The Round Table Degree Harmonization and Student Exchange Programmes was organized by three of the present authors (HJM, IN and VS) who decided at the outset that IN and VS would be concerned mainly with the question of harmonization, while HJM would concentrate on the exchange programmes. The need for a moderator and a co-organizer with the personal experience of student exchange programmes became apparent during our preparations, so the two remaining authors (CB and DS) became involved.

This final report should be viewed as a joint effort by all five authors. However, a word about its origin is in order. At the Round Table itself, a preliminary report, prepared by the three original organizers, was distributed to the participants. This preliminary report has now been augmented by DS’s account of the ERASMUS scheme which he coordinates (Section 4.2), by Professor Cioranescu’s account of her TEMPUS scheme, and verbatim accounts of part of the ECM Round Table discussions. It has also been subjected to minor revisions (linguistic and otherwise). It now forms most of Sections 2–4.

The Preliminary Report contained suggested recommendations, which were also summarized in the Abstract of the Round Table, distributed to all participants at the Congress. It is a testimony to the lively discussion which took place at the Round Table that the recommendations presented in Section 6 of the present report differ significantly from the earlier version, especially in the matter of a European Standard/European Degree in Mathematics.

The discussions at the Round Table have been interpolated in Sections 3.3, 3.8, 4.6 and 5, corresponding to the points at which they occurred during the presentation of the preliminary report. Every effort has been made to check that the account given here is a true picture of what each contributor wanted to say. But the five authors accept responsibility for the final wording.
2. Objectives

Mathematics has been an international endeavour for several hundred years, and mathematicians have been involved with student mobility long before official exchange programmes were created. Nevertheless, because of these programmes and the events leading to them (including the recent political changes in Eastern Europe and the advent of the EEC Internal Market) it is expected that the number of students doing part of their studies abroad will increase dramatically over the next decade and that “mobility” will become part of everyday life at universities.

With this in mind, the Organizing Committee of the ECM decided to include a Round Table entitled Degree Harmonization and Student Exchange Programmes. It should be emphasized that this was not an attempt to organize the unification of programmes on a European level. The intention of the Round Table was rather to analyze the present state of mathematics teaching at European universities and to judge to what extent, if at all, it would be useful, suitable or possible to harmonize programmes of study in order to encourage the easier mobility of students.

3. Harmonization of Degrees

3.1 Cooperation with EMS member societies

The member societies of the EMS were invited to contribute information about:

- General characteristics of programmes of study;
- Vertical division of programmes of study, that is, degrees or titles awarded, and internal divisions (e.g. by examinations);
- A description of the systems of examinations and/or other means of verification of knowledge gained from lectures and/or exercises;
- Opinions about a period of study abroad including conditions under which such a period abroad could be officially acknowledged by the home university;
- Detailed information on plans of study for basic courses during the first parts of programmes of study.

Thanks to the activity of colleagues from most European countries, much relevant material was collected. In particular, we received reports (in many cases detailed ones) from colleagues in the following countries: Austria, Belgium, Czechoslovakia, Denmark, Estonia, Iceland, Ireland, Lithuania, Luxembourg, Portugal, Sweden, Switzerland as well as from the Edinburgh Mathematical Society. From other sources we had (at least partial) access to information on the systems of study in France, Germany, Great Britain, and Italy. The information obtained is summarized and some conclusions are drawn in Sections 3.3-3.5 below.

For purely practical reasons, we decided to restrict ourselves to the study of mathematics in the narrow sense: we did not discuss informatics or the training of
future mathematics teachers.

3.2 The European student's record: a brief history

Attempts to make the exchange of students easier are by no means new. As we have learned from G. Choquet and F. Hirzebruch, around 1960 a European committee (whose members included E. Artin, H. Cartan, G. Choquet and F. Hirzebruch) prepared a booklet for students called the Student's European Academic Record Booklet. The booklet was multilingual (English, French, German and Italian) and its aim was expressed as follows:

"The purpose of the present booklet is to enable the student who moves from one University or College to another during the course of his studies to let those concerned know exactly what knowledge he has already acquired.

The attestations given in this booklet will be supplied by the professors or teachers directly in charge of the student. They are only intended for the information of other teachers, and in no way engage the responsibility of any Universities or Governments.

Each teacher should indicate the number of those parts of the Mathematics syllabus in which the student is proficient (please, refer to the numbers of the syllabus printed at the end of the present booklet). If teachers think it advisable, they will also have the opportunity to mention other subjects in which the student has rather good knowledge though they do not appear in this syllabus. Teachers are entirely free to express their appreciation as they think best.

The information supplied may relate to a successful examination; if there is no examination, information should be given by the teacher who knows the student.

Note on the syllabus. The syllabus printed in this booklet is obviously not intended to be compulsory or limiting in any way. It is mainly designed to be used as reference".

Syllabi for the first level include fundamentals of algebra, analytic geometry and classical differential geometry in two and three dimensions, first level linear algebra, elementary differential calculus, integral calculus, series, differential equations, numerical analysis, kinematics and dynamics, and introduction to the calculus of probability.

Second level syllabi are divided into two parts: pure mathematics and applied mathematics. The former includes algebra of sets, second level algebra as well as linear algebra, general topology, function spaces, second level integration, differential calculus, functions of a complex variable, differential geometry of curves and surfaces, while the latter contains advanced algebra, functions of a complex variable, advanced integral calculus, function spaces, integral equations, ODE's, PDE's, calculus of variations, distributions (including Laplace and Fourier transforms) and special functions.

Here are some samples of the syllabi.
First Level

1. Differential equations. Fundamental concepts of differential equations; trajectories of a vector field, initial value problems, boundary value problems. Illustration of these problems by equations which can be solved by integration; linear equations with constant coefficients. Linear superposition of the solutions of homogeneous systems of linear equations with variable coefficients. Non homogeneous equations.


Second Level (pure mathematics).


4. Function spaces. Distance of uniform convergence on the space of mappings into a metric space. The case where the latter space is complete, case of continuous transformations. Normed vector spaces, Banach spaces. Examples: norm of uniform convergence on a vector space of numerical functions, various norms on function spaces, defined by means of integrals. The Stone–Weierstrass theorem, or at least the Weierstrass theorem (approximation by polynomials). Pre-Hilbert spaces; examples: The space \( L^2 \) is complete (with Lebesgue integrals). Inequalities. Projection on a complete subspace, and more generally on a complete convex subset. The projection is a contraction. Pre-Hilbert
spaces with enumerable basis. The Schmidt orthogonalization. Applications: sequences of special polynomials, Fourier series.

Second Level (Applied Mathematics)

Definition of the characteristics of a quasi-linear system of two equations with two variables.
Pfaff equation in the case of complete integrability.
Equations of second order: separation of variables.
Equations of the second order with constant coefficients.
Elliptic equations: The Laplace equation $\Delta \varphi = 0$.
Mean value theorem, elementary solution, uniqueness for the Neumann and Dirichlet problem, Green’s function, the Poisson formula for the sphere, the energy integral (Dirichlet).
The Helmholtz equation $\Delta \varphi + k^2 \varphi = 0$, the radiation condition, reduction to integral equation.
Hyperbolic equations: the wave equation in 1, 2, and 3 space variables; elementary solution, boundary value problems, the Poisson–Kirchhoff formula. The method of descent (Hadamard). The energy integral.
Parabolic equations: the heat equation with one space variable. Elementary solution, boundary value problems.

3.3 Discussion of the student’s record at the Round Table

M. Karoubi, Paris:
I would like to understand why, as Henri Cartan said, this booklet was not so successful. Maybe Professor Hirzebruch can answer this?

F. Hirzebruch, Bonn:
Well, I can hardly give an answer to that. It was distributed to many European societies. I remember that I myself introduced it to the German mathematical society, but then the professors in the various universities maybe did not cooperate well enough. Maybe one should have sent it directly to the universities, and then whenever students left the university to go somewhere else, they should have used it. Maybe students were afraid that some records in the booklet would have given them bad grades; but the booklet was not connected with grades, so I think it was missing information.
I sometimes used it myself in German committees, when there was discussion about the minimum requirement for certain courses. This was also done in other countries when one was participating in official reform committees for the syllabus. And in that sense it was certainly helpful.
J. Winkler, Berlin:
Your work ignores a very serious problem, not so very essential for us at the university or for students working in a scientific direction, but for all other students. Starting next year in the EEC, a degree will have a new value for those students. In fact, a degree which is a professional qualification will be valid as such in every EEC country: for example, for becoming a teacher or for working in industry. For a student who intends to work in science at a university this is not so important, but if he wants to work in industry or outside the university, this is a very essential question.

R. Mlitz, Vienna:
I just want to point out that we are discussing the problem as representatives or members of mathematical societies, but, in the various countries, the content of university studies is usually not prescribed by the members of the societies. Such a booklet would be good — but we cannot impose it. I think this is one of the main problems.

M. Karoubi, Paris:
I think that this booklet could not—and should not—be imposed in any way. The general idea was to suggest a programme which could be harmonized throughout all Europe so that the students could travel easily. That’s what I understood. Now, I think the problem is more practical. First of all, is it necessary to come back to this idea? And secondly, if there is some general agreement that this idea is still good, even now, how can it be made practical? That is the question.

C. Berg, Copenhagen:
I think we will stop the discussion on this booklet now. We can come back to it in the general discussion afterwards, when we have more time. Of course there are many problems with such a book, but it could be easier for all of us, instead of just sitting and writing the whole syllabus every time a student comes or goes abroad, just to mark that this or that has been covered.

3.4 Vertical division of mathematics programmes and degrees
Within European countries, there is a great variety of systems of vertical division of study. Historically, in countries of the former eastern block, university study usually took five years without any subdivision. But now there is a clear tendency to adapt to conditions common in western European countries.

In general, the mathematics programme is divided into three parts, though the division may not be explicit. It is hard to choose a self-explanatory terminology, since similar expressions in various languages may refer to different situations.

For the purpose of this report we use

- First cycle.

Students enroll in the university at the age of eighteen or nineteen. Depending on the country, the first cycle takes 2–3 years. In addition to mathematics, there is
usually another subject (frequently physics, informatics, economics. Sometimes other choices are possible).

- Second cycle.
  This takes 1 or 2 years. There is a great variety of programmes. Students specialize more and are led to individual work.
- Ph.D study.
  Students choose their supervisor and a subject for their own scientific work from a wide spectrum of rather specialized fields. They usually have to pass some examinations and one of the main goals is to submit a thesis containing new mathematical results.

As illustrated below, the greatest variety of titles appears in the first cycle. In some countries a title corresponding to B.Sc. has a long tradition and is recognized on the job market. In other countries, on the contrary, no title of this sort is awarded. A continuous spectrum of possibilities can be traced in between.

The situation is more uniform after the second cycle. The majority of universities award a title corresponding more or less to M.Sc.

The doctoral degree is awarded to students having finished their Ph.D. This is also beginning to be adopted in former socialist countries, where the title “Candidate of sciences” has been in use for several decades.

In order to emphasize how the systems in European countries differ, we give a couple of examples.

In France, university study is divided into premier cycle ending with Diplôme d’Etudes Universitaires Générales. The second cycle, which also takes two years, is accompanied by two titles: licence at the end of the first year and maîtrise at the end of the second year.

In Belgium, the first diploma (candidature) is awarded after two years, but has no real significance. It is only the diploma of licence after four years that is recognized by the job market. Unlike the French system, third cycle programmes have a specialist orientation: the most common ones are in mathematics applied to insurance (e.g., a 3-year programme in actuarial science, a 1-year programme in statistics or business).

The first degree normally awarded in Scotland is either a B.Sc. or an M.A. About twenty-five years ago the majority of mathematics students would take an M.A. degree, whereas now the overwhelming majority take a B.Sc. degree. The above degrees are four-year honours degrees. It is also possible to take a three-year ordinary B.Sc. or ordinary M.A.

In Lithuania, an M.Sc. degree is awarded to students having average results greater than 7.5 out of 10.

In Germany there is no title corresponding to B.Sc. On the other hand, students have to choose a minor subject (Nebenfach).

Similarly, in Denmark, mathematics as a major subject most often appears
in combination with physics, computer science, statistics or business administration/economics. Other combinations are possible, though. The vertical division is: B.S. (3 years of study after high school), Cand. Scient. (corresponding to M.Sc. with a thesis, further 2 years) and Ph.D. (3 years as a rule). The ratio of major subject to minor subject for 5 years of study is about 70:30.

In Switzerland as well, the study of mathematics is usually accompanied by one or two non-mathematical minor subjects. Titles vary from university to university, for example, Dr.phil., Dr.phil.nat., r.sc.math., Dr.ès sciences, Dr.ès sciences techniques.

In Italy there is (or shortly will be) a degree called Diploma (roughly equivalent to B.Sc.); two other degrees are Laurea and Dottorato di richerca.

The general study programme in mathematics and natural science leads in Sweden to an M.Sc. degree, although single subject courses may be combined, under certain conditions and after at least three years of study, into a programme leading to a B.Sc. (Sw. Filosofie Kandidatexamen).

In the Portuguese universities the B.A. in mathematics called licenciatura now takes 4 years (5 between 1964 and 1986). A few years ago courses for the masters degree (two years more) were introduced.

Almost all university institutions in England and Wales offer three-year mathematics degrees. In the past, two types of degree predominated: honours mathematics in which other disciplines were not studied or were given very little attention, and Ordinary or General degrees which treated mathematics less deeply. Now honours degrees predominate, but a variety of “joint” honours degrees are offered, particularly at newer universities. Oxford and Cambridge are in many respects exceptional within the English university system.

3.5 Examinations

For the purpose of exchanging students, a survey of examination systems seems to be of great importance. Once again, there is a great variety of schemes and approaches.

In some academic systems, examination is more or less a continuous process of evaluation. Frequently, students take examinations at the end of each separate course; work in examples classes may also be taken into account. There are cases where mid-semester exams or the like are organized. These patterns of evaluation may or may not be terminated by a final exam. The situation also varies as far as the contribution of a written thesis to the final assessment is concerned.

On the other hand, the traditional examination system in some countries is based on a few examinations covering quite a large number of subjects taught during one or two (sometimes even more) years of study.

In most European countries the examination system lies between these two extreme cases.
Let us give some examples.

In Denmark, each course is evaluated by an examination at the end of the semester or the year. Each student typically has to take 2 to 4 exams at the end of each semester. There is a B.Sc. thesis which is usually a report based on the individual study of some mathematical literature. During the second cycle, courses are usually evaluated by an oral examination at the end. The thesis is evaluated by a committee appointed in each individual case. The M.Sc. thesis is typically a report on some recent development in the adviser’s area of interest. It need not (and in most cases does not) contain original research. An interesting feature is that typically the examination in Denmark is given by the teacher of the course in question plus an external examiner.

Scottish universities are responsible for granting their own degrees with quality assessed by a system of external examiners. Apart from the annual degree examinations, there are often one or two class examinations. A few courses may have some form of continuous assessment.

In Belgium, the general idea is that the basic unit is 1 year and each year the student must pass the examination on each course followed. In the first two years there are written tests in January, which sometimes count as final examinations (at the end of the course) or sometimes contribute to the final mark.

Oxford examines students at the end of their first and third years. Division of degrees into “classes” is based on performance in eight three-hour conventional written examinations taken within the space of a week. These examinations test all material taught in the compulsory parts of the three-year course as well as the options offered in later years. Students, then, have at one and the same time to show a grasp of a very wide range of “basic” mathematics plus more specialized knowledge.

Other English and Welsh universities, however, differ considerably from Oxford. Assessment is usually done at the end of each year and is principally by written examination. In some cases, however, examinations are held at the end of every semester (and this is likely to be the pattern for more universities in the future). Moreover, a variety of techniques may be used in addition to conventional examinations and can all contribute to the final mark. These include open-book examinations (where books or lecture notes may be consulted), coursework, essays, take-home papers, and investigations (but oral examinations are rare).

In Portugal, in most basic disciplines, the usual rule is to have one written test every semester and, for those students who do not get a satisfactory mark, a final written examination (followed by an oral, or not, according to the marks obtained).

The German system includes two main examinations (the so called Vordiplom-Prüfung and Diplom-Prüfung) at the end of the first cycle and second cycle, respectively. In addition, there is a more or less continuous system of evaluation of the student’s work in individual subjects.
Harmonization of Degrees

The reports we have received indicate, however, that the diversity of examination systems is not a bar to the exchange of students.

There seems to be no difficulty in incorporating courses from abroad into degree requirements, provided that an adequate description of the courses in question is available.

Experience so far indicates that a student should spend a whole “unit” of study at another university, which, in practice, means a semester or a whole year. The efficient exchange of students depends, of course, on the efficient exchange of information about the programmes of study at the universities involved. A student intending to study abroad for part of his/her university career will look for a list of prerequisites needed for a smooth continuation of study in another country. The procedure would be greatly simplified if a list of basic requirements, at least for the first cycle, were created on a European level. Such a list would surely help students prepare for a stay abroad and would provide a point of reference for universities when giving information to applicants.

3.6 Programmes of study

Programmes vary greatly from university to university. In particular, it is practically impossible to trace common features in the second cycle. One can even find programmes that are almost mutually disjoint. The situation is, however, different in the first two years of study, where quite a large portion of basic mathematical knowledge appears in all curricula.

The information from individual member societies was rather unhomogeneous. In some cases, detailed syllabi were provided, while in others only a few key words were given. A few basic subjects (frequently under different names) appear in all plans of study: mathematical analysis, algebra and linear algebra, geometry, numerical analysis, informatics, probability and statistics.

The first two subjects are studied more extensively than the others. The last three are sometimes integrated into a minor subject or into a part of the programme devoted to applied mathematics; often they are just introductory.

We tried to isolate the main topics usually covered by analysis, algebra and geometry. The distribution of individual topics among the courses is by no means uniform. Elementary set theory is taught in the framework of algebra, sometimes in analysis, or may even be included as a separate course. Similarly, analytic geometry may form a part of linear algebra, or may be included in a course on geometry. Surface integrals and Stokes’ theorem are usually treated in analysis, but may sometimes form a part of the differential geometry of curves and surfaces.

Nevertheless, several topics are present in most programmes and are grouped into three parts which we present as follows.

Mathematical analysis. Real and complex numbers. Sequences. Fundamental theorems on limits. Functions of a real variable, elementary functions,

Algebra and linear algebra. Vector spaces, linear dependence, bases, dimension. Linear maps, matrices, determinants, systems of linear equations, Gaussian elimination. Eigenvalues and eigenvectors, diagonalization, Jordan normal form. Linear forms, dual spaces, bilinear and quadratic forms, inner product spaces. Groups, rings, fields, quotient structures, the fundamental homomorphism theorems, group action, permutation groups. Polynomials, the division algorithm, factorization, unique factorization domains, ideals.

Geometry. Euclidean geometry, angles and distances, volumes. Analytic geometry, examples of quadrics. Curves and surfaces, length of a curve, curvilinear and surface integrals, Green’s, Gauss’ and Stokes’ theorems.

It would be desirable to continue tracing common features of European university mathematics teaching by collecting more information, particularly on subjects not covered above.

3.7 Reflections on a European standard in mathematics

The preceding sections indicate a rich diversity of systems of study, plans of study and degree titles, as well as of examinations and methods of teaching. Nevertheless, analysis of the information we received and exchange of opinion with numerous colleagues have led us to the conclusion that, during the first cycle, the common features of the courses at the various European universities are more important than their differences.

Further, as another part of this report shows, students typically spend their time abroad during the third and fourth years of study, not earlier.

These two observations, combined with initiatives from various European mathematicians, raise the question of whether it would be helpful to create a European standard for the amount of mathematical knowledge to be acquired during the first cycle. The Round Table could serve as a place for the exchange
of ideas on this question. The existence of a European standard could provide an inspiration for European universities and might have a positive influence on the teaching of mathematics at the university level.

It is not without interest to compare these new initiatives with the European Student’s Record mentioned in Section 3.2. There is a general consensus that the underlying idea could help in tracing the main features common to and typical of existing systems of study. There is not the slightest intention of imposing some kind of administrative unification of teaching programmes. Even if a European standard could be agreed upon, each university would have to have complete freedom to decide whether or not to conform to it. No doubt, there will be a broad spectrum of opinions about a European standard. Some mathematicians have reacted enthusiastically, others have had reservations, while yet others have been vehemently opposed.

It is hard to predict what the reaction of the mathematical community will be. The organizers hope that many colleagues will make their voices heard at the Round Table concerning the general principle as well as practical details.

It is our opinion that, among others, the following ideas should be discussed at the Round Table.

1. A large increase in student exchanges forces Mathematical Departments to produce descriptions of courses (in English?) for foreign students. In this situation it is very natural to reconsider the idea of an updated version of the European Student’s Record described earlier.

As follows from discussions among mathematicians, such a booklet should concentrate mainly on the first three years of study. For each subject, a “core curriculum” should be given (containing topics appearing in the curricula of practically all universities). To this part, topics which may or may not be included should be added.

If such a booklet were available, the teacher could simply mark the topics mastered by a foreign student without producing a lengthy description of the course.

2. The use of the booklet, in practice, could contribute to the formulation of a certain “European standard”.

This standard should consist of the topics which most frequently appear in the curricula of European universities. On a local basis, such attempts have already existed, as we shall hear in the next report: some ERASMUS as well as TEMPUS projects include curriculum development. It goes without saying that the development of a European standard should profit from the experience gained on these projects.

3. Suppose that the above mentioned European standard were to be created; the next step would be to consider establishing a European Degree in Mathematics based on the European standard. So far, however, discussions of this idea
suggest that such a project might involve the danger of a complex bureaucracy.

Further analysis and discussion will show to what extent such an idea should be developed.

3.8 Discussion on harmonization at the Round Table

A. Van der Sluis, Utrecht:
Would you say that on the whole a reasonable degree of harmonization already exists?

V. Souček, Prague:
I would not say so. It seems that the systems are really substantially different in the various countries, but that, at the moment, this does not prevent the exchange of students. Certainly, some sort of harmonization would be very good in the future, if it could be attained.

L. Lemaire, Brussels:
I am not sure that a real harmonization of a vertical division is possible. I am not even sure it is desirable. Because the major problem for teaching is really within each country. Universities have to be financed, diplomas have to have a legal value, and also a diploma of mathematics cannot be really different from the diploma in other sciences, in law or in any other branch, or it would probably become illegal in the country. So I do not think it would make any sense for the EMS to try to impose a substantial modification of the vertical division of the study of mathematics in the various countries. Thinking of Belgium, I would even object to such a proposal, because any modification would probably have an adverse effect on the financing of the universities and therefore on the support of mathematical research by teaching. So I think it is much more practical to see how a curriculum could be disseminated like the booklet and could be applied year after year. Certainly we cannot impose a substantial modification of the law in the various countries.

C. Berg, Copenhagen:
I agree completely with you in that respect. It is difficult enough within each country to get an agreement between the different universities on how things should be done.

A. Hajnal, Budapest:
Firstly, I apologize that we did not supply you with a curriculum. Ours is quite different from the one you read in the booklet, because in the first level we teach a lot of combinatorics, and even set theory is included. But I question whether harmonization is really good. I understand that it makes it possible for a student to travel, but if they learn the same thing everywhere why should they travel? I doubt that harmonization should be an aim.
M. Karoubi, Paris:

I do not think that we shall impose anything on every country: it is too complicated. Maybe it would be good to have another diploma which would be different: a European Diploma which would be given by universities in France or in other countries, but which would not be congruent to the diploma of any one country. The students want to travel. But what do I mean by travel? I mean that when we receive a student from another country we know what he has done. And harmonization does not mean that every country has to teach the same thing; it just means that you have to know about the teaching in each country. For example, when we receive a student from Hungary, we ought to know what his background is and what recommendations we can give him for improving his studies.

C. Berg, Copenhagen:

Concerning travel—of course it is nice to travel, and there is an important byproduct: we learn some languages, and we all need to know several languages when we study mathematics.

P. Michor, Vienna:

I think that an updated version of the red booklet would be just a least common denominator of existing curricula. Maybe it would be a good idea to have a model curriculum which is published somewhere and which is not aimed at being adopted by European universities. It would be just a model, and could be updated every 5 years and published so that universities could have a model to look at and explain why they deviate from it. They could see what the mathematics curriculum in an ideal university would look like. Of course no ideal university really exists.

C. Berg, Copenhagen:

I think that is a very good point, and I am also sure that such a booklet will have an influence. As mentioned in Cartan’s article in the Gazette\(^1\), the Danish mathematicians Fenchel and Jessen participated in the discussion with Cartan and others about curricula in Europe, and I am sure that it had a lot of influence on the new programmes in Denmark around 1960.

A. Van der Sluis, Utrecht:

You mentioned the description of the courses in English, thereby bypassing the difficulty of explaining what the influence of languages really is. Actually as the situation is now, each country has its own university courses given in its own language. In my country, the Ministry of Education has tried to promote the idea of giving university lectures in English. We got into a hell of a row, because so many people feel that in the language you find the soul of the nation. Languages are a very touchy subject within the EEC, so I think it is not to be expected that lectures will be given in languages different from the language spoken in the country where the lectures are given. So it might well be wiser to circulate a description of courses in the language in which the courses are given, since if the student is not able to

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read that, he will not be able to attend the lectures either.

R. Mlitz, Vienna:

I do not agree with my colleague from Vienna that something could be an ideal university, because if you asked 10 people what an ideal university was, you would get 10 different answers, and if you take the intersection, the programme would be quite small. And another thing that might be of interest is that in our new laws in Austria for studies at technical universities, we have now imposed the amount of eight semester hours of mathematics lectures in English for mathematics students. This is a first step. You cannot require the students to do everything in English, because in the beginning they have problems understanding the mathematics, and these problems should not be increased by having to learn in a foreign language.

H.J. Munkholm, Odense:

One of the questions we asked the European mathematical societies was precisely whether they would be willing to teach in a foreign language, if the need arose because of exchange of students, and the answers were pretty uniform, but I should qualify the statement by the fact that actually some large countries with Roman languages did not answer—not all, but some. But the answers were pretty much uniform:—God forbid—for the first 2 years—no way. Up to the Masters degree level, practically everybody says that if there is one student who wants tuition in English we will teach in English—and English is preferred, even by those Roman language countries that did answer. And at the Ph.D level it is completely uniform. So this little questionnaire seems to indicate that at the beginning level – no way can you teach in a foreign language systematically. But as soon as you come to the second cycle, or higher, then English seems to be a pretty good guess. But I would have liked to have those answers from a couple more of the Roman language countries.

I. Netuka, Prague:

I want to comment on the language question. We are a small country (practically no foreigner speaks Czech or Slovak), so the language problem is important for our students. For this reason some more advanced seminars are now held in English, just in order to train both teachers and students to be good at English mathematical communication. So I do not see any serious obstacle, at least in small countries.

A. Pelczar, Krakow:

I think it is very important that we are talking about this subject since the Conference of Rectors of European universities (CRE), that is, the conference of rectors, presidents and vice chancellors of European universities, is discussing this problem in a very broad framework, looking at curricula and the evaluation of curricula with respect to general aspects of a European education. It is part of this problem that we are presently discussing. We each have opinions about our own fields, and I think that there should be some connection between the permanent
committee of the CRE, referred to above, and the Executive Committee of the EMS.

4. Exchange of Students

4.1 ERASMUS

As is probably well known, ERASMUS (EuRopean community Action Scheme for the Mobility of University Students), is an EEC programme to stimulate cooperation across borders in university education. It works mainly by funding so-called ICPs (Inter-university Cooperation Programmes). Such an ICP involves a number of universities (from at least two member states). As far as mathematics is concerned there are four types of activity:

- Student exchange (practically all ICPs have this component),
- Teacher exchange (only one in five ICPs has this component),
- Curriculum development (about one in fifteen ICPs has this component),
- Intensive courses (fewer than one in fifteen ICPs have this component).

A gold mine of (statistical) information about ERASMUS is the ERASMUS AND LINGUA ACTION II DIRECTORY\(^2\)\(^3\) It gives a short description of each ICP (in 1991/92 the total number of ICPs is 1794). The style can be seen in Figure 1.

It also contains a large number of statistical and other tables as can be seen from the partial list of contents shown in Figure 2.

The table reproduced in Figure 3 shows that the programme is divided into roughly 20 main subject areas, one of which is called Mathematics/Informatics. It is seen that 3.8\% of the total number of 1794 ICPs fall into the Mathematics/Informatics category.

Mathematics/Informatics is further divided into 7 subsections, as shown in Figure 4.

In the following we only treat the first two of the above subsections. Together these two areas (mathematics and mathematics/informatics) account for

- 2.1\% of the approved ICPs; but
- only 1.3\% of the total number of students.
- around 1 million ECU (assuming an even distribution of money per student, roughly 100 ECU/month/student + other budget items).

4.1.1 Mathematics and mathematics/informatics in ERASMUS

\(^2\) Published yearly by the Commission of the EC, and available from the Office for Official Publications of the European Communities, L2985 Luxembourg.

\(^3\) Another valuable source for information is the ERASMUS NEWSLETTER, published by the ERASMUS Bureau, 70, rue Montoyer, 1040 Brussels, Belgium.
ICP-91-B-1176/11 (Student Mobility, Teaching Staff Mobility)

Subject Area(s): Mathematics, Informatics, Computer Science

B  Rijksuniversiteit Gent  Prof. dr. R. J. Delanghe
D  Rheinisch-Westfälische Technische Hochschule Aachen  Herr Prof. Dr. G. Jank
F  Université des Sciences et Techniques du Languedoc (Montpellier II)  Prof. S. Ciulli
NL  Technische Universiteit Eindhoven  Prof. dr. J. De Graaf
P  Universidade de Aveiro  Prof. Dr. J. D. Vieira
P  Universidade de Coimbra  Prof. Dr. J. A. F. De Carvalho
UK  University of Kent at Canterbury  Prof. J. S. R. Chisholm

Description of the Programme:

This renewal of ICP-90-B-0039 will enable up to 34 students to study for periods of between 3 and 9 months in another Community country. The estimated pattern of student exchange between the countries involved will be as follows:

<table>
<thead>
<tr>
<th>Home country to</th>
<th>B</th>
<th>D</th>
<th>F</th>
<th>NL</th>
<th>P</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
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<tr>
<td>NL</td>
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<td>0</td>
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<td>0</td>
<td>2</td>
</tr>
<tr>
<td>P</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>UK</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The structure of the study abroad programme in this ICP includes language preparation in the host country, regular academic coursework (lectures, seminars, etc) and thesis preparation or project work.

Staff mobility: arrangements made as part of this programme will involve an estimated 20 members of staff from the participating universities teaching courses in partner universities for a total of 100 weeks. The pattern of staff exchanges is as follows:

<table>
<thead>
<tr>
<th>Home country to</th>
<th>B</th>
<th>D</th>
<th>F</th>
<th>P</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
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<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>NL</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>P</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>UK</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 1.

STATISTICAL TABLES  917 1. Approved ICPs by primary subject area/type of cooperation  917
2. ICPs: General overview by Member State  918
3. Approved ICPs by Member State participation/subject area  919
4. Student months for home country/host country  920
5. Student numbers for home country/host country  920
6. Expected Student numbers in approved ICPs by subject area/home country  921
7. Student flows per Member State  922
8. ICP Applications from 1987/88 to 1991/92 by country of coordinating institution  923

INDEXES
1. ICPs by subject/Member State/type of cooperation  925
2. ICPs by Member State/institution  973
3. Alphabetical list of ICP programme coordinators and directors  1041

Figure 2.
### Table 1. Approved ICPs by primary subject area/type of cooperation

**Distribution des PIC acceptés par domaine d'étude/type de coopération**

| Subject Area                  | Number of ICPs | Type of cooperation | | | | | | | |
|------------------------------|----------------|---------------------|---|---|---|---|---|---|
| Agricultural                 | 26             | Student mobility    | 45 | 9 | 3 | 4 | Agriculture |
| Architecture                 | 57             | Student mobility    | 56 | 14 | 8 | 6 | Architecture |
| Fine Arts                    | 63             | Student mobility    | 57 | 11 | 5 | 4 | Beaux-Arts |
| Business Management Science  | 153            | Student mobility    | 148 | 25 | 8 | 3 | Gestion |
| Education/                   | 49             | Teaching staff      | 38 | 10 | 8 | 6 | Education/Formation |
| Teacher Training             | 183            | Teaching staff      | 155 | 21 | 7 | 7 | Sciences/humaines |
| Engineering/Technology       | 243            | Teaching staff      | 228 | 33 | 20 | 8 | Ingénierie |
| Geography/Geology            | 53             | Teaching staff      | 47 | 15 | 4 | 4 | Géographie/Géologie |
| Humanities                   | 104            | Teaching staff      | 90 | 21 | 5 | 7 | Sciences/humaines |
| Languages/Literature/Linguistics | 231         | Teaching staff      | 222 | 47 | 9 | 9 | Langues/Littérature/Linguistique |
| Law                          | 105            | Teaching staff      | 99 | 15 | 4 | 7 | Droit |
| Mathematics/Informatics      | 69             | Teaching staff      | 64 | 17 | 9 | 6 | Mathématiques/Informatic |
| Medical Sciences/            | 107            | Teaching staff      | 93 | 17 | 8 | 7 | Médecine/ |
| Psychology                   | 140            | Teaching staff      | 130 | 19 | 6 | 10 | Sciences naturelles |
| Natural Sciences             | 191            | Teaching staff      | 150 | 38 | 15 | 12 | Sciences sociales |
| Social Sciences              | 26             | Teaching staff      | 13 | 5 | 2 | 2 | Communication/Information |
| Communication/Informatics    | 26             | Teaching staff      | 12 | 6 | 3 | 2 | Autres |
| Other areas of study         | 26             | Teaching staff      | 25 | 7 | 3 | 3 | Accords-cadre |
| Framework Agreements         | 149            | Teaching staff      | 83 | 32 | 1 | 1 | Lingua |
| Total                        | 1794           |                       | 1661 | 341 | 122 | 101 | Total |

The category ‘Framework Agreements’ involves inter-university Cooperation programmes in several different subject areas, the main link between the different subjects being that a formal agreement exists between all the participating institutions at inter-institutional level.

La catégorie "Accords-cadre" regroupe des programmes interuniversitaires de coopération dans différents domaines d'étude, le point commun étant l'existence d'un accord interinstitutionnel formel entre tous les participants.

Note: One ICP may contain more than one type of cooperation, which explains why the total number of ICPs does not correspond to the sum of the totals of the different types of cooperation.

Note: Un PIC peut contenir plus d'un type de coopération; c'est pourquoi le nombre total des PIC ne correspond pas à l'addition des totaux des différents types de coopération.

**Figure 3.**

### MATHEMATICS, INFORMATICS

11.0 Mathematics, Informatics
11.1 Mathematics
11.2 Statistics
11.3 Informatics, Computer Science
11.4 Artificial Intelligence
11.5 Actuarial Science
11.9 Other Mathematics, Informatics

**Figure 4.**
In the 1991/92 ERASMUS directory there are 38\(^4\) ICPs under this heading.

We have assembled the information given in the directory into the following three tables\(^5\). In Figure 5, the “actual” number of student exchanges is based upon the generally accepted estimate that 60% of all expected exchanges are realized.

### Table 1: Number of universities, by country

<table>
<thead>
<tr>
<th>Year</th>
<th>B</th>
<th>D</th>
<th>D</th>
<th>G</th>
<th>E</th>
<th>F</th>
<th>I</th>
<th>R</th>
<th>I</th>
<th>L</th>
<th>N</th>
<th>L</th>
<th>P</th>
<th>U</th>
<th>K</th>
<th>total</th>
<th>expect no. of stud.</th>
<th>“actual” no. of stud.</th>
</tr>
</thead>
<tbody>
<tr>
<td>90/91</td>
<td>6</td>
<td>3</td>
<td>20</td>
<td>3</td>
<td>10</td>
<td>16</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>22</td>
<td>111</td>
<td>557</td>
<td></td>
<td></td>
<td>111</td>
<td>557</td>
<td>ca. 350??</td>
<td></td>
</tr>
<tr>
<td>91/92</td>
<td>6</td>
<td>4</td>
<td>27</td>
<td>5</td>
<td>11</td>
<td>24</td>
<td>4</td>
<td>0</td>
<td>5</td>
<td>6</td>
<td>27</td>
<td>132</td>
<td>866</td>
<td></td>
<td></td>
<td>132</td>
<td>866</td>
<td>ca. 500??</td>
</tr>
</tbody>
</table>

**Figure 5.** ERASMUS Networks. Mathematics and Mathematics/Informatics, Total Figures 1990/91 and 1991/92.

Figures 6 and 7 are based on the information given in the 1991/92 ERASMUS directory for the programmes listed under the headings “Mathematics”\(^6\) and “Mathematics/Informatics”, respectively. Each ICP is identified by a country code and a number, e.g. B1176. For each ICP, the table lists the number of universities involved (total, as well as by country); the expected number of students moved; and the projected period of study abroad for each student. In addition, if the ICP in question involves other topics than mathematics and/or mathematics/informatics, such other topics are mentioned. Also, for those ICPs which involve an exchange of teachers, the number of teachers exchanged, and the rough average duration is indicated. Similarly, the number of students or staff involved in intensive programmes [e.g. summer schools] can be seen.

In the 1990/91 ERASMUS directory each ICP also listed during which study year the students were supposed to go abroad. *The list shows a clear preference for the third and fourth years.* Such information is no longer in the 1991/92 edition, so it is not given below in the tables.

### 4.1.2 A questionnaire

In the 1990/91 edition of the ERASMUS directory there were 33 ICPs listed under mathematics or mathematics/informatics. A questionnaire shown in the appendix was sent to the main coordinator of each of these ICPs. We received answers from 16 of the 33. The results can be summarized as follows:

---

\(^4\) There were, in fact, at least 39 such ICP’s, see below.

\(^5\) In Figure 5, the numbers have been revised so as to take account of universities involved in more than one ICP.

\(^6\) ICP UK1539 did not appear in the directory, but has been included in this table.
Exchange of Students

<table>
<thead>
<tr>
<th>ICP</th>
<th>BDKGIELNK</th>
<th>Total</th>
<th>Expect. no. of stud.</th>
<th>Months per stud.</th>
<th>Other topics besides MATH and INF</th>
<th>Teacher exchange</th>
<th>Intensive Program stud. &amp; staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1033</td>
<td>1 1 1 2 2 5 12</td>
<td>14</td>
<td>4-6</td>
<td>CS ENG TECH</td>
<td>7 a 6 weeks</td>
<td>9 a 5 weeks</td>
<td></td>
</tr>
<tr>
<td>B1142</td>
<td>1 3 1 1 1 1 9</td>
<td>40</td>
<td>3-12</td>
<td>CS</td>
<td>8 a 5 weeks</td>
<td>9 a 5 weeks</td>
<td></td>
</tr>
<tr>
<td>B170</td>
<td>1 1 1 1 1 3</td>
<td>18</td>
<td>6</td>
<td>CS ENG TECH</td>
<td>6 a 2 weeks</td>
<td>9 a 5 weeks</td>
<td></td>
</tr>
<tr>
<td>B1185</td>
<td>1 1 2 1 1 7</td>
<td>21</td>
<td>4</td>
<td>CS</td>
<td>6 a 2 weeks</td>
<td>9 a 5 weeks</td>
<td></td>
</tr>
<tr>
<td>E1068</td>
<td>1 1 1 2 1 4</td>
<td>12</td>
<td>6</td>
<td>PHIL HIST</td>
<td>5 a 2 weeks</td>
<td>9 a 5 weeks</td>
<td></td>
</tr>
<tr>
<td>E1229</td>
<td>1 2 1</td>
<td>14</td>
<td>9</td>
<td></td>
<td>5 a 2 weeks</td>
<td>9 a 5 weeks</td>
<td></td>
</tr>
<tr>
<td>F0044</td>
<td>1 1 1 3 2 5</td>
<td>13</td>
<td>6-9</td>
<td>AI STAT</td>
<td>19 a 6 weeks</td>
<td>9 a 5 weeks</td>
<td></td>
</tr>
<tr>
<td>F1209</td>
<td>1 1 1 3</td>
<td>5</td>
<td>4-12</td>
<td>AI STAT</td>
<td>19 a 6 weeks</td>
<td>9 a 5 weeks</td>
<td></td>
</tr>
<tr>
<td>F1280</td>
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<td>22</td>
<td>4</td>
<td>PHYS CHEM</td>
<td>19 a 6 weeks</td>
<td>9 a 5 weeks</td>
<td></td>
</tr>
<tr>
<td>F1336</td>
<td>1 1 1 1 2 6</td>
<td>24</td>
<td>4-12</td>
<td></td>
<td>19 a 6 weeks</td>
<td>9 a 5 weeks</td>
<td></td>
</tr>
<tr>
<td>G1010</td>
<td>2 1 3 2 8 2 3 21</td>
<td>84</td>
<td>12</td>
<td>PHYS</td>
<td>25 a 4 weeks</td>
<td>40 &amp; 16</td>
<td></td>
</tr>
<tr>
<td>I1279</td>
<td>3 3 3 2</td>
<td>9</td>
<td>4-12</td>
<td>CS</td>
<td>25 a 4 weeks</td>
<td>40 &amp; 16</td>
<td></td>
</tr>
<tr>
<td>I1302</td>
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<td>7</td>
<td>3-12</td>
<td>CS AI</td>
<td>25 a 4 weeks</td>
<td>40 &amp; 16</td>
<td></td>
</tr>
<tr>
<td>IR1020</td>
<td>1 1</td>
<td>4</td>
<td>3-11</td>
<td>ENG TECH NS</td>
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<td>40 &amp; 16</td>
<td></td>
</tr>
<tr>
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<td>2 1 1</td>
<td>4</td>
<td>3-11</td>
<td>ENG TECH NS</td>
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<td>40 &amp; 16</td>
<td></td>
</tr>
<tr>
<td>NL1148</td>
<td>2 1 1 1 1 2 7</td>
<td>4</td>
<td>4-12</td>
<td>STAT</td>
<td>13 a 2 weeks</td>
<td>51 &amp; 9</td>
<td></td>
</tr>
<tr>
<td>P1032</td>
<td>1 1 1</td>
<td>6</td>
<td>10-11</td>
<td></td>
<td>13 a 2 weeks</td>
<td>51 &amp; 9</td>
<td></td>
</tr>
<tr>
<td>UK1013</td>
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<td>5-11</td>
<td>STAT</td>
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<tr>
<td>UK123</td>
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<td></td>
<td>Curriculum development in MATH INF COMM EDU TEACH</td>
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</tbody>
</table>

TOTAL 9 6 26 5 10 25 5 14 0 7 6 22 135 477

AI = Artificial intelligence; COMM = Communication science; CS= Computer Science; EDU = Education; ENG = Engineering; HIST= History; NS = Natural Science; PHIL = Philosophy; PHYS = Physics; STAT = Statistics; TEACH = Teacher training; TECH = Technology.
<table>
<thead>
<tr>
<th>ICP</th>
<th>Number of UNIVERSITIES by COUNTRY</th>
<th>expect. no. of stud.</th>
<th>Months per stud.</th>
<th>Other topics besides MATH</th>
<th>Teacher exchange</th>
<th>Intensive Program study &amp; staff</th>
</tr>
</thead>
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<td>B1176</td>
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<td>34 3-9</td>
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<td>INF CS PHYS</td>
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<td>52 &amp; 2</td>
</tr>
<tr>
<td>D1080</td>
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<td>19 4-11</td>
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<td>INF CS HIST</td>
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<td></td>
</tr>
<tr>
<td>D1260</td>
<td>3 1 1 1 2 2 7 38</td>
<td>38 5-6</td>
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<td>INF CS</td>
<td>4 a 6 weeks</td>
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<tr>
<td>DK1013</td>
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<td>19 3-10</td>
<td>INF PHYS</td>
<td>INF CS STAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EI023</td>
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<td>19 3-10</td>
<td>INF PHYS</td>
<td>INF CS TEACH</td>
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<td></td>
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<tr>
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<td>INF CS TEACH</td>
<td></td>
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<tr>
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<td>INF CS STAT</td>
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<td>1 2 1 3 1 2 8 19</td>
<td>19 3-10</td>
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<td>INF CS STAT</td>
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<td></td>
</tr>
<tr>
<td>I1010</td>
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<td>19 3-10</td>
<td>INF PHYS</td>
<td>INF CS STAT</td>
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<td></td>
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<td>INF CS STAT</td>
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<tr>
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<tr>
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<td>19 3-10</td>
<td>INF PHYS</td>
<td>INF CS STAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK1539</td>
<td>1 2 1 3 1 2 8 19</td>
<td>19 3-10</td>
<td>INF PHYS</td>
<td>INF CS STAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>1 2 4 18 8 8 19 0 11 0 5 4 18 97</td>
<td>389</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INF = Informatics; CS = Computer Science; ENG = Engineering; HIST = History; PHYS = Physics; STAT = Statistics; TEACH = Teacher training; TECH = Technology.
Question 1. Does the programme run roughly according to plan or did essential changes have to be made?

Several ICPs report that the number of students actually exchanged is lower than the expected number; in some cases much lower. The findings do not really support any numerical estimate. More or less official sources in the EC bureaucracy report that overall around 60% of the planned exchanges are realized. We see no reason to believe that mathematics deviates significantly from this figure. Some quotes:

- “We requested 19 grants for student mobility, and obtained approximately 15, of which we only used 7”.
- “Lately it became hard to find students to go abroad”.
- “... runs essentially according to plan”.
- “... runs roughly according to plan”.
- “... runs roughly according to plan, but fewer than 27 postgraduate students were exchanged (actually 12)”.

Question 2. As a coordinator do you feel that the results are worth the effort you (and others) put into it?

Almost everyone answers YES, but also indicates that the effort has been a considerable one. Here are some quotes to show the diversity of opinions:

- “Although it takes a lot of administration and there are only a few of our students interested, I still feel that it is worth the effort”.
- “... the Mathematics Departments of different EC countries have come to know each other better with respect to teaching ... at this moment the harmonization and homogenization of degrees in mathematics is a goal we could set ourselves, at least within certain university networks”.
- “I still think it is worth the effort but, taking into account all the work that has to be done, an accurate cost/benefit analysis would perhaps show otherwise”.
- “The effort that coordinators put into the programme should not be underestimated. ... It is worth reiterating that departmental support is vital ...”
- “In general the results are worthwhile. The students on the exchange certainly significantly improve their foreign language”.

Question 3. If financial support from the EC disappears, do you think the programme would be continued (by using funds from the universities involved or by students paying their own way)?

The answer here is almost unanimously NO, even though several organizers point out that the stipends are actually quite meagre, and that extra support is needed.

Again, here are some quotes

- “Financial support from the EC (even considering that our students receive
around 300 ECUs per month) has in many cases a kind of ‘symbolic’ attraction to the students (and their parents). As in ‘bargain’ sales, you think it is a big deal and therefore you are willing to spend more”.

- “It takes a lot of overhead costs to organize and coordinate the programme, which cannot be offered by our university”.
- Even now the parents of our students complain that staying abroad is still expensive even with ERASMUS support”.
- “The amount of the ERASMUS grants is obviously ridiculous”.
- “The European label is even more important than financial support, but the two are connected”.
- “If financial support from the EC stops, . . . [there] will be fewer students to apply . . ., they will be older and much more specialized, which for some professors might be a positive development”.

Questions 4a and 4b. How many mathematics students from your university go abroad as part of the programme? And how many go abroad to study as part of different programmes or unrelated to any official programme?

The purpose of these questions was to estimate the relative importance of ERASMUS for the student mobility of the Mathematics Department in question. Quite a few coordinators report difficulties in obtaining good estimates, so the answers are hard to summarize in a precise numerical form, but there is a clear indication that

- ERASMUS related mobility is much larger than all other forms put together.

Of course, it might be that universities that are not part of any ERASMUS scheme find other ways to create mobility. An attempt to answer that question was made in a questionnaire sent to (most of) the national mathematics societies in Europe (see below).

4.1.3 Conclusions

- Involving 232 mathematics professors and 132 university administrators (counted with a certain multiplicity, but still!) in moving roughly 500 students seems a very inefficient way of administering a total sum of at most 1 million ECU.
- Nevertheless, the psychological impact of ERASMUS can hardly be questioned.
- In particular, a lot of important personal contacts have undoubtedly been created.
- Any attempt to describe/compare European mathematics degrees should take advantage of the expertise found in the ERASMUS networks.
4.2 ERASMUS: a case study

The ERASMUS ICP which now involves the universities of Copenhagen, Leeds, Paris 7, Paris-Sud, Rome “La Sapienza”, Saarland and Utrecht, had its origin before the ERASMUS project started. From 1983 to 1987, Myriam Dechamps of Paris-Sud organized a programme under a previous EEC initiative. After some preliminary visits, this took the form of short exchanges of small groups of students and slightly longer staff teaching visits. Only the universities of Paris-Sud, Leeds and Rome took part at this stage.

These first exchanges were centered on the theme of computers in mathematics teaching. The students worked on projects using computers. The staff members helped with initial programming classes. The activities culminated in a conference on Educational Computing in Mathematics held in Rome in 1987.

When ERASMUS started, Leeds agreed to coordinate a continuation of the programme. The number of universities in the scheme increased, arriving by stages at the present position. The whole of mathematics (including applied mathematics, statistics, and computer science) was to be the field for both student and staff exchanges.

From 1988 to 1991, the programme included staff teaching visits of four to six weeks. These visits were a necessary condition for developing experience of and confidence in each others’ teaching methods before embarking on student exchanges.

The first students, three of them, arrived at the host universities in February 1990. In 1990–91, 28 students travelled abroad and in 1991–2, the figure was 49. Most of the students were away for a full academic year, the rest for half. They had all spent at least two years at their home university.

ERASMUS has led to several innovations at the universities concerned. Leeds has introduced a Mathematics (European) BSc degree which involves language training in year 2, the year abroad is year 3 and students return for their final year to Leeds. Several of the other universities have appointed official tutors for the ERASMUS students; several have given priority to ERASMUS students for accommodation. In general, the host university has responsibility for seeing that students have somewhere to live. Several of the universities have started clubs to help with social integration. Even with such help, finding friends in a foreign country takes time. A year at the host university (the maximum allowed) is just long enough.

The provision of language training has received a great stimulus from ERASMUS in general. Most of the support money in this programme goes towards the

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provision of language courses. So far, students in the programme have always attended lectures and taken examinations in the language of the host country. This is very hard for them at first. The structure of the Leeds degree allows students to learn a new language from scratch, if necessary (as is usually the case for Danish, Italian or Dutch.) Students from other universities generally have less than a year to learn or revise their language skills, which makes it more difficult, but not impossible, to recruit students to go to Copenhagen and Utrecht.

One of the conditions of ERASMUS is that the period abroad must count towards the student’s final degree. As may be imagined, it is a non-trivial task to adapt the examination results in one country to another university’s system. That it can be done at all is thanks to the annual meeting of staff, where each student’s performance is discussed, and to an official table of equivalences drawn up by the home university. Most students do as expected, but there are a few disasters and some outstanding successes.

One of the things the staff involved has learned is that there are considerable disparities between different countries’ grading schemes, which are not arbitrary, but reflect disparities between the various educational systems. For example, in some countries, students are not allowed to retake examinations; in others they are; in yet others, they need not take examinations until they feel they are ready to take them. Nearly all students have difficulty in adjusting to the different types of examination systems.

The students’ evaluation of their time abroad is almost always favourable, even in cases of relative academic failure. Typical comments are: “extremely worthwhile, both from an academic point of view and socially”; “Lectures in Italian were a nightmare at first. . . (but) I have certainly, during my exams, only encountered problems of a mathematical nature” (this refers to oral as well as written exams.) “I find there is more actual teaching here than I am used to. . . but. . . the pressure on the students. . . (is) very high.”

Turning to finance, the largest sum in this programme goes to the students as travel and subsistence grants. A grant is of the order of 1000 ecu per student, but varies widely, depending on which country the student comes from. Student grants are not administered by the programme coordinator, who, in this case, has a much smaller sum to support the organization of the programme. More than two thirds of the latter sum will be spent on language support. Most of the rest will go for the annual meeting of organizers and a very small sum will be spent on minor expenses such as photocopying and telephone bills. The European Community gets good value for its money, because universities bear much of the administrative cost of the scheme and usually subsidise the language training.

In conclusion, the ERASMUS scheme enables a significant number of students to live abroad, to learn mathematics in a different tongue and in a new cultural
setting. Those students who do not go abroad meet those coming from elsewhere. In administering the scheme, staff learn to appreciate different teaching and examining methods. The cross-fertilisation has already been productive. Most of the staff who work with the programme would agree with the students that ERASMUS is extremely worthwhile.

4.3 TEMPUS

A pamphlet, called TEMPUS — List of accepted projects academic year 1991–92, lists roughly 350 projects. The descriptions given are very brief, as can be seen in Figure 8 which reproduces the information given for those 7 projects that appear to have an essential mathematical content. A questionnaire sent to the main coordinators of these 7 is reproduced in the appendix. Only 3 answers were received, and no conclusions can be drawn. In comparison with ERASMUS projects, it seems clear, though, that the typical TEMPUS project involves a much larger grant, in part because TEMPUS also covers expenses for equipment, e.g. computers.

D. Cioranescu, Paris:

There are 7 TEMPUS programmes in Mathematics. I am coordinator of one of them: the programme JEP 2797 “Development of Applied Mathematics in Romania”. TEMPUS programmes have to involve at least two western countries and one eastern country. The programme I am talking about actually involves 32 universities or institutions from Romania and 8 countries from the European Community. Five Romanian universities participate in the project. The western countries are France, Germany, the United Kingdom, Spain, Portugal, Ireland, Italy and Belgium. Three institutions also participate: the Société Mathématique de France, the Société des Mathématiques Appliquées et Industrielles (France) and the International Centre of Pure and Applied Mathematics which depends on UNESCO. As we can see, JEP 2797 is quite large as regards the number of participants. It is also large from the financial point of view: we had a grant for the first year of the order of 320 000 ECU. The activities in the programme are the following:

- 12 fellowships of one year
- 12 fellowships of 6 months
- specialized courses in the field of Applied Mathematics in each Romanian university given by western mathematicians
- organization of 3 summer schools in Romania in Applied Mathematics
- publication of a mathematical review.

Another part of our activity concerned the furnishing of computers, photocopying equipment and books to the Romanian universities.

Our scientific committee (formed by 14 mathematicians representing the 9 countries) selected the students who were to spend a fifth year in a western country
JEP-1980-91  
**Unification and Development of Experimental Environment of the University Mathematical Education in Europe**  
Contact: Mr. S. Negrepontis, National University of Athens, Mathematics  
Panepistemiopolis, GR-15784 ATHINA  
Tel.: 30/1/7243241; FAX: 30/1/7243502  
Eligible countries  
E. C. Countries  
G-24 countries  
BC CS H E F GR I A  

JEP-2092-91  
**Applications of discrete mathematics**  
Contact: Mr. J. Siemons, University of East Anglia, School of Mathematics  
University Plain, UK-NORWICH  
Tel.: 44/603/56161; FAX: 44/603/58553; Telex: 975197  
Eligible countries  
E. C. Countries  
G-24 countries  
BG H D I UK  

JEP-2306-91  
**Development of new curriculum strategies and materials for the training of mathematics teachers**  
Contact: Mr. R. Gwyn, Manchester Polytechnic, Office of European Development  
All Saints, UK-MANCHESTER M 15 6BH  
Tel.: 44/61/2471033; FAX: 44/61/2367383; Telex: 667915 POLLIB G  
Eligible Countries  
E. C. Countries  
G-24 countries  
H D UK  

JEP-2692-91  
**Algebraic and categorical methods in computer science**  
Contact: Mr. J. Veiga, Universidade de Coimbra,  
Paço das Escolas, P-3000 COIMBRA  
Tel.: 351/351/3935448; FAX: 251/351/39325841  
Eligible Countries  
E. C. Countries  
G-24 countries  
Cs H B D I P UK USA  

JEP-2775-91  
**Statistics and Operations research for Applications**  
Contact: Mr. Prof. K. Ritter, Technische Universität München,  
Institut für Angewandte Mathematik und Statistik  
Arcisstrasse 21, D-8000 MÜNCHEN 2  
FAX: 49/89/2105828  
Eligible Countries  
E. C. Countries  
G-24 countries  
R D F GR  

JEP-2797-91  
**Développement des Mathématiques Appliquées en Roumanie**  
Contact: Ms D. Cioranescu, Université Pierre et Marie Curie (Paris VII)  
Dépt. d’Analyse Numérique  
Tour 55-65, ét.5, 4 Place Jussieu, F-75252 PARIS CEDEX 05  
Tel.: 33/1/44274298, FAX: 33/1/44274001  
Eligible Countries  
E. C. Countries  
G-24 countries  
R D E F I IRL P UK  

JEP-2814-91  
**Développement de l’enseignement dans la Faculté des Sciences à l’Université de Craiova**  
Contact: Mr. Y. Bouveret, Université Jean Monnet,  
34, rue Francis Baulier, F-42023 SAINT-ÉTIENNE CEDEX 2  
Tel.: 33/77421700, FAX: 33/77421799  
Eligible Countries  
E. C. Countries  
G-24 countries  
R B F  

Figure 8
Exchange of Students

and at this point we encountered some difficulties concerning the harmonization of European degrees. The students in France all took the DEA (diplôme d'études approfondies). It was the same in Italy, not exactly the same in Germany, but totally different in the United Kingdom. This remains a problem for the future. We also had bureaucratic problems, for instance the level of fees which varied with the different countries. The majority of French universities did not require any fees while the British ones asked for quite substantial sums. This is another problem which needs harmonization.

The students with 6 months fellowships are all now preparing a Ph.D thesis. In the second year of the project we will select 12 new students for a one year fellowship and the 24 students selected this first year will all have 6 months fellowships to begin or continue a Ph.D thesis. All the theses have two directors: one from a Romanian university and another from a western university, the Ph.D degree being the one supposedly recognized by both universities.

As planned, in each Romanian university we provided a course delivered by western professors as part of the curriculum.

Finally let me speak about the three summer schools organized in Romania, with the help of CIMI-UNESCO. One was on statistics (with France as coordinator), one on fluid mechanics (coordinators: the United Kingdom and Ireland), and the third on numerical analysis (coordinator: France). The support of CIMI-UNESCO allowed students from Poland, Lithuania and Russia to attend these schools.

Our aim is that these schools should continue regularly each summer with a large participation from the other eastern countries.

We hope by the end of this project to have a good basis for a Romanian school of Applied Mathematics.

4.4 Other programmes

NORDPLUS is a special ERASMUS-like programme involving the Scandinavian countries. Mathematics is almost totally absent in this programme according to the 1991 report.

The EC programme SCIENCE has involved a lot of student exchange, apparently mainly at the advanced Ph.D student and the postdoctoral level. The same will be true for the new programme HUMAN CAPITAL AND MOBILITY. These programmes are among the topics covered by the Round Table on European Science Policy for Mathematics, so they have been excluded from the present Round Table.

The main purpose of the COMETT programme is to sponsor the placement of students in an industrial "apprenticeship". It was, therefore, felt to fit better into the Round Table Mathematics and Industry even if it does involve some activities of a mathematical nature. One activity supported jointly by COMETT and ERAS-
MUS is ECMI (the European Consortium for Mathematics in Industry) which has created a 2 year postgraduate programme. Attempts to get a representative of ECMI to present this programme unfortunately failed (in part because of electronic communication errors). At the time of writing, ECMI can be contacted at the following address: ECMI secretariat, Prof. R. Mattheij, Den Dolch 2, Postbus 513, 5600 MB Eindhoven, The Netherlands.

4.5 Exchange outside programmes

4.5.1 A questionnaire

A questionnaire [reproduced in the appendix] was sent to mathematical societies in the following countries. Those listed in boldface answered.

<table>
<thead>
<tr>
<th>Austria</th>
<th>Belgium</th>
<th>Bulgaria</th>
<th>Czech Republic</th>
<th>Denmark</th>
<th>England</th>
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<tbody>
<tr>
<td>Ireland</td>
<td>Estonia</td>
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<td>Germany</td>
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<tr>
<td>Greece</td>
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<td>Hungary</td>
<td>Iceland</td>
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<td>Spain</td>
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<td>Luxembourg</td>
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<td>Roumania</td>
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<td>Sweden</td>
<td>Switzerland</td>
<td>Yugoslavia</td>
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</table>

The main purpose was to find out how many mathematics students go abroad for a significant part of their studies unrelated to programmes like ERASMUS, TEMPUS and NORDPLUS.

In the end, the response rate was quite reasonable. However, many answers came in rather late and were incomplete. The results leave us with two clear conclusions:

• The questionnaire was not really well thought out; but also
• Most mathematical societies in Europe are ill-prepared for answering such questions.

Nevertheless, some features of the answers are worth recording:

General comments

• “To be frank, it is difficult to answer the questions you raise even within a [local university] level and I should not know where to turn for national figures. . . . It may well be that this [national, mathematics education-related] committee will wish to carry out a national survey to discover more about current practice”.
• “. . . moves towards more modular course structures. If this happens, exchange of students with European universities might become easier and increase”.

Questions 1 and 1’. Additional, international exchange programmes? Eastern European networks?

• Estonia: “. . . there existed such programmes between ministries of higher education of USSR and Eastern European countries [and] academies of
Exchange of Students

sciences. We could use this network quite efficiently for Post. Doct. studies and sometimes also for graduate studies. *Now nothing replaces this system.*

- Switzerland mentions ETAP (European Thesis Abroad Programme).
- Portugal mentions ESEP (European Science Exchange Programme).

Question 2. How many mathematics students studied abroad (at different levels)?

No solid figures appear, but it is the impression that the numbers are (generally) quite small, and that ERASMUS has indeed increased the amount of exchange drastically at all levels below Ph.D. Here are some quotes:

- “[exchange of students may sometimes] mean that a Ph.D student went away because he found no hope of a career in XXXX and never came back. This is not mobility in a good sense”.
- “… ERASMUS has a strong psychological effect. Even if the fellowships are insufficient, they induce students to move”.
- “I think that things are going to be better with new programmes like ERASMUS”.

Question 3. Desire to study abroad (at various levels).

- “Because of the present chaos in our economics, everybody wants to stay abroad (in the West) at any possible level. I believe that about a hundred of our students (all well qualified) would go immediately abroad if they could. The same is true for members of the faculty. … the needs of our university … 5 students at the M.Sc level, 2 at the Ph.D level and 5 at the Post Doct. level each year”.
- “… increasing interest among students concerning exchanges with North America rather than Europe”.
- “… recently the overwhelming majority of these [Ph.D students] prefer (in order of preference) U.S., British, French and German Universities”.

Question 4. Willingness to teach in a foreign language (at different levels).

At the M.Sc. and the Ph.D level, almost everybody indicates ability and willingness to teach in English. Very few indicate other possible foreign languages. One should note, though, that the other major European languages are not strongly represented in the sample.

At the undergraduate level, the situation is equally clear: Almost nobody sees any need or desire to teach in a foreign language.

An interesting comment from Austria: “… the new Austrian law for studies at technical universities forces every mathematics-student to follow at least 8 semester-hours of mathematical lectures held in English”.

Conclusions

- Even though mathematics has been a very international endeavour for a long
time, there appears to have been rather little “spontaneous” exchange of students below the graduate level.

- ERASMUS is seen to have a large impact, even if the administrative work relative to the number of students moved appears large.
- Eastern Europe is likely to be left behind unless we improve the possibilities for their participation in ERASMUS and other programmes, e.g. by creating the possibility of combining ERASMUS and TEMPUS.

4.6 Discussion of student exchange at the Round Table

A. Van der Sluis, Utrecht:

The number of exchange students is disappointingly low. Have any investigations been carried out as to what kind of students applied for this programme? Actually, I could well imagine that the weaker students would be rather doubtful about going and spending some time in other universities, where they study subjects that do not fit in very nicely with what they have already learned. Also in some countries the time which a student may spend at his university is limited. In my country, for instance, you may not study longer than six years or else there is a big stick standing behind the door. And you could well imagine that the weaker student who already has problems in meeting deadlines will not apply for this project. So I was just wondering what kind of students apply for this programme?

H.J. Munkholm, Odense:

I think Salinger has more to say about what kind of students participate in the exchange, but I would like to add that mathematics builds so much on the preceding years at any given stage. You always build on what you were told last year and the previous year, and that is different in the humanities and probably even in physics, although it should not be, so maybe that is one reason why we are scoring low figures, as I think we are.

D. Salinger, Leeds:

We started by excluding weaker students, for obvious reasons, but a number of them have, in fact, profited from the scheme. Such students are quite willing to apply.

H. Martens, Trondheim:

I wanted to comment on the ECMI programme since you brought it up, and to put a slightly different, and not quite as pessimistic, perspective on the situation as Munkholm has done. The ECMI programme is run by a consortium, a group of institutions which co-operate in a programme of training mathematicians for industry. Part of that programme involves the exchange of students between the institutions. In fact, the idea is that ECMI will certify the training and that the cooperating institutions will carry out a programme that roughly conforms to ECMI’s specification. Now, in this case it is a question of perhaps seven or eight institutions. The COMETT and ERASMUS programmes are handled by a
common administration. I do not have the data on the number of students that are moved yearly—I am not an official representative of ECMI—but I think the order of ten students are moved every year between the institutions under the COMETT programme, which gives a slightly different perspective of the efficiency.

**H.J. Munkholm, Odense:**

<table>
<thead>
<tr>
<th>INPUT</th>
<th>OUTPUT</th>
<th>CONCLUSIONS</th>
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<tbody>
<tr>
<td>1 million ECU</td>
<td>500-600</td>
<td>Efficient?</td>
</tr>
<tr>
<td>225 universities</td>
<td></td>
<td>Bureaucratic!</td>
</tr>
<tr>
<td>225 administrators</td>
<td></td>
<td>BUT ALSO</td>
</tr>
<tr>
<td>225 mathematicians</td>
<td></td>
<td>IMPORTANT</td>
</tr>
</tbody>
</table>

This table is meant to be provocative. I do know that there is multiplicity in the 225, but still I think we should think about it.

**A. Figà-Talamanca, Rome:**

I planned to talk only at the end in the general discussion, but I cannot resist making a comment on the problem of efficiency. I would like to point out that, even though mathematicians are not allowed to decide where to spend the money, with 1 million ECU one could support about a hundred Ph.D students. A hundred Ph.D students are probably one third or one fourth of the Ph.D students in mathematics, which is reasonable for a country of about 50 million, so it is not much money, but we know how many countries have difficulties in financing graduate studies, so that is not a trivial amount of money. Perhaps too much to spend just for moral reasons and because it is important to talk about community and to let students travel. I also feel, because of the structure of the fellowships, because they are very small, and for many other reasons, that this programme is very discriminating in the sense that it is a very nice complement to the education of students coming from an upper middle class background.

**R. Mlitz, Vienna:**

I just wanted to remark that the ERASMUS is a programme, mainly based on the European Community, so for other states — for Austria — it is much more difficult. There are some agreements, but then when Austrian universities need to be involved with at least 2 or 3 European Community universities, participating involves quite a lot of bureaucracy.

**J.F. Rodrigues, Lisbon:**

I believe that my university was maybe one of those 225 universities, and

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8 Based on the unadjusted totals, see footnotes 5 and 6.
9 The figure should be 132, see previous footnotes.
I support professor Figà-Talamanca in demanding the question mark in the efficiency. And I would like to ask about the percentage of the one million ECU used for fellowships, for bureaucracy and for professors. Are there any numbers about this?

**H.J. Munkholm, Odense:**

There are figures in the ERASMUS Newsletter of the total level. As far as I remember, of the total budget of 65 million ECU for ERASMUS in 1991/92, something between 37 and 40 million ECU, about 60 to 65% went directly in student grants. So it may not be top heavy in that respect.\(^{10}\)

**D. Salinger, Leeds:**

Of the money that is allotted to universities for the support of the programmes, not more than 10% is allowed to be spent on photocopying, telephone calls, or minor administration. In practice one spends less. Certainly, in my scheme, the majority of the money goes on supporting language training.

### 5. General Discussion

The discussion was intended to concentrate on the following questions:

1. Updated version of student’s record book.
2. Formulation of a European Standard.
3. European Degree in Mathematics.
4. EMS-committee linking EEC programmes to the mathematics community. Lobbying. Guiding.
5. Is student exchange worth the trouble and bureaucracy?
6. Should the exchange of students be restricted to the research level (Ph.D students)?
7. Should the EEC create a Ph.D supporting programme?

**A. Figà-Talamanca, Rome:**

There is a bit of information I want to give. Italy has a two year diploma, a first cycle. This is not completely true: we are going to have it soon, but it will take some time for the universities to adopt the new regulations.

I just found out that the Italian Mathematical Union did not answer the Questionnaire simply because it was not sent to the right address.

I want next to talk about the problems with the programmes and the booklet. I think it is a very difficult problem, and one of the difficulties which has not been mentioned is that when mathematicians sit down at their desk and think about what should be taught at a certain level, they jump into a fantastic world, because they do not have the students in front of them.

\(^{10}\) Added after the Round Table: In 1990/91 the total budget was 61.2 MECU; direct student grants amounted to 32 MECU, i.e. 52%. The incorrect figures given at the Round Table were based on a mix up between 1990/91- and 1991/92 figures in ERASMUS Newsletter, No. 11, 1991.
It very often occurs that programmes which are stated, printed and circulated do not correspond to what students actually learn. This is quite common in many countries. In French high schools, this is true to an incredible degree, and perhaps at the university level as well, and it is certainly true in Italy. So we should be aware that it is very difficult to write a booklet containing minimal requirements for a degree in mathematics which corresponds to what actually happens.

On many occasions, the people who make these recommendations are mostly concerned with teaching at a relatively high level or in the best universities in their own country. Therefore they do not actually meet students with weak backgrounds from minor universities or in the first years of study.

So a harmonization which will be only formal is probably going to damage the system and will not be an improvement. Another difficulty about harmonization is that sometimes programmes are complementary to each other in various countries. There is a certain amount of mathematics which is really necessary in order to go on, both in science and in mathematics, say, calculus or linear algebra. In many cases, what is required to go on in mathematics, is mathematical maturity, which can be achieved by studying different topics.

It may very well be that someone achieves maturity by studying probability and another student will acquire it by studying algebraic geometry. And they will both be mature enough to open a book and understand things at a higher level.

Consequently we should concentrate on the very elementary and basic things in mathematics at the university level. So your recommendation to look at what happens in the first three years of study should be limited to the first two years. This corresponds to the first cycle in French universities.

If we are trying to make a correspondence between different universities, it is very difficult to do this course by course. People may have studied different things and yet be at the same level and have the same degree of maturity. My recommendation is that we attempt to have a uniform degree after the first two years which signifies a certain maturity, and a certain level of abstraction. After all this is perhaps not so important due to the small number of student exchanges.

But there is another more important question which perhaps should be taken up by the EMS. It is the question already mentioned about a European Community law concerning professional activities and access to the various professions.

First of all, in mathematics, this concerns only the profession of teaching or perhaps actuarial mathematics, or in some cases also business mathematics, because mathematics is not a profession but a science, a discipline. But it is very important that we do understand that—for the EEC countries now and most probably and hopefully for the other countries which join the European Community or become affiliated—if somebody has a three year degree which gives access to teaching mathematics at the secondary school level, this same person can teach mathematics, even as a state employee, in any other European country. The practi-
cal problem now is to make certain that programmes for secondary school teachers give them a sufficiently sound basis.

There may not be much migration of mathematics teachers from country to country, but this could be an opportunity, given by European Community law, to intervene in support of mathematicians who are trying to improve teacher education in mathematics. The EMS could arrange meetings in which these problems are discussed, and it could influence policy.

A. Bak, Bielefeld:

Who outside the mathematics community will be interested in harmonization of degrees? and what is their interest?

I. Netuka, Prague:

It is hard to react immediately, but I think we should discuss the notion of harmonization more extensively. To me the basic goal is to make student exchange easier, and this could be a consequence of a harmonization of programmes and degrees. There is hardly anybody outside the mathematics community interested in these questions.

J. Musielak, Poznan:

One should not have the exchange in only one direction from East to West. It is also a possibility in the other direction, and this point of view should be worked out.

D. Salinger, Leeds:

I am happy to report that we have sent an undergraduate student to Poland this year.

A. O'Farrell, Dublin:

I think that the concept of a European standard for a degree in mathematics is a terrible idea. Basically it has the prospect of creating a straitjacket. The simple adoption of such a standard by a body like the EMS, would put terrific pressure on people to conform to such a standard. I can see that down the road we will end up like the Americans: having to teach the same calculus course. We have at the moment a terrific diversity of programmes which we should treasure. It is fine to communicate with each other about what the students have done if they go from one place to another, but a European Standard Degree is awful.

C. Berg, Copenhagen:

I think that many are against such a European degree, but will anybody speak in favour of it?

R. Rentschler, Paris:

I think it would be a good idea to have at least some hints for a European standard, not as a straitjacket but to know an average level, so my opinion is slightly different from O'Farrell's.
M. Karoubi, Paris:

I am unhappy that some of my students are not here, because when I hear of the figure for rate of success in exams in England, only 5% fail\textsuperscript{11}. This would create a revolution here. My students would say that I am a poor teacher with 40% failing. Harmonization for my students would be: try to be a better teacher and try to have a system like in England. Let me put this as a question to Salinger: How do you obtain these 5%?

D. Salinger, Leeds:

This is not a simple matter. My personal reply is certainly not backed up by hard evidence, but my feeling is that many of the students getting third class results in Britain would not get their degree in a foreign country in the minimum number of years. However, there is almost no possibility of taking extra years in the UK. So we do not have students going on for 5 or 6 years to get their degree. This simply cannot be done. A very few take one year extra, but with no financial support. They are not allowed to take the final examination more than once. So there is a tremendous pressure to let the students pass, even if we feel that they have not understood very much of the programme. You are not under that pressure in France, and I sometimes envy you that position.

C. Berg, Copenhagen:

I should like to draw your attention to point 4 of our discussion: A committee which could influence the science policy of the EEC. Have you any comments on this?

F. Hirzebruch, Bonn:

The EMS already has such a committee. The chairman is Figà-Talamanca and I am very pleased to convey this recommendation to our executive committee, and I think we should develop our existing committee to look at all the different programmes which exist. In our newsletter we have already discussed the programmes on Human Capital and Mobility and cooperation with the eastern European countries. Professor Luc Lemaire of Brussels is also a member of our committee, and he is, as it were, our man in Brussels. So we are happy to take this recommendation as a good guideline.

J. Stegeman, Utrecht:

Concerning question 6, I think that everybody agrees that the answer is no: we should not restrict student exchanges to the Ph.D level. The experience of ERASMUS is very positive. And I also want to mention another positive effect. The students staying at home meet foreign students visiting. Concerning question 5 above, I would like to point also to what we, the staff, learn from all this: we see how varied the teaching programmes can be, and they all lead, hopefully, to good mathematicians, so there is no need to make one uniform programme. On

\textsuperscript{11} This relates to a somewhat speculative table, not reproduced here, comparing third year examination results in England and France.
the contrary, it is very good that it is the way it is. It is one of the fruits, already, of the ERASMUS programme that we have become, I think, on a much larger scale, aware of the variety, and this can have a very good influence.

**H. Ibisch, Nantes:**

I am afraid that there is a lot of misunderstanding about the ERASMUS programme.

First some facts. The ERASMUS programme was created by the European Community to develop the exchange of students between European universities. The objective was that about 30% of European students should visit a foreign university during the course of their studies. This programme started 5 or 6 years ago and, what is much less well known is that it will stop 4 or 5 years from now.\(^\text{12}\)

It is not an eternal programme. It is an opportunity given to the universities to develop student exchanges.

With respect to the initial object you can say it has failed, because only about 10% of the students participate in the exchange programmes. I think one of the reasons why it has failed is that university professors have not become sufficiently involved.

I am a coordinator of one of the programmes. Why did I take up this responsibility, which is a lot of work? I did it because our students asked me to. They wanted to go abroad. Right now 15 of our 120 mathematics and informatics students go abroad during their third year. Another reason why I accepted this responsibility is that the money accompanying these exchange programmes allows us to reinforce scientific relations with our European partners.

As I said before, to my knowledge there will be no phase 4 of the ERASMUS programme, so if you have not yet developed an ERASMUS exchange programme, you'll have to get a move on. Our university is looking for alternative financial resources to maintain the exchange programmes after phase 3. We have started to get additional support from regional funds.

One last remark. We were asked which students go abroad. In our university it is usually the best students.

**D. Cioranescu, Paris:**

I would like to say a few things about your question 6: Should the exchange of students be restricted to the research level? Surely not: from my own experience with the TEMPUS programme. It turns out that it is much more worthwhile for students to do their last year of study in a western country and start the Ph.D thesis afterwards. Ph.D studies are harder for people and, in applied mathematics, we even had the difficulty of knowing what is meant by applied mathematics in Romania compared to France, for example. In Romania we had only people in informatics who wanted to study applied mathematics in France.

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\(^\text{12}\) (added in proof) Prof. Ibisch was too pessimistic. ERASMUS will continue, as part of the new SOCRATES programme.
In conclusion it is very important not to restrict the exchange of students to the research level.

C. Berg, Copenhagen:

I shall comment on question 7. It seems to me that we send many of our best students to the United States for Ph.D studies. Of course there are often very good scientific reasons for this, but another point is that, in the United States, students can be financed to a certain extent by being teaching assistants. A similar system in Europe would be difficult to achieve because of language problems, for example, in small countries like Denmark. This makes it difficult to attract foreign Ph.D students, and they are certainly an important factor in a vital research group.

The EEC has recently launched the Human Capital and Mobility programme which is at the postdoctoral level. I think we need a European programme to support Ph.D studies in Europe.

L. Lemaire, Brussels:

I think it is possible to argue that in some cases the Human Capital programme can be used to finance Ph.D students, for example, in branches with a certain shortage of people.

6. Recommendations

Taking account of the views expressed at the ECM Round Table, the organizers make the following recommendations.

1. The European Mathematical Society should take steps to create an updated version of the European Student’s Record and ensure that it is distributed widely to all European university mathematics departments.

2. On the one hand, a considerable majority of the Round Table participants was opposed to the idea of harmonization of degrees or of the imposition of a European degree in mathematics, or of any kind of European standardization.

3. However, where the European Community has taken steps, through directives, or by other means, to create certification procedures for university courses involving mathematics, the European Mathematical Society should ensure that mathematicians’ voices are heard. This is potentially particularly important with regard to the certification of mathematics teachers.

4. The European Mathematical Society should monitor the participation of European mathematicians in European Community related programmes such as ERASMUS and TEMPUS for the purpose of increasing the visibility of such programmes for European mathematicians. Prominent in the domain of interest should also be the new European Community programme HUMAN CAPITAL AND MOBILITY.

5. The EMS should take active steps to ensure that Eastern European mathematics students can participate in all existing exchange programmes on an equal footing with citizens of the European Community.
7. Appendix

This appendix contains copies of the questionnaires mentioned in the main text.

7.1 Questionnaire concerning harmonization

Dear Professor . . .,

Thank you very much for your willingness to collaborate with us on behalf of your society. As you have been informed, several Tables Rondes will be organized during the European Congress of Mathematics, Paris 1992. We were appointed, together with Prof. Munkholm (Odense, Denmark), to be the coordinators of Table Ronde: Exchange programmes. Harmonization of European degrees in mathematics.

The main motivation for this is to contribute to an increase of mobility of mathematics students among individual European countries. We wish to emphasize that there is no attempt to organize any unification of programmes of studies on European level. We would like to collect relevant information, to make a comparison and to find common features. In our opinion, it would be desirable to clarify conditions under which some well-defined parts of the study in one European country would be acknowledged in the other one. We are fully aware that even within one country the plans of studies vary university from university. Therefore, it seems to be necessary to consider an “idealized” situation, it means to think in terms of a “typical” student of mathematics.

We would appreciate very much if you could elaborate on a report concerning the system of the study of mathematics at universities in your country. We feel that at this moment we should concentrate on the study of mathematics in the narrow sense, it means to leave aside the study of informatics as well as the training of future mathematics teachers. By the way, there is another Table Ronde “The role of mathematics in educational policies in Europe” (organized by Prof. M.-F. Roy). We hope that the overlapping should not be too large.

The report (which should not exceed 10 pages) should contain the following main points:

1. The general characteristics of the orientation of the study.
2. The vertical division of the study, i.e. degrees or titles awarded, including the internal division (e.g. by means of a special examination, final examination or so).
3. A description of the system of partial examinations and/or other means of the control of the knowledge obtained in lectures and/or exercises.
4. Specify, please, which requirement, in your opinion, could be ful-
filled by partial study abroad and under what conditions. Do you think that there is a prevailing opinion within your universities that such partial study at another place could be officially acknowledged in future (if it is not the case at present).

5. It is most probable that plans of study at various universities are overlapping very much in the first, say, three years. Could you provide us with a detailed plan of study (syllabus) for basic courses for this period? On the basis of this information, a “standardized” list of items (such as concepts, main theorems or methods...) could be compiled. It should be mentioned here that such an effort had already been undertaken about 30 years ago. As a result, a booklet “European student record” was produced. The booklet did not find a practical application, it seems that it was too premature. Fortunately, the situation in Europe has essentially changed since. So why not try to reconsider the old idea nowadays.

Besides your report, we would be happy to get any further material concerning the subject (a booklet for students, the list of lectures, regulations for the study as well as for examinations, etc.). If e-mail is available at your university please let us know your e-mail address.

We would like to express our conviction that the project could significantly contribute to a comparison and a better understanding of various programmes of study and could make student mobility easier.

Let us thank you very much for your assistance in this matter.

With best regards,
Ivan Netuka and Vladimir Souček

7.2 Questionnaires concerning exchange of students

7.2.1 To ERASMUS coordinators

Dear Professor...,

As you probably know, at the European Congress of Mathematics in Paris, July 6–10, 1992, there will be a number of Round Table presentations including one on “Exchange Programmes and Harmonization of Degrees” which will be co-chaired by myself and Ivan Netuka and Vladimir Souček from Praha. I am in charge of the exchange part of this Round Table, and in that capacity I am currently trying to ascertain how the ERASMUS programme works for mathematics. Since you are listed as the co-ordinator of one of the ICP’s involving mathematics I hope that I can get you to answer a few questions.

First of all, I should tell you that my information about the ICP you are co-ordinating comes from the 1990/91 ERASMUS handbook
(ERASMUS and LINGUA action II Directory). Thus I have a 4–10 line description including an expected number of students involved, the expected duration for each student, and the approximate study level targeted. For your information I enclose a photocopy of the relevant page of the ERASMUS handbook. I am particularly interested in the following questions:

1. Does the programme run roughly according to plan or did essential changes have to be made?
2. As a co-ordinator, do you feel that the results are worth the effort you (and others) put into it?
3. If financial support from the EEC disappears, do you think the programme will be continued (by using funds from the universities involved or by students paying their own way)?
4. Can you give an estimate for the following figures?
   a) How many mathematics students from your university go abroad as part of the programme?
   b) And how many go abroad to study (for a similar period or longer) as a part of different programmes (which?) or unrelated to any official programme?

I should be very grateful to get your answer before February 15. Your answers will of course be treated confidentially, and only statistical information will be given at the Round Table.

Yours sincerely,

Hans J. Munkholm

PS. If in connection with the establishing of the ERASMUS network you had occasion to make a comparison of the mathematics programmes in the various universities I should be very interested in receiving also a copy of such a description.

PSPS. If you prefer, the answers can also be sent by email.

7.2.2 To TEMPUS co-ordinators

Dear Professor . . . ,

As you may know, at the European Congress of Mathematics (July 6-10, 1992 in Paris) there will be a number of Round Table presentations, including one on Exchange programmes and harmonization of degrees where I am in charge of the exchange part. In that context I am trying to collect information on mathematics in relation to the TEMPUS programme.
You are listed as contact person for one of the 1991/92 TEMPUS projects which includes mathematics (at least it looks like that to me). I hope you will be willing to answer the following questions (or you may have available a description of the project from which I could dig out the information myself).

The information you give will, of course, be treated confidentially (unless we agree otherwise later on). I hope that you will be able to send your answer no later than Feb. 15.

**Question 0:** Please give a (short) description of the overall purpose of the project, including which parts of mathematics is involved (and whether non-mathematical subjects are also involved).

**Question 1:** (Optional if you do not want to supply money information). The contract extends over . . . . years, starting 19 . . . .; it involves a total of . . . ECU’s.

**Question 2:** If the project involves exchange of students, please tell

- how many students
- from where to where
- for how long a period
- at which level of study
- do the students work towards a degree in their home country or the host country?

**Question 3:** If the projects involves exchange of teachers, please tell

- how many teachers
- from where to where
- for how long a period
- at which level do they teach?

**Question 4:** Which other activities are involved?

**Question 5:** Has the risk of “brain drain” appeared in your consideration, and if so what have you done to avoid it?

**Question 6:** Are you aware of other TEMPUS projects (or other cooperative projects with Eastern Europe having a similar aim) related to mathematics excluding JEP-1980-91, JEP-2092-91, JEP-2306-91, JEP-2692-91, JEP-2775-91, JEP-2297-91, JEP-3814-91?

Yours sincerely,

Hans J. Munkholm
7.2.3 To European national/regional Mathematical Societies

Some time ago your society was contacted by professors Netuka and Souček who asked you to appoint a person to help them (and me) with some information concerning the Round Table on Exchange Programmes and Harmonization of Degrees at the European Congress next summer. If you already found such a person, please pass this letter on to her/him.

[This letter is being sent to]
1. those persons who promised to collaborate with professors Netuka and Souček concerning harmonization of mathematics degrees in Europe
2. Those national/regional mathematical societies for which no such contact person has been appointed.]

As you know, a series of Round Tables will be organized during the European Congress of Mathematics, Paris, July 6–10, 1992. One of these Round Tables, called “Exchange of Students and Harmonization of Degrees” is chaired by professors Netuka and Souček from Praha, and myself. We have divided the responsibility so that I take care of the exchange part.

I have contacted the EEC offices in Brussels to obtain information about the participation of Mathematics in the exchange programmes ERASMUS and TEMPUS as well as other EEC research and teaching programmes. Similarly I will get information from the nordic countries concerning NORDPLUS.

Since these EEC schemes are relatively recent inventions and mathematics has been an international subject for at least a few hundred years, it is clear that there is a lot of exchange that takes place through other channels.

I hope that you can help me get an impression of the relative importance of such other channels. In particular, I would like answers to the following questions:

1) Are you aware of any additional (relative to those mentioned above), formalized, international exchange programmes involving mathematics?
1') In particular some of you must know whether there exists/existed an Eastern European network of some kind.
2) Is it possible to estimate how many mathematics students from your country studied abroad
   a) for at least half a year during the undergraduate studies
   b) for at least half a year during their graduate studies (i.e. studies for a Master’s Degree or a Ph.D.)
c) for their full graduate degree (M.Sc. or Ph.D.)
d) for at least one year as a Post.Doc.

[The time period covered by the information should also be given, preferably for the period 1988/89–1990/91]

I am aware that it may not be possible to find such information at a national level. If so, can you give me some figures from your own university or from a group of universities that you know of.

3) Would more students be interested in a stay abroad at the various levels? Can you estimate the demand?
   a) at the undergraduate level
   b) at the M./Sc. student level
   c) at the Ph.D. student level
   d) at the Post. Doc. level.

4) Would your university be willing to teach in a foreign language in order to accommodate foreign mathematics students?
   a) at the undergraduate level?
   b) at the M.Sc. level?
   c) at the Ph.D. student level?

   If so, which foreign language?

5) If you have any further information concerning exchange possibilities that you might want to share with me, I should be most interested.

Yours sincerely,

Hans J. Munkholm