MATHEMATICAL INSTRUCTION IN AN INTERNATIONAL PERSPECTIVE: THE CONTRIBUTION OF THE JOURNAL *L'ENSEIGNEMENT MATHÉMATIQUE*

L'éducation mathématique dans une perspective internationale :
la contribution de la revue L'Enseignement Mathématique

par Fulvia FURINGHETTI

La revue *L'Enseignement Mathématique* a été fondée en 1899, dans un moment de grand ferment social et culturel qui touchait notamment les mathématiques. D'une part les États s'étaient dotés d'une organisation moderne comportant, entre autres, la mise en place de systèmes nationaux d'instruction. D'autre part, la recherche mathématique s'était développée dans différentes directions (pures ou appliquées), et ce de manière très efficace. Plusieurs revues de recherche mathématique étaient alors régulièrement publiées dans divers pays et le premier Congrès international des mathématiciens avait été organisé à Zurich en 1897. Dans le domaine de l'enseignement des mathématiques, des associations nationales d'enseignants avaient vu le jour dans de nombreux pays et des revues avaient été créées portant uniquement sur l'enseignement de cette discipline.

Les idées centrales faisant de *L'Enseignement Mathématique* un journal remarquable dans ce panorama sont l'*internationalisation* et la *communication*. Les fondateurs de la revue — le Suisse Henri Fehr (1870–1954) et le Français Charles-Ange Laisant (1841–1920) — en furent les directeurs jusqu'à leur mort. Dans la présentation du journal publiée dans le premier numéro, ils écrivaient que le monde de l'enseignement devait s'associer au grand « mouvement de solidarité scientifique ». Ils soulignaient aussi l'importance des réformes des programmes et du problème de la formation des enseignants. Pour aborder ces questions, ils préconisaient que l'on compare les systèmes d'instruction dans les différents pays et que les enseignants échangent leurs points de vue.

Le présent texte porte sur les premières années du journal, jusqu'à la première Guerre mondiale, au cours desquelles le projet des fondateurs a trouvé un terrain

favorable à son développement. A cette époque, le « Comité de patronage » du journal comprenait des personnages importants du milieu mathématique (directeurs de revues mathématiques, historiens, mathématiciens), tous avec un intérêt marqué pour les problèmes liés à l'éducation mathématique. Le journal publiait

- des articles généraux,
- des nouvelles du monde académique,
- des annonces bibliographiques et des comptes rendus de livres, articles et conférences,
- des correspondances diverses,
- des enquêtes lancées par le journal, ainsi que les résultats accompagnés de commentaires.

La langue utilisée alors est quasi exclusivement le français. Les articles généraux abordent des thèmes mathématiques d'intérêt pour l'enseignement aux niveaux secondaire et tertiaire, ainsi que l'histoire, la philosophie, l'épistémologie et la psychologie. Les auteurs des articles et des lettres étaient pour la plupart français ou suisses, mais on trouvait aussi des contributions provenant d'autres pays (Algérie, Allemagne, Argentine, Autriche et les régions de son ancien empire, Belgique, Danemark, Espagne, États-Unis, Grèce, Italie, Japon, Pays-Bas, Portugal, Roumanie, Royaume-Uni, Russie, Ukraine). Déjà au cours de la première année et durant les années subséquentes, on trouve dans la revue des articles sur la situation de l'enseignement des mathématiques dans divers pays, en conformité avec les buts d'information et de communication du journal.

La correspondance permit l'établissement de contacts entre les lecteurs et fut à l'origine d'initiatives intéressantes. Par exemple, c'est une lettre d'un lecteur qui inspira une enquête lancée par le journal sur les méthodes de travail des mathématiciens. Cette enquête fut réalisée au moyen d'un questionnaire de 30 questions adressées aux lecteurs et autres mathématiciens intéressés. Le questionnaire fut préparé par Fehr avec l'aide de deux psychologues de l'Université de Genève, Édouard Claparède et Théodore Flournoy. Le journal publia le questionnaire ainsi que l'analyse des réponses et des commentaires sur les résultats, rédigés par Fehr, Claparède et Flournoy. Cette enquête contribua à attirer l'attention des mathématiciens (entre autres, Henri Poincaré) et des enseignants sur certains thèmes reliés à la psychologie et sur le problème de l'invention en mathématiques.

La discussion sur les réformes à accomplir dans l'enseignement des mathématiques, lancée en 1905 par des lettres de mathématiciens (parmi lesquels David E. Smith et Gino Loria), fut à l'origine d'un mouvement plus général qui aboutit à la fondation de la Commission internationale de l'enseignement mathématique (CIEM/ICMI) lors du Congrès international des mathématiciens tenu à Rome en 1908. A partir de 1909, le journal devint d'ailleurs l'organe officiel de la CIEM et on y publia régulièrement les annonces, actes des rencontres et enquêtes de la Commission. Fehr fut Secrétaire général de la CIEM depuis sa création jusqu'au début des années 50.

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by Fulvia FURINGHETTI

INTRODUCTION

Among all the mathematical journals of the nineteenth century *L'Enseignement Mathématique* plays a particular role [1]). It was founded in 1899 by Charles-Ange Laisant and Henri Fehr and is still published today [2]). To understand why its role is so interesting I will analyse the first years of its life, in which it made a strong contribution to the birth of an international community of mathematics educators, alongside the community of mathematics researchers. We shall see that this analysis provides us with the opportunity to rethink important aspects of the history of mathematical instruction, including the birth of ICMI.

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[1]) Appendix 1 gives an idea of the range of the mathematical press when *L'Enseignement Mathématique* was founded. See [Friedelmeyer 1996] for further information on early mathematical journals.

[2]) At first the publishers were G. Carré and C. Naud in Paris (since 1902 C. Naud alone). In 1904 the administration and the printing house were transferred to Geneva, and the publishers were Gauthier-Villars (Paris) and Georg & Co. (Geneva). The present publisher is an independent foundation linked to the Department of Mathematics of the University of Geneva. The printer has been KUNDIG (Geneva) since 1903, with slight variations of the commercial name: W. Kündig & fils, Albert Kündig, Albert Kundig ('*umlaut*' removed in 1914!), etc., now SRO-Kundig.

In the first issue of *L'Enseignement Mathématique* the editors explained the aims of the journal in the following terms:

> A l'heure où la science a tant progressé, certaines simplifications peuvent être désirables, les programmes des diverses branches de l'enseignement appellent des réformes plus ou moins complètes. Et avec cela, il y a une question fondamentale dont on ne saurait méconnaître l'importance : c'est celle de la préparation du corps enseignant.
>
> Toutes ces transformations ne sauraient s'accomplir brusquement, ni sans de sérieuses réflexions préalables. Mais, pour procéder à une telle étude d'une façon judicieuse et utile, la première des conditions n'est-elle pas de connaître ce qui se passe dans les autres pays, de savoir quel est dans chacun d'eux le mode d'organisation de l'enseignement mathématique, quels sont les programmes en vigueur, les moyens de sanction des études, etc. ? […] Malgré les relations fréquentes qui se sont établies à notre époque entre savants qui cultivent un même sujet d'étude, malgré les congrès internationaux, si brillamment inaugurés à Zurich en 1897 et dont le principe est désormais établi, le monde de l'enseignement proprement dit n'a pu s'associer jusqu'à présent à ce grand mouvement de solidarité scientifique aussi pleinement qu'il eût été désirable. […]
>
> Nous avons voulu, par la publication de notre Revue, renverser les obstacles qui s'opposent à ces communications réciproques et créer une sorte de correspondance mutuelle, continue, entre les hommes qui ont consacré leur vie à cette noble mission : l'éducation mathématique de la jeunesse.
>
> En vue de ce résultat, notre premier soin a été de donner à la publication périodique dont il s'agit un caractère franchement et hautement international. [3])
>
> [Les Directeurs 1899, 1–2]

The target readership of the journal was those who taught mathematics (at secondary and tertiary level). As stated by the directors in the introduction to the sixth volume of *L'Enseignement Mathématique* :

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[3]) At a time when science has made so much progress, some simplifications may be desirable, the programmes of the different branches of teaching require more or less complete reforms. Linked to this there is a fundamental issue whose importance should not be overlooked : namely that of the education of teachers.

All these changes ought not to be carried out in an abrupt way, nor without serious preliminary reflections. But is not the first requirement for proceeding in such a study in a judicious and fruitful way, to be aware of what happens in other countries, to know the way mathematics teaching is organised in each of them, what teaching programmes are in force, the methods by which the studies are approved, etc. ? […] Despite the strong rapport that has been established today among scientists of the same field, despite the international congresses of mathematicians, so brilliantly inaugurated in Zurich in 1897 and accepted as a principle for the future, the world of education proper has not up to now been able to join this great movement of scientific solidarity as fully as would have been desirable […].

It has been our wish, through the publication of our Journal, to overcome the obstacles to reciprocal *communications* [my italics] and to create a kind of continuous mutual correspondence between men who have devoted their lives to this noble mission : the mathematical education of young people.

In view of this aim, our first concern has been to give this periodical a clearly and openly *international* [my italics] character.

> Le mot «Enseignement» a pour nous la signification la plus large. Il veut dire enseignement des élèves, et aussi enseignement des professeurs — et d'ailleurs l'un ne va guère sans l'autre.[4]) [*L'Enseign. Math. 6* (1904), 4]

To consider those who teach as persons accomplishing a 'noble mission', rather than persons following a profession, has been a typical attitude of the past.

The social role of science and links with progress in its various forms (industry, technology, …) are among the concerns of the editors. The key words of the journal's programme are 'internationalism', 'information', 'communication' and, of course, 'teaching mathematics'. Professional mathematicians were invited to collaborate actively with the project of the journal in order to keep the teaching of mathematics in touch with the advances in the subject itself.

Behind the ideas of internationalism and solidarity expressed in the journal there lay social and political ideals, very much alive in society at the time of its foundation, but which slowly withered away in the new century. The following passage hints at the changes in the international atmosphere and their consequences for the life of the journal:

> La guerre européenne porte un coup sensible aux institutions internationales. Dans les pays belligérants et dans les pays neutres voisins tout ce que la nation compte d'hommes valides est sous les drapeaux. Il devient donc matériellement impossible de continuer les travaux faisant appel à de nombreux collaborateurs. Les œuvres de paix telles que la nôtre passent à l'arrière plan. D'ailleurs, poursuivant un idéal commun librement choisi, elles exigent une volonté d'union qu'on ne saurait demander aux savants dans une période aussi troublée que celle que nous traversons.[5]) [Fehr 1914, 477]

I consider 1914 (the year of the beginning of the First World War) as the limit of the journal's pioneering period, in which it found a propitious environment in the international social atmosphere. My analysis of the journal goes[6]) from the year of the foundation (1899) to this crucial year 1914.

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[4]) The word '*Enseignement*' [teaching] has for us the widest possible meaning. It means the teaching of pupils, as well as the teaching of teachers — and, indeed, you can hardly have the one without the other.

[5]) The European war carries with it an appreciable impact on international institutions. In the fighting countries and in the neighbouring neutral countries all those whom the nation considers to be able-bodied are in uniform. Thus it becomes practically impossible to continue with activities requiring the support of numerous collaborators. Peaceful activities like ours have to take second place. Furthermore, being in pursuit of a freely chosen common ideal, they demand a willingness for unity, which ought not to be asked of scientists in a period as troubled as the one in which we are living now.

[6]) The steps of the history of the journal until the 1970s are sketched in [de Rham 1976].

THE FOUNDERS

As is well known, early mathematical journals were strongly linked to their founders, to the extent that many of them were referred to as the journal of its founder. For example the *Journal für die reine und angewandte Mathematik* (founded by August Leopold Crelle in Berlin, first issue in 1826) was simply known as 'Crelle's Journal'. This was also the case for the *Journal de mathématiques pures et appliquées* (founded by Joseph Liouville in Paris, first issue in 1836) and the *Giornale di Matematiche ad uso degli studenti delle università italiane* (founded by Giuseppe Battaglini in Naples, first issue 1863). In some cases the editors were also the owners of the journal. In journals devoted to mathematics teaching the importance of the editorial line is twofold: on the one hand cultural (in connection with mathematics), on the other hand social (in connection with systems of instruction). For the period we are considering, the editorial line of *L'Enseignement Mathématique* may be seen as a real expression of the personalities of its two founders and editors.

Charles-Ange Laisant was born in Basse-Indre (France) on 1st November 1841 and died in Paris (1920). In his obituary he is described as "homme de science, éducateur, philosophe et politicien" [Buhl 1920, 73] (see also [Sauvage 1994; Pascal 1983]). Both his life and his contributions to the mathematical community are a combination of all these characteristics. He studied at the *École polytechnique* in Paris. His first mathematical works were on the application of the theory of equipollence and the method of quaternions (see [Ortiz 1999; 2001]). Afterwards he turned predominantly to social and instructional themes. His view of society, based on values such as solidarity, collaboration and communication stimulated his enterprises in the community of mathematicians. In 1894 he founded (with Émile Lemoine) the journal *L'Intermédiaire des Mathématiciens*, which was conceived as a means of providing contact between mathematicians through the exchange of questions (which were something more than mere exercises) and answers, together with bibliographical references. In the first issue of that journal [*1* (1894), question 212, 113] the idea of the organisation of international congresses of mathematicians, to be held at regular intervals, was explicitly launched. Laisant also edited the *Annuaire des Mathématiciens* (C. Naud, Paris, 1902), a publication that contained the names and addresses of living mathematicians, of scientific societies and of scientific periodicals. He was, with Poincaré, a member of the commission charged with the production of the *Répertoire bibliographique des sciences mathématiques* (a precursor of the present journals of mathematical reviews).

In the field of mathematical education and instruction Laisant's works on pedagogy of mathematics were greatly valued by his contemporaries in France and abroad. His educational and philosophical leanings are evident in the editorial line of the journal and in the contributions he made to *L'Enseignement Mathématique*. For example, Buhl [1920] writes that Laisant's ideas were imbued with the philosophy of Auguste Comte and, indeed, in the second year of *L'Enseignement Mathématique*, we find an article on the philosophy of mathematics of Comte (see [Vassilief 1900]). Interesting aspects of Laisant's personality are shown by his contributions to French political life. Ortiz [2001] reports that he was a member of the national parliament in the Third Republic, up to the end of the century. In France this was a period of social changes which had repercussions in the scientific world. It was held that advancement in science occurs according to criteria similar to those necessary for industrial development. As Ortiz put it, Laisant showed

> cierta coherencia entre las agendas científica y política […], ambas muestran una preocupación seria por introducir ideas nuevas, por abrir nuevas posibilidades, y por buscar unidad dentro de una aparente diversidad.[7]) [Ortiz 2001, 83]

Henri Fehr was born in Zurich on 2nd February 1870 and died in Geneva (1954). He studied in Switzerland and afterwards in France. His doctoral dissertation was on the method of Grassmann vectors applied to differential geometry. Jacques Hadamard gave a positive review of this work. Fehr became professor at the University of Geneva (Sciences Faculty) and later dean, vice-rector and rector. Further information on Fehr is in [Anonymous 1955; de Rham 1955; Ruffet 1955].

A prominent characteristic of Fehr's personality was his interest in the social aspects of the mathematical community and academic life. He was regarded as a "pédagogue exceptionnel" [Anonymous 1955, 7], but he was also involved in social commitments such as the committee of the fund of pensions of his colleagues. He applied his skill as an organiser in founding[8]) the Swiss Mathematical Society (of which he was president), the Foundation for the Advancement of Mathematical Sciences, and the journal *Commentarii Mathematici Helvetici*. He received national and international honours and appointments. Fehr participated, as his country's delegate, in the International Congresses of Mathematicians and was vice-president of the ICMs in Toronto

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[7]) clear consistency between his political and scientific behaviours. Both in politics and in sciences he was seriously concerned with the introduction of new ideas, of opening up new possibilities, and looking for unity in things that appear different.

[8]) with R. Fueter and M. Grossmann

(1924) and Bologna (1928). He was also vice-president of IMU. He was one
of the founders of ICMI (in 1908), of which he was the secretary-general
until the Second World War. When ICMI was reconstituted (in Rome, 1952)
Fehr was one of the members of the special committee of five appointed
to draw up a plan of work in preparation for the International Congress of
Mathematicians to be held in Amsterdam (in 1954). When this committee co-
opted new members to form an ICMI Executive Committee, Fehr was again
chosen to be the honorary president of this new committee (see [Behnke
1951–1954]). Throughout all these years Fehr was the real soul of ICMI.

The main contribution of Fehr as author of articles in the journal was
in the field of mathematics instruction. He singled out some central points,
such as:

- innovations in the mathematical programmes and their links with the
  development of science and technology, as an echo of what was
  happening in many countries (see [Schubring 1996]);

- the relationship between pure and applied mathematics and its influence
  on the mathematics teaching;

- the education of mathematics teachers;

- new trends in mathematics teaching.

From a reading of what has been written about Laisant and Fehr one is left
with the impression that these two men enjoyed the esteem of all those who
had contact with them. As a pair they are a good example of the integration
of interests and strengths, which was essential to the enterprise of editing
L'Enseignement Mathématique.

THE FORMAT OF THE JOURNAL

L'Enseignement Mathématique was published every two months. Initially
(see [Les Directeurs 1899]) all papers were published in French and this
continued to be the predominant language, despite the fact that the editorial
address of 1913 states that papers written in the official languages of the
International Congresses of Mathematicians (English, French, German and
Italian) were accepted, with Esperanto also allowed. One of the very few
articles appearing in a non-French language (followed by a long summary in
French) is "The principles of mathematics in relation to elementary teaching",
the text of the talk delivered at the International Congress of Mathematicians
in Cambridge (1912) by A. N. Whitehead [1913]. The admission of Esperanto

was in line with the atmosphere of internationalism advocated by the editors and the strong interest in 'international languages' shown by the mathematical *milieu* (see [Roero 1999]). Actually a few contributions to the journal were written in international languages, two of them by Charles Méray [1900; 1901] illustrating the advantages of Esperanto for the internationalism of science, one by M. Frechet [1913].

From 1903, the French mathematician Adolphe Buhl (1878–1949) was added as collaborator to the editorial board and, after Laisant died, Buhl became one of the editors of the journal and held that office until his death [9]). Until 1914 the journal had a *Comité de patronage*. The international nature of the journal can be gauged from the names of the members of the first *Comité* (1899):

Paul Appell, Paris
Nicolas Bougaiev (Bougajeff), Moscow (until 1903)
Moritz Benedikt Cantor, Heidelberg
Luigi Cremona, Rome (until 1903)
Emanuel Czuber, Vienna
Zoel García de Galdeano y Yanguas, Zaragoza
Alfred George Greenhill, Woolwich, England
Felix Klein, Göttingen
Valerian Nikolajwitsch Liguine (Ligin), Warsaw (until 1900)
Paul Mansion, Gent

Gösta Magnus Mittag-Leffler, Stockholm
Gabriel Oltramare, Geneva (until 1906)
Julius Peter Christian Petersen, Copenhagen (until 1910)
Émile Charles Picard, Paris
Henri Jules Poincaré, Paris (until 1912)
Pieter Hendrik Schoute, Groningen (until 1913)
Kyparissos Stephanos, Athens
Francisco Gomes Teixeira, Porto
Alexandr Wassiljewitsch Vassilief (Wassilief), Kazan
Alexander Ziwet, Ann Arbor, Michigan

The following new members took the place of deceased members: in 1904 Vasiliy Petrovich Ermakof (Ermakoff), Kiev; Andrew Russell Forsyth, Cambridge (until 1910); Gino Loria, Genoa; David Eugene Smith, New York; in 1907 Jérôme Franel, Zurich [10]). The composition of the *Comité* covered a wide range of abilities and interests including research in mathematics or in the history of mathematics, editing journals, the writing of books, teacher education and mathematics instruction.

From 1905 the journal carried the subtitle "Méthodologie et organisation de l'enseignement. Philosophie et histoire des mathématiques. Chronique scientifique – Mélanges – Bibliographie". Following the inauguration of ICMI (in Rome, 1908) the lives of ICMI and of the journal were intertwined; since 1909 the frontispiece of the journal has described itself as the "Organe officiel

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[9]) For further information on Buhl see [Fehr 1942–1950].

[10]) The *Comité de patronage* ceased to exist in 1915.

de la Commission internationale de l'Enseignement mathématique"[11]).

The normal practice (both in the past and today) is for journals to contain a set of articles and a small part devoted to selected announcements and reviews of books and articles appearing elsewhere. In *L'Enseignement Mathématique* the main articles were only a part of the journal, the other sections being just as important. In 1904, when the administration and the printing services moved from Paris to Geneva, the editors clearly explained the structures of the journal and the purposes of the different sections. They stressed again their intention to foster communication between researchers and teachers.

As an example of the format of the journal, we can look at the organisation of the material published in 1905 (the seventh year of the journal, the middle of the period under consideration). We find the following sections:

A) *Articles généraux* (General articles: Methodology and organisation of teaching, History and Philosophy)

B) *Mélanges* (Miscellanies)

C) *Correspondance* (Correspondence)

D) *Chronique* (News)

E) *Notes et documents* (Notes and documents)

F) *Bibliographie* (Bibliography: Reviews or simple announcements of treatises)

G) *Bulletin bibliographique* (Bibliographical bulletin: Content of the main mathematical journals)

The categorisation of the various contributions was not rigid and absolute; thus sometimes the same type of contribution appeared under different headings. During these years there was little change in the way the material was organised (e.g. in names of the sections, the distribution of the subjects, etc.) in order to reflect accumulated editorial experience or requests from readers, although the journal always maintained its general character of being flexible, open and multipurpose. Major changes occurred, however, when the journal became the official organ of ICMI in 1909, after which it carried reports of meetings of the commission as well as proposals for ICMI studies and their outcomes. We can obtain a better view of the nature of the journal from some detail of the contents published under the various headings.

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[11]) I will use the acronym ICMI, but in the journal the commission was termed CIEM (Commission Internationale de l'Enseignement Mathématique). In Germany the acronym was IMUK (*Internationale mathematische Unterrichtskommission*). In *The Mathematical Gazette* (1912) the commission was termed 'International Commission on Mathematical Teaching' or 'International Commission on the Teaching of Mathematics'. In the presentation of the questionnaire for the inquiry into the training of secondary teachers of mathematics [*L'Enseign. Math. 17* (1915), 129–145] we find 'International Commission on Mathematical Education' in the English translation and 'Commissione internazionale dell'insegnamento matematico' in the Italian one. Now ICMI stands for 'International Commission on Mathematical Instruction'.

GENERAL ARTICLES. Section *A*, and sometimes Section *B*, contained the sort of articles one may expect in a standard mathematical journal. The general articles were classified into various sub-sections. Over time, one of these sub-sections, 'Organisation of teaching', became of increasing importance. After the birth of ICMI this sub-section contained the various business material of the commission. Other issues concerning ICMI appeared also in the sections 'Chronique' and 'Notes et documents'.

Some of the articles, especially those by important mathematicians, had been published before elsewhere. Often papers roused discussion among the readers and reactions were published in the correspondence.

Until 1903, besides the section 'General articles' there was a section 'Études pédagogiques' (Pedagogical studies), explicit evidence of the editors' wish to stress the links with mathematics teaching.

MISCELLANIES. This section contained short articles of various types. In some years this part was attached to the correspondence section.

CORRESPONDENCE. In the 'Correspondance' section there were interesting contributions which, in some cases, could almost be considered as articles in their own right. From the point of view of interpreting the spirit of the journal this section is important in helping us to understand the readership and the kind of problems that interested them. We shall see later that it was a reader's letter that inspired a major inquiry launched by the journal (into the methods of working of mathematicians). Letters are also important in showing that countries all over the world were reached by the journal, even if letters came predominantly from Europe.

Major mathematicians figured among those who reacted to the articles published in the journal: L. E. J. Brouwer [*13* (1911), 377–380] who commented on a paper by G. Combebiac on the theory of measure, G. Peano [*8* (1906), 315–316] who reacted to the papers by E. Carvallo and V. Jamet on the convergence of series.

NEWS. This section included all kinds of news about the mathematical community: announcements of death, awards, meetings, proposals of new national programmes, monuments to be erected, the activity of societies and academies. Thanks to this section the reader was able to participate in the life of the mathematical community. This section is also important for present historians for the variety of information it provides.

NOTES AND DOCUMENTS. This section is devoted mainly to providing information on academic courses (topics developed, names of the professors). When the journal became the official organ of ICMI this section contained the Proceedings of the works of the national sub-commissions.

BIBLIOGRAPHY. This section contained short reviews of treatises. It is valuable for us today, both in giving us the reactions of contemporary readers to treatises that afterwards became famous, and also in providing us with information about forgotten works.

BIBLIOGRAPHIC BULLETIN. This section provided information about new books (authors, publishers and town of publication, format, and price) and the tables of contents of some important mathematical journals, and proceedings of academies and societies. Journals of history of mathematics and elementary mathematics are also mentioned. The list of the publications is not exhaustive, but is a very rich source of information (see Appendix 1).

THEMES AND AUTHORS

To give an idea of the themes treated in the journal, the contributions that appeared in the sections 'General articles' and 'Pedagogical articles' (excluding editorial notes published at the beginning of the volumes) have been classified in the Table below under the following categories [12]:

Alg	Algebra	**Met**	Methodology in teaching
Ana	Analysis	**Mod**	Mathematical models
App	Applications	**Nom**	Nomography
Ari	Arithmetic	**NSu**	National surveys of systems of
Ast	Astronomy		instruction
Esp	On the Esperanto language	**Org**	Organisation of mathematical
FMa	Financial mathematics		instruction
Fou	Foundational themes	**Phi**	Philosophical themes
Geo	Geometry	**PhM**	Philosophy of mathematics
His	History (including obituaries)	**Pro**	Probability
IC	ICMI	**Psy**	Psychology
Inq	Inquiries	**Soc**	Society
Log	Logarithms	**ToN**	Number Theory
Logi	Logic (including set theory)	**Tri**	Trigonometry
MaP	Mathematical Physics	**Var**	Various themes
Mec	Mechanics	**Vec**	Vectors

[12]) My classification is made from a reading of the articles, without reference to the classification in *Jahrbuch über die Fortschritte der Mathematik*, nor to the present classification in *Mathematical Reviews* or *Zentralblatt.* The journal used a classification different from mine; see the list published in volume 40 (1951–1954). On the difficulties of classifying papers, and especially papers of the past, see [Furinghetti & Somaglia 1992].

CONTRIBUTIONS THAT APPEARED IN THE JOURNAL,
CLASSIFIED BY THEMES, AND THEIR DISTRIBUTION

Year		1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Alg	25			3	1	2	2		4	4	2	2		1	1	1	2
Ana	60	3	3	8	1	2	6	6	5	2	3	4	1	4	4	6	2
App	2			1									1				
Ari	9		1	1			3	1		2	1						
Ast	2								1	1							
Esp	3		1	2													
FMa	1											1					
Fou	30	5	5	5		3	1	1			2	3	1	1		3	
Geo	150	7	14	8	16	12	6	9	8	9	9	9	5	15	3	8	12
His	22	1	3	2	1	1		1	3	2		3	1	1	1	2	
IC	16										1	2	4	2	3	1	3
Inq	19				1		1	3	5	7	2						
Log	2		1			1											
Logi	9						2	3	1	2							1
MaP	2											2					
Mec	22	1	1		3	1	2	2	3	1			3	1		2	2
Met	41	10	1	3	1		1	9	4		2	2	3	1	2		2
Mod	1		1														
Nom	5	1	1			2										1	
NSu	18	3		2	2			3			2	1	3	1			1
Org	19	2	2	1	1	1					1	1		1	1	1	7
Phi	6		1		3				1	1							
PhM	2				2												
Pro	4						1		1							1	1
Psy	1													1			
Soc	1						1										
ToN	16				1				1	5		2	2	1	4		
Tri	10	1	1	2			1	1	1					2	1		
Var	2								1						1		
Vec	4	1			1										2		
Totals	504	35	36	38	34	26	26	41	37	36	25	32	24	32	23	26	33

Further information may be obtained from the list of materials published in the journal itself [*40* (1951–1954), 124–174].

In the period being considered we find 212 authors of general or pedagogical articles. Some articles in the sub-section 'Organisation of teaching' are anonymous. Collaboratively written articles are unusual. Authors contributing more than five articles were: J. Andrade (France), A. Aubry (France), P. Barbarin (France), C. Berdellé (France), V. Bobynin (Russia), C. Cailler

(Switzerland), G. Combebiac (France), L. Crelier (France), H. Fehr (Switzerland), G. Fontené (France), L. Godeaux (Belgium), C. A. Laisant (France), H. Laurent (France), G. Loria (Italy), C. Méray (France), J. Richard (France), E. Turrière (France).

Contributions came from a number of countries [13]) such as Algeria, Argentina, Austria and the regions of its old Empire, Belgium, Denmark, France, Germany, Greece, Italy, Japan, The Netherlands, Portugal, Rumania, Russia, Spain, Switzerland, UK, Ukraine, USA. Usually, at the end of an article, we find the author's surname, together with a first initial and the place from which the article was submitted; some of these places are just a village so that it is not always easy to determine the country of origin. From the various data it would appear that the desire for internationalism was indeed realised, even if the core readership was in Europe. As regards contributions, France led the way, followed by Switzerland, and in total rather more than 50% of the authors wrote from these two countries.

The majority of the contributions were on geometry. That this was at that time considered to be the backbone of the mathematical instruction at secondary level in many countries is shown by the many letters from readers discussing themes related to Euclidean geometry. Many of the articles on geometry concerned descriptive geometry and, in general, those aspects which have links with applications of interest to technical institutes and faculties. Among the authors contributing to this topic, J. Andrade published attempts at new approaches to geometry suitable for technical schools. A few of the articles dealt with non-Euclidean geometries. Often one feels that behind many articles lay the problem of answering such questions as the role of rigour and axiomatic methods in the teaching of mathematics. This subject is linked to the foundational debate, very much alive in those years. Indeed, following the birth of ICMI the debate on the place of foundations in mathematical instruction became the object of specific inquiries published in the journal.

The themes of the reforms in mathematics teaching were treated in articles surveying mathematical systems of instruction and in articles that focused on specific parts of mathematics. For example, the teaching of analysis is discussed at a general level by Klein [1906], in line with the ideas expressed in the Meran Syllabus, and in articles discussing didactical problems of specific topics, such as the paper of Fehr [1905a] on the concept of function. In the following years the publication in the journal of the studies launched by ICMI contributed to raising interest in the theme of teaching calculus and analysis

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[13]) I refer to the modern names of the countries.

in many countries. An echo of this interest is to be found in national journals devoted to mathematics teaching, such as the British *Mathematical Gazette* and the Italian *Bollettino della Mathesis*. The theme of analysis is typical of the relationships between curricular innovations, mathematical research and the needs of society at the time (see [Bourlet 1910]). Also the interest shown by the journal in the book *Traité de nomographie* [14]) by Maurice d'Ocagne [1899] is evidence of the interest in the applications of mathematics and the teaching of mathematics to students in technical schools.

At first glance some teaching suggestions, such as those in [Sainte Laguë 1910] on the use of squared paper, may appear naive or obvious to a modern reader, if one does not take into account the state of teaching methods of the time and the difficulty of introducing new ideas, such as the graphing of functions (see [Gibson 1904; Brock & Price 1980]).

The common mathematical interests of the two founders of the journal are illustrated by the attention paid to quaternions, the vectorial calculus and discussions about vectorial notations. In this regard we signal the article by J. S. Mackay [1905] on Peter Guthrie Tait.

The journal was open to a wide range of contributions and ideas even if, in some cases, the editors pointed out that they did not share the contributors' opinions. Among the authors there were various important characters in the world of mathematics education and of history of mathematics (Loria, Smith, etc.), famous mathematicians (E. Borel, C. Bourlet, L. E. J. Brouwer, E. Czuber, G. Darboux, F. Enriques, M. Frechet, Z. G. de Galdeano, J. Hadamard, D. Hilbert, F. Klein, H. Lebesgue, B. Levi, C. Méray, P. Painlevé, H. Poincaré, F. Gomes Teixeira, H. Weyl, etc.), philosophers such as L. Couturat, and a cohort of secondary and university teachers now forgotten, but very active at the time in contributing to the international debate.

THE INQUIRY ON THE METHOD OF WORKING OF MATHEMATICIANS

The editorial line of the journal ranged between two poles, one specifically referring to mathematics and the other concerned with pedagogical aspects linked to mathematics teaching. Psychology was a link between these two poles. In writing on mathematical topics some authors hinted at psychological

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[14]) As discussed in d'Ocagne's book, 'nomography' is a theory which permits the graphical representation of mathematical laws defined by equations of any number of variables (see the review of the book in *L'Enseign. Math. 1* (1899), 368–370). A passage of d'Ocagne's book is translated in [Smith 1929].

issues. For example, the two articles [Baron 1903; Bonola 1903] show on the one hand the attention paid to strands of contemporary mathematical research (foundational studies), and on the other hand the importance of explaining mathematical facts through factors exterior to mathematics. On the reports being published on foundational studies in geometry, Bonola wrote that they

> ont non seulement élargi le domaine de la Géométrie non-euclidienne, mais ils ont encore contraint les esprits bien organisés à suivre les édifices variés et admirables qui ont été inspirés par la renaissance scientifique, caractéristique du XIXe siècle, et à se rendre compte des connexions qui existent entre les branches les plus élevées des mathématiques et d'intéressants problèmes de Psycho-physiologie. [15]) [Bonola 1903, 317]

At that time, themes of psychology, such as the necessary conditions for creativity and invention, and their links with mathematical themes such as axiomatisation, rigour and intuition, were debated hotly in the mathematical community (see [Mannheim 1909; Poincaré 1908]).

This context may explain why the inquiry into the methods of mathematicians was promoted by the journal. This was first inspired by a letter from Ed. Maillet ['Correspondance', *3* (1901), 58–59]. He wrote that it would be interesting for young researchers beginning their profession to have information on: work and research methods, general 'hygienic rules' useful to their intellectual work, how to read papers, etc.

In the same year ['Chronique', *3* (1901), 128; 219–220] the editors acknowledged the great interest roused by the idea and launched the project of a questionnaire, which had to respect confidentiality and was to be more than a mere curiosity. Many readers responded to this note and sent questions to be included in the questionnaire [16]).

The first part of the questionnaire was published in 1902 [*4*, 208–211] and the final part in 1904 [*6*, 376–378]. The questionnaire was sent to the subscribers of the journal and also distributed to the participants at the International Congress of Mathematicians at Heidelberg in 1904 and those attending the congress of Saint-Louis [*L'Enseign. Math. 6* (1904), 481]. In Heidelberg, Fehr [1905b] presented a communication on the questionnaire.

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[15]) have not only extended the domain of non-Euclidean geometry, but have also obliged well organised minds to pay regard to various and admirable constructions, inspired by the scientific renaissance characteristic of the 19th century, and to take account of the links between the highest branches of mathematics and interesting problems of psycho-physiology.

[16]) At this time Ed. Maillet was one of the editors of the journal *L'Intermédiaire des Mathématiciens.* In 1902 (t. IX) that journal published two questions [question numbers: 2446 and 2447, 263–264] on the circumstances attending mathematical creation. Answers to these questions were published in the same volume [339–343].

Copies of the questionnaire were sent to other mathematicians and to those who requested it. In 1905 [*7*, 239] the editors thanked the scientific journals which had published the questions.

The aim of the enterprise was twofold: on the one hand to collect advice useful to researchers in mathematics, and on the other hand to contribute to research in the field of psychology of professions. The questionnaire was prepared and analysed by Fehr and two psychologists at the University of Geneva, Édouard Claparède (1873–1940) and Théodore Flournoy (1854–1920). The languages for the answers were restricted to English, Esperanto, French, German, and Italian. There were 30 questions in all and the names of responders were published only with their explicit agreement. Claparède, Fehr and Flournoy published the results with comments in 1905, 1906, 1907, and 1908. There was also a report of the inquiry published in book form [Fehr *et al.* 1908].

The analysis of the results was based on the answers of more than 100 mathematicians and on a few historical notes on the lives of previous mathematicians. The journal published statistical data, comments and a few sentences from the responders. Many of the published statements carried the names of the writers, so that we know that among the responders were L. Boltzmann, M. Cantor, J. Coolidge, L. E. Dickson, H. Fehr, Z. G. de Galdeano, C. A. Laisant, C. Méray, G. Oltramare and J. W. Young. With these statements the nationality of the responder was also indicated. The answers arrived from various countries. Comments to the questions, by G. Loria [*8* (1906), 383–385, questions 6 and 9] and V. Bobynin [*9* (1907), 135–141; 389–396, questions 4 and 5] were published [17]).

This inquiry is not mere folklore; it provides material for studies in mathematics education, epistemology, psychology and sociology. Also it constitutes an early example of making explicit the feeling mathematicians have about the nature of their discipline, of their work and of their being mathematicians. This willingness of mathematicians to be more open about their feelings and how they worked was shown in later years by a number of famous works (by Hadamard, Hardy, Poincaré, etc.). As concerns the results, Fehr himself [1908] acknowledged that it was difficult to draw general conclusions. As a matter of fact, the importance of this enterprise was in identifying themes which would have important developments in the following years. Even if the intentions of the designers of the questionnaire were mainly directed towards mathematical research, the questionnaire may have had an

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[17]) Appendix 2 contains the list of notes and articles dealing with this inquiry.

impact in the world of school, by introducing elements pertaining to the psychological domain in the reflection on students' mathematical performances. For example, we can cite the report of the German national commission *Psychologie und mathematischer Unterricht* by D. Katz [1913]. The review [Brandenberger 1914] reports that it was divided into three parts:

- psychology and mathematics teaching (the child's development of the representation of number and the conception of space, the methods of working of mathematicians in line with the inquiry published in *L'Enseignement Mathématique*, the psychology of great mental reckoners, teaching to low-attainers, etc.),

- psychology of technical and artistic drawing,

- psychology and pedagogy in teacher education.

This report therefore illustrates the impact which the *L'Enseignement Mathématique* inquiry had on the world of mathematics education.

In the preface to the posthumous article by Mannheim [1909], the editors reported that the inquiry had had 'unexpected side effects', for example Mannheim's and Poincaré's papers. As a matter of fact, the themes developed through this inquiry were close to the interests of a prominent member of the Committee of supporters, Henri Poincaré, who contributed four articles to the journal. The paper [Poincaré 1908], which is the text of a lecture delivered at the *Institut général psychologique*, may be seen as a bridge between the world of mathematicians and that of psychologists. It shows that this prominent mathematician, as well as Mannheim in his paper of 1909, was in agreement with the ideas of the editors of *L'Enseignement Mathématique*. At the beginning of the paper Poincaré wrote:

> La genèse de l'invention mathématique est un problème qui doit inspirer le plus vif intérêt au psychologue. C'est l'acte dans lequel l'esprit humain semble le moins emprunter au monde extérieur, où il n'agit ou ne paraît agir que par lui-même et sur lui-même, de sorte qu'en étudiant le processus de la pensée géométrique, c'est ce qu'il y a de plus essentiel dans l'esprit humain que nous pouvons espérer atteindre.
>
> On l'a compris depuis longtemps, et, il y a quelques mois, une revue intitulée *L'Enseignement Mathématique*, et dirigée par MM. Laisant et Fehr, a entrepris une enquête sur les habitudes d'esprit et les méthodes de travail des différents mathématiciens. J'avais arrêté les principaux traits de ma conférence quand les résultats de cette enquête ont été publiés; je n'ai donc guère pu les utiliser. Je me bornerai à dire que la majorité des témoignages confirment mes conclusions; je ne dis pas l'unanimité, car, quand on consulte le suffrage universel, on ne peut se flatter de réunir l'unanimité. [18]) [Poincaré 1908, 357]

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[18]) The genesis of mathematical creation is a problem which ought to inspire the intense

The Swiss environment was important in encouraging this kind of interest by the journal and one may say that the roots of future developments of the Geneva school of psychology [19]) may be found in those years.

To grasp the particular atmosphere of the period it is interesting to consider the review by Claparède [*L'Enseign. Math. 14* (1912), 81–82] of the book *Henri Poincaré* (by Dr. Toulouse, Flammarion, Paris). This book presents the results of a study on Poincaré's way of reasoning and a comparison with the results obtained from similar studies on the novelist Émile Zola. Claparède reports that the conclusions of the author are that Zola's intelligence is

> consciente, logique, méthodique, paraissant faite pour la déduction mathématique [...]. Au contraire l'activité mentale de M. Poincaré est spontanée, peu consciente, plus proche du rêve que de la démarche rationnelle, et semblait surtout apte aux œuvres de pure imagination [...]. [20])

THE DAWN OF ICMI

The international vocation of *L'Enseignement Mathématique* was clearly established in the first volume of the journal with the articles on mathematics teaching in Spain by Z. G. de Galdeano and on the history of mathematics teaching in Russia by V. Bobynin. In successive issues similar surveys of other countries were published. The readers were gradually invited to consider the importance of comparative studies on different systems of mathematical development (intended in the broad sense of including both research and instruction).

interest of the psychologist. It is the activity in which the human mind appears to take least from the outside world, where it acts or seems to act only of itself and on itself, so that in studying the process of geometric thinking we may hope to reach what is most essential in man's mind.

This has long been appreciated, and some months ago a journal called *L'Enseignement Mathématique*, edited by Laisant and Fehr, began an investigation of the mental habits and methods of work of different mathematicians. I had already defined the main outlines of my lecture when the results of that inquiry were published; I have not therefore been able to make much use of them. I shall confine myself to saying that the majority of witnesses confirm my conclusions; I do not say all, for when the appeal is to universal suffrage one can hardly expect to obtain unanimity.

[19]) Jean Piaget never missed an opportunity to mention the ideas of Claparède (see, for example, [Beth & Piaget 1961, 213–214]). He himself had been called by Édouard Claparède (in 1921) to teach at the J.-J. Rousseau Institute in Geneva. As a matter of fact there is a discussion of the *Inquiry* with reference to Poincaré and Hadamard's conceptions in [Beth & Piaget 1961, §26, 96–99]. We may add that Piaget's support was very useful when the second series of the journal was launched in 1955, and he even became a member of the editorial board.

[20]) conscious, logical, methodical, appearing suitable for mathematical deduction [...]. On the contrary, the mental activity of Poincaré is spontaneous, hardly conscious, closer to dreams than to the rational way, and seems most of all suitable for works of pure imagination [...].

These ideas became more concrete in the note [La Rédaction 1905b] published in the seventh year, where the editors call for the opinions of readers on the following questions:

1. What progress needs to be achieved in the organisation of the teaching of pure mathematics?
2. What should be the role of tertiary instruction in teacher education?
3. How should teaching be organised in such a way as to meet the requirements of pure and applied sciences better than in the past.

As indicated in the note, an important antecedent to this initiative lay in the resolution passed by the third International Congress of Mathematicians held in Heidelberg as reported on p. 53 of the Proceedings [Krazer 1905] and in a note by *La Rédaction* [1905a]. This resolution stated that the teaching of mathematics at the tertiary level had to be in accordance with the importance of technical sciences in the various countries. So it was stressed that there was a need for new professorial appointments, suitable libraries, collections of models, laboratories for drawing and practical work, etc.

J. Andrade, E. Borel, G. Loria, F. Marotte and D. E. Smith reacted to the questions with notes published in the journal [L'Enseignement Mathématique 1905], in which the key issues for reform were stressed. The discussion was enlarged to include the theme of mathematics teaching at the secondary level. Teacher education was the natural link between these two levels. Loria [1905] advocated the 'democratisation' of some theories that in those years were considered 'advanced' (e.g. analytical geometry). Smith [1905] proposed more international co-operation and the creation of a commission to be appointed in an international conference for the study of instructional problems globally. He stated that both the journal and the commission were the best means to improve mathematics teaching. Smith was relying on the community of mathematicians, but at the same time he was quite critical about it in remarking that the papers presented in the didactic section of the International Congress of Mathematicians in Heidelberg were discussions of mathematical details rather than of general problems of teaching.

The discussion on the need for educational reforms in *L'Enseignement Mathématique* was the stimulus for the idea of a commission appointed by an international congress, which had its culmination in the establishment of ICMI during the fourth International Congress of Mathematicians in Rome in 1908 (see [Howson 1984; Schubring 2003]). Fehr was appointed as the secretary-general of ICMI, with Felix Klein as president and Alfred George Greenhill as vice-president. The following year *L'Enseignement Mathématique* became

the official organ of ICMI. In particular, through the journal, ICMI launched its early studies on various themes of mathematics teaching (cf. [Schubring 2003]). The reports of the discussions on these themes were published in the proceedings of important conferences organised by ICMI: 1911 in Milan, 1912 during the International Congress of Mathematicians in Cambridge, and 1914 in Paris (see Appendix 3). Also the journal published regular news about the Sub-Commissions founded in the various countries. Pamphlets and volumes on the works of these sub-commissions were also published (see [Fehr 1920]). Together they constitute important documentation on the state of mathematical instruction at that time.

CONCLUSION

The journal *L'Enseignement Mathématique* played a unique role in the mathematical community (of research and of instruction) in the period I have considered. It was a bridge between some aspects of mathematical research, the world of school and society. It was also a forum for discussing problems of mathematical instruction and education. In addition it was a bridge between mathematics and other disciplines, such as philosophy, psychology, and technology.

The journal contributed to redirecting the attention of educators away from the core of traditional mathematical instruction (Euclidean geometry) towards new themes (analytical geometry, foundational studies, and analysis) linked to technical applications or to research being developed in those years. This contributed to raising awareness in a number of countries of the need for a discussion of the nature of their mathematical programmes. For example, in Italy the scientific lyceum, whose curriculum encompasses a strong mathematical programme, was created under the influence of the debate on the teaching of calculus and the study launched by ICMI on this subject (see [Furinghetti 2001]).

Some of the ideas discussed in *L'Enseignement Mathématique* were already gaining ground in the scientific environment; the journal had the merit of being an efficient promoter of these ideas and of providing the fertile soil in which the ideas could grow.

APPENDIX 1

JOURNALS LISTED [21]) IN THE SECTION 'BULLETIN BIBLIOGRAPHIQUE'

OF *L'ENSEIGNEMENT MATHÉMATIQUE* — YEARS 1899, 1900, 1901

(WITH THE TOWN OF PUBLICATION THE FIRST TIME THE JOURNAL IS QUOTED)

Acta Mathematica, Stockholm (Sweden)
American Journal of mathematics, Baltimore (USA)
Annales de la Faculté des sciences de l'Université de Toulouse, Paris, Toulouse (France)
Annali di Matematica pura ed applicata, Milan (Italy)
Annals of Mathematics, Cambridge (USA)
Archiv der Mathematik und Physik, Leipzig (Germany)
Atti della Reale Accademia dei Lincei, Rendiconti, Rome (Italy)
Bibliotheca mathematica, Zeitschrift für Geschichte der mathematischen Wissenschaften, Leipzig (Germany)
Bolletino di Bibliografia e Storia delle Scienze mathematiche, Turin (Italy)
Bulletin astronomique, Paris (France)
Bulletin de l'Enseignement technique, Paris (France)
Bulletin de la Société mathématique de France, Paris (France)
Bulletin de la Société Philomathique de Paris, Paris (France)
Bulletin de mathématiques spéciales, Paris (France)
Bulletin des Sciences mathématiques, Paris (France)
Bulletin des sciences mathématiques et physiques élémentaires, Paris (France)
Comptes rendus des séances de l'Académie des sciences, Paris (France)
Educational Review, Rochway, New York (USA)
El Progreso matematico, Zaragoza (Spain)
Giornale di matematiche di Battaglini, Naples (Italy)
Il Bollettino di matematiche e di scienze fisiche e naturali, Bologna (Italy)
Il nuovo Cimento, Pisa (Italy)
Il Pitagora, Palermo (Italy)
Jahrbuch ueber die Fortschritte der Mathematik, Berlin (Germany)
Jahresbericht der Deutschen Mathematiker Vereinigung, Leipzig (Germany)
Jornal de Sciencias mathematicas e Astronomicas, Coimbra (Portugal)
Jornal de sciencias mathematicas, physicas e naturæs, Lisboa (Portugal)
Journal de l'Ecole Polytechnique, Paris (France)

[21]) Spelling and capitalization as they appeared the first time each journal was mentioned.

Journal de mathématiques élémentaires, Paris (France)

Journal de mathématiques élémentaires; journal de mathématiques spéciales, Paris (France)

Journal de Mathématiques pures et appliquées, Paris (France)

Journal de mathématiques spéciales, Paris (France)

Journal für die reine und angewandte Mathematik, Berlin (Germany)

L'Éducation mathématique, Paris (France)

L'Enseignement chrétien, Paris (France)

L'Intermédiaire des Mathématiciens, Paris (France)

Le Matematiche pure ed applicate, Città di Castello (Italy)

Mathematische Annalen, Leipzig (Germany)

Mathesis, recueil mathématique à l'usage des écoles spéciales et des établissements d'instruction moyenne, Gand (Belgium), Paris (France)

Monatschefte für Mathematik und Physik, Vienna (Austria)

Nieuw Archief voor Wiskunde, Amsterdam (Netherlands)

Nouvelles Annales de mathématiques, Paris (France)

Nyt Tidsskrift for matematik, Copenhagen (Denmark)

Paedagogisches Archiv, Leipzig (Germany)

Periodico di Matematica (per l'insegnamento secondario), Leghorn (Italy)

Publications de la section des sciences mathématiques et naturelles de l'Université d'Upsall, Uppsala (Sweden)

Rendiconti del Circolo matematico di Palermo, Palermo (Italy)

Revista de Ciencias, Lima (Peru)

Revista trimestral de matematicas, Zaragoza (Spain)

Revue de Mathématiques (Rivista di Matematica), Turin (Italy)

Revue de mathématiques spéciales, Paris (France)

Revue de Physique expérimentale et de Mathématiques élémentaires, Odessa (Russia)

Revue générale des sciences pures et appliquées, Paris (France)

Revue scientifique, Paris (France)

Revue semestrielle des publications mathématiques, Amsterdam (Netherlands), Edinburgh (UK), Leipzig (Germany), London (UK), Paris (France)

Schweizerische Paedagogische Zeitschrift, Zurich (Switzerland)

Sciences physico-mathématiques, Moscow (Russia)

Supplemento al periodico di Matematica, Leghorn (Italy)

The american mathematical Monthly, Springfield (USA)

The Mathematical Gazette, London (UK)

Transactions of the American Mathematical Society, Lancaster, New York (USA)

Unterrichtsblätter für Mathematik und Naturwissenschaften, Berlin (Germany)

Wiadomosci Matematyczne, Warsaw (Poland)

Wiskundige Opgaven, Amsterdam (Netherlands)

Zeitschrift für das Realschulwesen, Vienna (Austria)

Zeitschrift für lateinlose hoehere Schulen, Leipzig (Germany)

Zeitschrift für Mathematik und Physik, Leipzig (Germany)

Zeitschrift für mathematischen und naturwissenschaftlichen Unterricht, Leipzig (Germany)

APPENDIX 2

THE INQUIRY ON THE METHOD OF WORKING OF MATHEMATICIANS

QUESTIONS [22])

Text of the first questionnaire: *4* (1902), 208–211
Text of the second questionnaire: *6* (1904), 376–378

ANALYSIS OF THE RESULTS

Question 1*a*: H. Fehr, *7* (1905), 387–395
Question 1*b*: T. Flournoy, *7* (1905), 473–478
Questions 2 and 3: H. Fehr, *8* (1906), 43–48
Questions 4 and 5: H. Fehr, *8* (1906), 217–225
Questions 6–9: T. Flournoy, *8* (1906), 293–310
Questions 10–13: H. Fehr, *8* (1906), 463–475
Questions 14–17: H. Fehr, *9* (1907), 123–128
Questions 18 and 20: T. Flournoy, *9* (1907), 128–135
Question 19: T. Flournoy, *9* (1907), 204–217
Question 21: H. Fehr, *9* (1907), 306–312
Questions 22 and 23: É. Claparède, *9* (1907), 473–479
Questions 24–30: É. Claparède, *10* (1908), 152–172

NOTES ABOUT THE INQUIRY ON THE METHOD OF WORKING OF MATHEMATICIANS

– *3* (1901), 58–59 (Maillet, Ed., 'Correspondance'); 128; 219–220
– *6* (1904), 481
– *7* (1905), 63–64; 239–240
– *8* (1906), 383–385: letter of G. Loria on questions 6–9
– *9* (1907), 135–141: reflections of V. Bobynin on the answers to questions 4 and 5
– *9* (1907), 389–396: reflections of V. Bobynin on the answers to questions 11–13

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[22]) For an English translation of the questions see Appendix I in Hadamard's book [Hadamard 1945, 136–141].

APPENDIX 3

INQUIRIES ON THE TEACHING OF MATHEMATICS LAUNCHED BY ICMI

– *13* (1911)

The questions discussed in the conference of the Commission in Milan (18–21 September 1911) are published on pp. 122; 443–446.

THEMES:

    A) Systematic exposition of mathematics (axioms, rigour, etc.) in secondary schools; the fusion of different branches of mathematics in secondary schools.

    B) The teaching of mathematics to university students of physics and of the natural sciences.

The Proceedings of the Milan conference with reports about these questions can be found in the same volume [437–511].

– *14* (1912)

The questions discussed in the conference held during the International Mathematical Congress (Cambridge, UK, 21–28 August 1912) are published on pp. 39; 132–135; 220; 299.

THEMES:

    A) Intuition and experimental evidence in secondary schools.

    B) Mathematics for university students of physics.

The Proceedings of the Cambridge conference with reports about these questions can be found in the same volume [441–537].

– *15* (1913)

The questions to be discussed in preparatory work for the conference to be held in Paris (1914) are reported on pp. 243; 414; 487. The translations of these questions into German, English, and Italian can be found on pp. 394–412.

THEMES:

    A) Results of the introduction of calculus in secondary schools.

    B) Mathematics teaching for the technical professions in higher educational institutions.

– *16* (1914)

The questions for the Paris conference are published on p. 54.

The Proceedings of the Paris conference (1–4 April 1914) with reports about these questions are published on pp. 165–226 and 245–356.

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