/1997/rass-stampa97/oct97/nobel.html>

[23] This hypothesis has been frequently denied in as much as during that time there were many other celebrated mathematicians, among them Hermite, Bertrand, Weierstrass, Poincare, Hilbert

[24] In the first draft of his will, Nobel bequeath a huge gift to the Swedish Academy of Sciences for the creation of the famous prizes which bear his name, namely 10 million crowns to the future University of Stockholm. Unfortunately for Mittag-Leffler and his colleagues, in the will of November 27, 1895 (Nobel died on December 10, 1896) the bequest was reduced to next to nothing, as Nobel decided to bequeath almost his entire estate to the foundation which bore his name and which was now charged with creating and awarding the celebrated prizes. Equally interesting is the book by Ragnar Sohlman, the chief executor of Alfred Nobel's will. From Da Comoglio, Mauro "*La strana storia dei matematici e di un premio negato*" <http://matematica.uni-bocconi.it/news/nobel.htm>

[25] Nobel Foundation <http://www.kva.se/eng/index.html>

[26] Mittag-Leffler, Magnus Gösta. In N. Rose "*Mathematical Maxims and Minims*", Raleigh NC: Rome Press Inc., 1988

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[Top](#)

[Home](#)

[Editorial Board](#)

[Contents](#)

[Issue 3](#)

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