

MATHEMATICS IN COSTA RICA, 1800 – 1940

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Abstract

In this work we offer a general outline of the history of mathematics in Costa Rica from 1800 to 1940, and we analyze some of its most important characteristics: the institutions where mathematics was developed, the programs, influences and foreign professors, and the general socio-economic and political context of the country.

The history of mathematics in Costa Rica can be clearly divided into three periods:

- from the colonial period until the reform by Mauro Fernández in the 80's of the last century,
- from the creation of the *Escuela Normal de Costa Rica* (1915) until the foundation of the University of Costa Rica in 1940 and, finally,
- from the creation of this university until today.

It is important to note that in the Costa Rica of this period does not exist any development of mathematics but the one related to national education. For instance, this is the reason why the foreign influence in our field was exerted by scholars or teachers who passed by Costa Rica or settled down, by importation of textbooks and by the main ideas of the international intellectual community on education or culture. This means that the global political and social movements that affected Costa Rican history are going to provide the fundamental characteristics of which would be the educational and scientific evolution of the country.

Costa Rica in Central America

Central America is a very small region of Latin America: 419.000 square kilometers, which is about 2 per cent of its total territory. It is smaller than Spain (which has about 505.000 km² or Sweden (about 450.000 km²). Today it has a population of about 35 million habitants, but at the end of the 18th century there lived almost 1 million people (while Latin America had about 19 million habitants).

In spite of their proximity, the nations keep important differences and contrasts between each other. The principal evidence of this fact can be found in its orography and the ecological context, which includes high and lowlands, an

infinity of intermediate levels and, at the same time, an extraordinary biodiversity. Once descending the Guatemalan highlands, with very numerous ethnicities and languages, we enter into what could be called the "Creole and Mestizo Central America". From the south of Guatemala to the north of Costa Rica the characteristics are obvious: "... *hombres de maíz*, farmers and day laborers, who combine the ancient Mayan or Mexican with Spanish and Creole characteristics"¹. But, neither the Creole culture nor the Spanish inheritance remained pure. The immigration of business and salesmen (many of them Anglo-Saxons), enriched life and customs of the dominant social groups in this region, especially since the expansion of the coffee exportation in the second half of the 19th century.

In the south, in the Costa Rican highlands, the characteristics are modified partially. Especially "the racial aspect of European inheritance is more evident".² Also the Mesoamerican cultural characteristics are less visible.

On the Atlantic side is situated the "Black Central America", from Belize to Panama. These are groups of Africans who came mostly during the second half of the past century, and formed minorities normally oppressed and with a culture that often contrasts with the Creole and Mestizo Central America. Based on this bio-diversity, with big ethnic and cultural contrasts, people constructed a complicated mosaic of social relations, and also of political history, education, and life.

It is sometimes difficult to imagine how these small provinces, which until 1821 formed the *Reyno de Guatemala*, as a Spanish colony, keep so many and so profound differences within each other. But this is the first aspect at the moment of trying to understand any part of the Central American history and each one of its countries.

Costa Rica as an independent country: *special characteristics of its history.*

The 19th century represents the end and the beginning of two ages in Costa Rican history. It is the end of colonial life and the beginning of republican life. This means that in the historical studies appear tendencies and characteristics of the former age, and the affirmation of the new elements that will form the future.

The most important elements which need to be considered in Costa Rican history of the 19th century are the following:

- the configuration of the nation,
- the confrontation between liberals and conservatives,
- the economical transformation because of the coffee exploitation,
- education, and
- the foreign influence.

To these elements we have to add the influence of Central American politics and the struggle for the regional hegemony.

Guatemala was always the center of economical and cultural welfare of the region. It was also the place where the political processes, which would act on the rest of Central America, had the strongest impact. Costa Rica, on the contrary, was the farthest and poorest province, formed by a few quite isolated villages which always wanted to impose their influence over the others, even if no blood was shed except in two occasions. The first half of the century was destined mainly to establish the basic political and social institutions, and to build up the nation. The process was meant to get a political and institutional centralization, which could provide an union to these poor and isolated villages, and was also meant to obtain an independence from the religious catholic influence, which was against the foundation of a laic state. Nevertheless, there did not come up any conflict, in clerical or anti-clerical terms. The problem was somewhat more complex.

The second half of the century was determined by the conflict between liberals and conservatives, especially the decade of the 70's. The same conflict took place in almost the whole Central American region. Nevertheless, it is impossible not to mention the existence of important differences in each country's way to take out the confrontation.

Coffee production and exportation was one element, which added a new universe to the national life. Even if it was introduced in the country since the beginning of the century, it didn't develop intensively before the decade of the 40's. In 1843 the first shipment of Costa Rican coffee to London took place. The new activity stimulated the creation of new dominant groups and a social stratification that moved away from a precarious agricultural economy and a shared level of poverty and equality of opportunities. From this moment on the new economical groups were the base of the power. Coffee plantation owners and military took an important part of the political decisions of that period.

Even if the worldwide admitted pacifism in Costa Rica is a reality since the last century, not for this reason it can be denied that the military in Costa Rica had certain importance until the second half of the 20th century: even if they never played the same role as in the rest of the region, which is characterized by large social, ethnical, and economical contradictions.

It is necessary to mention that, even if Costa Rica enjoyed its isolation and autonomy, it was always involved into the conflicts of power of the region (especially between Guatemala and Nicaragua). It even had a very outstanding in the war during the 50's against the North American Filibusters led by William Walker, who, in spite of being invited by the Nicaraguan liberals in order to act on their political benefits, had their own aims and pretended to annex the Central American region to the pro-slavery states in the south of the USA.

Another of the essential components, which helped to configure the bases of national life, was the importance of looking for a compromise in the solution of problems and a special vocation for legality. One can say that, until 1940, the governors of Costa Rica and an important part of its intellectual leaders were militaries (during the last century) or lawyers.

Education in Costa Rica represents the other of the main tendencies of national history. Since the first moment, the Costa Rican governors gave priority to the educational development. Already in 1849, under Dr. José María Castro Madriz, an important administrative reform took place in education, which impelled the creation of a Normal School, a Grammar School for girls and a more efficient coordination and inspection of primary education. In 1858 and in 1862, education was decided to be compulsory for all social classes and for children of both sexes. A few years later, in 1869, Costa Rica incorporated in its Political Constitution the free and obligatory primary education, on the state's expenses.

During the whole last century, a process of modernization and centralization took place in education, as part of the global efforts to build up a nation based upon those isolated and scarcely inhabited villages in which Costa Rica started its republican life in the year 1821.

The liberals incarnated the national sectors which looked for modernization of the country's institutions. Although the confrontation between liberals and conservatives took place like in almost all Latin America, neither the liberals were so liberal nor the conservatives so conservative, so that the extreme positions – which is typical for this country – were softened.³

Education in Costa Rica was the main social instrument to build the national identity and to guarantee the relationships between social classes. This was one of the banners of struggle and a political means for the social groups and liberal politicians. During the last century, in Central America the liberal program within the development of social education had success practically only in Costa Rica.

It is important to remember that Costa Rica was a very poor and scarcely inhabited country⁴ and always at the edge of the fundamental events in both the Spanish Colony and the independence movements, as much as, later on, in the more decisive republican life of the continent. Nevertheless, the quiet, bucolic way of life, and of national agreement, was a reason of immigration for those people persecuted for political or religious reasons. In a considerable number of cases, they were individuals of a high intellectual level.

One of the most interesting characteristics of republican life in the Costa Rica of the 19th century was the presence of foreign intellectuals and teachers, a phenomenon which took place in a permanent way and which defined the aims and tendencies in the process of shaping the educational institutions.

Swiss, Germans, British, and especially Spaniards taught mathematics in a Costa Rica strongly influenced by the liberal scheme in politics, education, and culture. A certain level of regional interaction was also characteristic above all in the first half of the century, a fact that allowed the presence of intellectuals from one country in another.

Let us complete the historical image of the 19th century's Costa Rica: at the end of the last century, since the government of Tomás Guardia (1870-1882), during the beginning of the construction of the Atlantic Railroad (from San José to Limón), an important immigration of Italians, Chinese and Jamaicans started. This would enlarge the *multiethnic* and *multicultural* spectrum of the country. Nevertheless, its influence in the educational and cultural development of the last century was insignificant.

From Costa Rica to Guatemala: *mathematics and the new science*

The panoramic view we just transmitted allows us to begin to already locate some of the persons who interfered in the national scientific life. Later we will go on with other global aspects, those related to the main ideas which influenced our cultural surrounding.

The precarious situation of education in Costa Rica during the colonial period was no obstacle for some individuals born in this territory to study philosophy, the culture and, in the case which we will mention, physics and mathematics. Already since the 18th century, the former *Reyno* of Guatemala had a Costa Rican expert in exact sciences and philosophy: José Antonio Liendo y Goicoechea. He lived and worked in Guatemala and not in Costa Rica. He did the first efforts in studies of experimental philosophy and had the honor to be, as a Central American, the pioneer of this teaching activity. In Guatemala, Goicoechea taught philosophy, physics and mathematics and, furthermore, directed the reorganization of studies in the University of San Carlos within the tendency of the "new science".⁵ He was born in Cartago in 1735. From 1765 until 1767 he studied in Spain; when he came back to Central American territory he brought with him some machines and instruments for experimental physics, books, globes, armillary spheres, planetary systems, maps and hydrographic cards, tables of longitudes and latitudes:

"But Goicoechea did more; he studied mathematics and taught this subject privately... In the year 1772, for the first time in Guatemala there were seen excellent exams of geometry... Goicoechea was one of the founders of the *Sociedad Económica*, institute in which he did important services for the country."⁶

In many writings he left testimony of his work and ideas.⁷ He died in 1814.

According to a Spaniard who settled down in Costa Rica, Constantino Láscaris, Liendo y Goicoechea was not very original in his ideas.⁸ Nevertheless, it has to be recognized that the cultivation of the New Science in this distant part of the globe says a lot in his favor, as does also his contribution to a university reform in San Carlos, which situated this institution –as the Nicaraguan Carlos Tünnermann refers– as one of the most progressive of Latin America, at the end of the 18th and the beginning of the 19th century.⁹ The judgment of the famous historian John Tate Lanning does not allow any doubt: “And, as the liberal, and useful-thinking lawyer circles grew, and after the foundation of the *Sociedad Patriótica*, Goicoechea became more and more outstanding as the relevant figure of intellectual life in colonial Guatemala.”¹⁰

Within the reorganization proposed by Goicoechea, was the chair of mathematics, considered by him as “necessary for physics”, and which included geometry, optics, mechanics, astronomy and sphere.¹¹ He recommended the use of textbooks written by Wolff, Claude F. Millet Dechaies¹², Cerant, Noel Antoine Pluche and Tomás Vicente Tosca.

The main university institution of the region was the University of San Carlos in Guatemala, until it closed in 1871, when Rufino Barrios attacked the scholasticism of that University.¹³ Nevertheless, the University of León in Nicaragua was also important for Costa Rica, especially because of its geographical proximity, which allowed a few Costa Ricans to study there.

The main educational institution in 19th century Costa Rica

The creation of the *Casa de Enseñanza de Santo Tomás*, in 1814, was one of the most important consequences of the *Constitución Española* of 1812, even if that *Constitución* was abolished and the *Cortes* were dissolved by the king Fernando VII, on march 4th, 1814. Although Cartago was the capital of the province, it was founded in San José due to socioeconomic conditions associated to the political hegemony this city started to enjoy during those days.

This educational institution, quite complex from the beginning, imparted lessons of first reading -as they were called- in which the children learned how to read and write, to count. Apart from these elemental subjects, we can find lessons of philosophy and Castilian and Latin Grammar; it cannot be said that the *Casa de Enseñanza de Santo Tomás* was an institution of primary or secondary education, but rather a mixture of both.

The *Casa* started operating during the year of its foundation (1814) under the direction of Bachelor Rafael Francisco Osejo, who had been engaged in Nicaragua by presbytery Manuel Alvarado, in order to take care of the philosophy professorship. Moreover, the higher administrative employment was assigned additionally to him by the municipal government of San José.

Back to the *Casa de Enseñanza de Santo Tomás*, we have to mention that the superior chairs and the employment as basic teachers were open to competence. Actually, in the superior division during the colonial period, only the lessons of philosophy and grammar worked regularly.

After several reforms and reorganizations, in the year 1824, the institution really acquired pre-university characteristics, so that they established the Bachelor's degree according to the constitution of the *Universidad de San Carlos* de Guatemala. Nevertheless, it was not before 1838 when the first applications for graduation in philosophy were reported; on January 4th, 1839, Vicente Herrera graduated as the first Bachelor of the *Casa de Enseñanza de Santo Tomás*.

We know that the *Casa de Enseñanza* involved into its studies, besides arithmetic, geometry. As a proof, Vicente Herrera offered a discussion about a subject of geometry in the act when he applied for his bachelor's title: "Several lines, angles and methods of measuring them in general."¹⁴ In the same way and the same year, Ramón Carranza offered the discussion: "The perpendicular line, its characteristics, and different methods for its construction: the proportion which exists between the inscribed and circumscribed square, and the circle."¹⁵

At the *University of Santo Tomás*

On may 3rd, 1843, president José María Alfaro and his general Minister, Dr. José María Castro Madriz, signed the decree by which the *Casa de Enseñanza de Santo Tomás* was transformed into University. The building of the *Casa* was destined to be the establishment of the chair of philosophy and Castilian and Latin grammar. The inauguration was postponed five times, until it finally took place on April 21st, 1844, thanks to the persistence of Dr. Castro Madriz. Its first director was the presbytery Juan de los Santos Madriz.

As its predecessor, the *Universidad de Santo Tomás* offered a mixture of different levels of education; there were superior lessons, but in reality the people here were not well prepared to be able to assimilate the lessons offered, because the primary education was very deficient and because the secondary education practically did not exist. From the first years on, within the *Universidad de Santo Tomás* there was a primary school and the children in reality passed from primary school to university lessons. After a few years the situation became more serious; the authorities in charge of the university were forced to create a college for secondary education, which was called *Instituto Nacional*, within the university, in order to fill these gaps and improve a little the university education as a whole. As we will see, this institute was an important experience in secondary education in Costa Rica, previous to the Educational Reform of Mauro Fernández.

According to the foundation statute of the University in 1843, this institution would include Minor studies (Castilian and Latin grammar, philosophy and mathematics) for obtaining the Bachelor's degree in philosophy, and Major

studies in medicine, theology and laws. Nevertheless, there was the possibility of opening other chairs according to the possibilities of the country. But, there was always a difference between theory or the statute, and reality.

According to Paulino González, in his book *La Universidad de Santo Tomás*, education of mathematics in the University of Santo Tomás did not appear in the beginning. The lessons in this subject started in 1846 and "...the subject and the books which were used were those determined by the statutes of the year 43", which would be: arithmetic with the *Benzont* book (translated by Benito Baill), geometry with the work of Lacroix. The lessons during the first 7 years were characterized as deficient, because of the lack of sufficiently capacitated teachers. Since 1854, lessons of algebra were incorporated and, later on, in 1874, the career became more serious and passed on to be incorporated into the professorship of engineering, where it was taught by academically better capacitated persons.¹⁶

Nevertheless, according to the sources of information we have studied it is difficult to establish exactly how things went on. Before 1848 we could not find but failed attempts to establish the chair of mathematics. In 1848, however, things were different. The chair of mathematics did exist and in that year had 16 pupils. In that year and, according Luis Paulino González, also in the following, the person in charge of the chair was Br. Baltazar Salazar. In 1852, moreover, the professor Juan Oppeln presented his name in order to be engaged for two years to teach in this chair, but it seems that this contract was not signed. In 1849, arithmetic, algebra and geometry were part of the subjects in which the aspirants of the Bachelor's degree in Philosophy and Humanities had to be examined.

In 1861, another important historical event for the development of mathematics in Costa Rica took place. The Government accepted, according to the Decree N° 8 of June 26th of that year, the application of declaring as university levels, the chairs of Philosophy and Mathematics, which were opened in Heredia in 1959 and had 20 pupils.

Since the second half of the 50's of the last century, there was a significant tendency in the University's board of directors, in order to establish technical careers in Costa Rica. This was how, since 1862, lessons of drawing were imparted in which not only the artistic but also the technical drawing was taught; this means that it also was useful for land surveying and even for improvement of the national craftsmanship.

Velázquez and the careers of Engineering, Architecture and Land Surveying

The motivation to found specific studies in engineering existed for the reason that the country needed specialists of this type, in order to build roads and

bridges which would communicate the peripheral regions of the Central Valley with the commercial centers in- and outside the country. On the other hand, land surveyors were also needed in order to measure the properties for the census. When the statutes of 1869 were passed, they also pretended that, once established the engineering studies, there would also be taught elements of military engineering to the students.

The lessons in this career in Costa Rica properly started when the contract was signed by the University's rector, Dr. José María Castro Madriz, and the Mexican engineer Angel Miguel Velázquez. It is known that engineer Velázquez arrived in Costa Rica in 1862, studied Science in New York and graduated as an architect in Rome. He designed the plans of the old pipe lines of San José, the road to Cartago, the construction of several rubblework bridges, the *Palacio Presidencial*, the railroad trace to the Pacific and the official plan for the site of the city of Limón. As for mathematics, he wrote an elemental work which was improved to be used as a textbook for a subject at the *Universidad de Santo Tomás*. This book, with the title: *Tratado Elemental de Matemáticas, Primera Parte*, was dedicated to the Minister of Public Education Lic. Julián Volio, to whom the author included a letter. The work was edited in 1865 and divided into six chapters, and those into articles.¹⁷ Mr. Velázquez was entitled to be teacher in these areas, and was in charge of lessons in this subject for six years.

Nevertheless, the opening of the careers of Civil Engineering, Architecture and Land Surveying, had the consequence, , that the Mathematics' Professorship was closed. There is no evidence of any graduated civil engineer or architect in the Universidad de Santo Tomás, but a statement of some graduated in Land Surveying. Nor is there any information about the textbooks which were used in these subjects.

The careers of Engineering, Architecture, and Land Surveying, started in 1864, were closed in 1866; in spite of the engagement of Velázquez, it did not last for more than two years and a half. The expectations of a formation of civil engineers and architects were diminished. Twenty years later, in 1884, a new attempt was made to establish lessons in these careers. Bertoglio, who arrived in Costa Rica in 1875, would be the director of an Engineering Faculty which as well did last a very insignificant time.

The Land Surveyors

One of the most interesting details which can be observed in the national science's history is the existence of "Licenciados Geómetras" in the Universidad de Santo Tomás. From the current point of view, it looks like if a "Licenciado Geómetra" is the one who has a degree of mathematics with this specialization; however, the "licenciados geómetras" graduated in the Universidad de Santo Tomás "had to know Arithmetic, Geometry, and furthermore, Trigonometry, the use of instruments in Land Surveying and the legislation related to the subject."¹⁸

Actually, such a “licenciado geómetra” was a land surveyor, whose title would be comparable with an actual topographic expert. Many of the graduated in this career were engaged as mathematics teachers in the University. Cérvulo Quirós taught in 1868, Salomón Escalante from 1869 to 1871 and José Céspedes in 1874.

The Secondary institutes of the University

In 1874, under the administration of don Tomás Guardia and by executive decree of July 4th, a secondary institution was created: the *Instituto Nacional*, in dependence of the Universidad de Santo Tomás. Dr. Lorenzo Montúfar, Rector of the Universidad de Santo Tomás, had the same position in the *Instituto*. On may 16th, 1875, the classrooms were opened with selected personal, within them were teachers from the Old Continent.

In addition to the rector, the establishment had a temporary director, Dr. Renard Thurmann (Swiss, a remarkable pedagogue), who was at the same time an English and philosophy teacher; others were Helmut Polakowsky and Gustavo Frangott Schwarz (Germans, their contract was rescinded in 1876) and the civil engineer Roberto Bertoglio.¹⁹ Bertoglio also worked as a mathematics teacher and became one of the most famous instructors of this subject.

In December 1879, for economical reasons, the *Instituto* turned to be a private college, by a contract between the government and Valeriano Fernández Ferraz, in order to direct it (the contract was valid since January 1880).²⁰

In 1883 it was closed and reopened as *Instituto Universitario* on march 10th, 1884, under the direction of Juan Fernández Ferraz. It had three sections: preparatory, secondary education and special lessons. The mathematics’ teachers of this institution were Francisco Picado (commercial and rational arithmetic), Carlos Francisco Salazar (algebra and its applications, plane and space geometry, rectilinear and spherical trigonometry, and differential calculation), who also already taught in the *Instituto Nacional* (since 1878), and Luis Matamoros (infinitesimal calculation, topography, rational mechanics), who also had already imparted lessons in the *Instituto Nacional*. Their mathematics’ schemes were quite ambitious and published in several numbers of the magazine *La Enseñanza* (during the years 1884 and 1886). The teacher Carlos Francisco Salazar played an important role in the development of the schemes and the textbooks which were used during the decade of the 80’s in this Institute. Salazar was disciple of Bertoglio.

In the *Instituto Universitario* there existed a first course of arithmetic and algebra, a second course of plane geometry, rectilinear trigonometry and astronomical geometry; the third course was about space geometry and spherical trigonometry and the fourth course about differential calculation, with which the bachelor’s degree was completed. The institute also offered special education

which included, for the *Mercantile Expert*, in the first year, arithmetic and algebra; for the *Land Surveyor* and the *Master Builder*, it included arithmetic and algebra, geometry and trigonometry (one course each year). The scheme of the fourth year is of a special interest for us, which was entirely of algebra and differential calculus, because, according to the scheme worked out by Velázquez in 1864, it was one of the few references about the teaching of superior mathematics (differential calculus) in Costa Rica (it is significant that, as in 1864 in the *Liceo de Costa Rica*, it had been included in the scheme of a secondary college).

On August 20th, 1888, the Congress decided the closure of the *Universidad de Santo Tomás*, and with this, a period of superior education in Costa Rica was finished.

The first book published in Costa Rica

Let us step back a few decades in this history. For many years, the main figure of the *Casa de Enseñanza de Santo Tomás* was Bachelor Rafael Francisco Osejo, born in León, Nicaragua, in 1780.²¹ He was a highly educated man and involved into the national politics life in those first years of republican life.²²

It is interesting that Osejo wrote about mathematics. In 1830, Bachelor Osejo finished his book *Breves Lecciones de aritmética*. The first edition was of about three hundred copies, with a total cost of 107 pesos; only one copy of this first edition could be saved.²³ The second edition was published in 1838 in the *Revista de los Archivos Nacionales*, but it included a lot of errors.

As Chester Zelaya mentioned in his book *Rafael Francisco Osejo*, the book is designed as "catechism", in other words: by questions and answers. The first part is "*About Arithmetics*", and starts with the question: "To which of the human sciences does it correspond?" Afterwards: "...it continues explaining the operations of adding, subtracting, multiplying and dividing, without showing neither proves nor justifications of these operations".²⁴ The second part is about "*The fractions*", and mentions how to express them. In the third part, it talks about the "*Theory of the decimals*", defined as the following: "This is how we call the fractions which have as a denominator a number with one, two, three or more zeros; this means that the denominator is multiplied by ten, according to the numbering system, and for this reason they are called decimals".²⁵ The fourth part is about the "*Potestades*" or "*Potencialidades*" and says that "*such is the product of a number multiplied by itself by a certain number of times*".²⁶

It has to be mentioned that "each one of the explanations was accompanied by examples and exercises, which completed them".²⁷ The book was sent to be printed in the "Imprenta de la Paz", property of Miguel Carranza. The book did not pretend to be an arithmetic treaty, but of an elementary level, with clarity and order, and corresponds to primary and the first years of secondary education.

*The most significant aspect is, nevertheless, that this has been this first book or educational text edited in republican Costa Rica.*²⁸ There is no doubt that, then, the work in mathematics realized by Bachelor Osejo shows us how was the mathematical formation during those years.

Some of the teachers

This is a good moment to mention briefly the names of some of the mathematics' teachers of that time, Costa Ricans and foreigners: in 1850 we find Baltazar Salazar, "Licenciado" in Philosophy, as a professor of the mathematics' chair at the Universidad de Santo Tomás. He was Dean of the Faculty of Humanities in 1850 and some of his talks during university events have been conserved.²⁹

In 1867 Máximo Pérez arrived from Nicaragua as an exiled, and formed part of the tribunals of the extraordinary exams in mathematics. He was in charge of the land surveying, physics, and algebra chairs in the Faculties of Mathematics and Physics of the University.³⁰ From 1874 until 1878, when the studies at the Universidad de Santo Tomás were reduced to Laws, the *Instituto Nacional de Enseñanza Media* was opened within this University.³¹ There, Luis Matamoros was one of the mathematics' teachers. In 1885, Francisco Picado and Carlos F. Salazar were teachers at the institute.³² During our period of study, José Torres Bonet, born in Cataluña, was a distinguished personality. In Costa Rica he founded the "Colegio de San José" in 1882. Moreover, he was a teacher in the *Instituto Nacional* and there his mathematics' schemes were published.³³ In 1882 Juan Urrutia was engaged in Spain, in order to teach mathematics at the University.³⁴

Liberalism, Positivism, and Krausismo

Before proceed with our mathematics' concerns, it is important to resume the context of ideas and the participation of some individuals who, in the Costa Rica of the second half of the last century, played a key role in the development of education and the national cultural and political structuring.

To begin, it is interesting to remark that the intellectual ideas which have an influence among our liberals, are the British economic liberalism, the ideas of the French Revolution about the nation-state and the importance of education; moreover, positivism³⁵ underlines the importance of science and the progress within history (in the case of Mauro Fernández, the positivistic version of Spencer is the one which had the greatest influence): an ideological mixture was created between free market, a strong state which centralizes and imposes itself, and the search for knowledge and education as social means for progress.

The influence of the French Revolution can be appreciated when, in the moment of the foundation of the Universidad de Santo Tomás in 1843, the General Minister José María Castro Madriz, said that with this institution a new era

would begin: the reign of reason, law and justice. The positivist spirit showed up in the same occasion: "How sad a country which does not accept science as a guide of its undertakings and work. It will be retarded, it will be the servant of the others and its ruin will be for sure." And he added: "The day that the most insignificant business is studied and practiced scientifically, the salesmen and farmers who lack enlightenment can be ruined easily."

Two of the characters who most influenced the Costa Rican ideas of the moment were Lorenzo Montúfar and Antonio Zambrana, one from Guatemala and the second from Cuba. As told by Constantino Láscaris, a Spanish philosopher who settled down in Costa Rica and died in 1979, Montúfar was an archetypal character in the history of Central America and represented the non-confessional liberal. Born in Guatemala in 1823, he obtained the Bachelor's degree at the University of Guatemala and was licensed in Laws. He participated in liberal struggles in Guatemala. In 1850 he was exiled to Costa Rica, and after two years he was named professor of the Universidad de Santo Tomás. He left and re-entered Costa Rica according to the political ups and downs of that time. In 1865 he was elected director of the Universidad de Santo Tomás. He had political occupations in Costa Rica as well as in Guatemala and had a special influence among the liberals of the moment.

Antonio Zambrana was a positivist with influences from German Idealism. He was born in La Habana 1846 and very soon got involved into the pro independence and liberal movements. He passed by Chile and France and had even contacts with Victor Hugo. In 1876 he settled down in Costa Rica, although entering and leaving the country as did Montúfar. He had many positions, among them he was member of the *Consejo de Instrucción*, President of the *Colegio de abogados*, and even magistrate of the *Sala de Casación*. He was a very famous orator and had a strong impact.

We may not forget the influence of the Spanish Krausismo in Costa Rican Education, which was introduced by the brothers Fernández Ferraz, who were authentic living institutions in Costa Rica.

Krausismo was the most important philosophical and pedagogical process in 19th century Spain. Krause's pantheistic point of view was adapted by Sanz del Río and his pupils to become an "harmonist" metaphysics (as said by C. Láscaris), religious but based on rationalism and liberal humanism. In education he rejected boarding schools and punishment and stood for the conduct of the teacher as an example, the philological sense of culture and self-responsibility of the student.

According to C. Láscaris: "in the University, which now was no more than the Law School, between 1871 and 1915, Krausismo was, besides Positivism, the philosophical background which led to rationalism and liberalism to the generations who would organize the state during 40 years".³⁶ Krausismo was the base of the secondary education schemes in the Costa Rica of those years.

Valeriano Fernández was a doctor in classical philology at the University of Madrid, a well-known academic and professor in Spain, who came to Costa Rica due to the political difficulties of that moment. He stayed in Costa Rica between 1869 and 1882; during these years he organized and directed the *Colegio de San Luis Gonzaga*. From 1879 until 1882 he was director of the *Instituto Nacional* in San José, which was the first laic college of the country and a platform for the liberals. After this, he went to Cuba, where he would be the dean of the Faculty in the Universidad de La Habana. In 1890 he was asked by the Costa Rican government to contract 30 Spanish teachers, and to participate in planning a reorganization of education in Costa Rica. Since 1891 until his death in 1925 he stayed in Costa Rica.

Juan Fernández Ferraz, born in the Canary Islands in 1849, was also a Krausist, and a free-thinking republican. He was working hard as a journalist and politician in Spain. He was a teacher at the *Colegio San Luis Gonzaga* since 1871; director and philosophy teacher at the *Instituto Universitario* between 1884 and 1887; General Inspector of Education in 1886, director of the Office of Statistics between 1890 and 1891, and, a few years later, director of the National Museum. The “Ferraz brothers”, as they were called, had a big influence on the intellectual life of the country. This is a very interesting historical detail, because the country got in a direct way and by intellectuals of high levels, the influence of the most important philosophical-pedagogical currents of 19th century Spain.

The combination of English liberalism, French rationalism and illustrated Statism, and Positivism and Krausismo, defined the basic ideology of the liberal Costa Ricans of that moment, whose influence would last even until the first half of the 20th century.

Secondary Education.

It can be said that Costa Rican secondary education was born in 1869, the year in which some arrangements were made for this level and the *Colegio San Luis Gonzaga* was founded.³⁷ The birth of a Costa Rican secondary school was difficult and arduous. In 1886 secondary education existed in four schools: the *Colegio San Luis Gonzaga* in Cartago, the *Seminario* in San José, the *Colegio San Agustín* in Heredia and the *Instituto Universitario* de la Universidad de Santo Tomás in San José. There did not exist any unified studies' scheme for these educative centers and, of course, neither was there any uniformity concerning the schemes of every subject.

At the *Colegio San Luis Gonzaga*, in 1873, the studies' scheme was of 5 years (and one preparatory), in which many mathematics' lessons were included: arithmetic and geometry (preparatory), arithmetic and geometry (first year), arithmetic and commercial calculation, and algebra (second year), geometry, algebra and trigonometry (third year). During those years the *Colegio* was under

the intellectual direction of the Fernández Ferraz brothers. In that time, José Rodríguez Pérez, Francisco Ortiz, and Francisco Picado were mathematics' teachers. In 1872 the magazine *La Enseñanza* was created, which included articles about public education and academic life at the college. (When the administration changed, the magazine was discontinued, but reappeared in 1884, when the *Instituto Universitario* was created). By reading this magazine, the programs of two of the mentioned subjects can be known: algebra and arithmetic and commercial calculation.

In 1876, when the Colegio was already directed by the Jesuits, the studies program was, at a beginning, of three years. Concerning mathematics, there were taught: during first year, arithmetic (including decimals); during second year, arithmetic was continued and the decimal metric system, and finally, during third year, elements of algebra were studied. During the following years, lessons of different subjects were introduced, among them mathematics applied in agriculture. Nevertheless, the number of mathematics courses was reduced during those years.

Normally the primary and secondary schools offered lessons in arithmetic, geometry, algebra, and trigonometry; in a few cases, geometry was rectilinear, in others plain, or objective. Sometimes commercial applications were included, and land surveying. Only in two occasions the teaching of differential calculus was planned (and only once integral calculus, in 1864). The programs of the *Instituto Universitario* were the most ambitious of the whole century.

In spite of the big difficulties of a small and poor country, far away from the important centers of development and culture, between 1814, when the *Casa de Enseñanza de Santo Tomás* was opened, and 1888, year in which the Universidad de Santo Tomás was closed, we have to recognize that, no doubt, there was a progress in quantity and quality in the mathematics' education in Costa Rica. While, during the first time, only the four basic operations were taught, in the second period, even if it was for very few persons, differential calculation was accessible in Costa Rica, taught by professors of this region. However, it was part of the nation's progress in all dimensions.

Before the creation of the secondary schools in 1869, the most important part of the mathematics' education took place in the *Casa de Enseñanza* and later *Universidad de Santo Tomás*. The *Colegio San Luis Gonzaga*, because of the influence of the Fernández Ferraz brothers, was a transcendental cultural center within the nation; also because of the formation in mathematics which was taught during those years. When the administration of the school was passed to the Jesuits, the *Instituto Nacional* was the one which occupied this academic place until 1879, when it was obliged to be managed privately. This school began to decay mainly because of the influence of the economic crisis which took place during the first years of the influence of the economical crisis which took place during the first years of the eighties. The creation of the *Instituto Universitario*

was an attempt to get the *Instituto Nacional* out of the crisis, and tried to recover the quality of a few years before. As to mathematics, the range and quality of the courses' programs expressed this academic ambition. However, the destiny of this Institute depended on the "educative macro-reform" of Mauro Fernández. The Liceo de Costa Rica would inherit the academic pretensions which were present within the directors of education and of the country during those years.

Textbooks for mathematics

During many decades, the efforts in primary education were about building schools; nevertheless, the absence of qualified teachers retarded the academic concerns. Mathematics' instruction was reduced essentially to arithmetic. We can find one of the first references through the requirements for being a teacher in the *Casa de Enseñanza de Santo Tomás*, so, in 1820, the Provincial Representatives of Nicaragua and Costa Rica examined those who applied to teach in the primary schools and, concerning mathematics, required "to know the fundamental operations of entire numbers and fractures, and the main sentences of the theory of arithmetic".³⁸ In the 30's the arithmetic's book of Bachelor Osejo is our reference.

In 1864, the Italian professor Francisco Alfonso Cinelli arrived to San José, and was named inspector for schools in the capital; Cinelli had a big interest in didactic textbooks, and the following volumes survived: *Enseñanza de la Gramática Castellana* (1865), *Compendio de los deberes del hombre* (1865), *Compendio de Geografía e Historia de Costa Rica*, *Citología*; *Compendio de Aritmética Elemental*.³⁹ Based on a few texts like Cinelli's and others by Lorenzo Alemany (1857) Juan Bautista García (1859)⁴⁰, and Joaquín González (*Aritmética Elemental*, 1872), published in Costa Rica, it is possible to know the main contents of arithmetic which were taught in the Costa Rican primary schools during the main part of the 19th century: elementary operations with integer and fraction numbers, roots and powers of numbers, rations and proportions, the rule of 3, simple and compound interest, resolution of first degree equations, measuring tables, and the decimal metric system (from the decade of the 70's).⁴¹

In 1869, Guillermo Molina sent a notebook with the four rules of arithmetic to the Secretary of Public Instruction.⁴² We believe that it was the book titled: *Primeras Lecciones de Aritmética para uso de las Esucelas de Párvulos*, which was printed in San José in 1875 in the author's press. According to the author it was a notebook, which provided the four tables of addition, subtraction, multiplication and division, and also a few notions about numbering and the four basic rules, in order to give them a preparation for the first lessons, without which they would not be able to pass on to the elementary primary schools.

The text contains the following subjects: preliminary notions, formation and numbering of integers, numbering (written and spoken), the four operations, adding integers, addition table, means of easy addition; subtraction tables,

multiplication of integers, multiplication tables, abbreviations of multiplication, division of integers, division table, instruction for its use, abbreviations of division, proving a division, examples of addition and division, use of the four operations, change or value of golden coins, imported or which are to be imported according to decree XII of April 1st, 1869⁴³, length, volume and weight measures, Castilian and Costa Rican measures, reduction of some of the measures, changes for England, rules for practice and the way to use the tables. The book contains 116 pages.⁴⁴

Among foreign texts introduced into the schools, in the second half of the past century, there were *Aritmética* by Mariano Vallejo and, between 1870 and 1880, those of Rubí Rito and Dominguez. After 1880 there were used *Aritmética* by Vallín y Bustillo and *Aritmética* by Urcullú.⁴⁵

In 1867 *Geometry* by Esteban Paluzie was used. In 1869 the primary schools only included arithmetic's studies. At the superior primary schools, arithmetic was taught in a more extensive way, and some elemental practical geometry.⁴⁶ After 1880 geometry was generalized and the textbooks of Lobo Paluzie and Cortázar were used.

In spite of the many efforts, the way of teaching left many problems up to solve. According to Francisco Picado, a school inspector who had been a distinguished mathematics' teacher, and his report of 1878, the most important aspect for the majority of teachers in arithmetic, doctrine and sacred history, was that "the pupils answer accurately the catechism given in the books, even if they don't have the slightest idea of the subject in question; and so it is not strange to listen that a child knows very well the first twenty pages of mathematics."⁴⁷

At the end of that period, there were also frequently used the mathematics' books of French authors such as Bourdon, Birot, Rit, and Gillet Damitte.⁴⁸

It is known that in geometry the book *Geometría para niños* by Vallín y Bustillo was used in the superior division, and *Elementos de Geometría* by Giró y Miró for the intermediate course. In arithmetic, the intermediate course used *Aritmética Primaria* by Robinson.⁴⁹ Also the books *Aritmética Comercial* by Urcullú, González, Tejada, and Molina Rojo were used, and in geometry, even if scarcely, those by Guim and López Catalán.⁵⁰

Other texts in use were: *Curso Superior de Aritmética y Geometría* by Vintéjoux, *Aritmética* by Cortázar, *Tablas de Logaritmos* by Quiapo, *Tratado de Geometría Elemental* by Cortázar, *Trigonometría* by Cortázar, *Tableas Trigonométricas* by Quiapo and *Eléments de Géométrie descriptive* by Duffailly. Moreover, several texts were proposed for consultation, among them *Ejercicios prácticos de Aritmética y Geometría* by Terry, *Arithmétique* by Leyssenne, the books about arithmetics by Lacroix, by Ferry and by Sánchez Vidal, the geometry

books by Combette and by Rouché, *Cours de Trigonométrie* by Rebière and *Tratado de Geometría descriptiva* by Leroy.⁵¹

Especially one book of 1888 makes it possible for us to know some of the contents of geometry imparted in the primary schools. It is the one by M. Dalseme, translated in Costa Rica by Austergildo Bejarano and Manuel Antonio Quirós: *Geometría Objetiva para uso de las Escuelas Primarias*. This work was financed by the government and printed in the Tipografía Nacional. Even if we cannot affirm that all the material included in this book was taught at the schools, we can be sure that it was an important reference for the teachers.

The compulsory use of the decimal metric system was an important task. In 1886 it was written:

"As the time is approaching in which the use of the decimal metric system for weight and length has to become obligatory, the Government thought that it was convenient to declare this subject compulsory for all national schools and, moreover, installed evening schools for adults, in order to teach them his system, in the provinces' capitals and chief towns of the departments."⁵²

The work of Level, titled *Sistema Métrico, demostrado según el aparato del método Level* was used for the students' instruction in this system. They used the translation of Manuel A. Quirós.⁵³

The Reform by Mauro Fernández

Another progress of the institutional education development was the reform of education by Mauro Fernández. This famous Costa Rican was "Secretario de Instrucción Pública" (Secretary of Education) during the presidency of Bernardo Soto and, at the same time, Minister of the Treasury. The reform condensed some procedures in Costa Rican education which had existed since many years.⁵⁴ Mainly, the control of educational policies of higher levels was transferred to the State; also, the laicization of education progressed. This was reached by a state centralization of the existing education system of that moment.

Mauro Fernández was influenced by Spencer, whom he knew personally, by the North American Horace Mann and the educational practice of Jules Ferry⁵⁵, and also, as in many countries of Latin America, by the ideas of Andrés Bello and Domingo Faustino Sarmiento.⁵⁶

The axis of the last century's liberal reform concerning education were the transfer of the educative policies to the state's control as well as to progress in laicization of education. This was reached by state centralization and rationalization of the whole existing educational apparatus. It is evident that many of the actions which we will resume can be explained under this context:

the new administrative apparatus, a new structure of programs (which, because of the exclusion of religion and sacred history lessons, supposed the adoption of new texts for studies, including the obligation to use the decimal metric system), and especially, the creation of state mechanisms in order to control the development of the new tasks.

The positivist and liberal ideas gave special relevance to knowledge, science and techniques; the nation had to be supported by a rational system, and education was the instrument which could turn into reality the new order. Besides the educational reform, the National Museum, the National Library, and the National Physical-Geographical Institute were created.

As for mathematics as well as other sciences, the recognition of its importance for students instruction was a big contribution to the reform. For example, Mauro Fernández affirmed, in the *Memoria de Instrucción Pública* of 1888: "As the Faculty of Law is organized, the country claims preferably for the establishment of physical-mathematical studies."⁵⁷ Never during those years a School for Engineering or Agriculture could be created, nor could be promoted science and mathematics. Nevertheless, in primary school, in a few cases the study of science was introduced, and in others it was extended. Moreover, the traditional lessons in secondary school were accompanied by technical instruction.

From the years on in which the reform began, the programs of mathematics, in primary as well as in secondary school, went through a few changes, especially the number of subjects to study was enlarged.

It can be said that from the administrative and political point of view, the reform had great success, particularly because of the finance it had due to several reasons.

On the other hand, the internal reorganization of primary education was another important task of the reform, as it abolished some old vices as *Lancasterian* education, unitary schools, and corporal and moral punishments as parts of the instructive methods. It also established and extended the relevance which corresponds to science within education, and created the conditions for hiring foreign teachers in science and mathematics. Another fundamental aspect was conceding to secondary education the corresponding importance, an aspect which had been neglected until that moment. During the following years, the conditions of secondary schools were improved.

The following are aspects of difficulties which were left open in the reform: on one hand, the normal sections of secondary schools were not effective for the preparation of the teachers and, on the other hand, the closing of the Universidad de Santo Tomás made it impossible for the country to rely on an institution for integrated superior education, able to offer a unified cultural and professional

instruction. Nevertheless, it can't be forgotten that the lack of financial resources were a strong reason in order to understand the decision of Mauro Fernández.

The educational reform must be understood within the political and ideological background of the moment. It was a special procedure used by the liberal sectors in order to weaken the political and social influence of the Church and the town councils, inherited from the colonial era and to reinforce a national state according to its beliefs and interests.

The Universidad de Santo Tomás was closed⁵⁸ during the reform⁵⁹, which tried to attract foreign teachers for secondary schools⁶⁰. Nevertheless, as a consequence of the poor economic conditions of the country, this was realized in a very limited way; the main part came from Spain but also from Switzerland, Germany, or Italy⁶¹.

Teachers

We are going to mention some of the names of professors who participated in mathematics education of that time.

When the *Liceo de Costa Rica* started to work, it was organized as follows: the Elementary Division (including arithmetic), the Inferior Division (including arithmetic and elements of geometry), and the Superior Division (including arithmetic, algebra, geometry, and trigonometry). The Elementary Division was of 25 weekly hours of mathematics during five years. Since 1890 the teachers of mathematics were: in the Superior Division: Prof. Juan Umaña, in the Inferior Division: Prof. Antonio Vargas Calderón; in the Elementary Division: Prof. Calderón S. Camacho, Prof. J. Quesada, Prof. Juan Rodríguez.⁶²

In 1888 the *Colegio Superior de Señoritas* began to work, directed by Marian Le Cappellain from England, and with the German teachers Laura and Elisabeth Hinrrichs, Francisca Schardinger and Ana Ferrier. The mathematics' teachers were 1893: Félix Pacheco; 1894: Talia Pacheco Sanabria; 1895: Napoleón Quesada; 1898: Fernando Pons.⁶³

In the year 1869 the *Colegio San Luis Gonzaga* began to work. The mathematics' teachers were: 1869-71: Joaquín Sánchez Catalejo (from Spain), for arithmetic, geometry, algebra and trigonometry; 1871-75: Francisco Picado Lara; 1875: Ramón Céspedes Formaris (for arithmetic); 1876: Father Daniel Quijano and Father Francisco Pavón; 1890: Elías Castro Ureña, Alejandro Mata Valle, Emilio Strassburger, Rigoberto Centeno, Pedro Valiente; 1890-92: eng. Austergildo Bejarano, Carlos Francisco Salazar; 1893-1909: Juan Umaña Marín; 1895-96: Pbo. German Schmilzter, for arithmetic, algebra, and geometry; 1895-1913: Clodomiro Picado Lara; 1895-1902: Eng. Nicolás Chavarría.⁶⁴ Professor Juan Umaña Marín (1893-1909) prepared some lessons for the Colegio San Luis Gonzaga, which are conserved in the Archive of the school.⁶⁵ Also a booklet of 50

pages of arithmetic including problems is conserved. The book contains details of the lessons given in the school. It taught arithmetic until the extraction of cubic roots, measuring systems and problems.⁶⁶ During the same time, in private education, we can find the following mathematics' teachers: José María Zelaya (Nicaraguan, who stayed in Costa Rica between 1858 and 1864).

In the middle of the 19th century, the teacher J. J. Peatfield, Bachelor from the University of Cambridge, imparted private lessons of mathematics. In 1859 Joaquín González was an arithmetic teacher at the *Colegio de Humanidades de Jesús*, in San José. In 1866, Leonidas Alfaro was the arithmetic teacher at the *Colegio de Alajuela*. Between the years 1870 and 1873 Eleodoro Trejos was a mathematics teacher at the *Colegio de Heredia*. Dr. J. M. Lleras and Carlos F. Alvarado were teachers at the *Colegio de Santo Tomás*, from 1873-74. In 1878, Enrique Villavicencio (from Málaga, Spain), founded the *Colegio Costarricense* (private). In 1880 he was Director of the *Instituto de Alajuela* and in 1883, of the *Instituto Nacional*. He published a pamphlet about public instruction in 1886.⁶⁷

Some foreigners in Costa Rican mathematics

From a historical point of view, one of the consequences of the emancipation from the Spanish authority in America was the contact with other European countries, but not exclusively. Europeans, Mexicans, Central Americans, Colombians, and Cubans had an influence in cultural life in Costa Rica, as well as, through some ideas or social programs, Chile (pedagogy) and Argentina (legislation). The historian Luis Felipe González values the first 50 years of independent life as follows:

"The period of national life which we have been referring to, is one of the most important in the country's culture. This period is characterized by the European influence in all our cultural activities. Our scientific, educational, artistic, and industrial development is closely related to the development of our relations with the foreign countries and the contact with European civilization."⁶⁸

As our interest are mathematics and science, we refer mainly to these concerns. Costa Rica was of interest for naturalist and geological studies, so that many English, French, German, North American, and other researchers came to this territory. Nevertheless, in the main part of the occasions these scientists and researchers did not get involved into national life nor played any important role in institutionalization of sciences, education, or mathematics in the country. The principal influences were still Spanish, but it results interesting to mention the presence of French, Swiss, German, and Belgian teachers of scientists, who strengthened culture and in several cases they taught mathematics in Costa Rica, and that they had a deeper impact in national culture.

Among the French, as a first reference Lucien Platt can be cited; he offered physics and chemistry lessons at the Universidad de Santo Tomás since 1865. There has to be mentioned Louis Charpentier, who was a teacher in the *Instituto Universitario* and, afterwards, for many years at the *Liceo de Costa Rica*. The French influence, in general, was accomplished by books, texts, and because of the French Revolution or the later ideas, as those of French thinkers like Comte.

Partly as a consequence of the political conflicts which took place in Europe around 1848, an emigration of intellectuals and academics to America took place. Among them, several distinguished Germans came to Costa Rica. Eng. Franz Kurze, Alexander and Karl von Bülow, Wilhelm Nanne, Franz Ellendorf, Johann Braun, Wilhelm Witting, C. W. Lutmer, Franz Rohrmoser, Martin Flutsch, Karl, Albert and Eduard Johanning, J. H. Golcher, Wilhelm Joos, H. Lutchanning, Otto von Schroeter, Ludwig von Chamier.⁶⁹ All these offered important services to the scientific and educational development of the country, and many of their last names are now part of national life.

Between 1889 and 1894, Otto Littmann lived in Costa Rica. He was a German doctor in philosophy from the University of Bratislava, and engaged as a teacher for the Liceo de Costa Rica. During his stay in Costa Rica he wrote two textbooks, one of them was for arithmetic's education and inspired by the methods of the groups of Grubbe.⁷⁰ He had much influence on pedagogy.

In 1901 Ernst Henrici imparted lessons in mathematics and geodesy. He was graduated from the University and Academy of Berlin and a pupil of Helmholtz, Virchow, and Monsem.⁷¹

Of course, not only in mathematics appeared famous Germans; for example, in 1894 arrived Karl Beutel, a chemist and pharmacist (Karlsruhe, Baden), one of the founders and first teachers at the Faculty of Pharmacy (1898-1912).

Because of the influence of the liberal reform, in 1886 several Swiss scientists arrived in Costa Rica; among them Paul Biolley; in 1887 Henri Pittier arrived and stayed for 15 years; in 1889 Gustav Michaud and Jean Rudin. Johann Sulliger from Switzerland arrived in 1887, and imparted mathematics' lessons at the Liceo de Costa Rica.

Paul Biolley was born in Switzerland; he was Licensed in Literature, professor in the Netherlands, and candidate to be lecturer at the University of Bonn. He arrived in Costa Rica when he was 23; invited by Mauro Fernández, worked at the *Colegio Superior de Señoritas* and at the *Liceo de Costa Rica* as a Science teacher. He helped to develop the national science by his researches, among them: mollusks of the Coco Island, Invertebrate animals of Costa Rica; he also published *Elements of Botany*, and *Elements of Greek Grammar*.

Henri Pittier had been a teacher of natural science at the Institute of Henchoz and of physical geography at the Academy of Lausanne. In our country he had several charges, among them he was a teacher at the *Colegio Superior de Señoritas* and Director of the *Instituto Físico Geográfico* which was annexed to the National Museum. He contributed very important scientific researches to the country, many of them correspond to Natural History of Costa Rica, others were about meteorological observations, etc.

Johann Sulliger arrived in Costa Rica accompanied by Pittier, he was an engineer and a pupil of the Polytechnical Academy of Zurich, and was also a mathematics' teacher. He stayed a short while in Costa Rica.

Gustav Michaud was known in Switzerland for having written two scientific works for publication: *Chémie populaire y Terre, l'eau, l'air et la feu*; in 1886 he became a doctor in physical sciences at the University of Geneva. He was a teacher in his home country and in the United States. In Costa Rica he worked at several secondary schools and other institutions. It is interesting to remark that Michaud had been engaged in order to establish and direct a Physical-Mathematical Faculty. When, for political reasons, Mauro Fernández left the Secretary of Public Instruction in the hands of Ricardo Jiménez, the contract of Michaud was modified; he then taught science at the *Liceo de Costa Rica*. Between 1895 and 1905 he was professor at the American international College in Springfield, Massachusetts; in 1905 he came back to Costa Rica, but kept being a frequent collaborator of several magazines in the United States, Switzerland, and France. He is considered to be the real initiator of the lessons in physical sciences in Costa Rica.⁷²

Jean Rudin from Switzerland arrived in Costa Rica in 1889, engaged by Mauro Fernández; he was dedicated to studies in mathematics, physics, geology, and astronomy. He had worked in Hungary and in his home country he collaborated with the mathematics' teacher Kinkelin in the workout of a school statistics in Switzerland; many of his principal activities in Switzerland were related to astronomy. In Costa Rica he worked at the *Colegio Superior de Señoritas* (1895-1904), at the *Liceo de Costa Rica* and at the *Colegio San Luis Gonzaga* (he was its director when he arrived in Costa Rica). He also collaborated at the *Instituto Físico-Geográfico* (1893-97). He designed and embossed map of Costa Rica which is now in the National Museum; he wrote an excellent didactic work about cartography: "Cosmography at Primary School", and he published several scientific articles. His pedagogical influence on the Costa Rican primary schools was remarkable.

Julius Van der Laet came to Costa Rica in 1887, from Belgium, he had studied at the University of Lovaine, where he became a doctor in physical chemistry and natural science. In our country he dedicated his work in order to form agricultural companies, to serve the government and promote agriculture.

He was the technical chief of the Department of Agriculture and director of the "*Boletín de Fomento*".

Bertoglio and the Mathematics in Costa Rica

As an important character in mathematics' instruction, Rodolfo Bertoglio deserves special attention. Born in Milano in 1844, he was a Bachelor in physics and mathematics from the Liceo St. Alesandro, he had frequented the University of Naples, where he obtained the degree, and at the Polytechnic of Milano he became an engineer.

When he finished his studies, he became a teacher in several private schools of Milano, and prepared several children of the most selected families of Lombardy for their acceptance at the Military Academy of Modena. Later he was engaged at the Central Lyceum of Porrentrury, where his friend and companion Renard Thurmann had the chair of literature and philosophy. Few professors had had such a remarkable influence upon our youth like did Bertoglio; it is said that he was born a teacher as well as others are born poets. There in his classroom, with some chalk in his hand, surrounded by pupils, he showed his great love for youth, inspired much sympathy in his pupils and had for them a kind of magnetic power; even the laziest temper became active during his lessons and, because of the interest which he woke, he could make that even limited talents acquired easily some understanding in mathematical science.

The attitude of Mr. Bertoglio left valuable traces in our country's culture: he was a teacher at the *Instituto Nacional* (accidentally director of the same), director and founder of the ephemeral Engineers' School (another of the schemes for the studies in this subject), a member of the Council for Public Instruction, and inspirer of the Fundamental Law for Public Instruction, pronounced on August 12th, 1885. He worked out its studies' program as well as the plan which was in use when he worked as head of the *Instituto Nacional* in 1882.

Among the works done in this country, there are his topographical studies about Santa Clara, the plan for the *Asilo Chapuí*, and for the building of the sewers in San José. He left important studies without publishing, about properties of numbers, logarithms, several subjects of geometry and the notable *Espiral of Bertoglio*, by which he got eulogies of his professor Porro: an ingenious instrument which allows to solve complicated problems by the use of the compasses. About his influence in mathematics' education in Costa Rica, Mauro Fernández expresses himself like this: "The assiduous representative and propagator in our country of the modern instruction methods for mathematics from 1879 until 1886 was the engineer Rodolfo Bertoglio. It can be affirmed that he founded a school." ⁷³

Bertoglio, connoisseur of superior mathematics and strong in abstractions and generalizations of science, did not forget in education the slow and difficult process of the objective conception of the number, in order to approach gradually his students to the symbolical representations of amounts; connoisseur of physical and natural science, neither was he one of those who teach only pure mathematics, apart from the external observation, and from the phenomena of the real world, indifferent to the existence of substance.

Bertoglio was always one of the disciples of the eminent and wise Porro, who was paid by the Italian government for his lessons on Saturdays at the Polytechnic School of Milano, eight thousand francs a year, two hundred each lesson, which always was about some of the new researches by the wise mathematician.

In January of 1886 the distinguished professor left for Nicaragua and a year later, on February 13th, 1887, he died in León, when Costa Rica was about to make use of his service again.⁷⁴

Mathematics Education in Costa Rica

From the years on in which the liberal reform began, the primary as well as the secondary education in Costa Rica changed, especially because of the amplification of subjects to be studied.

As for primary education, the programs were divided into two parts: arithmetic and geometry. In arithmetic, there were studied the natural numbers (operations and basic elements of the theory of numbers like divisibility and calculation of the maximal common divisor), fractions (operation, mixed numbers) and measuring units (length, capacity, weight and time). As an application, the study of the simple rule by three was proposed as well as calculation of interests and discounts, and relations to other assignments of the scheme. In geometry, there were studied straight lines and curves, plain and spacial geometrical figures; calculation of perimeters, areas and volumes, all this from the intuitive point of view and without the use of many formulas; in general, the first years were about recognizing lines and figures and the next years, about realizing a few elemental calculations. Moreover, the relation of geometry with the remaining assignments and professions was proposed (use of the plumb, the watermark and drawing triangle). In general, the programs had to be studied gradually during the six years, each year repeating and amplifying the subjects studied before.

When the creation of . secondary schools, unified programs were edited. These programs planned much less contents than the one used before in the *Instituto Universitario*, but they were much more realistic and had more contents than the other secondary schools before. For example, the mathematics' program of 1892 established the study of one of the mathematical branches every year.⁷⁵

The organization concerning the number of years as well as the imparted subjects suffered few changes in the years after the Reform. Particularly, the programs for mathematics in secondary education, except for some minor variations were maintained with the same spirit and the same contents during many years. We can say without any doubt that these programs only had substantial changes during the reform of 1964. As an example, we can mention that in 1904, the secondary instruction was organized in two periods: inferior and superior, of three years each period. During the four initial years, mathematics was taught four lessons a week, and during the last two years, three lessons a week.

In the edition of the school programs of this period between 1890 and 1920 there can clearly be seen the interest in that the child acquires knowledge through discovery and not by using formulas without any sense for him. When other national thinkers like Carlos Gagini, later Joaquín García Monge and others, the educative course heralded by Mauro Fernández kept going. The *Reglamento Orgánico del Personal Docente de las Escuelas* (Regulation for School Teachers) was emitted in 1906 and the program for Primary Education in 1908.

With the new programs worked out by the professors Roberto Brenes Mesén and Joaquín García Monge, it can be said that in 1908 education acquired – let us say – a practical and useful mean, which obliged to establish some changes in the programs, methods and supervision at school. One of the notorious aspects: the schools were divided into urban and rural, and so there were proposed some differences concerning instruction in these two types of primary institutions. The general aims in these programs were resumed in the presentation as follows:

“The school of our country, in our concept, has to aim to stimulate the faculty of invention, to promote the spirit of undertaking, to sew in the heart of the individual the marvelous seed of confidence in our own powers. At school we have to learn for life and to obtain force; and not to fulfill programs nor to present exams.”⁷⁶

According to what was established in general for the primary instruction in 1908, mathematics was provided by general explications in which there was presented the idea of what was supposed to be reached in this area; moreover, the subjects were presented minutely precise and with prolix explications about how to work them out.

The programs for the rural schools established the same contents as those of the urban ones, but emphasizing that the exercises and examples had to be oriented according to the requirements of the rural communities.

The ideas of Roberto Brenes about the rural school continued within the programs of 1918, when they were edited during his period as Minister of Education of the government of Tinoco. In 1918 for mathematics it was established the necessity to introduce the concepts of number, amount, and geometrical aspects through activities which were closely related to agricultural work, excursions to the countryside, the work of milkmen, bakers, and different communal activities. A certain practical sense continued, which during the thirties would acquire a major importance within a pragmatist educative philosophy.

In 1910, Carlos Gagini edited new programs similar to the former ones; the following educative texts for mathematics were proposed: *Aritmética* by V. de Castro, the one by Vintéjoux, by Leysenne and by Nelson, *Tabla de equivalencias* by M. A. Quirós, *Geometría* by Dalséme, *Geometría* by P. Bert and *L'initiation mathématique* by C. A. Laisant. Again, in 1926, some programs for primary education were proclaimed, based on:

“The finality of our schools, which aims the harmonic development of the child’s nature and the promotion of new currents of social, economical, agricultural and industrial welfare.”⁷⁷

It established that the instruction in mathematics had to focus two aims: the educative and the *practical*. The first, because mathematics are useful in order to develop the mental faculties of the individuals by allowing abstraction and interest in science. The second, because it helps to the “success in undertakings”. In those schemes it was recommended that the subjects to be studied had to follow the process of objective presentation, abstraction, memorization, and application. The problems of application had to be useful for all subjects and of the activities of the individuals and the community.

From the *Escuela Normal de Costa Rica* to the *Universidad de Costa Rica*

Generally, we can identify six stages in the formation of teachers in Costa Rica. The first stage, based on the *Reglamento Orgánico de Instrucción Pública (Rules for Public Instruction)* of 1849, article 254, put into action the idea of a *Escuela Normal* in San José for the teachers’ education. It was formulated like a simple superior primary school. A second stage can be perceived in the creation of the Normal Sections of the *Liceo de Costa Rica* and the *Colegio Superior de Señoritas*, with the Reform by Mauro Fernández (level of secondary schools). A third stage, with the creation of the *Escuela Normal* in 1914 in Heredia (post-secondary preparation and two years for the specialty of primary education). Another stage began in 1936 with a reform of the Section of Humanities at the *Escuela Normal*. The fifth stage began with the creation of the Universidad de Costa Rica: the School of Pedagogy was organized and the formation of teachers was raised to the university level (although the program was still of two years). The sixth stage began during the Reform of the *Universidad of Costa Rica* in 1957, when the School of Pedagogy was converted into the Faculty of Education.

In 1914, during the presidency of Alfredo González Flores, and with the presence of his brother Luis Felipe González as a Minister of Public Instruction, a new turn for the Costa Rican Education was given. In November of 1914, the *Escuela Normal de Costa Rica* was founded, with the main objective of solving the serious problem of the education of Costa Rican teachers. This act was the second big moment after the Reform of Mauro Fernández. One of the principal problems which was not solved by the Reform, was the education of teachers and professors. The confinement of this formation into normal sections of two high schools (whose orientation and dynamics helped for another professional specialization), and moreover the absence of a superior educational center which would give an academic sustain, blocked the adequate development of the training of teachers. The creation of the *Escuela Normal* meant then, an institutional mechanism to respond to these necessities and the start of a new stage in national education.

Three famous directors: Arturo Torres, Roberto Brenes Mesén and Joaquín García Monge, gave firm bases for its beginning and to ensure the success of the *Escuela Normal*. The Normal Schools annexed to the *Liceo de Costa Rica* and the *Colegio Superior de Señoritas* disappeared and the Normal School was strengthened and was converted into the *Alma Mater* of Costa Rican education.

The *Escuela Normal de Costa Rica* came to satisfy the urgent need of the training of teachers. This required six years of study, three years of general studies and three years of specialized studies, which were basically those which prepared the student for his work as a teacher. The *Escuela Normal* had three sections: General Studies (3 years of secondary studies), Normal (3 years of the proper Normal and professional training) and the School of Application (which were the 5 years of primary school).

Two decades later the internal structure of the *Escuela Normal* was changed, by the decree n° 16 of August 26th, 1936, emitted by the Government of León Cortés and being Alejandro Aguilar Machado the State Secretary in the Ministry of Public Education. In this decree it was established that the *Escuela Normal* would have two sections: one of Humanities which was of five courses, and the other of Educational Sciences, which was composed of four. Moreover, it was indicated that the Section of Humanities would follow the same studies' program and the same institutional organization which ruled the secondary schools. With these, it would also give the Diploma of a Bachelor in Humanities. On the other hand, the Pedagogy Section would be a professional school dedicated to prepare the teachers and professors of the Republic. To enter, it was essential to have the grade as a Bachelor of Humanities. At the end of the second course, this section would give the diploma of a *Normal Teacher*, and at the end of the fourth, that of a *Normal Professor*.

When the *Universidad de Costa Rica* was created, the Section of Pedagogy was turned into the School of Pedagogy of the University. This event supposed an administrative decentralization; also, during the first years of working, or rather of transfer to the *Universidad de Costa Rica*, it did not suppose any important change in its institutional life. The School of Pedagogy continued training teachers for primary education and the direction of the school for pedagogy was still occupied by Dr. Marco Tulio Salazar (from may of 1940 until march of 1941), who also directed the Normal School, whose name was reserved for the Section of Humanities; for this reason the Bachelor titles until 1950 were given by the *Escuela Normal*.

Generally, concerning mathematics at the *Escuela Normal* we can say the following: on one hand, the first three years, which corresponded to the general studies, were the same as those of the *Liceo de Costa Rica*, so that the same programs were followed, especially in mathematics. Actually, during this period the secondary instruction in our country was not much extended. Between 1915 and 1940 the *Escuela Normal* also worked as a secondary school. Until 1940 there were not created any new official high schools, although during some years there worked a few private schools like the *Seminario*, *La Esperanza*, *La Escuela Nueva* and *Evans*.

It was in the mentioned high schools where there was taught the major part of the few mathematical knowledge available in that moment in this country. The official programs for mathematics for the secondary education were a true reflection of that situation.

In the beginning of this period, the primary and secondary instruction of mathematics in Costa Rica was influenced by different currents, for instance, the German one. In 1889, when Otto Littmann arrived in the country, at first his text was adverse by Dr. Fernández Ferraz, who was then councilor of Public Instruction; nevertheless, the method of Grubbe was required in all schools from 1899. Also, the German influence arrived here by Costa Ricans who had studied at the *Instituto Pedagógico* of Santiago de Chile. This institute was organized by German professors in 1888. The Chilean government hired six German professors for superior instruction; among them, one for mathematics, professor August Tafelmacher, with a diploma from the University of Göttingen. Tafelmacher wrote several works about mathematics which were used as texts in our country. Among those who studied at the *Instituto Pedagógico de Chile* (from 1897 until 1890), there was Salomón Castro, who studied pedagogy and mathematics and afterwards was incorporated to the *Liceo de Costa Rica*. In another group of Costa Ricans was Nicolás Montero, who began his studios at the *Instituto Pedagógico* and studied mathematics.

The *Escuela Normal* was influenced by the pedagogical ideas of John Dewey (in 1900 he wrote his famous book *The School and the Society*), which differed from the pedagogical vision of Herbart, Ziller, Rein, Dittes, Dilthey, etc., and

established the so-called “pedagogical socialism”. The pragmatism which can be found in the base of Dewey’s ideas, had important consequences in the *curriculum* and methods which still have an impact on Costa Rican education. Concerning mathematics, the North American influence during this period can be seen in some texts which were used at the primary and high schools of the country: the book of *Arithmetic* by Robinson, *Arithmetic* and *Algebra* by Wennoth and Smith, as well as the geometrical cases which allow the objectivation of certain concepts such like the equivalence of volumes of some bodies.

An interesting detail: between 1929 and 1940, around the *Liceo de Costa Rica* existed a *Newton Studies Center*, for many highly esteemed young people, who afterwards would be professionals and persons of importance in the country: José Joaquín Trejos Fernández (president of Costa Rica 1966-1970), Rafael Zúñiga Tristán and Rafael Lluvere among many others. This center, inspired by the Swiss professor Charles Borel L., motivated the studies of science and technology for high school students who had to prepare an exposition about selected subjects and to write a monograph about them. Many of the students who belonged to that center afterwards became distinguished professors of the Universidad de Costa Rica, whose creation in 1940 meant its closure.

In the year 1935 a reform of the educative system was attempted, which should not only include primary and secondary education, but also the superior education which was until then separated and in a poor situation. Therefore, the government of Ricardo Jiménez, together with his Secretary of Public Instruction, the eminent historian Lic. Teodoro Picado (afterwards President of the Republic, in 1944-48) introduced a Chilean educational mission integrated by distinguished and authorized teachers: Luis Galdames (who presided it), Oscar Bustos and Arturo Piga. Nevertheless, the fear of introducing changes, added to the lack of a policy which would be well-working and able to realize the reforms which had been recommended, did not allow the means recommended by the Chilean technicians to succeed.

The administration of Dr. Rafael Angel Calderón Guardia, with the participation of Lic. Luis Demetrio Tinoco, who was then the Secretary of Public Education, introduced important changes into the Costa Rican education.

About the programs of mathematics in Costa Rican primary and secondary schools, we can say that, in reality, until 1964 they did not change essentially; in all of them there can be observed the same contents within “classical” mathematics: arithmetic, algebra, geometry and trigonometry. The differences between the programs rather were established by the explications which were offered in the introductions, referring to general aspects of mathematics’ instruction. The scheme proclaimed in 1964 did contemplate substantial variations concerning contents and the orientation of the subject, but this is the subject of another work.

The new cultural and educational context which supposed the creation of the *Universidad de Costa Rica* opened a new stage within the evolution of Costa Rican education and culture and, particularly, a new historical context for the development of mathematics and its instruction in the country.

The *Universidad de Costa Rica* was founded on August 26th, 1940, when the Law n° 362, *Ley Orgánica de la Universidad de Costa Rica*, was signed, during the administration of Dr. Rafael Angel Calderón Guardia. Nevertheless, its installation was realized on March 7th, 1941.⁷⁸

REFERENCES AND NOTES

¹ Pérez Brignoli, Héctor. *Breve historia de Centroamérica*. Madrid: Alianza, 1985.

² Pérez. *Op. cit.*

³ In Central America this confrontation and the liberal reforms were made according to different rhythms and programs. Láscaris, for example, says that in El Salvador these reforms were not even realized.

⁴ According to the British Robert Glasgow Dunlop, in 1844 Central America had a population of about 2 millions, which would be 3 millions about fifty years later. The population was distributed as follows: Guatemala with 1 million of inhabitants (800.000 indian, 150.000 mestizo and 50.000 white); El Salvador with 350.000 inhabitants (3 or 4 thousand white and 20 or 30 thousand blacks or mulatto); Nicaragua with 300.000 inhabitants (2 or 3 thousand white, 5 or 6 thousand black), Costa Rica with 85.000 inhabitants (75.000 white). See Láscaris, Constantino. "Las ideas en Centroamérica". *Revista de Filosofía*, Universidad de Costa Rica, Vol. XXVII, N° 65, June 1989. San José, Costa Rica.

⁵ Liendo y Goicoechea was an "encyclopedist", pupil of Escoto and Feijóo. In 1869 he imparted a course of philosophy where he introduced experimental physics, confronted with the Aristotelian instruction.

⁶ González Flores, Luis Felipe. *Evolución del Desarrollo de la Instrucción Pública en Costa Rica*. San José, Costa Rica: Editorial Costa Rica, 1978; pp. 65-67.

⁷ José Antonio Liendo y Goicoechea, left behind the following publications, among them: (1) Acto Público de Tesis de Física Experimental, lead in Guatemala in the year 1769. (2) Acto Público de Teología Dogmática, printed in Guatemala in 1792. (3) Acto Público de Religiones. Extracted from *La Gaceta* of Guatemala. (4) Acto Público de *Legibus*. Printed in Guatemala. (5) Disertación Político-Económica, sobre los medios de destruir la mendicidad y socorrer a los verdaderos pobres de Guatemala. Printed in 1797. (6) Memoria Político-Económica sobre Hospicios. Manuscripts. (7) Sobre los estilos. Several writings and reflections about erudition. Published in *La Gaceta* of Guatemala, with the name Licornes. *Ibid.*, p. 67.

⁸ "As a thinker he lacks originality and cannot even be considerate a brilliant expositor. Nevertheless, he began the opening to modernity in Central America and provoked a reaction in his surrounding." Constantino Láscaris. *Historia de las Ideas en Centro América*. San José: EDUCA, 1982, p. 296.

⁹ Within his plan of reorganization, which, even if it was rejected, had an influence on the one which resulted materialized: "If we amplify considerably the horizon of studies, which were then circumscribed about 11 chairs, Goicoechea proposes 12 new ones, among them rhetoric, mathematics, experimental physics and anatomy; he suppresses the limitation of one single text and introduces the system of compulsory lectures and "additional" or complementary subjects. Following the illustrated current, he recommends the use of Spanish at the university professorship, besides Latin". Charles Tünnermann. *Historia de la universidad en América Latina. De la época colonial a la Reforma de Córdoba*. San José: EDUCA, 1991.

¹⁰ John Tate Lanning. *La Ilustración en la Universidad de San Carlos*. Translated by Flavio Rojas, Guatemala: Universidad de San Carlos, 1978; p. 105.

¹¹ Cfr. J. T. Lanning, *Op. cit.* p. 99.

¹² In 1674, a volume of his works appeared in *Mundus Mathematicus*. Cfr. Lanning, *Op. cit.* p. 112.

¹³ As in Costa Rica, in 1852 Guatemala signed a *Concordato* which turned education to confessional.

¹⁴ A.N.C.R. (Costa Rican National Archives). Serie Educación 889, f. 26.

¹⁵ A.N.C.R., Serie Educación 888, f. 35.

¹⁶ *Ibidem*, p. 83.

¹⁷ The contract celebrated between Angel Miguel Velásquez and the Rector was signed on march 28th, 1864 and its first paragraph said: “On the coming may 1st there will be opened at University, lessons for the instruction of civil engineering, architecture, and land surveying”. Cfr. Archivos Nacionales de Costa Rica (Costa Rican National Archives). Secretaría de Instrucción Pública 1058. March 28th, 1864.

¹⁸ González, Paulino. *La Universidad de Santo Tomás*. San José: Editorial UCR, 1989, p. 99.

¹⁹ Marta V. Rojas, Daniel Calderón. *El Liceo de Costa Rica: Su Proyección Histórica, Cultural y Política*. Graduation work in order to obtain the "Licenciatura" in History, Ciudad Universitaria Rodrigo Facio, July, 1981. p. 1.

²⁰ Although Fernández Ferraz had to be directing the Institute during four years, he quit in 1882 and Rodolfo Bertoglio followed, who also quit. The latter one was followed by Enrique Villavicencio and finally by José Torres Bonet (four directors in four years). It is interesting to mention that Bertoglio, Villavicencio and Torres Bonet taught mathematics at the Institute. The *Instituto Nacional* in those years suffered a decay.

²¹ According to Orlando Cuadra he was born in 1780; according to Chester Zelaya he was born in 1790 and died in 1849.

²² It is important to mention that Bach. Osejo had directed, in 1817, a philosophy chair in Cartago.

²³ It was acquired by the Banco Central de Costa Rica “about fifteen years ago”, according to Tatiana Láscaris Slepuhin, in her graduation thesis, for the amount of ten thousand colones. Cfr. Láscaris Slepuhin, Tatiana. *Luis González, una época en la Matemática*. Thesis for the "Licenciatura" in Mathematics, 1976, p. 12.

²⁴ Chester Zelaya. *Rafael Francisco Osejo*. San José: Ministerio de Cultura, Juventud y Deportes, 1973; p. 109 ff.

²⁵ *Ibid.*, p. 14.

²⁶ At the end, it referred to “Ratios and Proportions”. Please observe the methods:

“Question: How many types of rates are there?”

Answer: Two, arithmetic and geometry.

Question: What is an arithmetical rate?

Answer: The relation of excess or difference between two amounts.

Question: What is a geometrical rate?

Answer: The relation which shows how many times one amount contains or is contained in another.

See the graduation thesis by Tatiana Láscaris on pp. 14-15 or the book by Chester Zelaya on p. 11.

²⁷ Chester Zelaya. *Op. cit.* p. 111.

²⁸ It is interesting to note that even a book of mathematics was written according to the method of catechism. During many years the Spanish educative patterns, full of religious incense, conditioned the contents and the way of intellectual elaboration. Precisely, one of the principal struggles which were carried out by the more dynamical sectors as the laicization of education and the introduction of new methods. This was always difficult.

²⁹ Ibid., p. 17.

³⁰ Ibid, p. 17.

³¹ Later, this institute was substituted by the *Instituto Universitario*.

³² Ibid., p. 17.

³³ Ibid., p. 18.

³⁴ Ibid., p. 18.

³⁵ In Europe, Comte was in favor of an education for the proletariat.

³⁶ Láscaris, Constantino. *Op. cit.*, p. 45.

³⁷ Before this, there were some attempts to fulfill this stage of studies. For instance, the so-called “Minor” studies at the Universidad de Santo Tomás, which corresponded to what we could call secondary education. During the sixties and seventies, there appeared a few establishments which we could call primary-secondary and which worked in San José, Cartago and Heredia. We can say that they are the precursor of the proper intermediate education, but they cannot be considered as that. At the end of the decade of 1870, there worked several centers of secondary education: *Instituto Nacional* (in San José), *Colegio San Agustín* (in Heredia), *Instituto Municipal* (in Alajuela) and *Hermanas de Sión* (in Alajuela). Already in 1884 there worked ten secondary educational institutions (including public and private), nevertheless, this increase was stopped by the crisis of 1881 which, in the middle of that decade, stated the need of a global reformation.

³⁸ Cfr. Archivos Nacionales de Costa Rica. Complementario Colonial 3669, f. 161.

³⁹ González Flores, Luis Felipe. *Historia de la Influencia Extranjera en el Desarrollo Educativo y Científico de Costa Rica*. Imprenta Nacional, San José, Costa Rica, 1921, p. 283.

⁴⁰ Entitled: *Definiciones Técnicas de las Principales Operaciones de Aritmética para la instrucción de la juventud costarricense y uso de las escuelas elementales del país*. Cfr. Fonzález Flores, Luis Felipe, *Evolución de la Instrucción Pública en Costa Rica*. San José, Costa Rica: Editorial Costa Rica, 1978, p. 268.

⁴¹ The exams also allow us to confirm some of the subjects to be taught. In 1865, 1396 students were examined in theory of numbering, 33 in ordinary and decimal fractions, 7 in division of denominates, 2 in the extraction of roots and the rule of three and one in elemental arithmetic and geometry. Archivos Nacionales de Costa Rica. Congreso 21136.

⁴² Document n° 1134 of the Secretary of Public Instruction, corresponding to April 7th, 1869.

⁴³ In the *Indice Bibliográfico* by Luis Dobles Segreda, the date appears as 1879, which we assume as an error.

⁴⁴ Dobles S., Luis. *Indice Bibliográfico de Costa Rica*. Tomo III, 1929, pp. 15-19.

⁴⁵ González F., Luis. *Evolución de la Instrucción Pública en Costa Rica*. Editorial Costa Rica, San José, Costa Rica, 1978, p. 266.

⁴⁶ ANCR: Secretaría de Instrucción Pública 1134, about the Basic Law for Primary Instruction of april 7th, 1869, (art. 2).

⁴⁷ Cited in González Flores, *Evolución de la Instrucción Pública en Costa Rica*. p. 330.

⁴⁸ Cfr. González, Luis F. *Historia de la influencia extranjera en el desenvolvimiento educacional y científico de Costa Rica*. Editorial Costa Rica, 1976; pp. 239 y 264.

⁴⁹ *Ibidem*.

⁵⁰ *Archivos Nacionales de Costa Rica*. Congreso 21136.

⁵¹ Secretary of Public Instruction. *Programas oficiales de Segunda Enseñanza*. 1892.

⁵² *Archivos Nacionales de Costa Rica*. Congreso 1886, Memoria de Instrucción Pública, p. 3. This note was the object for the Decree of September 21st, 1886.

⁵³ The work was constituted by 58 pages and published in the Imprenta Nacional in 1886. The translator says that it is destined to direct teachers and there could be found the preceptors of indispensable means in order to impress upon the intelligence of the children all the necessary notions to acquire knowledge of the system. Some equivalencies of the metric system and several explications of the laws and dispositions which established them were added. After the work of Level, the translator adds an "Introduction to the Tables of Equivalence published on August 21st, 1884", with some explications taken from the *Arithmetic* by Ritt; he also proposes many problems. The study by Level contains: 1. About weighing and measuring instruments which accompany the Level apparatus, and which in its totality is known as the Level apparatus, complete; 2. About the metric system; 3. About the meter and the measures of longitude; 4. About area measures; 5. About agrarian measures; 6. About cubes; 7. About capacity measures; 8. Weight measures; 9. Volume measures; 10. Measures for timber; 11. Currencies; 12. Instruction for the use of metrical solids. Cfr. Luis Dobles Segreda, *Indice Bibliográfico*, Vol. III, San José, 1929; pp. 27-28.

⁵⁴ The clearest antecedent of the Reform by Fernández was the plan by Julián Volio in 1867.

⁵⁵ It is interesting to note that, although the formation of Fernández was English, he adopted the classical plans of the French Illustration. In this sense he was a "afrancesado".

⁵⁶ For Sarmiento the primary or popular education was enough in order to reach the transformations which were required in the agrarian economy of that moment.

⁵⁷ Fernández, Mauro. *Memoria de instrucción Pública*. 1888.

⁵⁸ Maybe influenced by the preoccupation of the primary school and because of the positivist ideas, or because of an error in the political calculation which did not foresee that it had only a few years to make the plans work.

⁵⁹ This "error" was common to the liberals in almost the whole Central America. In Guatemala, in 1875 the Universidad de San Carlos was closed and substituted by separate professional faculties. (Although there they created a Polytechnical School, which did never exist in Costa Rica). In Costa Rica as well as El Salvador and Nicaragua there were closures of universities, but not so in Honduras: in 1879, the Universidad Nacional de Occidente was founded in Santa Rosa de Copán.

⁶⁰ Mauro Fernández closed in 1888 the Universidad de Santo Tomás, adducing that it did not respond to the needs of the Costa Rican society. Mauro Fernandez had the idea that the government would reform the University (in fact, he thought about a french-style polytechnical school, where science and techniques would play the fundamental role), but first there had to be a complete reorganisation of primary and secondary school, base of the superior education. On the other hand, the Universidad de Sant Tomás, according to Fernández, did not have any organised faculty, the secondary education which worked under the protection of the same

university, with the intention of correcting anomalies which carried the students during their process of formation, had also disappeared, so that only the School of Law remained. This gave sustain to the purpose of closing the Universidad de Santo Tomás, which, when that took place in 1888, woke big polemics, as it does still in our times. Some said that this represented the intellectual stagnation; others said that it was a sane procedure, because the inferior levels had to be structured first. But, the dream of Fernández, to organize the superior education according to the most urgent needs of the country was frustrated, the lack of time and the absence of economical means for this purpose made it impossible to come to a happy end. We have to remember that in 1853 it was declared Pontifical, after the *Concordato* of 1952. In spite of all the limitations which could have had that institution, it had a big influence; an important part of the governors and politicians of that period had been in its classrooms. But, moreover, as there did not exist, for a long time, any rationalized and centralized educational system, it came to occupy a key role of orientation and educative direction.

⁶¹ It can be said that from the administrative point of view the reformation had great success, also because of the facilities of financiation which existed for different circumstances. On the other hand, the internal reorganisation of primary education was another important point of the reform, because it laid aside very old vices as the Lancasterian education, the unitary schools and the importance of corporal and moral punishment as part of the educative methods. It also establishes the just importance of science in education. Another fundamental aspect was to concede to secondary education the corresponding importance, an aspect which had been neglected until then. As negative aspects of the reform there can be cited: on one hand, that the preparation of the teachers was not realized in an adequate way, and, on the other hand, the closure of the Universidad de Santo Tomás without having an alternative for it, because in this way the opportunity was discarded to organize, based on a better structured elemental education, an university education which would correspond better to the needs of the country; this also blocked an adequate formation of teachers for secondary education, an important aspect, as it was clear that possibly the country could no longer afford importing competent professors.

⁶² Ibid, p. 23.

⁶³ Ibid, p. 24.

⁶⁴ Ibid, p. 25.

⁶⁵ According to Tatiana Láscaris, it was a thick volume of 251 sheets, handwritten.

⁶⁶ Ibid, p. 26.

⁶⁷ Ibid, pp. 27-28.

⁶⁸ González Flores Luis Felipe. *Historia de la Influencia Extranjera en el Desarrollo Educativo y Científico de Costa Rica*. San José, Costa Rica, Edit. CR, 1978; p. 54.

⁶⁹ González Flores, Luis Felipe. *Historia de la Influencia Extranjera en el Desarrollo Educativo y Científico de Costa Rica*. San José, Costa Rica: Editorial Costa Rica, 1978; p. 87.

⁷⁰ See Láscaris, Tatiana. *Luis González, una época en la matemática*. Tesis de Licenciatura en Matemática, UCR, 1976; pp. 23...

⁷¹ González Flores, Luis Felipe. *Historia de la Influencia Extranjera en el Desarrollo Educativo y Científico de Costa Rica*. San José, Costa Rica: Editorial Costa Rica, 1978; p. 96.

⁷² González Flores, Luis Felipe. *Historia de la Influencia Extranjera en el Desarrollo Educativo y Científico de Costa Rica*. San José, Costa Rica: Editorial Costa Rica, 1978; p. 280.

⁷³ González, Luis F. *Historia de la Influencia Extranjera en el Desarrollo Educativo y Científico de Costa Rica*. Editorial Costa Rica, 1976; p. 265.

⁷⁴ González Flores, Luis F. *Historia de la Influencia Extranjera en el Desarrollo Educativo y Científico de Costa Rica*. Imprenta Nacional, San José, C.R., 1921, p. 284-285.

⁷⁵ So, in the preparatory course, arithmetic and geometry were taught. In the arithmetic part, there were studied different systems of numbering, fractions, divisibility (maximal common divisor and minimal common multiple), the decimal metric system and other measures used in Costa Rica, second and third potency, square and cubic roots, logarithms, the rule of three and progressions. Moreover, the resolution of application problems was proposed. Concerning the part of geometry, it was constituted by a review, with a major grade of intensity of what was studied in primary school (including some aspects as congruency, similitude, perpendicularity, etc.). During the first year, only arithmetic was taught, from a more rigorous point of view, establishing definitions and theorems. Some elements of the theory of numbers (theorems about divisibility, maximal common divisor, minimal common multiple, prime numbers, the fundamental theorem of arithmetic), fractions, potencies, radicals; proportions, the decimal metric system, the simple and composed rule of three, arithmetical and geometrical progressions, logarithms, and some elements of financial mathematics. In the second year algebra was studied: potencies, radicals algebraic expressions, integers, polynomials (operations, factorization, maximal common divisor, minimal common multiple of polynomials), algebraic fractions (operations, simplification), first and second grade equations, first grade equation systems with two or more unknowns, elements of combinatory analysis, inequalities, logarithms, basic notions of determinants, continuous fractions. The scheme of the third year was a study of geometry from a more rigorous point of view. In the fourth year, trigonometry was studied: trigonometric ratios for acute angles, basic formulas, tables, resolution of triangles, some application problems and element of spherical trigonometry. Finally, the scheme of the fifth year was totally related to the study of projective geometry.

⁷⁶ Gámez, Uladislao. *Planeamiento integral de la Reforma de la Educación en Costa Rica*. San José, 1970. p. X.

⁷⁷ *Programas oficiales de educación primaria*, Imprenta Nacional, San José, 1926. pág. 3.

⁷⁸ Four global circumstances defined the national institutional frame and academic space in which university mathematics would be developed during the past 58 years: the creation of the Universidad de Costa Rica in 1940, the University Reformation by Rodrigo Facio in 1957, the Third University Congress of the UCR in 1972-73, and the creation of the new state universities in the decade of the seventies: the *Universidad Nacional*, the *Instituto Tecnológico de Costa Rica* and the *Universidad Estatal a Distancia*.