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How Place and Audience Matter: Perspectives on Mathematics Plural Identities from Late 1950s French and English Middle School Textbooks

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Argument

In this paper, I argue that studying school textbooks is a fruitful way to investigate mathematical conceptions in different national contexts. These sources give access to the written production of an extended mathematical milieu whose members write for various audiences. By studying the case of late 1950s French and English textbooks issued for a growing audience of 11- to 15-year-old pupils, I show that a plurality of conceptions was projected at the time onto pupils and their teachers in both national contexts. I link this diversity to contemporaneous debates regarding mathematics teaching and argue that textbooks themselves have to be considered as active agents of such debates.

For several years now, historians of mathematics have discussed the effects of historical writing on the representation of mathematics as a discipline. They have emphasized the fruitfulness of bridges established with history of science and history in general, which have contributed to strengthen local (as opposed to universal) aspects of mathematical knowledge and the dynamics of the discipline (Corry 2004; Ehrhardt 2010; Gispert 2015, foreword). Recent historiographical trends have contributed to shift the focus from the development of mathematical knowledge towards its broader cultural and social place. How is mathematical knowledge socialized, especially thanks to its teaching? what kind of values does it embody? how much prestige does it enjoy and for whom? what kind of mathematical practices do different social groups develop, and how are they influenced by historical events? These have become legitimate questions for historians of mathematics and science, which have resulted in showing the stratification of the mathematical milieu in different countries and in single national contexts (see for instance Belhoste 1998; Bottazini & Dahan Dalmedico 2001; Chabert and Gilain 2014).

In this paper, I aim at exploring further the French and English cases of the 1950s by focusing on specific sources which contribute to shape representations of mathematics – school textbooks. In doing so, I use textbooks as a strategic site for investigating mathematical conceptions in a given national context rather than for a study of classroom practices. Since the professional and personal profiles of textbooks authors are varied, these sources give indeed an access to the written productions of an extended mathematical milieu (Gispert 2015; D'Enfert 2012a). Moreover, textbooks are both reflections of on-going representations and active agents that contribute to (re)shape those representations. Far from being only an adaptation of conceptions held in the academic sphere, textbooks encapsulate and stabilize formulations that result from a process of book-making which confronts heterogeneous constraints and involves different professional communities (Radtka 2013, 303–364; Shapiro 2012, 2013). Once they come into being, they tend to materialize certain conceptions and to define what the subject they deal with should be for their readers. Mathematics textbooks thus contribute to building the discipline and to defining its identity – even though this textbook identity might be called into question by mathematicians working in the university. Because there is no reason to suppose textbooks held homogeneous conceptions of mathematics in a given context, they can be considered as sources susceptible to give an access to a plurality of representations. Following this idea, I investigate in this article potentially fluctuant identities of mathematics by focusing on textbooks issued at the end of the 1950s and at the beginning of the 1960s.

This moment witnessed in many countries numerous debates about mathematics and its teaching. Regarding the situation within academic research, it was in particular in France a period when competing conceptions of mathematics opposed each other. The development of computers and the work on discrete problems and coding theories opened new fields of research. Yet, it was difficult for practitioners working in these fields to be recognized as fully-fledged mathematicians as their activities greatly differed from the dominant Bourbakist approach (Petitgirard 2004, 525–531; see also Dahan Dalmedico 2005). Regarding the situation within the educational sphere, it was a period of questioning in many countries. As Gispert and Schubring (2011) showed for the French and German cases, debates which then took place cannot only be understood from within mathematics education or even within the school system. They have to be related to changing social and cultural values as well as to changing epistemological conceptions of mathematics.[1] The comparative approach undertaken in this paper is hence a means to take into account such diverse parameters and to identify specificities in the discourses about mathematics and mathematics teaching.

In the 1950s, France and England shared some common features regarding mathematics teaching, and in both cases, a competitive textbook market existed. In order to be able to conduct a relatively detailed analysis of the numerous textbooks published at the time, I have chosen to focus on textbooks that had been published

[1]Regarding the importance of different conceptions of mathematics' identity over the debates during this period, see also Phillips (2014) for the case of the United States.

for the growing audience of 11- to 15-year-old children, and more specifically, for the most ordinary (that is those who were not part of a recognized élite) of these youngsters. This age-range constituted then an inescapable issue for mathematicians, politicians, education administrators and educators: more and more children pursued their studies at a post-elementary level and thus called into question the institutional organization of the schooling system, the teaching methods, and the aims of education. The first section of this article sets the terms of late 1950s debates on mathematics teaching and describes the context in which mathematics textbooks for 11- to 15-year olds were published. This section is more than a stage setting as the educational context was part of the dynamics, along with publishing practices and scientific considerations, which determined the textbooks contents. It also underpins the analysis of textbooks which forms the second section of the article.

1. Mathematics Teaching in a Period of Intense Changes and Debates: Post-War Transformations of Education and Mathematics

After World War II, an international reform movement in mathematics education was re-launched through the work of the International Commission on Mathematics Instruction (ICMI).[2] The ICMI started an international study motivated by the idea that mathematics teaching was linked to the social role of mathematics and mathematicians. Based on the gathering of national investigations dealing with Germany, Austria, France, the Netherlands, Italy, and the United States, a report was presented by Georg Kupera at the 1954 international congress of mathematicians in Amsterdam (Kupera 1955).

Overall it emphasized the influence of the war years on the evolution of mathematics and their social embedding: growing numbers of mathematicians (which included engineers) worked in fields as diverse as structures, logic, optimization, calculators, numerical analysis, statistics, and computer science.[3] They were pictured as key players in the industrialized society. Such a situation required a change in teaching methods and in the subjects taught, during a period when “education and the cultural and scientific effort become massive” (Kupera 1955, 108). It justified the implication of mathematicians in debates regarding mathematics teaching. Since the report prepared for the international congress of Amsterdam dealt with mathematics teaching for 16- to 21-year-old youngsters, the situation also required further investigation of the state of mathematics teaching, by looking at the situation of children under 15 years old (ICMI 1955, 263). A phenomenon of generalization of education, especially at a secondary level, was indeed underway in many countries. Together with changes within

[2]The ICMI had been founded in 1908. After the Second World War, it was re-established as an International Mathematical Union (IMU) committee. The IMU itself had been re-founded in 1952 and had then put teaching questions at the forefront of its agenda (Gispert and Schubring 2011).
[3]The ICMI investigation pertained to a more general movement of scientists counting (Shapin 2015).

mathematics and their social embedding, this phenomenon shaped international and national debates regarding mathematics teaching.

1.1. *Expanding audiences of 11- to 15-year-old children and their accommodation in France and England*

Since the end of the war, the preparation of an important institutional reform had dominated debates regarding education in France: between 1947 and 1959, when a reform named after the minister of Education Jean Berthoin actually took place, 14 reform projects had been worked out. All planned to widen the access to secondary education. However the growth of the number of pupils engaged in post-elementary education had not awaited actual reform (Chapoulie 2010). Long-term trends show that more and more pupils pursued their education in one of the different types of schools which were, at the time, accommodating 11-to 15-year-old children.

The educational system was then still organized according to the principles put forward by the Third Republic. It distinguished pupils according to their social origins, their expected professional and social destinies, and their results in schools. Autonomous and parallel courses of study, theoretically independent from each other, catered for, on the one hand, pupils of the people and, on the other hand, pupils of the social élite. The first stream was called the "primary" order: it included elementary and more advanced education. Post-elementary education was delivered in *écoles primaires supérieures*, *cours complémentaires*, and specifically for teachers-to-be in *écoles normales* and *écoles normales supérieures* of Saint-Cloud and Fontenay. The second stream was called the "secondary" order: pupils received elementary education in "small classes" of *collèges* and *lycées*, and could continue their studies in these types of schools until the *Baccalauréat*, the exam which opened the path towards University. Post-*Baccalauréat* education was also included within this order with the preparatory forms to competitive exams for national higher schools, such as notably the *École normale supérieure* (located at rue d'Ulm in Paris) which trained future *lycées* "professors." Thus, progressively, an entirely separated system had developed and assured that primary schools pupils were taught by teachers having a similar educational (and social) background to theirs, and that secondary schools pupils were taught by professors having received secondary and higher education (Lelièvre 1990; Prost 2004, 232–236; Caspard, Luc, and Savoie 2005, intro.).

The system that still accommodated children at the end of the 1950s had been thought of as a system that would reproduce the social order. However, over the years and more remarkably since the interwar-period, reforms and children schooling paths have progressively undermined the strong theoretical separation between the "primary" and the "secondary" orders,[4] known as the "educational duality." After World War II,

[4]In the interwar years, the "primary" and "secondary" orders had been officially renamed as the "first degree" and "second degree," but the use of the previous phrases remained.

growing pressure on the schooling system caused by the rise in population of children also prompted the question of the 11- to 15-age group of pupils and its teachers as a major issue. In order to designate the different types of schools that accommodated 11- to 15-year-old pupils, I use the phrase "middle-school level." By the use of this category, I follow recent historiography which helps to focus on an age-group representing high stakes for educational reforms in the late 1950s.[5]

At this stage, children in France were accommodated according to their social origins and their expected academic and professional futures. An important percentage of children who were not expected to study beyond the compulsory school age went to "*Classes de fin d'études*" and were trained by primary school teachers.[6] Others were incorporated in schools where they would be able to receive post-compulsory education. Among them, an important percentage of children attended *cours complémentaires*[7] and short courses in *lycées* and *collèges* where they stayed up to the age of fifteen. They were expected to access intermediary jobs or to pursue technical or vocational studies. Other children, who would sit the *Baccalauréat*, attended long courses in *lycées* and *collèges* up to 18. Thus, at the middle school level, children (and their teachers) could belong either to the primary order (*classes de fin d'études* and *cours complémentaires*) or to the secondary order (short and long streams of *collèges* and *lycées*). While the increase in pupils' population was general, the *cours complémentaires* were actually the streams which knew the stronger increase in numbers during the 1950s (Table 1). At the start of the school year 1959–60, there were more pupils accommodated in the first year of *cours complémentaires* than in the first year of *collèges* and *lycées* (including *collèges modernes* which were the heirs of the *écoles primaires supérieures*[8]) (Chapoulie 2010, 418; Prost 2004, 268).

The difference between the orders was not only an administrative one; it was also social and intellectual. Regarding the curricula, the aims, objectives and practices within both orders traditionally diverged. For science education, primary school teachers were often "bivalent," which means that they had been trained in both mathematics and physics at a relatively advanced (even though non-university) level.[9] By contrast, university-educated teachers of the secondary order were specialized in one discipline.

[5]See especially studies conducted by and under the supervision of Renaud d'Enfert.

[6]In France, the school-leaving age was 14 until 1959 when it was raised to 16 by the Berthoin reform.

[7]The 1959 Berthoin reform transformed the *cours complémentaires* in *collèges d'enseignement general* (CEG). This change of name was important as it paralleled a change of administrative status (CEG no longer belonged to primary instruction but to secondary instruction). It had nonetheless no direct impact on the mathematics curricula. For the sake of clarity, I thus use only *cours complémentaires* in the article.

[8]The *écoles primaires supérieures* had been transformed in 1940 into *collèges modernes*. Even though the minister of education of the Vichy government intended this change as a means to separate more strongly primary streams from secondary streams, it actually had the opposite effect.

[9]Primary school teachers were trained in *Écoles normales*. Those who would teach at post-compulsory level, either in *Écoles normales*, *Écoles primaires supérieures* (until 1940 when this type of school was transformed into *collèges modernes*), or *cours complémentaires*, received longer training in *Écoles normales supérieures de Saint-Cloud* (for male teachers) and *Fontenay* (for female teachers). This organization explains why, even at a post-elementary

Table 1. Evolution of the number of pupils accommodated at the middle-school level in France, 1945–1960 (thousands of pupils).

	1945–1946	1959-1960	Evolution
State-maintained *lycées* and *collèges* (short streams and first four years of long streams)	206,6	458,5	+122 %
State-maintained *cours complémentaires*	152,8	474,3	+210 %
Private *lycées* and *collèges* (short streams and first four years of long streams)	[128,8] (data for school-year 1949–1950)	201	[+56 %]
Private *cours complémentaires*	58,4	119,9	+105 %

Adapted from Prost (2004, 268) and d'Enfert & Kahn (2010, 9).

Even at a time when changes contributed to widening the teachers' population of secondary schools and to slowly changing their practices and culture,[10] differences between the two orders were still noticeable in the late 1950s. *Collèges* and *lycées* education was traditionally a scholarly one, while *cours complémentaires* (and modern streams of *collèges* and *lycées*) inherited a much more practical approach of education.

What is more, children followed different syllabi according to their school. Regarding the sciences, those enrolled in *cours complémentaires* and in short modern streams of *collèges* and *lycées* were taught a two-year course of physical sciences in addition to the mathematics and natural sciences four-year courses. Pupils who attended long courses in *lycées* and *collèges* studied physical sciences only in the fifth year. Moreover, the curricula were still influenced by the "educational duality" inherited from the Third Republic. Regarding mathematics, it meant that for secondary and university-educated teachers and students, the subject would rather be abstract, theoretical, and deductive, while for primary teachers and students, it would be more concrete and practical (D'Enfert 2012c).

The question of accommodating a growing population of pupils was also central in England. As was the case in France, different paths and types of schools could

level, primary school teachers were not (usually) university-trained teachers and had not been pupils in secondary schools.

[10]For teachers who taught in *lycées*, the prestigious and highly competitive *Agrégation* remained a door opener, especially to teach in the post-*Baccalauréat* forms, but it was not a requirement to teach in secondary schools. For a long time there had been teachers who held "only" a bachelor's degree and who sometimes taught while preparing the *Agrégation* (Verneuil 2005). Besides, over the years, new certificates had been created, first in 1941, with the certificate to teach in *collèges* (CAEC), which was replaced in 1950 by the CAPES (for *certificat d'aptitude au professorat de l'enseignement du second degré*). The latter allowed teaching in both *collèges* and *lycées*.

accommodate children who had completed their elementary education. However, the repartition of children among these types of schools did not obey the same criteria as in France; the meanings of the terms "primary" and "secondary" were also different.

In England, thoughts and decisions regarding schooling, organization, and pedagogical practices had been prompted by the 1944 *Education Act* which had made secondary education compulsory and free up until children's fifteenth birthday. Thus an entire new kind of audience gained access to post-elementary schooling, defined as education after 11 years old and called "secondary" education: in 1955, more than 2 million pupils were provided with secondary education.[11] As no existing structures comparable to the French "primary" schools that provided post-elementary education were in place to accommodate this new audience, a new organization (as well as new schooling facilities) had to be built.[12] Debates, recommendations, and exam systems were strongly shaped by the idea that the system should respond to a great variety of needs, types of interests, and abilities. The stress put upon the diversity of situations the system was required to meet can be related to noticeable differences with the French case. First, while the social question was not absent from the English reflections, it was not put at the forefront of the arguments as it had been in France for decades. Second, the Ministry of Education had a lesser role in the organization of the system and Local Educational Authorities (LEAs) were in charge of defining the number and types of schools in their jurisdiction. Last, external examinations were prominent in the way one could think about children's paths and pupils' inflow planning in the different types of schools.

In England, the social élite attended expensive (and sometimes renowned) "public schools," but most children were accommodated in state-funded schools. For the latter, an exam taken at the end of primary education, the *eleven-plus*, served as a means to select and direct children to different types of schools. Even though the role of LEAs was essential for the organization of schooling, a "tripartite system" was promoted after the Second World War at a national level through reports, pamphlets, and public speeches given by ministers of education. This system distinguished *grammar schools* from *technical schools* and from *secondary modern schools*. It had been designed to mirror a vision of the repartition of intelligence and types of minds already expressed before the war (McCulloch 2002, 36–41): the first two types of schools accommodated those who were believed to have, respectively, either an academic or a practical type of mind, while the latter type of school was supposed to cater to the rest of pupils.

[11] This figure is of the same order of magnitude as the population of 12- to 15-year-olds in France for the same year. The rate of pupils accommodated in *cours complémentaires* and at the early secondary level was then approximately 38 percent (Prost 2004, 268).

[12] The compulsory leaving age was actually raised to fifteen in 1947. The previous raising of the school leaving age (up to fourteen) followed the Hadow Report of 1926 and contributed to developing varieties of senior schools. Even as these became for the most part secondary schools, new schools had to be built and new methods of teaching had to be developed to take charge of the new audience accessing secondary education. In the years 1954-61, 1,808 new secondary schools in England and Wales were completed (Ministry of Education 1963, § 38).

In fact what has been called a "bipartite" system of grammar and modern schools by McCulloch (2002, 43) was put in place in many local areas. Indeed, secondary technical schools catered to fewer children than had been anticipated, and by 1961 they represented only three per cent of secondary schools. For their part, grammar schools represented by 1961 22 per cent of secondary schools (Price 1994, 155). As they notably opened the route towards university, grammar schools were the most prestigious type of schools. Secondary modern schools generally suffered from a lower consideration, but they accommodated the vast majority of the 11 to 15-age group. In 1955, there were 1,250 thousand pupils in secondary modern schools. Their number kept increasing over the years despite the problems the schools encountered, so that there were more than 1,500 thousand pupils accommodated in secondary modern schools in 1960 (Bédarida 1990, 331).

According to McCulloch (1998, 77), it had become apparent during the 1950s that secondary modern schools mainly catered to working class pupils. However recommendations for teaching within these schools from the ministry of education and debates among teachers associations and educationists remained shaped by arguments of local needs and children's various interests and abilities. Such recommendations and debates were important in the English case as no national curriculum (as the one existing in France) determined the contents of teaching. It was even more the case for secondary modern schools as these newly-established schools were strongly encouraged to work out syllabuses on their own. Besides, contrary to grammar schools which took for models prestigious public schools and determined their syllabuses according to the preparation of external examinations such as the General Certificate of Education (GCE) Ordinary (O) and Advanced (A) levels, secondary modern schools were invited to free themselves from the preparation of external examinations.

A discrepancy existed between intentions and actual classroom practices. Independence regarding external examinations remained for a large part an instance of wishful thinking and teaching in secondary modern schools questioned the absence of recognized certification (Brooks 2008). Progressively, more and more secondary modern teachers engaged their pupils in the preparation of external examinations. At the end of the 1950s more than 15,000 candidates sitting the GCE O-levels came from secondary modern schools while the number of candidates sitting the four main non-GCE external examinations that could be passed below 16 years old (such as the ones delivered by the College of Preceptors or the Royal Society of Arts) grew up to 70 per cent (Brooks 2008). The question of mathematics teaching within this type of school was thus also shaped by the teachers' opinions regarding the preparation of external examinations – a parameter that was not central in the French case.[13] However, despite the differences underlined in the current section, the English and French cases

[13]This is not to say that French pupils were not studying to prepare examinations as many vocational schools selected their students.

shared an important common feature: during the 1950s in both countries, mathematics teaching was considered as one (among others) means to achieve modernization.

1.2. Science and technology at the forefront of countries' general and educational policies

Both in France and in England, as well as in other countries, science and technology were put at the forefront of policies during the 1950s and the 1960s. In Britain, important investments were dedicated to the construction of research laboratories (often in a military context), and the government encouraged the extension of higher education especially in science and technology (Edgerton 1996, 1997, 2005a, 2005b). What is more, a strong relationship developed between science and national identity (Agar 1996, 18–23). Within the field of education, reform movements were engaged in order to adapt training to new political, social and cultural demands. A strong emphasis was put on the grammar and public schools for which sponsors and agencies of reform in the 1950s advocated a replacement of the traditional classical training by a more scientific and technological one (McCulloch 1988). Such an emphasis also permeated general recommendation for the secondary level, especially when it came to mathematics teaching. As the Minister of Education Geoffrey Lloyd stated in the foreword of a pamphlet issued by the Ministry of Education in 1958: "Our standard of living and our position in the world depend upon our ability to remain in the forefront of scientific advance, both pure and applied" (Ministry of Education (ME) 1958, iii).

For their part, the authors of this very pamphlet stressed the necessity of identifying future specialists and training children for their future occupation, in which mathematics were believed to play a key role.

In France, the 1950s and 1960s knew similar dynamics. Progressively, French industry and identity became entwined with science and technology. The trend resulted in some very well-known cases such as the links established between France and nuclear technology (Hecht 1998), as well as in a generally recognized role overtaken by the general De Gaulle regarding scientific research (Larcan 2003). Actually the stress put upon science and technology by politicians did not wait for De Gaulle to be in power: already in the 1950s close relationships had been established between scientists, entrepreneurs, state administrators, and politicians, especially around Pierre Mendès France (Chatriot and Duclert 2006). Organized in Caen in 1956 by those close to Mendès France, a colloquium exemplified how the wish to "do something for scientific research" resulted in the necessity to take into account the situation of "secondary education, academic structures, CNRS, medical reform" (Crémieux-Brilhac 1995). As I have shown in my PhD thesis, the debates actually tackled education more generally as they included remarks and reflections on the "primary" order and on teaching contents and practices (Radtka 2013, 72–73).

The thought that reforming education was necessary to prepare citizens for modern society was an internationally widespread idea during these decades; it got reinforced with the 1957 launch of Sputnik. Especially in the United States, the event gave reformers more influence by raising the specter of an advantage of the Soviet Union on the Western world (Rudolph 2002) and the history of mathematics teaching modernization became entwined with the history of the Cold War (Philipps 2015, 22–46). In Europe, mathematics teaching did not remain only a national issue. It was also taken over by organizations for European economic development implemented within the framework of the Marshall plan. The OEEC (Organisation for European Economic Cooperation), later renamed OECD (Organisation for Economic Cooperation and Development), became an important actor on the subject and promoted reform of the contents and methods of mathematics instruction for 12- to-19-year-olds (Gispert 2003, 2010). It initiated meetings of experts in order to outline the general orientations of a modern program of mathematics teaching, the first of which took place in France, in Royaumont, in 1959.

Among the participants of these meetings, there were members of international mathematical organizations such as the ICMI and the *International Commission for the Study and Improvement of Mathematics Teaching* (CIEAEM) (the latter had been founded in 1952). These organizations held different reflections from the economic ones: during the 1950s, the ICMI focused on the societal dimensions of mathematics while the CIEAM was particularly interested in the psychological dimension of mathematics learning (Gispert 2010). However, through meetings and circulation of ideas and people, these different trends converged at the end of the 1950s. They influenced contemporaneous debates on mathematics teaching and progressively prompted the idea that modernization of mathematics teaching would take the form of implementation of "new math"[14] curricula (Gispert and Schubring 2011). These international reflections were also mirrored at national levels, as prominent members of the international organizations were actors on the national stage, especially within teachers associations.

1.3. Reflections on the modernization of mathematics teaching in France and England

As in international debates, the emphasis on the societal and economic dimension of science met a reflection on the modernization of mathematics teaching in both England and France. In France, a major actor of this reflection was the association of mathematics teachers of public secondary schools, *Association des professeurs de mathématiques de l'enseignement public* (APMEP). In England, two different associations were key players in these debates, the Mathematical Association (MA) and Association for Teaching Aids in Mathematics (ATAM) which became in 1962 the Association of Teachers of Mathematics.

[14] In this article, I use interchangeably "new math" or "modern mathematics."

In both countries, debates were linked with the extension of the audience for post-elementary mathematics. What is more, the diversification of the audience and, especially the access to secondary education (in the English sense) gained by children who traditionally were leaving school early to enter the labor market, prompted debates regarding the kind of mathematics such children should study, even among bodies like the MA or the APMEP which traditionally took a low interest in such audiences.[15] Founded in 1897, the Mathematical Association (MA) was a recognized body.[16] It had been a long-standing partner for the Board of Education (and later the Ministry of Education) in the elaboration of recommendations regarding the curriculum (Price 1994, 153–158). In 1949, the MA published an interim report dealing with mathematics in secondary modern schools; it was followed by a more developed report ten years later (MA 1949, MA 1959). In-between its journal, the *Mathematical Gazette*, published some articles on works dealing with the subject conducted in local branches of the association. Through these reports and articles, the association fostered the idea that secondary modern schools required other mathematics than grammar schools. This alternative mathematics was pictured as rather "practical" than abstract or deductive, even though the meaning of the phrase "practical mathematics" was far from stable.

According to the different proposals, the label could be applied to works done in modeling or 3-D construction, as well as to works involving surveying, navigation, and technical drawing, or even to works using graphical or experimental approaches (Price 1994, 173–174). Moreover, in the English context, the phrase also established a link with a view advocated by the engineer and educational reformer John Perry (1850–1920) at the end of the nineteenth century. According to Perry, "practical mathematics," which was part of engineers' education, was also useful for pupils of elementary and secondary schools (Price 1981, 221–228). This particular background added to the diversity of meanings that could be attached to the notion.

Some of the most active teachers and educators within the MA on the question of mathematics for secondary modern (and primary) schools also promoted a shift of emphasis from mathematics *teaching* to its *learning*. This shift came along with a greater focus on the learning process and child psychology, as well as an interest towards the educational environment and teaching aids. After the Second World War, the interest in material aids for education (that is audio, visual, and tactile) was quite general. It contributed to the foundation of a new association, the Association for Teaching Aids in Mathematics (ATAM). The ATAM started its work under Caleb Gattegno's presidency, who was also the founder of the CIEAEM.

[15]The low interest towards mathematics teaching in secondary modern schools which accommodated the majority of this new population is attested by Price (1994, 173). Regarding the APMEP, this low interest has to be explained by the very nature of the association, mainly constituted of teachers of the "secondary" order.

[16]The Mathematical Association (MA) had its origins in the Association for the Improvement of Geometrical Teaching. The history of the MA is accounted for by Price (1994).

Gattegno was a cosmopolitan person with a very diverse academic itinerary. Born in Alexandria in 1911, he studied physics in France, earned a doctorate in mathematics in Switzerland, taught mathematics in Egypt. After World War II he settled in England where he trained mathematics teachers, worked at the London Institute of Education, and founded the *Cuisenaire Company.* He was also influenced by the Swiss philosopher and psychologist Jean Piaget and translated some of his works into English (Powell 2007). Caled Gattegno published his first article in the *Mathematical Gazette* in 1947, and was then co-opted to the primary schools subcommittee of the MA in which he promoted the shift towards children's modes of thought and Piagetian ideas. Despite this work in collaboration with the MA, his views were very different from those usually promoted by the MA, and the foundation of the ATAM partly resulted from disagreements (Cooper 1985, 70).

The ATAM rapidly increased in size and its aims diversified. Initially focused on teaching aids, the young association also started to promote a renewal of the contents of mathematics teaching, which prompted divergences among its members (ibid., 78–83). The journal of the association, *Mathematics Teaching*, reflects these changes (Radtka 2013, 116–117). In articles dealing with mathematics teaching in primary and secondary modern schools and reports of working groups and conferences about the subject, a growing disagreement among ATAM members appears: while some educators remained over the years strong advocates of a non-preparation for external examination in order to design a curriculum based on children's centers of interests and skills, other teachers who actually taught in such schools defended their preparing pupils to sit external examinations.

Besides, these debates were soon overtaken by the shift of emphasis towards "new math" which dominated the 1960s. During the 1950s, some articles presented original teaching practices specifically designed for secondary modern school children (for instance Hodgkinson 1958). From 1959 onwards, the journal included articles signed by prominent mathematicians and educators such as Gustave Choquet or Lucienne Félix (for instance, Choquet 1960), and soon enough *Mathematics Teaching* became a platform promoting "new math." Debates over such suggestions did not completely disappear as the journal welcomed in its columns critiques and commentaries of other teachers who expressed their doubts, but the journal progressively promoted the idea that the best way to prepare children to modern society would be to study the same kind of mathematics whatever pupils' abilities or needs, and that this mathematics would be "new math."

In France, a similar progressive shift took place even though different mathematical traditions were still supported by the educational structures. As contents, methods, and aims of mathematics teaching were called into question in relation to the general emphasis put on science education and the growing population of pupils at the middle school level (D'Enfert 2012b; Gispert 2009; see also Gispert and Schubring 2011), the role of the APMEP in this shift was important. The association was indeed, since the beginning of the 1950s, particularly committed to promoting a change in both teaching methods and mathematical contents aiming at introducing "modern mathematics" in secondary education (D'Enfert 2010, 120). Many of its active members were influenced by the works of the Bourbaki group and were convinced that mathematics that was taught in schools was no longer in line with mathematics that was practiced by mathematicians (D'Enfert 2010; Barbazo and Pombourcq 2010; Barbazo 2010; Carsalade et al. 2013). Reformers wanted to introduce the "spirit" of contemporaneous mathematics in schools and, in particular, modern algebra. For them, this introduction had to be understood as an encompassing project: even though it could be seen as a way to better prepare future students to university, the idea was to make pupils learn mathematics that were actually practiced by mathematicians. Such a project had consequences not only in the last stages of secondary education, but also at the middle school level and even in elementary schools. This objective went hand in hand with a renewal of teaching methods.

Ideas regarding the introduction of "new math" contents occasioned controversy among the members of the APMEP, and in other mathematical spheres, especially within the *Inspection générale* which, at the time, contributed to the writing of the syllabi (Legrand 2002). The use of "active" pedagogical methods, and among them the introduction of mathematical notions through so-called "practical works" (*travaux pratiques*), was on the other hand quite consensual. Here, we can stress the fact that during the 1950s, "new math" promoters were not opposed to the use of concrete and material devices in mathematics teaching, quite the reverse. For them, "practical works" were considered to be a means to make children access, thanks to a concrete start, the "abstract essence" of mathematics. More generally, thanks to "active methods," children would be put in situations in which they would solve problems and explore the mathematical world – that is work as mathematicians. Eventually, as "new math" contents would be introduced, the unity of mathematics would become apparent (D'Enfert 2010).[17]

Actually, "active methods" were already applicable in mathematics teaching as they had been advocated during the interwar years. For the *Inspecteur général* Émile Blutel (1862–1945) for instance, such methods implied that pupils were encouraged to elaborate solutions to problems and exercises by themselves under the teacher's guidance. Be it in secondary or in primary schools, mathematics teaching should no longer be considered as the observation and reproduction by pupils of solutions first exposed by teachers, but it would imply experimentation and manipulation (D'Enfert 2015, 23).

Moreover, the phrase "practical works" also echoed the practical culture of primary school mathematics teachers. This culture was related to the objectives of primary schools: preparing pupils for the time when they leave schools as citizens and workers. In order to do so, mathematics was considered a tool for responding to everyday life and

[17] For a general view on the relationship between "new math" and applications during this decade, see also Gispert (2003).

job requirements. As such, theoretical and abstract aspects were excluded and stress was put on calculating practices and solving problems. These problems were to be related to everyday life or working situations (such as commercial, industrial or agricultural situations), to usual operational practices, and should involve real (and not invented) data (such as prices, trains time tables, etc.) (Sarrazy 2003; D'Enfert 2015, 21–22).

Despite or maybe thanks to the diverse meanings of "practical works" and "active methods," APMEP reformers influenced the official directives of the national curriculum published from 1957 onwards: mathematics syllabi included some "practical works" for pupils in *collèges* and *lycées*, as well as for pupils in *cours complémentaires*.[18] Listed among such works, one could find activities as diverse as the use of instruments (a ruler, a compass, a chronometer, or a surveyor's chain), astronomical observations, construction of fractions of geometrical shapes, or the listing of equivalent fractions. The influence of the APMEP was quite important, and after the Berthoin reform, in 1960, teachers of all the different *sixième* and *cinquième* forms (which became with the reform an "observation stage" (*cycle d'observation*)) were invited to model themselves on teachers who introduced "new math" contents to their pupils and to use "practical works" as a means to give access to the "abstract essence" of mathematics (D'Enfert 2010, 126–127).

However, the syllabi remained overall traditional, and former directives showed that the intentions behind the syllabi differed according to the type of schools, even when the contents looked similar. It was in particular the case for "practical works": in January 1958, "practical works" were presented in *collèges* and *lycées* as "a means to bring, slowly but in greater numbers, our children towards the abstract essence of mathematics" (quoted by D'Enfert 2015, 462), but they had more practical objectives in *cours complémentaires*. In the latter case, they were a means to teach children how to use instruments (and through them understand the significance of order of magnitudes and margins of error), to link geometrical shapes with their representations, and to help pupils experimentally test mathematical proprieties.[19] Thus, in France, despite on-going changes that tended to bring mathematics teaching closer in the different types of schools and to progressively promote "new math" contents, the situation in

[18]The National Curriculum progressively imposed close and even similar contents in mathematics teaching for the different streams at the middle school level and the mathematics syllabus for the second year of *cours complémentaires* ("*cinquième CC*") published in the *Bulletin officiel de l'Éducation nationale* on 9 October 1958, even pointed out that "the syllabus is the same as for *cinquième* in *lycées* and *collèges*." The same year, an addendum made the syllabus previously published for the first year of *cours complémentaires* ("*sixième CC*") similar to the syllabus for the *sixième* form of *lycées* and *collèges*. For the last two years of *cours complémentaires* ("*quatrième CC*" and "*troisième CC*"), the syllabi were published in 1959 and 1960. They followed the publication in 1958 of the syllabi for the corresponding years in *lycées* and *colleges*. For detailed references of the syllabi, the reader is referred to Radtka (2013). Mathematics syllabi published for the *cours complémentaires* are reproduced with comments by D'Enfert (2015, 446ff).

[19]"Instructions relatives aux travaux pratiques de mathématiques dans les classes de sixième et de cinquième des cours complémentaires," published in the *Bulletin officiel de l'Éducation nationale* on 2 October 1958, reproduced by D'Enfert (2015, 462-463).

the late 1950s was far from being stable and homogeneous: the "new math" reform that would completely rebuild mathematics teaching in France was still to come, and the plurality of meanings of key pedagogical notions as well as existing traditions left room to important variations.

As a result, in both France and England, while official directives stressed the need to expand the recruitment of scientists, engineers, and technicians in order to meet the challenges of the time and insisted upon the role of mathematics in this regard, the kind of mathematics that was actually to be taught remained subject to debate. Textbook publishing in the late 1950s and at the beginning of the 1960s can thus be seen not only as a mirror of contemporaneous practices, but also as a way for their authors to take part in this debate.

2. Late 1950s Mathematics Textbooks: A Window on a Plurality of Proposals within Each National Context

Within a period of turmoil or (re)definition of the boundaries and identity of a subject, studying textbooks that are actually published is particularly fruitful (Armatte 1991)[20] : textbooks have then to be seen not only as mirrors of on-going debates, but also as tools for their authors (and possibly, even though to a lesser extent, for their publishers) to promote their personal ideas regarding epistemological conceptions of the discipline. If homogeneity appears amongst textbooks during a period of intense debates, the results also invite readers to study the forces that tend to normalize textbook production.

In both France and England, textbook production was a liberal business in the 1950s: private publishing houses had the initiative of publication, and they advertised, through different means, their production to teachers. In France, textbooks had to follow the syllabi defined by the national curriculum, but the State did not control the books before their release. As a result, in both countries, several textbooks were in competition on a textbooks market.

Identifying these textbooks is not an easy task: it first requires defining what has to be considered as a proper textbook for the purpose of the study[21] and to actually construct a corpus of textbooks. I have chosen to select only books that stated explicitly their didactical intentions (and thus I have excluded books that might have been used in classrooms whereas they had not been published as textbooks *per se*). The covers of such books usually indicate in which context (i.e., type of school, school year, or form) they should be used. They are also, most often, part of textbook series which usually establish equivalence between the school year and the book number in the series.

[20] For a general discussion of textbooks as historical sources, see Chopin (1980), a thematic issue published in the journal *Science and Education* (Bertomeu-Sánchez et al. 2006) and a focus in the journal *Isis* (Vicedo 2012).
[21] On the far from obvious definition of a textbook, see Chopin (2008).

In order to identify textbooks series I have used different sources according to the national context. For the French case, my identification is based on the supplement "*Rentrée des classes*" of the *Bibliographie de la France* published by the Cercle de la Librairie for the years 1958 to 1961. This source consists of a compilation of publishers' brochures which usually distinguished in the late 1950s textbooks for *cours complémentaires* (and later *collèges d'enseignement général*[22]) on the one hand, and textbooks for *collèges* and *lycées* on the other hand. For the English case, I have used the *Education Book Guide* published by the National Book League for the years 1956 to 1964. The latter source organizes the textbooks' production according to (among other criteria) their intended audience: I have chosen to follow its categories and to include textbooks published in previous years if their references were still given by the *Guide* for the years 1956 to 1964.

Besides, I have restricted the corpus to textbooks dedicated to the mass of 11- to 15-year-olds who were not part of an educational élite. This choice aims at focusing on the growing audience that accessed post-elementary education after World War II. As we shall see below, some textbooks did not mention specific audiences but encompassed an entire generation – in such cases they have been included in my study. Other books were explicitly and exclusively dedicated to the educational élite of pupils (books for grammar schools in the English case for instance); these have been excluded of the study.

As a result, I have identified:

(1) for the French case: 24 textbooks series published by 20 publishing houses;
(2) for the English case: 45 textbooks series published by 27 publishing houses.[23]

The purpose of the study is to identify whether these competing textbooks tended to foster different or even antagonist conceptions of mathematics. Moreover, when heterogeneity occurred through the textbooks in each national context, my ambition was to characterize the different proposals. In order to do so, I have conducted an analysis which takes into account visual and material aspects of the books (the typography, layout, pictures types, etc.), together with the grammatical type of texts. In such an approach, I have considered *books* rather than *texts*, and followed methods put

[22]After the 1959 Berthoin reform, publishers usually modified the label of the section dedicated to the *cours complémentaires* in their brochures to follow the new terminology. However, such a change did not imply a change in textbooks contents as the syllabi published from 1957 onwards remained applicable. Actually modifications were often limited to the change of the textbooks' titles (*collèges d'enseignement general* instead of *cours complémentaires*), but not all publishers up-dated the already published books in this way.
[23]These figures are given for information purpose only. Since they depend on my choices to construct the corpus, they should not be considered as irrevocable ones. The references of the textbooks are given at the end of the paper.

forward in book history, semiotics, and mathematics textbook analysis (Chartier 1989; Eco 2010; Kress 2009; Breakell 2001; Dowling 1996; Haggarty and Pepin 2002).[24]

I have conducted the analysis on different scales and I have progressively restricted the number of textbooks to scope when getting closer to mathematical content:

(1) First, at a general level, I provide an overview of the different textbooks by focusing on all features (title, function, graphic displays) that appeared prominently on each book's front cover. Even though the cover of a book cannot be considered as a straightforward image of the book's contents (in particular because it is strongly determined by commercial arguments) it contributes to emphasizing some features of the subject. Thus it participates to the shaping of the subject's identity and has to be considered in a book analysis;
(2) Second, I bring to light different conceptions of mathematics expressed at the time by textbooks' authors. For this purpose, I select some textbooks within the corpus and focus on forewords and addresses to the reader (which I call "paratexts") in which authors alluded to on-going debates or explicitly discussed the kind of mathematics their books featured;
(3) Lastly, I give some details on the status attributed to practical approaches of mathematics by focusing on specific contents. As we have seen, the meaning that ought to be attributed to phrases as "practical works," "concrete mathematics," or "practical mathematics" was far from stable in the discourses. It is thus important to see how the diversity of meanings could be actually handled when it came to actual teaching media, such as textbooks.

Throughout the analysis, the methodology had to be adapted to publishing practices in each country. Thus the treatment of the English and French cases is not rigorously symmetrical.

2.1. Grasping a diversity of visions: using textbooks covers as indicators

In order to compete on the market for textbooks, publishers have developed various commercial strategies, notably by giving a clear identity to their production. This trend has led to the constitution of textbook series – that is several books which shared graphic rules and denomination and were usually (but not systematically) written by the same authors. Giving a title to a textbook series and clearly featuring the authors' names on a cover constitute different ways to identify textbook series. As we shall see such publishing practices are not meaningless regarding the identity of the subject dealt with: titles can convey ideas regarding mathematics identity; authors' names, especially

[24]Such choices also constituted a means to avoid tacking implicit ideas regarding the nature of mathematics on to books by using a too rigid and contemporary analytical grid. See Van Dormolen (1986) and a critic of his tools to conduct a textual analysis by Pepin & Haggarty (2001).

when they are followed by authors' functions or indications regarding their training, can refer to different traditions of mathematics teaching.

In the English case, publishers often gave an original name to the textbook series: in the late 1950s, less than a quarter of titles referred exclusively to the subject (that is, mathematics, or a subdivision of mathematics as geometry), possibly restricted or modified by the level or context of study. These types of titles apart, textbooks' headings gave connotations to the subject, and slogans or catchphrases involving the term "mathematics" could express a specific sense regarding what was at stake in mathematics teaching at the time. In what follows, I propose a classification of titles given in the late 1950s. Different classifications can be made of these titles; mine distinguishes titles that alluded to the aims of mathematics learning, from titles that made reference to a certain kind or portion of mathematics, and from titles that made reference to modernity or novelty in the subject (see Table 2).

Why or for what reason should children study mathematics? Two opposite views regarding this question could be evoked simply through the title given to textbooks by their publishers. Giving the name of a mathematical object or notion to a textbook series, such as "A Book of Graphs" or "Measuring, Drawing and Reckoning," tended to present mathematics as a specific world, inhabited by objects one might study or manipulate thanks to particular methods. In such cases, textbooks appeared as tools to study this particular world for its own sake. On the contrary, other choices regarding the titles could highlight the usefulness of mathematics: be it in order to pass examinations when "certificate mathematics" was featured or to be it "for everyday life," mathematics appeared in these cases to serve other purposes.

Alongside titles referring to the question of purpose, most titles made actual reference to the type of mathematics children would study. I include within this category titles that made reference to the types of schools or the level of mathematics tackled by the textbooks, as well as those which stressed the "practical" aspect of mathematics. In doing so, I consider the word "practical" as a reference to on-going debates and existing traditions on the English scene rather than as an allusion to mathematics' usefulness. I add to this group titles that emphasized the repeated practice the subject required when the word "practice" was used.

Another group of titles also emerges, which includes references to new approaches or contents of mathematics. Titles such as "modern algebra" or "new mathematics" clearly referred to debates regarding not only the use of modern pedagogical methods but also the very contents of the courses. In such cases, titles tended to position the textbooks' authors in favor of the introduction of "new math" in schools.

Eventually more ambiguous titles are brought together: the category includes titles alluding to the publisher's name, as well as titles sounding like puns or slogans. Indeed if a title such as "Pioneer Maths" can evoke a novelty in mathematics, its meaning is far less straightforward than a simple phrase such as "New Mathematics" in the context of the late 1950s. For this reason, it cannot be added to the previous group. Similarly, even though a title such as "Individual Mathematics" can evoke a repeated practice, its

Table 2. Categories driven from English late 1950s mathematics textbooks' titles.

Aims of mathematics study	
Mathematical objects, notions and methods: studying mathematics for its own sake	Brown, *A Book of Graphs*
	Kraft, *Number Work*
	Kline, *The Language of Number*
	Leslie, *Measuring, Drawing and Reckoning*
	Ward & Hill, *Elementary Calculations**
Passing exams or preparing oneself for life outside school: studying mathematics for other purposes	Fox, *Certificate Mathematics*
	Payne, *Certificate Mathematics*
	Burns, *Daily Life Mathematics*
	Raven & Ault, *Mathematics for everyday life*
Different kinds of mathematics	
Scope of the subject	Bass, *Mathematics*
	Household, *A Preparatory Algebra*
	Jeavons, *Unified Mathematics*
	Levy, *Geometry and Trigonometry*
	Norris, *General mathematics*
	Raven, *Mechanical Arithmetic*
Type of schools and level of study	Clarke, *Mathematics for the general course*
	Daffern, *Basic Arithmetic*
	James, *Modern School Mathematics*
	Newth, *First Course in Arithmetic*
	Phillips, *Elementary Mathematics*
	Snell & Morgan, *New Mathematics: a unified course for secondary schools**
	Tucker, *An introduction to secondary school mathematics*
	Vesselo, *Secondary School Arithmetic*
	Ward & Hill, *Mathematics for Modern Schools*
	Ward & Hill, *Elementary Calculations**
Practical approach and/or necessity to practice	Barrett & McInnes, *Practice in pre-senior mathematics*
	Crawford & Crosher, *Problem Practice*
	Harris, *Practical Arithmetic for Boys*
	Fallows, *Practical General Mathematics*
	Levin, *Gateway Practical Geometry**
	Webb, *Daily Practice in Mathematics*
	Worley, *Target Practice in Arithmetic*

Table 2. Continued.

Novelty in mathematics	
New approaches or contents	Hopkins, *Modern Arithmetic*
	Horrocks, *Modern Algebra*
	Mansfield & Thompson, *Mathematics: A New Approach*
	Snell & Morgan, *New Mathematics: a unified course for secondary schools**
Ambiguous meanings or non-mathematical allusions	
Reference to publisher's name	Howard, Farmer & Blackman, *Longmans' Mathematics*
Others	Goddard & Grattidge, *Individual Arithmetic*
	Goddard & Grattidge, *Individual Mathematics*
	Harris, *Cornerstone Mathematics*
	Keith & Martindale, *Know your Maths*
	Levin, *Gateway Practical Geometry**
	Shaw & Wright, *Discovering Mathematics*
	Smith, *Pioneer Maths*
	Smith, *Topic Arithmetic*
	Webb, *Direct mathematics*
	Webb, *Planned Mathematics*
	Williams, *Kingsway Mathematics*

* Titles appearing twice in the table, showing the plurality of meanings that can be made from the titles given to textbooks series.

meaning seems too uncertain in the context to count it among the titles referring to a certain kind of mathematics.

Such a classification of titles cannot be directly related to approaches and contents featured within the textbooks. However it provides an overview that indicates that, for English publishers of the time, playing with words in order to give an identity to their books could be a means to stress some characteristics of mathematics that were, in the given time, debatable. As this commercial practice could convey the promise of textbooks adapted to diverse approaches teachers could choose to follow in the classroom, it also resulted in picturing a situation remarkable for its diversity. Right away, the English situation escapes a uniform characterization, labeled "English," of mathematics' conceptions presented to an increasing number of children.

Besides, the comparison with the French situation indicates that publishing practices have consequences regarding the picture drawn at this general level. Indeed, in France, titles given to textbooks series obeyed a stricter norm: most covers indicated the subject ("mathematics" or a sub-subject such as "geometry" or "arithmetic"), and the form or type of school. They also often made a reference to the national curriculum or official instructions. For instance, a *Mathématiques. Classe de* 6^e*. Arrêté du 12 août 1957* by François Brachet and Jean-Auguste Dumarqué and a *Mathématiques. Classe de* 4^e*, lycées et collèges. Programme 1958* by Victor Lespinard and Roger Pernet were issued in 1958 respectively by the publisher Delagrave and by Desvigne. As a result, a more formal conception of the subject than in England, directly articulated to the organization of the educational system and to the national curriculum, was promoted. Thus despite a relatively important number of competing series, a more homogeneous conception of mathematics seemed to emerge in the French case compared to the English one.

For all that, French textbooks covers still reflected the complex institutional, epistemological and pedagogical situation of the late 1950s. Other precisions evoked indeed the different approaches and teaching traditions of the time as textbooks' series were often identified thanks to the name of their authors or editors. Besides their identifying function, these names allowed the publishers to present some of the authors' titles and professional functions. Because they referred to their training and professional origins, such mentions tended to indicate the authors' position regarding the "educational duality" that still characterized the French system at the time and was to be related with different conceptions of mathematics: rather practical, concrete and experimental for teachers of the primary order and rather formal and deductive for those of the secondary order.

For instance, following the publication of the new version of mathematics syllabi, the publishing house Armand Colin published in 1958 the first volume of its new series entitled *Cours de Mathématiques J. Marvillet* after the name of its editor, Joseph Marvillet. He was presented as a former student of the *École Normale Supérieure* and a current teacher in Strasbourg *Lycée* Kléber. Another important publishing company, Nathan, also took the opportunity of the curriculum change to publish new versions of its long-standing series named *Cours de mathématiques Lebossé et Hémery.* Its two authors, Camille Lebossé and Constantin Hémery, were respectively identified as *agrégé de mathématiques* and teacher at *Lycée* Claude-Bernard (which implicitly meant in Paris) for the first one, and *agrégé de mathématiques* and teacher at *Collège* Lavoisier (also implicitly in Paris) for the second one. At the same time, Hachette published, under the name of one of its regular authors, a new textbook series: the *Inspecteur général* Roland Maillard, who had been an associated author of previous mathematics series since the 1940s, became the editor of the *Cours R. Maillard* written with other mathematics teachers. Considered all together, the authors' and editors' titles and functions of the different textbooks series indicated that the secondary tradition of mathematics teaching would be more widely present than the primary tradition: *agrégés de mathématiques* and *lycées* teachers dominated thus suggesting that the textbooks' authors had mostly been trained at the University or in the *École Normale Supérieure* (see Table 3).

Indeed, many of the authors of late 1950s textbooks obtained the *Agrégation* during the 1920s–1930s. They were of the same generation as the future founders of

Table 3. Titles and functions of French authors such as given by mathematics textbooks and publishers' brochures.

Number of textbooks authors and editors	50
Function	
Inspector	*3*
Primary school inspector	1
Secondary school inspector within a regional education authority (*Inspecteur d'académie*)	2
Inspecteur general	4
Teacher	*26*
In *collège* or *lycée*	22
In *cours complémentaire*	3
Without any detail regarding the type of school	1
*Other function**	*5*
Title or degree	
Agrégé	19
Licencié (graduated from the University)	2
Former student of the	
École Normale Supérieure	6
École Normale Supérieure de Sèvres (élite institution training future female teachers of *collèges* and *lycées*)	1
École Normale Supérieure de Saint-Cloud	2
Neither function nor title mentioned	7

* Other functions represented among the authors were school directors or administrators, as well as university professors or lecturers.
In this table, I separated functions from titles, whereas it was usual for a textbook author or editor to mention both aspects at the same time. The reader should keep in mind that I copy the titles and functions as they are presented on the cover pages of the textbooks. Such mentions result from an editorial choice and make invisible the complexity of some individual career paths.

Bourbaki with whom some of them got acquainted at the *École Normale Supérieure*.[25] During the interwar years, the education that the latter received at the *École Normale Supérieure* consisted mainly of courses given at the Sorbonne. Many of the most famous mathematicians who then started a career felt that their teaching was not up-to-date (Andler 1994). Despite their disappointment, they received training and benefited from a certain freedom which allowed many of them to pursue and renew their mathematical

[25] That is for instance the case for Roland Maillard who was a classmate with Jean Dieudonné – which does not mean that once an *Inspecteur Général* Roland Maillard favored the introduction of new math curriculums, on the contrary. I thank Dominique Maillard for this information.

research in the following years in logic and algebra (be they members of Bourbaki as Jean Dieudonné or Charles Ehresmann or not as Jacques Herbrand or Paul Dubreil),[26] but not in more practical branches of mathematics which were generally despised in this institution.[27] Other students of the *École Normale Supérieure* became *lycées* teachers according to the choice they could made at the end of their studies between teaching and research. Some of them pursued their career in the inspectorate. They conducted inspections of secondary schools either within a regional education authority when they were *inspecteurs d'académie* or on a national scale for those who joined the *inspection générale*. In the latter case, they also participated to the writing of official syllabi.

Some former students of the *École Normale Supérieure* and other laureates of the *Agrégation* also became editors or authors of textbook series which included volumes for 11- to 15-year olds accommodated in *collèges* and *lycées*. Their textbooks could also be aimed at pupils of *cours complémentaires* when titles did not specify any type of school besides the name of the form (as was for instance the case of the *Collection Cossart et Théron* named after its two editors Édouard Cossart and Pierre Théron who both were former students of the *École Normale Supérieure*[28]) or when they explicitly targeted audiences belonging to both primary and secondary orders (as did for instance the *Collection Paul Dubreil* named after its editor who was then professor at the Faculty of Sciences in Paris and written by teachers who all were *agrégés* of mathematics[29]). Thus some series written by authors coming from the secondary order and its élite institutions presented undifferentiated books for students accommodated in all types of schools, and conveyed a unified conception of mathematics whatever their audience.

However, other textbook series suggested differentiating mathematics teaching according to the type of schools. In such cases, the series included five to six textbooks instead of four, which otherwise covered the four school-years at the middle-school

[26] Recent historical works have shown that it is no longer possible to describe the two decades of the interwar period by their immobility: if the first part of the 1920s can be indeed characterized by a certain continuity regarding the professors teaching at the Sorbonne, the second part of the 1920s and the 1930s saw an important renewal of the professors. As a result, doctoral theses prepared under their supervision started to tackle new domains (Gispert & Leloup 2009; Gispert 2011).

[27] The case of Jacques-Louis Lions is a remarkable (and quite later) exception (Dahan Dalmedico 2005).

[28] The integration of this series within the secondary order is confirmed by the background of the authors of the different volumes. These were written by Laurent Krüger (*sixième* form), Marcelle Couturier (*cinquième* form), Marcelle Couturier, Pierre Théron, and Édith Galmard (*quatrième* and *troisième* forms). Krüger and Galmard were teachers in Parisian *lycées*, Couturier was an *agrégée* who had been trained at the ENS of Sèvres and Théron was an *Inspecteur general* and former student of the ENS.

[29] In this series, the volume *Mathématiques. Classe de 6ᵉ, lycées et collèges d'enseignement général* (1961) was written by André Fouché and Anne Brailly-Marchand, both *agrégés* and *lycée* teachers; the volumes *Mathématiques. Classe de 5e, lycées et collèges d'enseignement general* (1961) and *Mathématiques. Classe de 4e, lycées et collèges d'enseignement général* (1962) were written by Mireille Clavier, also *agrégée* and *lycée* teacher; the volume *Mathématiques. Classe de 3ᵉ* (1963) was written by Huguette Mazet and Georges Thovert, both *agrégés* and working respectively at the Faculty of Sciences in Paris and at the Ampère *Lycée* of Lyons. The editor of the series, Paul Dubreil, had been appointed to the chair of arithmetic and number theory of the Faculty of Sciences in Paris in 1954.

level[30]: this was the case for the series published by Bourrelier and written by Roger Duma and Gilbert Mallet (5 volumes), the above-mentioned *Cours de Mathématiques J. Marvillet* (5 volumes), the series *La Classe de Mathématiques* (6 volumes) published by Belin, the *Cours Complet Lespinard & Pernet* (6 volumes) published by Desvigne, and the *Cours de mathématiques Lebossé et Hémery* (6 volumes) published by Nathan.[31]

These textbooks were written by authors of various pedagogical, scientific, and social backgrounds. Some were written by authors coming from the secondary order even though they distinguished in separate volumes the mathematics they presented according to their audiences: it was the case for the series published by Nathan and written by, as I have already mentioned, Camille Lebossé and Constantin Hémery who were both *agrégé* teachers in respectively a *lycée* and a *collège*, and for the *Cours Complet Lespinard & Pernet*, also written by two *agrégés*. The other series gave more important space to authors belonging to the primary order. Thus, while Roger Duma was an *agrégé* who had left teaching to become a school inspector, his co-author Gilbert Mallet was a *cours complémentaires* teacher[32] (who specified that he also had a university degree in science). Maurice Monge and Marcel Guinchan, authors of the series *La Classe de Mathématiques*, also formed a mixed team as the first one was a former student of the *École normale supérieure* and a *lycée* teacher while the second one taught in *cours complémentaires*. Regarding the *Cours Marvillet*, two authors belonged to the secondary order (Robert Girard and Lucette Chopard-Lallier who both were *agrégés* and taught in *lycées*), but the other two, Pierre-Marie Fournier and Alphonse Adam, belonged to the primary order as they were respectively head of a school of *cours complémentaires* and primary school inspector. For his part, even though it was not visible for the audience, the editor of the series Joseph Marvillet was an example of existing links between the primary and secondary orders. As I have mentioned above, he was presented on the books' covers as a former student of the *École normale supérieure* and a *lycée* teacher, but he actually came from the primary order since he had been initially trained, after the First World War, to become a primary school teacher.[33]

[30]Some of these textbooks series actually counted more textbooks if one takes also into account volumes published for pupils engaged in long courses of *lycées* and *collèges*.

[31]Here I mention all the series that covered all types of schools and distinguished their audiences at some point. Other series included more than 4 volumes but because they proposed separated volumes for different sub-subjects (for instance the *Cours de Mathématiques sous la direction de G. Cagnac et L. Thiberge* published by Masson included 5 volumes: *Arithmétique. Classes de sixième* and *Géométrie et arithmétique. Classes de cinquième* both published in 1958, a brochure entitled *Notions d'astronomie. Classes de* 6^e *et* 5^e published in 1959, and the volumes *Arithmétique, algèbre, géométrie,* 4^e and *Arithmétique, algèbre, géométrie,* 3^e published in 1960.

[32]As the textbook series was published in 1961, after the Berthoin reform, Gilbert Malet was actually presented as a teacher in a *Collège d'Enseignement général*, but as I mentioned above, such a professional situation in the early 1960s indicated a primary-order origin (and a teaching practice in *cours complémentaires*).

[33]Joseph Marvillet studied at the *école normale d'instituteurs* of Vesoul from 1918 to 1921. He later got a grant to pursue studies at the *École normale supérieure* where he studied from 1924 to 1927. These details come from his administrative file recorded at the French National Archives under the reference F^{17}29223.

A primary-order background also characterized the authors of a textbook series which was the unique complete series entirely and specifically dedicated to *cours complémentaires* pupils after the release of the new mathematics syllabi in 1957. Published by Hachette and entitled *Mathématiques avec travaux pratiques*, this series was authored by Marcel Hémeret and Albert Lermusiaux who both were former students of the *École Normale Supérieure de Saint-Cloud* – that is the élite school of the primary order.[34] The situation was less clear for older series dedicated to this particular audience and still presented by the publishers in their brochures in the late 1950s, but for these series too, the authors' backgrounds matched their audience to some extent.[35]

All the complexity of individual career paths was not apparent to the textbooks' readers. Nonetheless, when the publishers mentioned some of the titles and functions of their authors, they conveyed references to the dual structure of the French educational system and to the different mathematics teaching traditions that existed at the time. Such references also accounted for a possibly greater diversity of mathematics within French textbooks than the homogeneity of titles and the predominance of authors coming from the secondary order would have suggested. As a result, the necessity to identify different textbook series on a competing market also drew a picture of diversity when the whole of the books is considered. Thus, even though publishing practices were different in France and England, they displayed in both cases hints on the books' covers which suggested diverse treatments of mathematics. Such hints invite to look more in-depth at some of the textbooks published in the late 1950s to see whether contemporary debates were explicitly addressed by the authors within their textbooks.

2.2. *Identifying competing conceptions of mathematics and mathematics teaching: following the authors' words*

Both in France and England, many textbooks opened with forewords or addresses to the readers where, in this period of redefinition of curricula and debates on mathematics teaching, authors or editors could justify the choices they had made during the conception of their textbooks. In this section I focus on just a few books in each national context that were identified, thanks to their covers, as potentially different with regards to the kind of mathematics they presented.

[34] The training received by in the *élite* institutions of the primary order (*École Normale Supérieure de Saint-Cloud* and *Fontenay*) is less known than that of the *École Normale Supérieure*.

[35] René Échard, author of a series published by Charles-Lavauzelle, was a secondary school inspector, but he had actually been first trained as a primary school teacher (see his administrative file recorded F^{17}30289b in the French National Archives). An older series was also still promoted by the publisher Hachette: it had been written by the *inspecteur général* Roland Maillard and Albert Millet. No mention indicated the titles and functions of Albert Millet, but he was a former student of the *École Normale Supérieure de Saint-Cloud* who had joined the secondary order: before he retired, he had taught at the Janson-de-Sailly *Lycée* and the *École Normale Supérieure de l'Enseignement Technique (ENSET)*.

For the French case, I have selected, because of the various backgrounds of their authors, the series edited by Paul Dubreil, Joseph Marvillet, and Roland Maillard as well as the series written by Albert Lermusiaux and Marcel Hémeret. All were published after the release of new syllabi for mathematics from 1957 onwards. For the English case, the analysis is restricted to series that announced, through their titles, potentially different approaches to mathematics teaching in secondary modern schools. I have selected the first series that was explicitly dedicated to this type of school, *Modern School Mathematics* written by Edward J. James and published in 1954–56, a series which later advocated the preparation of external examinations, *Certificate Mathematics* written by Ronald W. Fox and a series entitled *Mathematics: A New Approach* published by Chatto and Windus in the early 1960s. The span-time considered in the English case is thus longer than in the French case; it is a means to take into account the debates of the second part of the 1950s in a context where no official syllabi were issued for secondary schools.

In the French context, divergences in the identity of mathematics and the aims of mathematics teaching were most clearly stated when authors and editors commented on the "practical works" that were the pedagogical innovation of the recent official syllabi. For instance, the mathematician Paul Dubreil considered "practical works" to be a pedagogical means that favored actual practice in mathematics because it was opposed to lectures and permitted children's active involvement. Such a means was essential because, as he insisted in the foreword of the *sixième* textbook he edited, work in mathematics required constant practice, not only when it came to practical works, but in all its different areas:

> I cannot recommend strongly enough to attach the greatest importance to the first part of this book, entitled – overly modestly to my mind – 'calculation practice'. Other parts of the book show the importance and interest of practical works, more lively and efficient than ex cathedra teaching. In particular, some chapters are almost exclusively constituted by descriptions of practical works that ought to be really done by pupils.[36] (Dubreil 1961, 5)

The authors of the *Cours J. Marvillet* insisted for their part on another aspect of practical works. They too made a reference to the importance of this pedagogical innovation and quoted an extract from the national curriculum, but they gave their own interpretation of the use in mathematics teaching of facts and events that were actually "practicable" or "observable":

[36] "On n'accordera donc jamais trop d'attention à la première partie de ce livre, intitulée, trop modestement je crois, « Pratique du Calcul ». / La rédaction des autres parties de ce livre met en évidence l'importance et l'intérêt des travaux pratiques, plus vivants et plus efficaces que l'enseignement ex cathedra. En particulier, certains chapitres sont constitués presque uniquement de descriptions de travaux pratiques qui devront être réellement exécutés par les élèves."

> In no instance, should this attention towards the use of intuitive or experimental notions as starting points make one lose sight of the training of logical thought. ... The purpose of practical exercises cannot be reduced to the intuitive discovery or to the verification of a property or a result. They shall aim at helping the pupil to progressively appreciate the necessity of rigor and the requirement of demonstration.[37] (Marvillet 1958, foreword)

Such a distinctive identity of mathematics was also apparent in the forewords written by the authors of the *Cours R. Maillard* when they noticed that "practical works" were an opportunity to "take advantage of children's existing knowledge to acquire new knowledge and to rise from concrete situations to precise notions"[38] (Maillard 1958, 5). A similar idea, stressing the dynamics of elevation from the concrete to mathematical precision and abstraction is again stated in the next textbook, published the following year (Maillard 1959, 7).

By contrast, the former pupils of the *École Normale Supérieure de Saint-Cloud*, Albert Lermusiaux and Marcel Hémeret, succinctly commented in the syllabus by highlighting yet another aspect of practical works. Following the official directives they insisted on the need to include this approach within mathematics teaching, and stressed the importance of "experience and concrete reality." They also brought to light a more organizational aspect of teaching in *cours complémentaires* when they recommended "the closest link between manual works and mathematics" and noticed that: "If the mathematics teacher is not in charge of manual works, teachers of both subjects should establish together the exercises of manual works"[39] (Hémeret & Lermusiaux 1958, 2).

Manual works (*travaux manuels*) were an instance of technical teaching, which underwent at the time an important curriculum change, related to contemporary institutional evolutions (Lebeaume 2010). This short extract taken from Hémeret & Lermusiaux (1958) indicates that, while a specific profession was emerging for this subject, its teaching could remain in practice the responsibility of mathematics teachers, thus accounting for some closeness between mathematics and more physical and practical subjects. Such closeness also appeared in the suggestions made for some practical works for the *sixième* form in this book: for solid geometry, pupils were invited to use objects they had constructed during manual works to introduce the definitions of

[37] "En aucun cas, ce souci de partir de notions intuitives ou expérimentales ne doit faire perdre de vue la formation de la pensée logique. [...] Les exercices pratiques ne sauraient donc avoir pour seul objet de faire découvrir intuitivement, et au besoin de vérifier, une propriété ou un résultat. Ils doivent surtout faire sentir à l'élève, peu à peu, la nécessité de la rigueur et faire naître progressivement chez lui, le besoin de la démonstration."

[38] "profiter des connaissances qu'ont déjà les enfants pour fixer une acquisition, pour *s'élever du contact concret à une notion précise.*"

[39] "Si le professeur de mathématiques n'est pas chargé personnellement des travaux manuels, les professeurs de mathématiques et de travaux manuels établiront ensemble la progression des exercices de cette dernière discipline."

some mathematical solids. Thus, at least to a certain extent, mathematical notions and definitions would be constructed in continuity with the physical word, and concrete objects would appear adaptable to different viewpoints, rather than as mere starting points to introduce a distinct approach typical of mathematics as the forewords of the *Cours J. Marvillet* and *Cours R. Maillard* suggested.

Textbooks published for the next forms took these competing views further, as they also made diverse positions regarding the teaching of "modern mathematics" apparent. While Paul Dubreil suggestively noticed that the book for the *troisième* form he had edited showed the authors' refusal to "tone down" (*édulcorer*) mathematics (Dubreil 1963, 5), textbooks for the *troisième* forms of the *Cours J. Marvillet* were advertised in a more explicit manner. Among the main characteristics of the books, the publisher stressed in his catalogue the "exclusive use of deductive reasoning (except for solid geometry) and modern terminology," as well as "the prudent introduction of the notion of set." These indicated a commitment for the "new math" which was explicitly stated when the books were described as a means to "give *lycée* pupils a closer contact with the modern point of view which would only be studied in *seconde* form, and allow short-stream pupils not to leave school while ignoring the new orientation of mathematics" (Librairie Armand Colin 1961). The *Cours R. Maillard*, which shared with the *Cours J. Marvillet* a conception of mathematics as an abstract, logical, and deductive subject, insisted on the contrary on the novelty of the method rather than on the introduction of "new math" content: the entire series was advertised as a "proposal to renew the traditional manner both in the exposition of lessons and in the presentation of subjects for practical works and problems that would be of interest for the pupils as news topics" (Hachette 1960).

For its part, the series written by Albert Lermusiaux and Marcel Hémeret fostered yet another approach in the textbook for the *quatrième* form. The book included a long foreword in which the authors justified the approach they had followed in the previous books in response to critics who had pointed out a certain lack of rigor. Meanwhile, they stressed the importance they dedicated to demonstration and reasoning. They also presented their book as a response to dilemmas which were peculiar to mathematics teaching in *cours complémentaires* and highlighted the interest of an experimental approach in order to meet contradictory aims:

> It must be acknowledged that traditional mathematics teaching was a bit too much intended for brilliant pupils, which is why it appeared as an uninterrupted succession of logical and rigorous deductions, with only a remote connection with everyday life. Yet most pupils of *cours complémentaires* will rapidly need *useable mathematics*. . . . However teaching in *cours complémentaires* should not handicap pupils who would study further, especially future students at teacher schools. To try to reconcile these very different priorities, new mathematics teaching dedicates a very great space to practical works; these are useful to make mathematics teaching less austere, more concrete while at the same time they give an opportunity to show children how useful mathematics is and

how its applications have been developing.[40] (Hémeret & Lermusiaux 1960, foreword; emphasis added)

All together, these different assumptions show that long-standing traditions in mathematics teaching and considerations regarding the children's academic paths were still put forward by textbooks authors in late 1950s France. As a result, while institutional dynamics and on-going debates fostered more and more the idea that mathematics teaching could be quite similar for different audiences at the middle-school level, these textbooks suggested to their users (both teachers and pupils) diverse approaches. For some, experimental approaches based on the manipulation and study of concrete objects and their physical properties would tend to be considered as a proper mathematical method. For others, such approaches would be mere pedagogical methods, which may be necessary regarding the pupils age but could not be typical of "true" mathematics. However, despite these important differences, all textbooks' authors also mentioned the importance attributed to demonstration and reasoning, whatever the audience. This feature distinguished the French case from the English one.

As I already mentioned, in England no national curriculum defined compulsory contents that had to be taught in school in the late 1950s. Even more than other types of schools, secondary modern schools were invited to design their own syllabi, according to children's aims, needs, and identified aptitudes, but the preparation of external examinations progressively played an increasing role in these schools too. In such a context, textbooks were presented as tools to help in curriculum design. The first to explicitly and exclusively address secondary modern school pupils in its textbooks, Edward J. James, was a teacher at Redland Training College whose interest in the subject was recognized within the MA, since he joined the association's subcommittee on secondary modern schools the very same year he published the first textbook of his series (Price 1994, 177; James 1954). In this textbook, Edward J. James added some notes intended for the teachers after the pupils' contents. There, he expressed the issues faced by Secondary Modern School teachers in curriculum shaping, which justified for him an approach different from the ones followed in other schools: "Merely adding more material to an existing syllabus is not a suitable means of catering for the increased age-range of the pupils; nor is simplifying a Grammar school syllabus a method for satisfying the new status of the school. An entirely fresh approach is needed" (James 1954, 133).

[40] "Il faut bien reconnaître que l'enseignement traditionnel des mathématiques était un peu trop destiné aux seuls élèves brillants et c'est pourquoi il se présentait comme une suite ininterrompue de déductions logiques et rigoureuses n'ayant souvent qu'un rapport lointain avec la vie de tous les jours. Or la grosse majorité des élèves des cours complémentaires auront rapidement besoin de mathématiques utilisables. [...] Mais, par ailleurs, l'enseignement des cours complémentaires ne doit pas handicaper les élèves qui continueront leurs études, les futurs normaliens en particulier. Pour essayer de concilier ces deux impératifs bien différents, l'enseignement nouveau des mathématiques accorde une place très grande aux travaux pratiques destinés à rendre l'enseignement moins austère, plus concret tout en montrant aux enfants l'utilité des mathématiques et le développement de leurs applications."

Having considered these challenges, he presented his course as aiming "to show mathematics in use and, at the same time, to introduce to children a wide range of mathematical ideas which they can understand and enjoy." For him, the choice of the method was essential in order to allow children to understand and use mathematical notions and processes: "In Modern School Mathematics subjects such as algebra, geometry, trigonometry, etc., are introduced, but in each case the approach to the subject and the work done are both especially planned for Modern school pupils" (ibid.). James did not give his approach a name in this text; he rather insisted on the importance for children to "make up their own examples similar to those given in the book" and on the necessity to introduce mathematical ideas before using formal definitions and technical terms.

Eight years later, Ronald W. Fox, head of the Mathematics Department at Vincent County Secondary School, took a pragmatic stance. As he justified his textbooks' specific organization by the preparation of external examinations, he highlighted what had become in-between an influential trend on the organization of schooling:

> The increasing desire amongst Secondary School pupils to secure qualification by external examination has produced a need for a series of text-books designed to cover their particular needs. . . . The course has been arranged in three terms based on the hope that this will assist the teacher in planning the allocation of time to the various topics. (Fox 1962a, v)

To his mind, such a requirement should lead teachers to distance themselves from contemporaneous recommendations regarding mathematics teaching:

> The present tendency to teach the various branches of mathematics as an integrated subject is no doubt highly desirable yet . . . is not necessarily best suited to the need of the average child. The slower pupil, the late developer is less academic in his approach and usually prefers to have the subject arranged tidily in its various compartments. (Ibid.)

As a result, whatever the conception of mathematics might be for the teachers, children's needs and aptitudes would determine the design of the curriculum. To Fox's mind, mathematics represented above all for children a tool to secure a qualification. Could such an opinion be considered as lacking ambition or even potentially prompting a misconception of mathematics? Some parts of Fox's foreword tend to say so as he reassured his readers by asserting that "integration [of the subject] occurs quite naturally at a later stage" and that "a belief that pupils should learn something of the wider aspects of mathematics has encouraged the author to add a fourth section to each volume" which dealt with "a variety of topics, including an insight into the history of mathematics, simple surveying and elementary statistics." Considering the risk of being accused of giving away mathematics' identity and integrity in favor of immediate benefits of qualification, Fox's position was quite a bold one. it signaled that the wish for a different, but not precisely characterized, approach that had been expressed by James eight years earlier had become difficult to maintain.

Contemporaneous debates on mathematics teaching and evolutions witnessed by secondary modern schools in the late 1950s also found an echo in the first volume of *Mathematics: A New Approach* published by Chatto and Windus. Its foreword was signed by Pr. Bryan Thwaites, who chaired in 1961 a conference organized at the University of Southampton as a follow-up to the conference of Royaumont organized by the OEEC. In England, he initiated the School Mathematics Project (SMP), a research project of the University of Southampton on mathematics teaching in secondary schools (About the Collaborative Group for Research in Mathematics Education 2010). Such an imprimatur emphasized the closeness between the approach adopted in *Mathematics: A New Approach* and the international "New Math" movement. Thwaites also praised the novelty introduced by the authors and its actual usefulness for teachers, and in a way which stood out from the usual arguments, he stressed the interest of the book for mathematics (rather than for pupils):

> If mathematics is to survive the ever-growing and desperate shortage of competent teachers, it must present a new face to young people in schools, a face looking forward to the challenge of modern technological civilization rather than sideways to the mechanical repetition of obsolescent formulae. This book is facing in the right direction. (Mansfield & Thompson 1962, foreword)

For their part, the authors of the series were less radical. Donald Mansfield and Derek Thompson, authors of the first three volumes of the series, were both heads of mathematics department in secondary schools,[41] while Maxim Bruckheimer who authored the books 4 and 5 with D. Mansfield was professor in a technological institute in London. They considered the first three volumes of the series to be an introductory course to mathematics, suitable for *all* children.[42] They thus broke with the idea that mathematics teaching should be adapted to the different types of schools and diverse children's aptitudes. In coherence with the series' title, they also emphasized the issue of approach, which was for them the most important aspect of mathematical teaching. To the authors' minds indeed, its modernization was less a question of introduction of lessons about modern contents than the modernization of the approach (Mansfield and Bruckheimer 1965, 7). It resulted in an "attempt to combine the new mathematics with the old" (Mansfield and Thompson 1962, 11) which, even though it might appear difficult for the teacher, simplified the pupils' work because it allowed economy of thought (Mansfield and Bruckheimer 1965, 7). For the pupils' attention they described mathematics neither as a mere tool for other subjects, nor as a set

[41] In the 1960s, Donald Mansfield took part in the Nuffield Mathematics Project which devised a renewed approach for primary school children.

[42] This view is most clearly expressed in the teachers' book going along the fourth volume of the series (Mansfield and Bruckheimer 1965, 7).

of formulas and algorithms to use, but as a discipline organized in thematic branches, which had evolved in time and became integrated by the search of laws which explained and predicted observable phenomena.

While expressing a unified view of mathematics, the authors of this new series shared with their competitors on the textbook market a way of arguing by referring to one or several characteristics of their intended audience, which in turn influenced the kind of mathematics pupils had to study. In doing so, they echoed contemporary debates on the national scene. As we have seen, the parallel between debates and explanations given by authors in the textbooks' paratexts also existed in the French context even though arguments relied there more on existing traditions of mathematics. Another difference between the French and English contexts also permeated paratexts in some textbooks series. In England, the study of mathematics could be linked more clearly than in France to applications and modern technologies. The authors of *Mathematics: A New Approach* stated such a close relationship in the clearest way when they mentioned technological developments that could be related to the Second World War and its following years:

> Science, engineering and all the many kinds of technology are forms of applied mathematics. There has been, since World War II, an enormously rapid increase of activity in all the fields which depend on mathematics. Jet propulsion, computers, artificial satellites, space flight, radio astronomy, atomic and nuclear energy, new metals, new plastics, new methods of manufacture, new ways of reasoning, new and better ways of controlling machines and factories, automation: all these are new, all expanding rapidly, and all depend on mathematics. (Mansfield and Thompson 1962, 11)

Such a conception was not a mere advertisement; as we shall see in the subsequent section, it was also materialized in the contents of the textbooks.

2.3. Investigating in greater detail mathematics' identity: focusing on textbook contents and their presentation

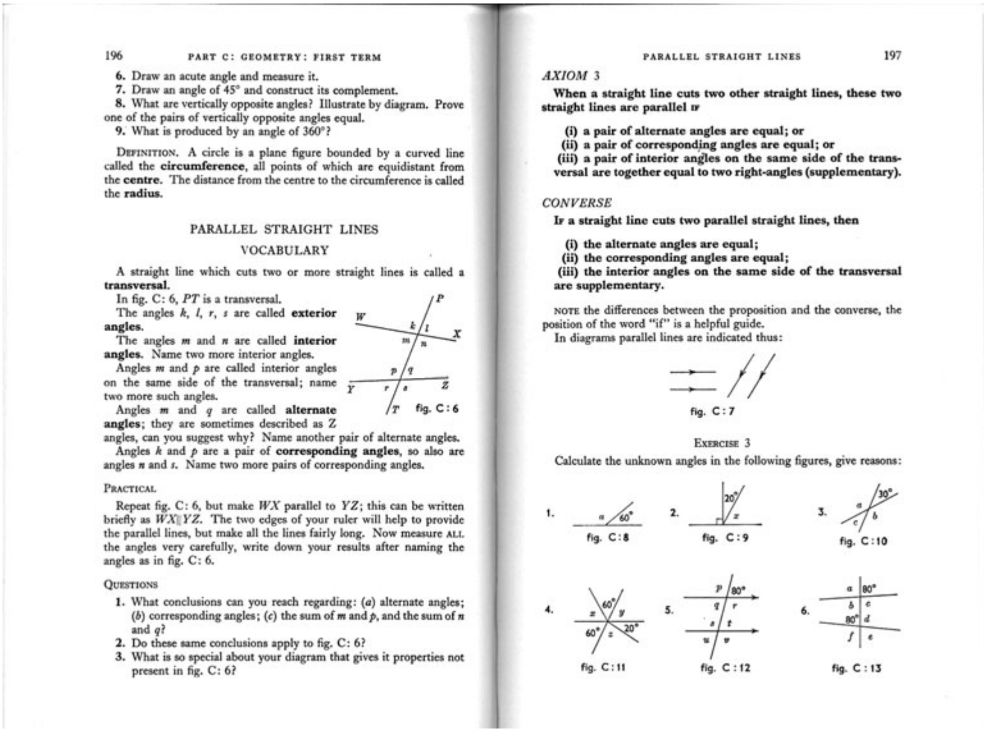
Considering the diverse conceptions expressed by the authors in England and in France, one might expect many differences within textbook contents. However, it is useful to start this section by pointing out a common feature of all these books – might it seem obvious to the reader: the importance of numerous exercises and problems, some of which were solved and used as worked examples. Far from being a common feature of all science textbooks in the late 1950s, the space devoted to exercises and problems tended to characterize mathematics as a subject that required actual practice rather than as a subject that could be described or narrated (as physical or natural sciences could be) (Radtka 2013, 492). As we shall see, this primary distinction could be lessened or on the contrary reinforced by other ways used to present knowledge in these textbooks.

Among the different textbook series studied in section 2.2, the one which presented a very limited part of descriptive or explicative texts was the *Modern School Mathematics* (James 1954). In line with the foreword's introduction, the textbooks of this series invited their readers mostly to work out exercises by themselves. Instructions were given so the reader would "write down" numbers, "copy" tables, "find" missing numbers, "use" his protractor, "draw" lines, "express" angles in degrees, etc. and to, more generally, answer questions and use worked examples as models. The wording of exercises and chapters' titles linked the skills that were progressively acquired by the pupil with everyday life or practical situations. Punctually, explanations or vocabulary was introduced, but it directly followed or preceded an exercise to solve: no more typographical tools than the use of bold fonts added emphasis to the text. In the case of this series, the visual aspect of the books paralleled a conception of mathematics as an activity of handling numbers and figures.

In the English case, Ronald W. Fox's *Certificate Mathematics* also gave exercises a central role. However, different types of texts were identified and visually organized the book's contents. Each section started with a text describing and explaining either the purpose of the following exercises, or the object of a specific branch of mathematics, or the links for the reader with already studied methods or notions. Besides, some "notes" were punctually inserted at the end of exercises, examples, or explanations; and (mostly in geometry sections), generalizations, conventions, rules were distinguished as definitions, theorems, axioms, etc. The theoretical or practical aspect of the activities was also emphasized by labels. Accordingly, this series did not leave it for the teacher to decide whether a clarification of the status of these different statements was required or useful for the student: rather, it tended to impose the image of mathematics as a logically organized body of knowledge. Thus, graphical and typographical choices were constitutive of the conception of mathematics materialized in the textbooks[43]: the reader was dealing with neither an uninterrupted succession of exercises nor a linear narrative; he was confronting a mixture of explanations to read, exercises to solve, and examples to follow which progressively constructed a unified and relatively autonomous body of knowledge.

Such a parallel between textbooks layouts and the presentation of mathematics as a logically organized body of knowledge also existed in the French case, but in an even more explicit way. As in the case of Fox's textbooks, French textbooks' different layouts pointed out to the reader the diverse nature of successive sections of the text, and a stronger emphasis was put on phases of reasoning and demonstration.[44] Typographical and graphical choices supported the authors' commitment to rigorous demonstration and reasoning expressed in forewords even when, as was the case for Lermusiaux and Hémeret, they advocated an experimental and practical conception of mathematics for pupils of *cours complémentaires*. This common feature, expressed in forewords and

[43]See Figure 1.
[44]See Figure 3 for an example.


196 PART C: GEOMETRY: FIRST TERM

6. Draw an acute angle and measure it.
7. Draw an angle of 45° and construct its complement.
8. What are vertically opposite angles? Illustrate by diagram. Prove one of the pairs of vertically opposite angles equal.
9. What is produced by an angle of 360°?

DEFINITION. A circle is a plane figure bounded by a curved line called the **circumference**, all points of which are equidistant from the **centre**. The distance from the centre to the circumference is called the **radius**.

PARALLEL STRAIGHT LINES

VOCABULARY

A straight line which cuts two or more straight lines is called a **transversal**.

In fig. C: 6, *PT* is a transversal.

The angles *k*, *l*, *r*, *s* are called **exterior angles**.

The angles *m* and *n* are called **interior angles.** Name two more interior angles.

Angles *m* and *p* are called interior angles on the same side of the transversal; name two more such angles.

Angles *m* and *q* are called **alternate angles**; they are sometimes described as Z angles, can you suggest why? Name another pair of alternate angles.

Angles *k* and *p* are a pair of **corresponding angles**, so also are angles *n* and *s*. Name two more pairs of corresponding angles.

fig. C: 6

PRACTICAL

Repeat fig. C: 6, but make *WX* parallel to *YZ*; this can be written briefly as *WX*∥*YZ*. The two edges of your ruler will help to provide the parallel lines, but make all the lines fairly long. Now measure ALL the angles very carefully, write down your results after naming the angles as in fig. C: 6.

QUESTIONS

1. What conclusions can you reach regarding: (*a*) alternate angles; (*b*) corresponding angles; (*c*) the sum of *m* and *p*, and the sum of *n* and *q*?
2. Do these same conclusions apply to fig. C: 6?
3. What is so special about your diagram that gives it properties not present in fig. C: 6?

PARALLEL STRAIGHT LINES 197

AXIOM 3

When a straight line cuts two other straight lines, these two straight lines are parallel IF

(i) a pair of alternate angles are equal; or
(ii) a pair of corresponding angles are equal; or
(iii) a pair of interior angles on the same side of the transversal are together equal to two right-angles (supplementary).

CONVERSE

IF a straight line cuts two parallel straight lines, then

(i) the alternate angles are equal;
(ii) the corresponding angles are equal;
(iii) the interior angles on the same side of the transversal are supplementary.

NOTE the differences between the proposition and the converse, the position of the word "if" is a helpful guide.

In diagrams parallel lines are indicated thus:

fig. C: 7

EXERCISE 3

Calculate the unknown angles in the following figures, give reasons:

1. fig. C: 8
2. fig. C: 9
3. fig. C: 10
4. fig. C: 11
5. fig. C: 12
6. fig. C: 13

Fig. 1. Contrasting visual aspects within a single textbook: pages 196–197 and pages 294–295 in *Certificate Mathematics Book 1* (Fox 1962a).

supported by books' layouts, also resulted in forging an overall deductive identity to mathematics in the French case.

The relationship existing between the conceptions of mathematics that textbooks tended to foster and their visual aspect can also be pointed out in cases that broke with this overall image, both in the English and in the French situations. For instance, the series *Certificate Mathematics* featured some "topics" the author considered as "diversions" (Fox 1962a, vi): history of mathematics, surveying techniques, weighing instruments, calculating machines or elementary statistics, etc. were introduced in specific sections. Then, the pages displayed descriptive texts, pictures and drawings. As a result, the visual aspect of the books changed: exercises were no longer a dominant feature, and description (thanks to text and picture) took first place.[45] In French textbooks too, some sections slightly modified the conception of mathematics which resulted from dominant layouts and suggested links between at least some part of mathematics and physics. It was in particular the case of sections devoted to astronomy,

[45]See Figure 1.

By Courtesy of the Middlesex County Times

PLATE D (i) Modern measuring equipment. Try to identify as many items as possible.
(ii) Surveying equipment. See pp. 298–300.

PLAYING WITH NUMBERS 295

MAGIC SQUARES

The mystery surrounding numbers and their behaviour was responsible for the belief in some societies that "number governed the universe". There were male and female numbers, and each had its own special magic significance. You can discover more about this if you so wish, but we will concern ourselves here with just one aspect of the magic of number.

The Chinese made a pastime of constructing Magic Squares as long ago as 1000 B.C. or even earlier. Fig. D: 18 shows an arrangement of

4	3	8
9	5	1
2	7	6

fig. D:18

4	9	5	16
15	6	10	3
14	7	11	2
1	12	8	13

fig. D:19

9 numbers such that the total horizontally, vertically and diagonally is 15; this arrangement was certainly known to the early Chinese, though in a somewhat different form.

Fig. D: 19 is an arrangement using 16 "cells", and the total in the three directions is 34.

Can you see the connection between fig. D: 20 and fig. D: 18? Fig. D:18 is a "basic square", as also is fig. D: 19. Try constructing magic squares of your own. You might leave a number of cells empty and allow your friends to try to complete the square.

7	6	11
12	8	4
5	10	9

fig. D:20

S	A	T	O	R
A	R	E	P	O
T	E	N	E	T
O	P	E	R	A
R	O	T	A	S

fig. D:21

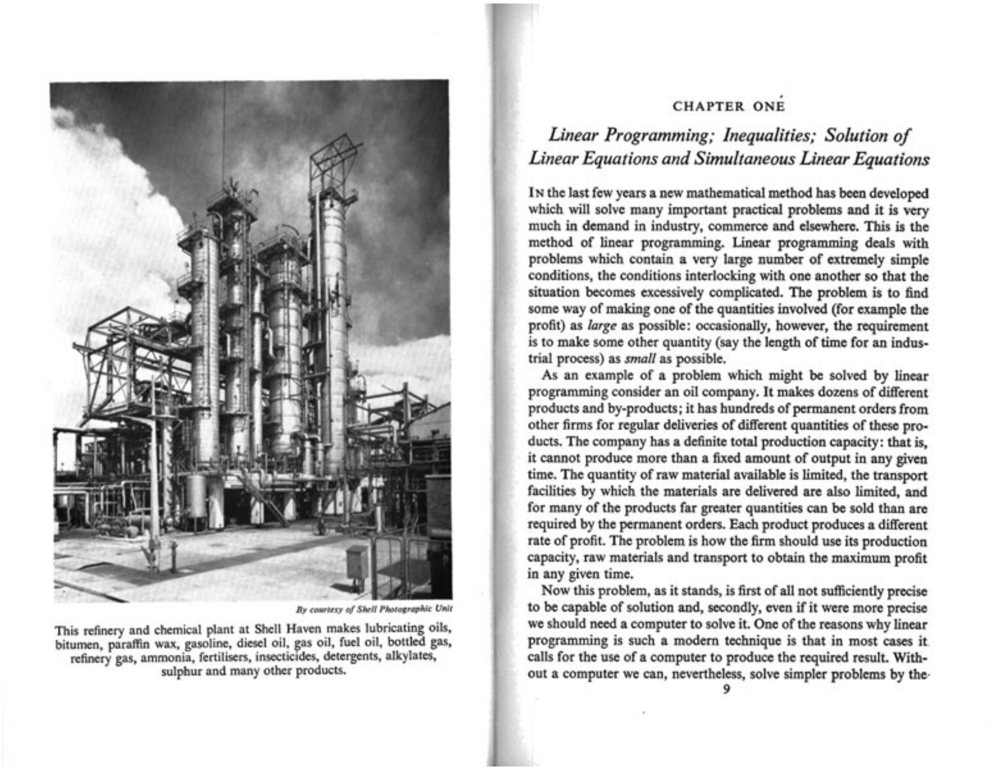
Fig. D: 21 is a word square taken from an inscription at Cirencester, Glos. It is a Latin sentence *Sator Arepo tenet opera rotas*, which translated means "Arepo, the sower, delays the wheels by his works."

Fig. 1. Continued.

which were in the late 1950s included in all textbooks in the form of practical works,[46] and of sections exposing physical quantities and measurement units in textbooks for the *sixième* and *cinquième* forms. There, the space devoted to images (including photographs) and descriptive texts was more important than in other sections of the textbooks, which resulted in blurring, to some extent, the boundaries between mathematics and physics (Radtka 2015, 736–740).

In the French case, while the trend was general because of the existence of official syllabi, it was not unequivocal. As was the case regarding the aims of the introduction of "practical works" in the official syllabi, the treatment of such contents was adaptable, and was indeed, adapted by the authors according to their various

[46]Such contents derived from the official syllabi released from 1957, but they were not an entirely novel aspect of mathematics teaching: the inclusion of astronomy within mathematics referred to a 19^{th}-Century consensus between mathematicians and physicists (Atten 1996); it was coherent with the study of cosmography in the last form of *lycées* within mathematics (Le Lay 2016), and with the training that primary schools teachers had traditionally received (Flammarion 1911).



By courtesy of Shell Photographic Unit

This refinery and chemical plant at Shell Haven makes lubricating oils, bitumen, paraffin wax, gasoline, diesel oil, gas oil, fuel oil, bottled gas, refinery gas, ammonia, fertilisers, insecticides, detergents, alkylates, sulphur and many other products.

CHAPTER ONE

Linear Programming; Inequalities; Solution of Linear Equations and Simultaneous Linear Equations

In the last few years a new mathematical method has been developed which will solve many important practical problems and it is very much in demand in industry, commerce and elsewhere. This is the method of linear programming. Linear programming deals with problems which contain a very large number of extremely simple conditions, the conditions interlocking with one another so that the situation becomes excessively complicated. The problem is to find some way of making one of the quantities involved (for example the profit) as *large* as possible: occasionally, however, the requirement is to make some other quantity (say the length of time for an industrial process) as *small* as possible.

As an example of a problem which might be solved by linear programming consider an oil company. It makes dozens of different products and by-products; it has hundreds of permanent orders from other firms for regular deliveries of different quantities of these products. The company has a definite total production capacity: that is, it cannot produce more than a fixed amount of output in any given time. The quantity of raw material available is limited, the transport facilities by which the materials are delivered are also limited, and for many of the products far greater quantities can be sold than are required by the permanent orders. Each product produces a different rate of profit. The problem is how the firm should use its production capacity, raw materials and transport to obtain the maximum profit in any given time.

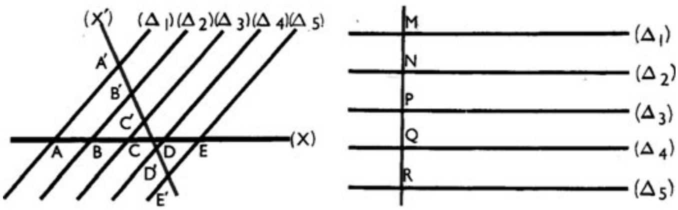
Now this problem, as it stands, is first of all not sufficiently precise to be capable of solution and, secondly, even if it were more precise we should need a computer to solve it. One of the reasons why linear programming is such a modern technique is that in most cases it calls for the use of a computer to produce the required result. Without a computer we can, nevertheless, solve simpler problems by the

9

Fig. 2. Linking mathematics with contemporaneous technological developments: pages 8–9 of *Mathematics: A New Approach Book 2* (Mansfield & Thompson 1963).

audiences (Radtka 2015, 740–743). Heterogeneity in the English case is to be expected even more, because of the absence of official syllabi and of the diverse proposals promoted by the authors in their forewords. There, while in the case of the series *Certificate Mathematics*, the adaptation of the layout contributed to underline the different status granted by the author to different pieces of knowledge, an original visual aspect supported the novelty advocated by the competing series *Mathematics: A New Approach*.

Indeed, *Mathematics: A New Approach* included remarkably long texts – so much so that some critics regretted their length even when they positively praised the series (ATAM 1962, 73; ATAM 1963, 61). Besides, the series also gave greater space to photographs than usual: while in other textbooks the iconography consisted mostly of charts, diagrams, geometrical figures, and some illustrative simple drawings, the photographs of *Mathematics: A New Approach* materialized the authors' conception of mathematics. As they stated in the foreword, mathematics was at the basis of almost



116 *MATHÉMATIQUES*

Appelons A′, B′, C′, D′, E′ les points d'intersection respectifs de (X′) avec (Δ_1), (Δ_2)... (Δ_5) *(fig. 15)*.

L'examen des droites (Δ_1), (Δ_2), (Δ_3), coupées par (X) et par (X′), donne :

$$A'B' = B'C'.$$

L'examen des droites (Δ_2), (Δ_3), (Δ_4), coupées par (X) et par (X′), donne :

$$B'C' = C'D';$$

et enfin, l'examen des droites (Δ_3), (Δ_4), (Δ_5) coupées par (X) et par (X′) donne : $C'D' = D'E'$.

▪ THÉORÈME. — ***Si des droites parallèles découpent sur une sécante des segments consécutifs égaux, elles découpent des segments consécutifs égaux sur toute autre sécante.***

Fig. 15. Fig. 16.

En particulier, de telles droites découpent des segments consécutifs égaux sur une droite qui leur est perpendiculaire : MN = NP = PQ = QR (*fig. 16*). Pour cette raison, on dit que ces droites forment une famille de *droites parallèles équidistantes*, car les mesures des segments MN, NP, PQ... sont les distances de deux parallèles consécutives quelconques.

☆ DÉFINITION. — ***On dit qu'une famille de droites parallèles est une famille de parallèles équidistantes pour exprimer que ces droites découpent sur l'une de leurs perpendiculaires communes des segments consécutifs égaux.***

Nous venons d'établir l'équivalence logique suivante :

Les droites (Δ_1), (Δ_2)... (Δ_5) sont des parallèles équidistantes : MN = NP = PQ = QR, ces segments ayant pour support une droite perpendiculaire aux parallèles (Δ_1)... (Δ_5).	⟷	Les droites parallèles (Δ_1), (Δ_2)... (Δ_5) découpent sur toute sécante des segments consécutifs égaux : AB = BC = CD = DE.

Fig. 3. Identifying different types of texts thanks to the layout: pages 116–117 of *Cours R. Maillard classe de 3^e^* (Maillard 1960).

all technologies and physical realities, the range of photographs' subjects and providers varied greatly and was a means to display modernity within the textbooks.[47] Through such choices, the series broke with established publishing practice and materialized the promise of its title.[48]

The series distinguished itself with regard to both the English and the French contexts also when it came to its treatment of mathematical notions. Indeed, this

[47]See Table 4.
[48]See Figure 2.

82. Applications. — I. *Partager un segment en* n *parties égales.* — Soit à partager le segment AB en 5 parties égales. Traçons une demi-droite quelconque A*x*, d'origine A, et dont le support ne contient pas B. Portons sur cette demi-droite, 5 segments consécutifs égaux (*fig. 17*) :

$$Ac = cd = de = ef = fb. \quad (1)$$

Traçons la droite *b*B et traçons ensuite par A, *c*, *d*, *e*, *f* les parallèles à *b*B. Nous obtenons ainsi 6 parallèles. En vertu de (1), ces parallèles sont équidistantes, elles déterminent donc sur AB les segments égaux :

$$AC = CD = DE = EF = FB.$$

Le problème est résolu.

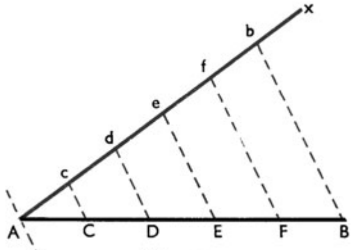


Fig. 17.

• Remarque. Il est inutile, en pratique, de tracer les 5 parallèles à *b*B. Il suffit de tracer celle qui passe par *c* (ou par *f*). On obtient, en effet, alors le point C (ou le point F) et l'on a ainsi déterminé l'un des points de division, d'où l'on déduit les autres.

II. *Connaissant le rapport de deux segments et l'un des segments, construire l'autre.*

Donnons-nous le segment AB et soit à construire un segment MN tel que :

$$\frac{MN}{AB} = \frac{3}{5}.$$

Cela revient à : $MN = \frac{3}{5}AB.$

On partagera donc AB en 5 parties égales et MN sera la somme de trois de ces parties. En se reportant à la *figure 17* on aura donc :

$$MN = AE.$$

• Remarque. *Si le rapport donné est algébrique,* ce qui suppose que les segments appartiennent à une même droite ou à des droites parallèles, il faudra orienter MN dans le même sens que AB ou en sens contraire suivant que le signe du rapport sera + ou —.

Fig. 3. Continued.

series put forward new aspects that were related to modernity. The first type of modernity exposed in the textbooks derived directly from the introduction of "modern mathematics." For instance in the first book, algebra was not presented as a branch in which, as a competing textbook (Fox 1962a, 1) stated, "we use symbols as well as figures and these symbols can be treated just as we treat numbers in arithmetic"; it was used in the plural, in the sense of a structure, and its study lead to the introduction of the notion of sets of operations (Mansfield and Thompson 1962). The third book of the series *Mathematics: A New Approach* devoted even more space to "modern mathematics" as it dealt with sets, matrices and determinants, descriptive topology,

Table 4. List of photographic plates in the *Mathematics: A New Approach* series.

Photograph's subject	Courtesy of	Reference
Electronic digital computer Pegasus 2	Ferranti Ltd	Book 1 p. 12
Ruled surfaces	Science Museum London	Book 1 p. 26
Comparison of standards	National Physical Laboratory	Book 1 p. 93
The nine regular solids	Oxford University Press	Book 1 p. 121
Oil refinery and chemical plant	Shell Photographic Unit	Book 2 p. 8
A surveyor using a tellurometer	Crown (Ordnance Survey)	Book 2 p. 119
Meeting of Swiss and Italian engineers digging a tunnel under the Alps	Keystone Press Agency	Book 3 p. 30
Analogue Computer	F.C. Robinson & Partners	Book 3 p. 85
Thunbergia Alata	J.E. Downward, FIBP (Fellow of the Institute of British Photographers)	Book 3 p. 106
Stonehenge	Crown	Book 3 p. 119

and algebraic structures (Mansfield and Thompson 1964). In this regard, this series was different from its competitors on the English textbook market,[49] but also from its French counterparts. In France, because "modern mathematics" was not part of the official syllabi at the time, its promoters could only prepare the ground for such contents, as the authors of the *Cours J. Marvillet* tried to do in their textbook for the last form of the middle-school level.

However, *Mathematics: A New Approach* was not all about "new math." Traditional subjects and contents were still an important part of the textbooks. For instance, the series classically opened with the study of the "ordinary" system of numeration and, for geometry, with the study of simple geometrical shapes. Yet its authors innovated. The decimal system was introduced by a presentation of electronic computers and binary numbers and the study of simple geometrical shapes started only after the presentation of geometries (in the plural). Here again, this series is remarkable with regard to both the English and the French markets, not so because it introduced mathematical notions by leaning on objects and instruments or by situating it in a wider field of knowledge (these were common features at the time[50]), but because these objects, instruments and knowledge were characterized by some sort of modernity. The idea of a plurality of geometries alluded to academic work in mathematics; it was thus an original way

[49]Regarding the introduction of "new math" contents, this series was a precursor on the English market, soon followed by other titles such as *Mathematics* written by D. Bass and published by Cassell from 1963 to 1966 or textbooks of the SMP. On this question, see Breakell (2001).

[50]Except for books which, as I have pointed out in the case of E.J. James' *Modern School Mathematics*, limited the part devoted to descriptive or explicative texts.

to introduce the study of simple geometrical shapes, especially in the English context where the knowledge of current work done by mathematicians was not considered as an essential need for pupils of secondary modern schools.

For its part the presentation of computers and calculating devices referred to recent applications and technologies. As we have already mentioned, this was a more general commitment to expose modern achievements which was paralleled by iconographic choices. Compared with other English textbooks, the proposal was not unique, but *Mathematics: A New Approach* was the first series to present a modified aspect and to visually treat developments regarding mathematics (as a field of knowledge), exposition of modern devices, and treatment of mathematical contents in the same way. This was a position that differed from its competitors, even those who, as R.W. Fox (1962a, 1962b) did, dedicated some space to mathematics' past and present by exposing some instruments, techniques and applications and their inventors.

Compared with French textbooks, the proposal put forward by *Mathematics: A New Approach* looked even more original. In the French case indeed, even when modern achievements and applications were mentioned in textbooks they were given only an illustrative status. In French textbooks, twentieth-century instruments and achievements found a limited space, mostly thanks to some photographs. Thus, the textbook for the *sixième* form of the *Collection Théron et Cossart* (Krüger 1959) was the one which included most photographs. By displaying for instance a military rocket or the CNIT (*Centre des nouvelles industries et technologies*) constructed in Puteaux (near Paris) in 1958, such photographs indicated that the question of modernity was also raised in France with regard to mathematics teaching. Yet, publishing practices did not result in displaying numerous photographs in mathematics textbooks and pictures of modernity remained quite rare.

Conclusion

My analysis of late 1950s French and English textbooks has shown that different mathematical conceptions existed in post World-War II education for 11–15 year-old children not only when one country is compared to the second one, but also within single national frameworks. Because authors justified mostly their diverse proposals by referring to characteristics of their intended audience for the English ones, and to existing traditions of mathematics teaching and current institutional organization of the schooling system for the French ones, textbooks echoed contemporary debates in mathematics teaching. They also fostered competing conceptions of mathematics which resonated with divergent academic conceptions, teaching traditions, authors' backgrounds and pupils expected needs. As a result, late 1950s textbooks have to be seen not only as mirrors of the diversity of conceptions and arguments existing in each national context, but also as actual promoters of one or another conception.

Such a status is particularly important to take into account when it comes to the question of "new math" curricula in the English case. As I have shown in my analysis, "new math" contents were to some extent already present within late 1950s textbooks – quite in advance of what could be expected according to the historiography of the "new math" movement. As English textbooks made up for the absence of a national curriculum, the fact that there is no French equivalent of an explicit commitment in favor of "new math" might not seem surprising. Yet it still has to be nuanced since some authors tried to prepare the ground to the introduction of "new math" contents in their textbooks. Besides, in France taking part in contemporaneous debates thanks to textbooks actually referred to the divergences of meaning and status attributed to practical works and experimental approaches in mathematics. Thus, in both France and England, textbooks were a means to promote alternative conceptions and possible agents to change the fate of debates and, indirectly, of classroom practices when they reached an important audience – which was for instance the case of *Mathematics: A New Approach* (Breakell 2001). More generally, for both cases, further investigation would be required to understand what happened to the diverse and competing conceptions of mathematics in the following decades, especially with regard to the introduction of the "new math" curricula.

So far, my study pointed out the richness, the diversity, and also the complexity of late 1950s mathematics when seen through the lense of school textbooks. It illustrated the close relationship formed in the educational sphere between mathematics' identity and its audience. It also stressed the necessity to enrich our knowledge of mathematics by taking into account various and socially diversified practices and conceptions, thus avoiding the pitfall of limiting the scope of this question to the academic sphere or to an élite culture.

This is not to say that there is no relationship between the academic and the educational spheres. As can be deduced from this study, such links existed not only because some teachers considered mathematics teaching at the middle-school level as a step in the training of future mathematicians, but also because some textbook authors came from or had been trained in elitist academic institutions and had exposed a unified conception of mathematics to their readers, whatever their schooling paths. This is not to say that the complexity brought to light from the analysis of school textbooks prevents us from the possibility of bringing out some national features.

In the French case, the opposition between abstraction and practicality that existed in the educational sphere echoed a similar opposition existing in the academic sphere. There, the dominance of an abstract and formal conception of mathematics obstructed the research on digital computing and the use of computers within mathematics, all aspects that were also absent from mathematics textbooks in the late 1950s even when authors favored, especially for *cours complémentaires* pupils, experimental and practical approaches. Research on digital computing eventually developed but in relationships with engineering or physics communities (Petigirard 2004, 449–458). As we have seen in this study, there is no equivalence, in the French case, between experimental and practical approaches and interest in computing and applied aspects of mathematics but, in addition to a less formal conception of mathematics, primary school pupils were also engaged in more technical curricula than secondary school pupils. Together with the trend which tended to more and more present scientific and technical careers as prospects to primary schools pupils, such elements invite us to investigate whether a rather primary conception of mathematics could have influenced actors who later became engineers or mathematicians. They also tend to characterize the French case when compared with the English one: in the latter case, there was no opposition *within* mathematics to applications, experimental, and algorithmic approaches and some of these aspects found a material existence in school textbooks.

List of referenced mathematics textbooks

Each entry listed below matches a textbook series, i.e. most often several books. I thus give the period of publication and all the authors' names.

English textbooks

1. Barrett, W.G., and M. McInnes. 1961. *Practice in Pre-Senior Mathematics.* London: Cassell.
2. Bass, D. 1963–1966. *Mathematics.* London: Cassell.
3. Brown, A. 1961. *A Book of Graphs.* London: Cambridge University Press.
4. Burns, P.F. 1952–1960. *Daily Life Mathematics.* London: Ginn.
5. Clarke, R.H. 1963. *Mathematics for the General Course.* London: Harrap.
6. Crawford, D.R., and G.R. Crosher. 1959–1961. *Problem Practice.* London: Methuen.
7. Daffern, T.G. 1951–1955. *Basic Arithmetic.* Oxford: Blackwell.
8. Fallows, T. 1958. *Practical General Mathematics*. London: Dent.
9. Fox, R.W. 1962–1963. *Certificate Mathematics*. London: Edward Arnold.
10. Goddard, T.R., and A.W. Grattidge. 1955–1956. *Individual Arithmetic.* Huddersfield: Schofield & Sims.
11. Goddard, T.R., and A.W. Grattidge. 1959–1960. *Individual Mathematics*. Huddersfield: Schofield & Sims.
12. Harris, R.E. 1957. *Practical Arithmetic for Boys*. London: Macmillan.
13. Harris, R.E. 1961–1964. *Cornerstone Mathematics*. London: Macmillan.
14. Hopkins, C.H. 1962–1963. *Modern Arithmetic*. London: Longmans.
15. Horrocks, A.J. 1962–1964. *Modern Algebra*. London: Longmans.
16. Household, H.L.M. 1959. 1961 [2nd ed.]. *A Preparatory Algebra*. London: University of London Press.
17. Howard, A.E., W. Farmer, and R.A. Blackman. 1963–1965. *Longmans' Mathematics*. London: Longmans.
18. James, E.J. 1954–1956. *Modern School Mathematics*. Oxford/London: Oxford University Press.
19. Jeavons, W. 1958–1960. *Unified Mathematics*. London: Black.

20. Keith, A., and A. Martindale. 1956–1957*. *Know your Maths*. Glasgow: Blackie.
21. Kline, M. 1960–1961. *The Language of Number*. London: Harrap.
22. Kraft, E. 1959–1962. *Number Work*. London: Methuen.
23. Leslie, G.H. 1956. *Measuring, Drawing and Reckoning*. Watford: Odhams.
24. Levin, D. 1961–1963. *Gateway Practical Geometry*. London: Methuen.
25. Levy, L. 1961. *Geometry and Trigonometry*. London: Longmans.
26. Mansfield, D.E., D., Thompson, and M. Bruckheimer. 1962–1964. *Mathematics: A New Approach*. London: Chatto & Windus.
27. Newth, G.H.R. 1958 [4th ed.]. 1960 [5th ed.]. *First Course in Arithmetic*. London: University Tutorial Press.
28. Norris, E.T. 1955. *General Mathematics*. London: Nelson.
29. Payne, N.P. 1962. *Certificate Mathematics*. London: Pitman.
30. Phillips, L.W. 1957 [2nd ed.]. 1961 [3rd ed.]. *Elementary Mathematics*. London: Macdonald.
31. Raven, A.J. 1958–1961. *Mechanical Arithmetic*. London: Heinemann.
32. Raven, A.J., and S.M. Ault. 1962–1964. *Mathematics for Everyday Life*. London: Heinemann.
33. Shaw, H.A., and F.E. Wright. 1960–1963. *Discovering Mathematics*. London: Edward Arnold.
34. Smith, C.V. 1960–1961. *Pioneer Maths*. Leeds/London: E.J. Arnold.
35. Smith, H. 1960. *Topic Arithmetic*. London: Hulton Educational Publications.
36. Snell, K.S., and J.B. Morgan. 1960. *New Mathematics: A Unified Course for Secondary Schools*. London: Cambridge University Press.
37. Tucker, G.L. 1963. *An Introduction to Secondary School Mathematics*. London: Hutchinson Educational.
38. Vesselo, I.R. 1955–1956. *Secondary School Arithmetic*. London: Allen and Unwin.
39. Ward Hill, T.H. 1955–1956. *Elementary Calculations*. London: Harrap.
40. Ward Hill, T.H. 1962. *Mathematics for Modern Schools, Alternative Book 4*. London: Harrap.
41. Webb, H. 1954–1955. *Direct Mathematics*. London: Nelson.
42. Webb, H. 1962. *Planned Mathematics*. London: University of London Press.
43. Webb, H. 1963. *Daily Practice in Mathematics*. London: Nelson.
44. Williams, S.E. 1955. *Kingsway Mathematics. Supplementary Series*. London: Evans.
45. Worley, R. 1957. *Target Practice in Arithmetic*. London: Chambers.

*Even though this is a Scottish publication, I count it in my corpus as it is mentioned in the *Education Book Guide* together with English publications.

French textbooks

1. 1958. *Algèbre. Enseignement secondaire court, cours complémentaires et commerciaux. Par une réunion de professeurs.* Paris: Ligel.*
2. 1958–1962. *Arithmétique. Par une réunion de professeurs*. Paris: Ligel.*
3. 1960. *Géométrie. Cours complémentaires et enseignement secondaire court. Par une réunion de professeurs*. Paris: Ligel.*

4. Boutin, P. 1959–1960. *Mathématiques.* Paris: De Gigord.
5. Brachet, F., and J. Dumarqué. 1958. *Cours F. Brachet, J. Dumarqué, R. Rostolland*. Paris: Delagrave.
6. Brailly-Marchand, A., A. Fouché, M. Clavier, and H. Mazet. 1961–1963. *Collection Paul Dubreil. Mathématiques*. Paris: Vuibert.
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12. Echard, R. 1955–56. *Mathématiques. Cours complémentaires et collèges modernes*. Paris: Charles-Lavauzelle.
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14. Hémeret, M., and A. Lermusiaux. 1958–1961. *Mathématiques avec travaux pratiques*. Paris: Hachette.
15. Huisman, A., and J. Itard. 1961–1964. *Cours de Mathématiques*. Paris: Wesmael-Charlier.
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17. Lebossé, C., and C. Hémery. 1958–1961. *Cours de Mathématiques Lebossé et Hémery*. Paris: Nathan.
18. Lespinard, V., and R. Pernet. 1959–1961. *Collection Lespinard et Pernet. Cours complet. Programmes 1958*. Lyon: Desvigne.
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20. Maillard, R., R. Cahen, and E. Caralp. 1958–1959. *Cours de mathématiques R. Maillard*. Paris: Hachette.
21. Monge, M., and M. Guinchan. 1958–1960. *La Classe de Mathématiques*. Paris: Belin.
22. Roux, L., and E. Miellou. 1958–1961. *Cours de Mathématiques Roux & Miellou*. Grenoble: Didier et Richard.
23. Schaeffer, H., and J. Lebaile. 1959–1960. *Cours Schaeffer-Lebaile. Mathématiques*. Paris: Delagrave.
24. Thiberge, L., and E. Gilet. 1958–1960. *Cours de Mathématiques sous la direction de G. Cagnac et L. Thiberge*. Paris: Masson.

* I count three different series for the textbooks published by Ligel according to their title and cover illustration. Under the title *Arithmétique*, one can find a single volume for the four forms of the middle school (sixième to troisième) or separated volume for each form.

** The textbooks belonging to this series (one for *cinquième* and *quatrième* forms and another one for the *troisième* form) are promoted in the publisher's brochures up until 1961, but there are absent from the collections of the *Bibliothèque nationale de France* and of the library of the *Institut français de l'Éducation*. That is why I give no date for their publishing.

*** The textbooks (four volumes entitled resp. *Algèbre des debutants*, *Géométrie des débutants*, *Algèbre* and *Géométrie*) belonging to this series are promoted in the publisher's brochures. I was unable to find volumes printed in the late 1950s in the libraries, but I found some copies printed in the middle of the decade at the library of the *Institut français de l'Éducation* and some copies printed in the 1960s at the *Bibliothèque nationale de France*, which is why I give no date but include this series within my corpus.

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