SABBATICAL REPORT

TRAVEL IN THE EUROPEAN COUNTRIES

BY

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1976-1977

MT. SAN ANTONIO COLLEGE

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Introduction

When I first contemplated going on sabbatical I hesitated to request leave for the purpose of travel. In the first place, I thought that this aim was too narrow and generally unrelated to improving my skills as a mathematics instructor. Secondly, I felt there was too little time available to arrange a meaningful itinerary in relation to my goals of visiting schools and institutions involved in mathematics instruction and which might incorporate television, mathematics laboratories, or computers in their programs. Finally, I had misgivings about my ability to collect information in countries where English was not widely used or understood. Nevertheless, I submitted my proposal a year ago, stating my goals essentially as mentioned above, and awaited consideration by the sabbatical committee. When approval came, my insecurity increased. But there was no turning back, so I continued my efforts to get in touch with English and European institutions which I thought would be worth visiting. I followed leads given me by the Mathematical Association of America, the U.S. Office of Education, school catalogues, and sometimes the country's tourist literature. Responses were slow in coming; this was one of my first disappointments. It seemed that my best recourse was to appear directly in person, identify myself, and respectfully request information of any official who would be willing to provide it for me. And so it was, except for four places where my queries were answered and arrangements were made by mail in advance.

This rather informal approach had its drawbacks, as can be imagined. Sometimes I sat in reception rooms for an hour or longer while waiting for someone to unburden himself of more pressing duties before paying attention to me. Indeed, on one occasion, I found it difficult to locate a single

professor to talk to, but this was unusual. The incident happened in the Technische Universität Berlin, and they were in the middle of registration--swamped by students. More often I was received quite cordially, even by the Rektor (President or Director) himself once.

My fear of not being able to communicate in English was not unfounded though, except for the British Isles--where it obviously ranks above all other languages--it was a valuable asset because of its popularity as a common second language. In Toruń, Poland, I had to forego a tour of the University campus because they could not find a colleague who could speak English, but this also was unusual. In Warsaw I was received very warmly by the head of the math department of the University, and he was glad for the chance to practice his English on me. In Paris I could communicate in my limited French, and Spain was no problem. Even in Portugal, I spoke Spanish while a professor at the University of Coimbra spoke Portuguese, and we got along grandly!

Because of the limitations imposed by my unannounced appearances, not every visit was a complete success. Thus my report may sound sketchy in some places. Depth is included only when I had occasion to conduct extensive interviews. This was most easily accomplished in England, notably at the Polytechnic of Central London, and in Germany, particularly the Fachhochschule Karlsruhe, where I was fortunate to observe instruction over a period of several weeks. Additional limitations were imposed on my research by unforeseen local holidays and vacation schedules. For example, while visiting Sevilla during Holy Week the University was on recess, but when we returned a couple of weeks later they were celebrating their gay Feria, so the University was closed again. For different reasons, students were on strike in Karlsruhe, Germany; Madrid, Spain; Coimbra, Portugal; and Bologna, Italy. And we seemed

to be following the crest of this wave as we moved from campus to campus. In Athens, Greece, I was unable to follow through on some contacts with mathematics faculty at the Panepistimiopolis because we got caught in a horrible traffic jam and missed our appointment.

In view of the above, I decided to include in this report not only the schools I visited, but other institutions which bear some witness to man's technical and cultural progress through the centuries. Part of my sabbatical proposal was to observe what other countries are doing in mass transit, pollution control, etc. Therefore I did not think it inappropriate to describe my vists to the Royal Greenwich Observatory, the International Bureau of Weights and Measures in Sèvres, the Museo della Scienza e della Tecnica in Milan (it featured Leonardo da Vinci's inventions, as well as radio equipment designed by Marconi and an IBM exhibit on the development of modern computers), plus other timely exhibits on Solar Energy and British Genius.

The remaining goal of my sabbatical year of travel in Europe was cultural enrichment. I feel this part was amply fulfilled as we traveled over 2500 miles more than the circumference of the earth, and everywhere we went we attempted to see the worthwhile attractions as listed in tourist literature. We went to many art galleries and museums. We dealt with the people in open-air markets and, in general, we shared a little of their culture while we lived or transited through their country. Unlike many tourists who are often plagued by misgivings about traveling in foreign countries, we had none. While on the road, our home was a VW campmobile. We did not have a single flat tire, or any other incident work mentioning. People were generally helpful and courteous everywhere we went. We learned to respect and understand their customs.

This sabbatical leave has helped me render more effective service to the college in the following ways:

1. I have observed the great diversity with which schools attack the problem of mathematics instruction. Many of them do not restrict themselves to textbooks, but attempt instead to use a variety of media to meet the student at his/her level. I have an increased awareness of the role of modern audio-visual learning aids in use in European schools. I have learned how some school districts efficiently utilize computers as instructional aids. I have observed how many schools provide part-time jobs for students to complement their experiences in the classroom.
2. At the same time, I have grown more conscious of the tough time teachers have to make their pleas heard whenever updated equipment or additional staff is needed. Austere budgets and swelling student numbers have put a heavy strain on their instructional programs, particularly those that wish to introduce innovations.
3. Through my efforts to learn even a few phrases to communicate with the people of a country, I have grown more aware of the needs of foreign students on our campus. This translates itself into increased empathy for their needs and aspirations.
4. Through living for a year in countries which have long used the metric system almost exclusively, I have been "converted" to the SI idea and look forward to the orderly transition from English to metric units in this country. I believe I can persuade my students that it is to their advantage to learn the metric system if they wish to communicate with most other technologically developed countries of the

world and, indeed, even those emerging countries which have yet to reach a moderate level of economic sufficiency. Our sophisticated scientific achievements can be shared most easily if we have a basic vehicle of communication such as the metric system.

5. Lastly, I recognize the superior conditions under which I am fortunate to be employed. It is, by comparison with many I have seen, a situation which not only does not inhibit but also fosters creativity on the teacher's part, and the many ideas which are brewing in my head have a good chance to turn into positive activities which will benefit my students.

I hereby wish to thank the Mt. San Antonio College administration and the Board of Trustees for affording me this unique opportunity to broaden my horizons and enrich my experiences.

Brief historical sketch

Traditionally British policy in higher education has been based on three institutions: the university, the teachers' training college, and the further education college. The universities have always been numerically dominated by men and have significantly taken a very small number of working-class women. The training colleges have been the traditional form of higher education for working-class women. After the war the employers wanted better workers and the workers wanted better jobs. The further education colleges were initially developed within the same institutions as technical and trade schools. "They have grown astronomically since 1945 as the rag bag of education beyond secondary school, incorporating not only vocational training of workers but also the overflow from the universities."[1]

In the 1950's many of the colleges of technology had a rude reshaping after a short taste of university-level work. Student numbers had declined, and sometimes their classes collapsed for lack of students. The universities raised their entrance requirements, and the work of the colleges was geared to prepare students--principally overseas students and students transferring from other schools to make up deficiencies. Then the large scale of post-war technological development in the USA and the USSR became apparent to politicians. This gave concern about the state of technical education and resulted in a 1956 White Paper. There had also been growing pressure on university places for which the existing universities were quite unprepared.

1 Unless otherwise credited, quotes in this section are taken from: The New Polytechnics by Eric Robinson, Penguin Books Ltd., 1968.

Polytechnics ("The People's Universities")

They form the most rapidly expanding sector of English education. The majority of the 15-18 age group who are in formal education are not in secondary school at all but in college--in technical colleges and schools of "further education."

"English education system is based on the assumption that a few people will have interesting and worthwhile careers and the remainder will merely have jobs or be unemployed." With this frame of mind, a government committee in 1963 recommended that higher education should be expanded to include a larger number of an elite minority. But the government departed significantly from the committee's proposals when it allowed large-scale development of education outside the universities--in the colleges of education and in the major technological and other further education colleges. This was confirmed in a White Paper in 1966 which proposed to form some large polytechnics based on existing colleges. The future patterns of higher education in this country can be set in the development of these institutions as comprehensive people's universities.

The mid-sixties saw the effect of the post-war bulge in the birth rate. There was a greater demand for post-secondary education. But even before, as wages and employment were high, the working class family envisioned their son or even their daughter aiming at a university degree. The White Paper of 1956 legitimatized for the first time the development of higher education to university level outside the universities. Twenty-four colleges were picked to receive government funds to continue advanced development in this direction. But soon disillusionment followed for the majority, as the government decided to concentrate development of advanced work in only nine colleges. They were called Colleges of Advanced Technology, or simply CATs. These were to be institutions which accepted students from the entire country and concentrated

on university level work. They were quickly to shed their lower level work and, in the image of the contemporary university, to lose their interest in part-time students. The remaining listed colleges were to continue their traditional role as an overflow receptacle for the established system of higher education. "The local education authorities which had committed resources to their development had no alternative but to regard their colleges as frustrated, aspirant CATs."

"One of the problems facing the government of today is the extent to which future growth can be predicted, planned, or controlled. Politicians can derive little encouragement from recent history: the evidence is that, if young people exist who want higher education, the national government must take very drastic action indeed to prevent them getting it."

In the spring of 1966 came the publication of the White Paper which proposed the incorporation of some sixty colleges of technology, building, art and commerce into thirty new polytechnics and the concentration, as far as practicable, of courses of full-time and part-time higher education in these centers.

A Council for National Academic Awards (CNAA) had been established in 1964. This implied a significant shift in the balance in higher education between the autonomous and public sectors. Within a decade this autonomous sector has become only a minor part of higher education in England and Wales, and the CNAA has become the largest degree-awarding body in the country.

The CNAA is the only body in the United Kingdom (other than the universities) which is empowered to award degrees. In addition, the CNAA approves contents of courses leading to degrees. Its panels include people from universities, polytechnics, and from relevant professions and occupations. The CNAA is also required by its charter to ensure that the awards that it confers

are comparable in standards to awards granted and conferred by universities.

Most of the courses offered in the colleges of technology do not lead to the award of degrees but to certificates and diplomas. Their value to the student depends on the recognition of these certificates and diplomas, either directly or via professional institutions, as qualifications for particular types of skilled employment. There is thus a significant difference between the degree of a university and a certificate or a diploma of a college. The university degree is generally recognized as in itself a certificate of general capability and social status; the college certificate or diploma is not generally recognized as such but as a training qualification for a particular type of employment.

Due to the fact that there is a great variety of certificates and diplomas which are awarded in England, I though it proper to summarize the most popular types as I heard them mentioned in the schools I contacted.

ONC (Ordinary National Certificate): A two-year course requiring an initial entry qualification of GCE"O"levels (General Certificate of Education--Ordinary level) or a preliminary technical college equivalent. A very good pass in ONC is equated by some universities with passes in GCE"A"level (Advanced level). HNC (Higher National Certificate) and HND (Higher National Diploma: Success in both of these courses generally leads to acquisition of full professional status. But there is a catch in the restrictive policies of some professions. Some professional institutions' policies toward part-time education and the HNC scheme "are likely to lead to the creation or the attempted creation of a new subprofessional group which will include a significant number of men with a bitter sense of grievance that they have been prevented by arbitrary regulation from reaching their full academic potential."

In an up-to-date newspaper article about education, I read that there

are currently 31 polytechnics and they are maintained by local authorities. Most are envisioned to have plenty of room in the next few years, even though their building programs have been halted. Fewer teachers are being trained today.

In a further article lamenting the sad situation occasioned by drastic cuts in education budgets, a reporter told of wholesale reduction in "link" courses. These are courses which young people had an opportunity to take at their local technical college. They included a variety of subjects such as machine engineering, motor vehicle maintenance, welding, plumbing, etc. The reporter claimed that students are being "sold short", as they are being denied the teaching expertise they might have expected. Tight budgets also prevent a college from replacing a senior lecturer, when he has left, with a teacher of similar qualifications and experience. Under current regulations he can only be replaced with a lecturer grade I. Students learn on out-of-date equipment. One teacher complained, "If you're going to teach techniques that belong to the 1980's, it's essential that you have sophisticated, up-to-date machinery." Instead, in addition to being understaffed, the colleges must make do with obsolete and often inoperative equipment.

Another education writer explained how England goes about filling about 50,000 university places this year. "A" (Advanced) level examination results come out about the middle of August, and the universities had already offered places to something like three or four times the number of students they have room for (conditional on A level results).

There were six percent more applications this year than last. The writer said that this may be accounted for by the raising of the school leaving age four years before, but more likely from the high birth rate of the late 50's. In order to consolidate the onerous problem of handling admissions, the uni-

versities have established a University Central Council. Based in Cheltenham, this Council makes use of computers and operates like an airline booking agency. The writer pointed to the polytechnics as being a practical alternative for young men or women who were unsure of getting a place in a university. But he also advised those who had not yet heard from the university to which they had made application: "A really persuasive letter from a head teacher stressing the student's true brilliance (as reflected in good A level results) might make a difference."

Cambridge (Visited Friday, 20 August 76)

There are about twenty colleges in this university city dating from the 13th century. We saw the campuses of Christ's College, Corpus Christi College, and Queen's College. The whole city was a pleasant blend of magnificent old buildings and spacious open areas called "pieces," "backs," "greens," and "commons." We saw no students, and I was not able to contact teaching personnel. They were on recess. These were the dates of their study terms in 1976: January 13-March 12, April 20-June 11, October 5-December 3.

We also visited the Fitzwilliam Museum, which had a great collection of Egyptian, Persian, and Palestinian antiquities. The museum was exhibiting in a special place a Madonna by Van Dyke. Apparently they wanted to rescue it from a trip to the USA and were soliciting donations. The painting had hung in a museum gallery for sixteen years, but suddenly its owner had decided to sell it and some museum in the USA had offered a premium price for it. The Fitzwilliam Museum needed to raise over L250,000 (about $435,000 at the then current exchange rate) to be able to keep the painting!

Nottingham (Visited Tuesday, 24 August 76)

People's College for Engineering and Science. They offered a wide range of courses in these subjects. The majority of their courses were oriented toward the part-time students and technician aspirants. They administered the City, Guilds, and East Midland Educational Union examinations. Graduates received diplomas or certificates in such subjects as Animal Technology, Dental Surgery Assistant, and Medical Technologist. But they also prepared students for GCE (General Certificate of Education) exams at both the O (Ordinary) and A (Advanced) levels. In addition, students could work toward an ONC (Ordinary National Certificate) in Sciences.

Sir Isaac Newton's Birthplace (Visited Wednesday, 25 August 76)

At Woolsthorpe by Colsterworth (found after considerable wandering about because there are other villages named Woolsthorpe in the area), surrounded by tranquil low hills and pastures. The three-story house had been built by Newton's grandfather out of cotswold stone, a vein of which was exposed not far from the town. The live-in guide who showed us around told us about Isaac's birth three months after his father's death, his precarious first weeks of life (he was a premature child), his upbringing by his grandfather. Though fascinated by mechanical things when he was a young boy, he had an undistinguished first year away at school in nearby Grantham. He spent some time at Trinity College in Cambridge, then the Black Plague closed the university and forced his return to his grandfather's farm house in Woolsthorpe. This was a provident event that enabled him to concentrate his energies and pour out all that was brewing in his brain as so much water from a pitcher. According to our guide, he did twenty years' work in those two years that he was isolated at Woolsthorpe. He wrote his Theory of Gravitation, discovered

the composition of light, invented the Binomial Theorem and Calculus. Newton lived from 1643 to 1727. The following couplet was carved on the edge of the fireplace mantle in the bedroom where Newton was born: NATURE AND NATURE'S LAWS LAY HID IN NIGHT. GOD SAID "LET THERE BE NEWTON" AND ALL WAS LIGHT. - Pope.

The famous apple tree which dropped an apple and inspired the young Newton to write his famous Gravitational Theory blew down in a storn in 1805. There is a surviving descendant from a cutting and it is currently bearing fruit in the front yard. People sold the branches of the original tree for souvenirs, and someone even made a rocking chair with the wood.

Glasgow College of Technology (Visited Wednesday, 15 September 76)

Mr. Jamieson--head of the Department of Mathematics and Physics--and Dr. Usher--in charge of the computer unit, talked to me about their programs. The college was founded only in 1970. It is patterned after the polytechnics of England and Wales. There were 2200 full-time students, 4000 part-time. They pursued courses leading to degrees or HND's.

The campus of Glasgow College of Technology stands amidst one of the largest city redevelopment programs in Europe. In this same area are located the University of Glasgow, the University of Strathclyde, and several other institutions of higher learning.

The college's efforts are channeled to provide a strong academic staff, but the physical plant is not neglected. There is a modern library with 37,000 predominantly recent volumes. There is also a computer unit. Its main tasks have been defined as follows:

--Educating students about computers and their applications

--Teaching aid in a wide range of subjects

--Used in research, developmental and research work

--Administrative uses of the college

I wish to focus on one of the majors offered by GCT, the HND in Applicable Mathematics. This is a course of three years' duration. It originated from a survey made in 1973-74 of courses available in Scotland. This survey indicated that a Higher National Diploma did not exist in Scotland, such that it integrated Mathematics, Statistics, Computing, and Economics with approximately the same weighting. Replies to a questionnaire sent to some of the largest Scottish industrial concerns indicated a demand for personnel trained to the grade of Higher Technician in the application of Mathematics, Statistics, and allied disciplines. The entry requirements specified GCE passes in Math at Advanced level, and in three other subjects at Ordinary level.

For the first two years of the course the student spent 25 weeks in college each year, and a minimum of 20 weeks in industry. The third year he spent 25 weeks in college. In addition to a good foundation in Mathematics, Statistics, Computers, and Numerical Analysis, the student had Economics during his first year, Accounting in his second year, and Operations Research in his third year.

Aberystwyth --West Coast of Wales (Visited Monday, 20 September 76)

There is a university in this city.

I wish to report on a conversation I had with the wife of a history professor. Her own teenage son went to the local public school. She said that local education authorities had mandated the teaching of Welsh to school children. She felt that it was a waste of time, and that it should be made optional at the discretion of the parents. It would be difficult, with our brief visit, to gauge the sentiment of the rest of the people in this respect.

But if one were to base a judgment on the many signs in the local Welsh language, there is strong pride in local traditions, customs, and culture. Example of some signs we ran across:

BRYN - hill
CYFLEUSTERAN - conveniences (i.e., toilets)
DYNION - Men
MERCHED - Ladies
LLWYBR CYHOEDDUS - Public Foothpath

These are the names of a large city and two small towns in Wales, respectively:

ABERYSTWYTH, PENRHYNCOCH, PENRHYNDEUDRAETH

Worcester College of Technology (Visited Wednesday, 22 September 76)

County of Hereford and Worcester.

This is another one of the 31 Colleges of Technology in England and Wales. It offers a variety of courses, the majority of which led to awards of certificates or diplomas. I talked to G. M. Hughes, principal lecturer in mathematics, who gave me insights into relationships between his department and other departments in the school. Because WCT had a good description of the work involved in getting a National Diploma, I wish to include it here.

Ordinary National Diploma in Sciences: This is a two-year full-time course designed to provide a substantial continued education and to give a basis of scientific and mathematical principles and their applications. Persons possessing an Ordinary National Diploma in Sciences who enter industry can take further part-time courses leading to the Higher National Certificate in Chemistry or Physics or Mathematics, Statistics and Computing, and to the Licentiateship and Graduateship of the Royal Institute of Chemistry or of the Institute of Physics and the Physical Society or of the Institute of Mathematics and its Applications. Alternatively the OND is an accepted qualification for entry to polytechnics and most universities where students can proceed to

a full-time course leading to a Degree or Higher National Diploma in many of the Pure and Applied Sciences.

Higher National Certificate in Mathematics, Statistics and Computing:

The course requires attendance on one day and one evening each week for two years. It is designed to benefit all those involved with General Mathematical Processes, Statistical Methods, Numerical Analysis, and Computing for Scientific and Design Purposes. The two principal qualifications for entry to the course are: i) G.C.E."A" level in Mathematics (or a GCE subject at this level related to Pure Mathematics), together with satisfactory grades in three other subjects at GCE "O" level; ii) An ONC or OND in Sciences with Basic and Elective Mathematics or their equivalent.

A student gaining a Higher National Certificate in Mathematics, Statistics and Computing plus approved supplementary certificates which have required study in an approved course for approximately 250 hours, will be eligible for consideration for the Licentiateship of the Institute of Mathematics and Its Applications. Holders of the certificate are eligible for exemption from Parts I and II (Preliminary and Stage I) of the Institute of Statisticians examinations.

The following subjects will be studied during both years of the course:

1. Mathematics (Pure Mathematics and Analogue Computing)
2. Statistics
3. Computing Methods (Numerical Methods and Computer Programming)

In Worcester we also visited the famous Royal Porcelain Factory. The factory traces its ancestry back to 1751, when a Dr. John Wall established a porcelain factory near a soaprock mine. In 1788 the factory was visited by George III, the first of many royal visits which led to the company

receiving permission to describe itself as "Manufacturers to Their Majesties." In 1976 Royal Worcester merged with Spode, "Potter and English Porcelain Manufacturer to His Royal Highness the Prince of Wales." Together they have become one of the most important manufacturers of fine bone china in the world today.

Another item of interest was an old map in Hereford Cathedral. It was Richard de Haldingham's Mappa Mundi, dating from the year 1300. It was designed as an altar piece and gives an idea of what people knew of the world at the dawn of the 14th century. The names were in Latin, with Norman French being used on special items. The unique map showed a flat world, one ocean, and only three continents. America and Australia did not exist in the map-maker's scheme. Besides geography, the map taught people natural history, mythology, and gave a commentary on the Bible. Whole areas were left blank, with pictures of beasts and the legend: HERE ARE DRAGONS. The center of the map was occupied by Jerusalem and the Holy Land.

Greenwich Royal Navy Observatory (Visited 27 September 76)

There is a handsome complex of buildings on the south bank of the Thames. It was here that the Tudor sovereigns had their palace. The architecture is associated with some of the most famous names in English history: Sir Christopher Wren and Inigo Jones, to name two. The palace is presently the home of the Royal Navy College and the National Maritime Museum. In this latter we saw an exhibit on the American Bicentennial. It was very well put together, and offered insights that only the English could bring out, having their own point of view. Crossing a nice park one comes to the Royal Navy College Observatory, reduced to the role of museum nowdays. (The observatory

was moved to Herstmonceaux Castle and Estate in Sussex in 1948.) The old observatory in Greenwich has many historical astrolabes, or latitude-measuring devices. There were also many clocks, chronometers, sextants, etc. Because of most of the world shipping trade already using "London Time" as a standard, a meeting in Washington in 1888 made it official: Greenwich was selected as the Zero Degrees Longitude or Prime Meridian. Tourists pose for snapshots by the line through the old observatory, and we could do no less.

Central London Polytechnic (Visited Tuesday, 28 September 76)

People whom I contacted: Dr. Sample, head of the Math Department; Angela Penny, principal lecturer; Dave Laycock, senior lecturer.

PCL was created by the amalgamation of The Polytechnic, Regent Street and Holborn College of Law, Languages and Commerce, following the Government's White Paper "A" plan for Polytechnics and Other Colleges. The plan was presented to Parliament in 1966. The Royal Polytechnic Institute at 309 Regent Street was founded in 1838 by Sir George Caley. Holborn College of Law, Languages and Commerce was founded by the London County Council in 1958. Electrical and Electronic Engineering, Engineering and Systems Technology, LIfe Sciences, Mathematics and Computing and Physics transferred to the New Cavendish Street building in 1971.

In addition to its undergraduate and postgraduate courses, PCL has been, and is developing further, a wide variety of post experience, part-time and evening courses at all levels to exploit its central location and offer a comprehensive education opportunity to the community.

Believed to be the only programs of its kind in England and perhaps in Europe, PCL offers a BA degree in Photographic Arts and B Sc Honours degree in Photographic Sciences. Each of these courses lasts three years.

School of Science and Engineering:

B Sc Honours in Mechanical Engineering.

There is a common first year with a course in Instrumentation and Control Engineering. Subjects studied are: Mathematics and Computing, Materials and Product Technology, Mechanical Science, Systems Technology, Electronic Technology in Engineering and Commerce, and General Studies. The following three years have a "sandwich" pattern (industrial experience between academic years).

PCL offerings have a lot of flexibility for the student. For example, students who fail to keep up with the work of the degree courses have the opportunity to be considered instead for a HND. Likewise, students who have demonstrated "exceptional achievement" in the first year of the HND course are given the opportunity to enter a degree course.

Computer Facilities:

An ICL 1902 A (International Computers Limited) is used for teaching and research. Programming and application of computers is an essential part of almost all courses in the department of Engineering and Science.

B Sc Modular Degree with or without Honors: Three years

Each student selects, under counselor guidance, twelve units (four each year) out of a total of over seventy. The following subject areas are offered: Behavior, Biochemistry, Botany, Chemistry, Computing, Ecology, Electronic Instrumentation, Mathematics, Microbiology, Operational Research, Physics, Physiology, Psychology, Statistics, and Zoology.

For the Honors degree, the required 12 units must be selected from Life Sciences, Mathematical Sciences, and Physical Sciences. In addition, four units must be selected from group A (listed in catalog as the beginning courses in a subject) in the first year, at least two from group B the second year,

and at least two from group C the third year. The student must show a Pass in at least ten of the attempted twelve units.

HND in Computer Studies:

This is a two-year full-time course providing practical experience in programming. It is supported by a wide theoretical background, and is designed mainly for those wishing to enter commerce, industry, or the Civil Service as computer programmers in the data processing field. The entrance requirements for the above course can be fulfilled in a variety of ways, as listed in the college catalog under subheadings a) through f). Part a) specified GCE passes in Mathematics and three other subjects with one of the passes at Advanced level. Part f) gave the Joint Committee the option to pass judgment on any individual case not covered by the others. It said: "any qualification deemed by the Joint Committee validating the course to be equivalent to any one of the above."

Professional Course for Statisticians: Three years

At the conclusion of this course the candidate takes an exam to qualify as Member of the Institute of Statisticians (MIS). This is a degree-equivalent qualification. There are actually three stages to this examination. The student takes the first stage at the end of the first year of study, the second stage at the end of his second year of study.

The student acquires a basic groundwork in basic statistical knowledge and techniques with their application to problems of administration and research which arise in industry and commerce, as well as in other fields of applied science.

Fees:

Students at PCL are charged normally about L140 for full-time courses, "and a proportionate fee for sandwich courses." Students enrolling on a

CNAA course are required to pay an additional L44 registration fee in the first year. Students residing in the UK are normally eligible for a grant from their local authority for full-time and sandwich courses. The fees charged by Worcester Technical College were from L120 to L175 for full-time courses.

By way of contrast, the fees at the University of Oxford are about double that amount at least. Each college sets its own fees.

Oxford University (Visited Thursday, 30 September 76)

The University of Oxford is basically a federation of colleges. There are thirty-four of them altogether, yet the student population in the academic year 1975-76 was only about 8000 undergraduate and about 3000 graduate! Each college is a self-governing corporate body. Each selects its own graduate and undergraduate students.

A hundred years ago every undergraduate was male and most were sons of parents who could afford the fees. This has totally changed. Women have been admitted beginning in the last quarter of the 19th century. They have been full members of the University since 1920. After World War II, even the poor students could afford to come to Oxford, being helped by newly established National Grants.

At Oxford the academic year is divided into three terms curiously called Michaelmas (October to December), Hilary (January to March), and Trinity (April to June). An "Exhibition" is a scholarship, and an "Exhibitioner" is a scholarship holder.

Admission to the different colleges is by a comprehensive Entrance Examination usually written by the prospective student in November of the pre-

vious year that he seeks admission. GCE "A" level results are taken into consideration as well.

Course of Study in Mathematics: Three years

The first year involves work in the following subjects: Basic Algebra, Analysis, Mechanics, Potential Theory, and Probability. There is a Final Honour Examination at the end of the third year. The work of the third year is divided into three sections: I. Algebra, Analysis (including differential and integral equations), and Probability. II. Choice of options under the headings Logic, Galois Theory, Partial Differential Equations, Applied Analysis, Geometry, Calculus of several real variables, Mechanics, Electromagnetism, Continuous Media, Numerical Analysis, Statistics, and Operations Research. A note of welcome relief is added, explaining that "the student is not expected to cover more than half of the section II syllabus. III. Study of one or two mathematical subjects in depth.

Students also have the opportunity to learn computer programming and the University has an ICL 1906 A computer available. Research along this line is divided into two fields: 1) Numerical Techniques for solution of scientific problems of all kinds, and 2) Investigation of the structure of existing programming languages of all kinds, hence to "improve" the basic languages, their compilation, and "various other software applications."

A brochure on Oriel College (founded in 1326) gives the following brief sketch of Cecil Rhodes, one of their benefactors:

"This strange man of both visionary idealism and astute practical genius was an undergraduate at Oriel between 1873 and 1881 (after University College had turned him down!), working off and on for his degree whilst at the same time earning a fortune for himself at the Kimberley diamond mines. Living in lodgings as he did, he seems to have found his friends rather more outside the

college than in it; but he never forgot Oriel and took pleasure in returning there later in life." Today many fortunate American graduate students ("Rhodes Scholars") are able to study in British universities due to the munificence of this man.

The city of Oxford exuded dignity with its ancient college buildings with quaint porterage offices, delightful open courtyards, chapels, and halls. One leaves the 20th century behind as he steps through the stately carved doors of a college. The Bodleian Library, one of the most distinguished in England (and the world!), had an elegant quadrangle and contained a colorful room with the Duke of Humphries Library. We saw a special exhibit of exquisitely illuminated books with handwritten Latin texts. They were richly bound in leather, and were but a short sample of the Bodleian's extensive collection of books antedating William Caxton and the first printed books in English.

Berlin. Technische Universität. (Visited Monday, 11 October 76)

History: Even reading their catalog, I was not able to glean much about the original date of the founding of this Technical University. However, it occupies modern structures on a sprawling campus in the Charlottenburg section of West Berlin.

Besides the common ones of Mathematics, Physics, and Computer Science, the TUB has studies in Science of the Environment and the Nature of Traffic. Degree courses can be pursued in twenty-one academic subjects. TUB shares computer center facilities for instruction with the Free University and the City of Berlin.

There is a Studienkolleg geared to meet the needs of foreign students who may experience difficulties in adapting to TUB, particularly as far as language

is concerned. This college offers a one-year program to ease the problem of adaptation for foreign students. They receive up to 35 hours of instruction per week in German, Math, Physics, and Chemistry. The students can use a language laboratory, and the instruction includes demonstrations and practical exercises as well as an introduction to German literature.

Library: At the end of 1975 there were approximately 700,000 volumes. Special collections include the publications of the German Research Institute, in Architecture, City Construction, Community Planning, Geodesy, Surveying, Cybernetics, and Futurology.

TUB grants degrees called Diplom-Ingenieur, -Chemiker, -Geophys, -Informatik, -Phys, -Math. Normally it takes eight or nine semesters to earn one of these. The Unviersity also confers the Magister Artium (MA) in several disciplines. Lastly, several Doctor-level degrees can be earned. They are differentiated from one another by the professional suffix, such as Dr-Ing., Dr-Agr, etc.

Nicholas Kopernicus University, Toruń, Poland (Visited Monday, 18 October 76)

In the old city of Toruń we visited Copernicus' birthplace and we saw the fountain where he was baptized. The city had many old streets lined with burghers' houses. Copernicus was born in one of these. When the city celebrated the 500th anniversary of his birth (in 1973), the even richer house next door was annexed to the museum that had already existed in Copernicus' house. Then the exhibits pertaining to this famous physician-astronomer were increased.

Copernicus literally revolutionized man's concept of the universe, describing the earth and other planets in their proper orbits around the sun.

The accepted theory up to that time had been Ptolomy's Geocentric Theory, which held the earth to be the center of the universe, and therefore that the sun went around the earth. Interestingly enough, Copernicus' work was not published until 1543 in Nürnberg. It was called "De Revolutionibus Coelestium." Copernicus died in Frombork (near Gdansk) in the same year of 1543. Put in the proper perspective of the times, Copernicus' work could not have seen the light of day during his lifetime without clashing with the Church. Galileo (1564-1642) dared espouse Copernicus' "Heliocentric Theory" of the universe and he was humiliated before the Inquisition and forced to recant. Tradition says that he muttered "but it moves nevertheless"--referring to the revolution of the earth around the sun--as he stepped off the witness stand.

On the edge of the city (the suburb of Bielany) we visited the Universytet Mikolaya Kopernika. This university was founded in 1945, but it has occupied its present site only since 1973. At the present time it has about 4000 full-time students and an academic staff of 600. It is strong in the departments of Mathematics, Physics, Chemistry, and, true to the patron after which it was named, Astronomy. There were many modern buildings in a wide open campus, even though only the first stage of construction had been finished.

I was surprised that a booklet given to me at the office of the Rector Magnificus had explanatory notes in Polish, English, then Russian, but no German! Later the reason came to me. Due to their traumatic experiences under Hitler, an extensive program of de-Germanization and re-Polonization was started after WWII. German was not even taught in schools until very recently. (This explained also why we found that only the older people spoke German.) Copernicus University itself had only since 1972 established a department of German Philology, and there is only one professor in it. A unique department was the Institute of Preservation and Conservation of Works of Art.

Warsaw (Visited Thursday, 21 October 76)

Quite by chance I happened across the Polish Academy of Sciences and the Banach Center. They occupied quarters in the same building in a central section of the city. There was a seminar on Math Stat in progress, as well as one on something called Discrete-Time Martingales. Lecturers for the day were E. Platen, S. Holm, J. Jureckova, and K. Jagdeo. I talked to Zbigniew Kietczewski, a visiting professor from the University of Poznan, who recommended that I visit the U. of Warsaw Math Department in the Palace of Culture.

The Palace of Culture is a giant monument, product of Stalin's munificence to the Polish people. It houses many exhibit halls, theaters, restaurants, a 3000-seat Congress Hall, and even a swimming pool. My wife and I were very much impressed by the almost opulent decor, the maze of halls, corridors, and rich chandeliers. When we finally found the elevators, we made our way to the ninth floor. The Math Department of the University of Warsaw pays the city rent for the use of three floors in this building. I had a pleasant talk with one of the professors, who interrupted his afternoon coffee to chat with me awhile. He said that their classes had from 14 to 19 students, and that students could select from three tracks in the department: Pure Math, Mechanics, and Pedagogics. He also said that most of their teachers must travel about the city in order to teach some classes in the secondary schools and in other departments of the university (located in several sections of the city).

When I finished the interview we walked down stairs in order to catch the express lift to the 28th floor, from where we had heard there was a good view of the city. On the way downstairs we observed what is apparently a satellite attachment the Russians included with their Palace: a woman at each landing

of the flight of stairs. We believe her job was to help persons not acquainted with the geography of the building find their destination. She is usually rotund and wears a large ring with keys as a badge of her office.

Incidentally, the view from the top was somewhat disappointing, as it was getting dark and Warsaw also suffers from the malady of "motorization," with the attendant smoke and low visibility. The city's skyline is no longer dominated by the sharp tower of the Palace of Culture, as many new buildings of the steel-and-glass variety have been constructed. In particular, the Orbis Hotel offered rooms on the 30th floor (where the air was notably less polluted).

Vysoké Učení Technické (VUT) (Visited Thursday, 28 October 76)
Brno, Czechoslovakia

The Technical University in Brno was founded 125 years ago, so it is one of the oldest schools of its type in Europe. The city holds an annual Engineering Fair in the Autumn, and it is also the largest city in Moravia.

Prof. Doc. Ing. Miloslav Samotny, C. Sc (Professor Docent Engineer, Candidat Science), Ing. Josef Sveda, and Prof. Ing. Cestmir Vermouzek, C. Sc. were three persons on the staff with whom I had personal contact. Prof. Vermouzek in particular was very helpful to me, as he spoke English very well. He told me that the University had very good support from Industry, that beginning in 1977 the transfer of students between universities in the country will become easier. Students normally spend their second year of work in a Resident Project in industry. He said that classes average about twenty students and that an advanced student generally aids the teacher instructing the rest of the class. In particular, Prof. Vermouzek described to me a long-term computer project in which VUT had been involved. It was in the discipline of Chemistry, but students had to integrate economics and math in order to make

a complete study of a chemical process, from market analysis to product testing. Their first two years, students in all majors take the same math, including Descriptive Geometry. In the third and fourth years the students branch out to math which specializes in their own major. Great attention is paid to the different backgrounds of the students, and there is much opportunity for close teacher-student contact. The aim of the math department is to integrate the classical methods of teaching with the modern ones, both in content and in terminology.

VUT was proud to have the best equipped computer laboratory in Czechoslovakia. They are equipped with an array of truly international machines: a MINSK 22 from Russia, a SAAB 21 from Sweden, and a TESLA 200 from their own country. In addition, really lucky students may get to use an industry-based IBM 360, from the United States. Little batch processing is done in their installation, as almost all their programming is done on terminals using Harvard-invented PL-1.

Fachhochschule Karlsruhe (Visited several times in November and December 76)

This school was founded in November 1878 under the name "Grossherzoglich Badischen Baugewerkeschule." From 1963 to 1971 it was known as the "Staatliche Ingenieurschule." Presently it occupies modern buildings across the street from its former location on Moltkestrasse. The old buildings are now occupied by the "Pädagogische Hochschule" or teacher's college.

The government of Baden-Württemberg has plans to further develop this Fachhochschule according to a long-range plan wherein it will become a model in this area for an integrated school of superior studies ("Gesamthochschulmodell"). Studies in this engineering school usually last eight semesters, two of which the student spends in industry. Sometimes these semesters are the first and

the seventh, sometimes the second and the seventh, depending on the major. The first "Praxissemester" is for the student to become acquainted with the problems that need to be solved in the real world of production, construction, or administration. During the second semester he is expected to solve some of the problems with the application of the knowledge he picked up in school. The student emerges as a Graduierter Ingenieur, abbreviated grad-Ing, and can seek employment in responsible positions in industry and commerce.

Since my interest was particularly in programs which integrated mathematics and computers, I will describe what this school offered in this respect.

Major in "Informatik." (Computer Programming and Data Processing)

Established only in 1971-72, this major grew out of the demands of the rapid growth of automation and the application of computers to facilitate and speed up complicated processes in industry, commerce, and research. There is an emphasis on applications, and the student will become skillful in several programming languages. He will also work with analog computers, in the form of switches and circuits which he builds himself to simulate a problem situation.

The goal of the education in this major is to turn out a person who is application- and software-oriented, and whose place in the economy can be quite diversified. They should be able to find employment in departments of research, projects, and principally where applications of computer are called for. Karlsruhe FHH has a Univac 9300 as terminal of a larger Univac 1108 of the Computer Center of the University of Karlsruhe. In addition, there is a Zuse Z 22, and an EAI TR 58 Analog computer.

The first two semesters the student is busy with learning fundamentals: Chemistry, Physics, Mathematics are heavy on his schedule. The third semester

is spent in industry. The fourth and fifth semesters he has more math, including probability and statistics, "Regelungstechnik" (control processes), computer programming, processors and interfaces. Then comes the second industry semester. The seventh and eighth semesters the student is busy with courses in information processing, electronic measuring laboratory, economic and management techniques, and a special project as conclusion to his studies. In summary, he attends a total of 154 units of "lecture" and only 13 of laboratory (these include electronic instruments, computer programming, and data processing labs).

Fachhochschule Karlsruhe has ten "vertical" departments, ranging from Architecture to Precision Mechanics. Social Sciences, Physics, and Chemistry form what they call "horizontal" departments. This means that they span across and service the vertical departments. There is also a program of free seminars on subjects ranging from metaphysics to questions about religion. Curiously enough, each vertical department takes charge of the particular math that its students need, so there is no department of Mathematics as such. Also, textbooks in math are not regularly used, each instructor preferring to teach material which he/she selects and the students take notes. For example, Dr. Fischer, a professor in the Fachbereich Maschinenbau, used Analysis für Ingenieure, a textbook put together by an education committee and published In Leipzig. Dr. Fischer confided to me that the teachers were plagued by an avalanche of publications by authors in West Germany, and to avoid the hassle involved with colleagues who may have been authors, and also with high pressure sales people, he chose an East German text that was quite adequate in covering the material needed for his students. He also added, by the way, that East German mathematics was quite untainted by communist or socialist ideologies.

Wednesday, 10 November 1976 Fachhochschule Karlsruhe

Today I sat in on a conference titled Cleaning Up Industrial Gases, or "Wirtschafliche Reinigung von Rauchgasen." The speaker was Dipl. Ing. Gregor Klinke of the firm Wiegand Karlsruhe GMBH. He explained that his company specializes in chemical factories, that most of their contracts are for work within West Germany, but that sometimes they have done jobs in Switzerland. The audience consisted of perhaps thirty people, the majority of whom were students in the Mechanical Engineering Department of Fachhochschule Karlsruhe. There were perhaps eight faculty members, and these were among the most participatory individuals when the time came for questions. There were no women. At the end of the presentation the audience knocked on their desktops with their knuckles by way of applause.

Despite my unfamiliarity with the subject and particularly the language, I was able to derive some benefit from this conference because it involved some physics, chemistry, and mathematics. The formulas which the speaker referred to with the help of an overhead projector were familiar to me and, in summary, the contact with colleagues in another country was healthy.

Weekend of 2-4 December 1976

I attended a conference titled Learning Goals-- Help through Lecture Planning, or "Lernziele--Hilfe bei der Kollegplannung." The seminar was held for the teaching staff of Fachhochschule Karlsruhe, FHS Kehl, FHS Mannheim, FHS Offenburg, and FHS Pforzheim. Prof. G. Böhme of Furtwangen was the overall director. In all, there were twenty teachers who registered for the seminar, eleven from Karlsruhe (the host institution) and the rest from the remaining above-listed schools. The conference had the following program:

Thursday, 2 December

14:00 Opening Lecture: "Why Goal-Oriented Instruction?"

14:45 "System Conception as Work Designation" Didactic Preparation of a subject matter--specifically from Physical Technology.

15:50 Break

16:15 Distribution into work groups. The following themes are anticipated:

NACHRICHTENTECHNIK	(INFORMATION TECHNOLOGY)
REGELUNGSTECHNIK	(CONTROL TECHNOLOGY)
BAUKONSTRUKTION	(BUILDING CONSTRUCTION)
MESSTECHNIK	(MEASURE TECHNOLOGY)
THERMODYNAMIK	(THERMODYNAMICS)
DIGITALTECHNIK	(DIGITAL TECHNOLOGY)
ARBEITSRECHT	(EMPLOYMENT LAW)
KOMMUNIKATIONSWISSENSCHAFT	(COMMUNICATION SCIENCE)

16:30 Separation of the different work groups

18:00 Arrangement of a Lesson: Development of a Learning Matrix.

Friday, 3 December

9:00 Presentation of results of the several work groups. The following is a typical schedule for each group:

20 minutes:	Short report over the learning goal matrix that has been prepared
20 minutes:	Showing of a TV program on the same subject
20 minutes:	Discussion

12:00 Noon break

13:30 Continuation of the work group presentations to the whole assembly

17:30-18:00 Evaluation of the above presentations in relation to a catalogue of criteria in the single different groups.

Saturday, 4 December

9:00 Announcement of the results of the evaluations

9:30 Consequences for Instruction in the FHS

12:00 End

This conference on instruction was valuable to me as a teacher in the following ways:

--It gave me an opportunity to see first-hand the latest premises underlying classroom instruction in the technical schools of West Germany.

--I saw several good video tapes on specific subjects--one on Control Technology, one on Thermodynamics, a third one on Digital Technology, and a last one on Employment Law.

--The colleagues who came together for the conference had many diverse points of view on a particular subject, and sometimes the discussion was heated. Unfortunately my very limited German precluded my involvement in any but the most elementary conversation. In the workgroups (I selected to work in Digitaltechnik) I was less handicapped, as one of the colleagues (Böhme) spoke a little English.

In summary, I would say that the orientation of the conference was toward fulfilling certain theories about learning, particularly the setting up of goals or objectives and "learning matrices." It also gave me a contact which I followed up later by visiting another technical school, Fachhochschule Offenburg, where I saw more of the practical aspects of the theories which were discussed at the Karlsruhe conference.

General Observations About German Education

Children are put in certain tracks which determine their future education as early as eleven years of age. It is then that the child goes to the Hauptschule, Realschule, or Gymnasium. But there are some progressive schools which combine two or more of these tracks. They are called Gesamtschule and the student has the opportunity to choose from several alternative routes and at the same time he can be observed by his teachers who are in a position to recommend him.

Students who need additional help to qualify for a specific program are not ignored. For instance, the state of Nordrhein-Westfallen has what it calls Vocational Preparation Year, or "Berufsvorbereitungsjahr," and a one- or one-and-a-half year Vorklasse to qualify certain students for the Fachoberschule. Fachhochschule Karlsruhe offered a Vorsemester for those students who needed to make up deficiencies but who were otherwise qualified to enroll in the school.

The Fachhochschule track offers more practical training as contrasted to the more theoretical emphasis of the universities. An engineer graduate of the former earns the title Ing (grad) or Graduerte Ingenieur, while one from the latter receives the title Dipl. Ing. or Diplom-Ingenieur. It is difficult for a Ing (grad) to cross over to the university side and get a diploma--the two tracks are almost mutually exclusive in emphasis if not in content. The Ing (grad) has received even from the sixth grade onward a more practical and application-oriented education. His counterpart in the university, on the other hand, has delved into the more theoretical aspects of the same subjects, and could easily continue his studies toward higher professional goals like a PhD. Understandably, the Dipl-Ing enjoys a more prestigious position and

generally commands higher pay than the Ing (grad). I collected some clippings from a newspaper which very clearly differentiate between the two degrees in offers of employment.

A couple of articles from local dailies in the region of Baden-Württemberg will illustrate the sort of problems that educators are currently grappling with in West Germany:

From the Badisches Tagblatt, Wednesday, 9 February 1977

> Professor Helmut Engler, rector of the University of Freiburg, who will be leaving his position soon, will not give up his fight against "replacement money." He supports his battle against the professional and technical administrative nonsense of the politically hot educational budget of the state. A human cadaver on the dissecting table is a teaching aid and costs the students no replacement money. A frog on a dissecting plate is a learning aid and therefore costs replacement money. Engler shows with this grotesque example that the classification of things that need replacement money is done arbitrarily.

Another article from the same paper described the financial situation of students at the Unviersity of Freiburg:

> Freiburg (hei) "For most of our students things are not bad at all." Student Body and University administration want to improve the living conditions of the students. Students in Fachhochschulen and pedagogic colleges have "poorer" parents than students in the universities. While 80% of the students in the FHS and 60% of beginning teachers get help from BaFöG (Bundes Ausbildunguns-Förderungsgesetz, or Federal Education Assistance Law), at the University of Freiburg only 40% avail themselves of this means. Altogether 41% of all students have their parents pay for their study and 40.2% from public means. 75% of all students could have at their disposal 500 DM per month or more, and 25% 600 DM.
>
> These data are from a social survey made by the Student Body of Freiburg, including the students of the Padagogische Hochschule Freiburg,

Musikhochschule Freiburg, the Fachhochschule Furtwangen, Offenburg and the University of Freiburg. The contribution from the parents, on the average 226 DM, muddle these statistics (including the 38% who receive nothing at all). The Student Body estimates monthly expenses to be 630 DM per student. The difference is made up either by BaFöG (40.2%), the student's own earnings (6.6%), from the means of a married couple (4.3%), or from loans (2.4%). For that reason the Studentebude (traditional student room) sought to meet the largest portion of eating expenses with an average of 178 DM. But the "Student room" in the old sense doesn't exist any more. Today only 12.6% of the students have a room in the house of a landlord, 26% live as sublettors in a separate room. The overwhelming majority (32.8%) of today's students in Freiburg are or feel themselves to be principal tenants, even if their apartments are small or built underground, or are located maybe in community houses. 12.5% live with their parents, almost the same number in student residence homes. This trend to independent and free living is taken into account by the student body so that in the future no student houses in the traditional sense are built, but only the two structures that are planned now, and they will be fitted out more as apartments and living quarters in which at most two to three rooms have to share a bathroom and thus they imply more individual responsibility.

The student government is striving with the support of the city of Freiburg to open up more places to the possibility of student housing in the city area. Some housing needs sanitation improvement and renovation and this can be done with money from student government, and then the houses can be rented to the students on a long-lease basis. Negotiations with public settlement and living quarters companies are in the process,

because it is also in the interest of the city, according to the opinions of Dr. Graf, who added that "only then will the real mixed living conditions" of students be improved. The student government does not want to put up, as Director Fletschinger stresses, "luxury living quarters," but only create the simplest adapted common student room.

Rector Engler and student government director Fletschinger concluded: "For the greatest part of our students things are not bad. We must help with all means the small portion who have problems. If no other way, it can be accomplished with the solid self-help of the students who have a few extra Marks."

Education news in West Germany (continued)

FLIGHT ENGINEERS NEEDED

Lufthansa, the country's state-owned airline, needs more flight engineers. The "third man in the cockpit" can get an initial salary of 3900 DM per month, with a possible maximum of double that amount.

ADDITIONAL TEACHERS NEEDED

One-third more vocational school teachers will be needed by 1981. In the next five years the number of teachers should increase from 60,000 to over 80,000. The increase is projected because of the high birth rates of the early 1960's. The additional teachers will teach not only in the vocational schools, however. According to a government program of Implementation of Advanced Measures for the Reduction of Occupational Risks of Youth, or "Program zur Durchführung vordringlicher Massnahmen zur Minderung der Beschäftigungsrisiken von Jugendlichen," the majority of the teachers will go to professional schools and will be busy in the first or foundation year of the profession.

UNIVERSITY OF GIESSEN UNDERSTAFFED

The General Student Union of the University of Giessen complains about

the shortage of professors. The students have protested against severe personnel cuts which make their continued education impossible. As examples, the students in Giessen say that only two of eight professors scheduled in Physical Education were actually hired and lecturing. Another six teaching positions in the Economics department have not been filled and, in addition, they lack a lecturer, an academic counselor, and four scientific colleagues. These shortages have led to overcrowding in seminars as well as to cramped lecture conditions. In the course Introduction to General Chemistry, or "Einführung in die Algemeine Chemie," there are at the present time 1200 students, even if the lecture hall can scarcely hold 500. In the basic laboratory of Inorganic Chemistry there are three to four students for each place on the benches, and in the department of "Didactic Chemistry," (this is where teachers of chemistry are trained), fifty percent of the faculty slots remain unfilled.

Fachhochschule Offenburg

Following an invitation extended to me by a colleague who attended the conference on Instructional Goals at Fachhochschule Karlsruhe, I spent a day at Fachhochschule Offenburg. This was a technical college located in the city of Offenburg, about twenty miles east of Strassburg, an important Alsace metropolis. Professors Hermann Tuckermann and Hans Rentschler arranged a very pleasant and informative tour of their facilities. These were located mostly in a new campus on the bank of a river, but there were others in the city itself. I was shown several machine shops and electronics laboratories which were used by the college in its instructional program. In particular, I saw their computer center which featured a HP 2100 A 24K-core computer. Professor König showed me their four terminals and told me that students in the mechanical engineering department were busy programming in BASIC. In addition to two IBM keypunch machines, the laboratory had two French and one Japanese model.

Students at this technical college pursue an eight-semester course of study which includes two semesters in industry. During their academic semesters they attend lectures approximately thirty hours per week. The goal of the first semester in industry is for the student to become acquainted with his choice of a fabrication process. He will also get an overview of the technical and organizational problems involved in production, plus the sociological problems of the profession. During the second industry semester the student gains a deeper insight into the complete production process. He also maintains a close association with engineers and thus shares in construction and development (research), production planning, or production management. The student who plans an industry semester gets little time between the end of his academic semester and the beginning of his duties in industry, as the following schedule shows:

	ACADEMIC SEMESTER	INDUSTRY SEMESTER
Summer	15 March - 31 July	1 March - 30 September
Winter	1 October - 15 February	1 September - 28 February

Justus Liebig Universität, Giessen

I was one day in this important university of the state of Hesse. Dr. Seebach, chairman of the chemistry department, was very kind to me. Much basic research is being done in the area of organic chemistry, continuing a tradition begun by the man after whom the university is named. The laboratory is equipped with modern machines and computers. Dr. Seebach oversees the predoctoral work of about thirty graduate students. Because of continued problems associated with inadequate funding of research and other financial cuts which have severely crippled the instructional program, Dr. Seebach confided to me that he is leaving Giessen at the end of the current term and will teach and conduct research at the Eidgenössischen Technischen Hochschule, or ETH, in Zürich, Switzerland.

Professors' offices are scattered throughout the city of Giessen. Dr. Seebach took me downtown to chat with a member of the math department, Dr. Kurt Endl. Dr. Endl told me that the math department has perhaps 220 students majoring in mathematics. There are 14 full-time professors, who also teach the math required for the chemistry, physics, economics, and psychology majors. Dr. Endl had written a book on Analysis, based partly on notes he had made on a course he taught at the University of Wisconsin when he was in the United States on an exchange year.

Gewerbeschule Donaueschingen

In Donaueschingen, a small city high in the southern Black Forest, I had the pleasure of visiting a combination Gymnasium and vocational school. I

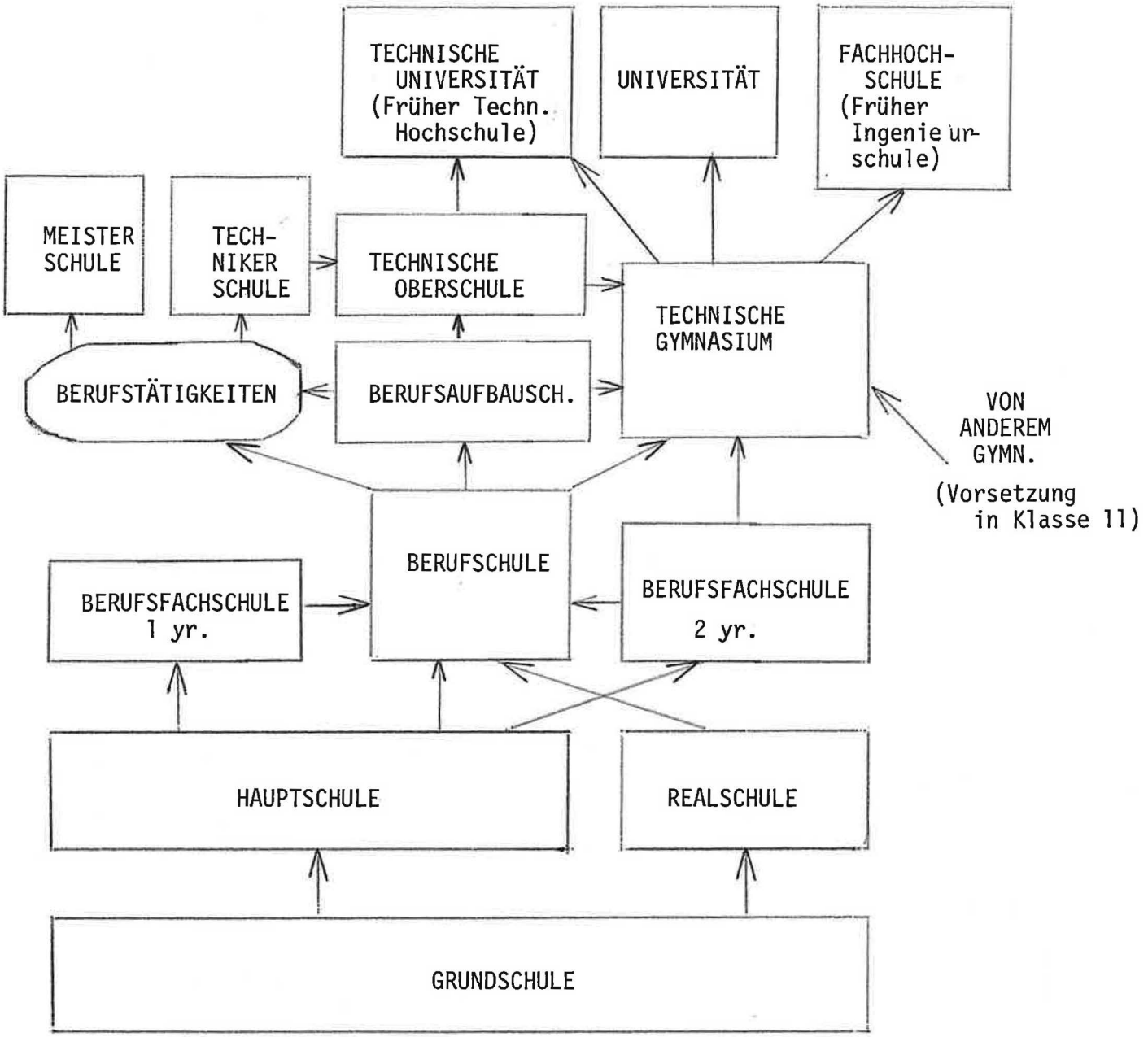
talked with Dr. Schmelzer, himself a graduate of the University of Stuttgart. He explained to me that the university-preparatory portion of the school (the Wirtschafts Gymnasium, which grants the Abitur, or graduation diploma) was on its fifth year of operation. Dr. Schmelzer taught all the mathematics the students needed to get into the university. The school also offered vocational trades such as Berufskolleg 1, where girls learned the fine points of being good homemakers (Hauswirtschaft). In the Berufsfachschule für Bürotechnik students learned secretarial skills, and the Kaufmännische Berufschule offered a three year part-time course where students learned to be salespersons by actual on-the-job experiences. Young men and women were given positions in the business establishments of the city or surroundings and attended formal classes two days per week. Since vocational training forms a large segment of the educational scheme of Germany, I feel it is appropriate for me to include in this report a diagram of the various routes which channel young students into programs leading to occupational oriented goals or the more demanding direction of university degrees.

GLOSSARY

Grundschule:	Lower Elementary School
Hauptschule;	High School
Realschule:	Polytechnic High School (Languages, arts, and sciences)
Gymnasium:	Combination Elementary and High School, 9 years university preparatory, ages about 10 to 19
Berufschule:	Vocational School (also called Berufsfachschule)
Berufstätigkeit:	On-the-job Training
Berufsaufbauschule:	Advanced Vocational School
Fachoberschule;	Advanced Professional School
Volkshochschule:	People's University
Fachhochschule:	Technical College

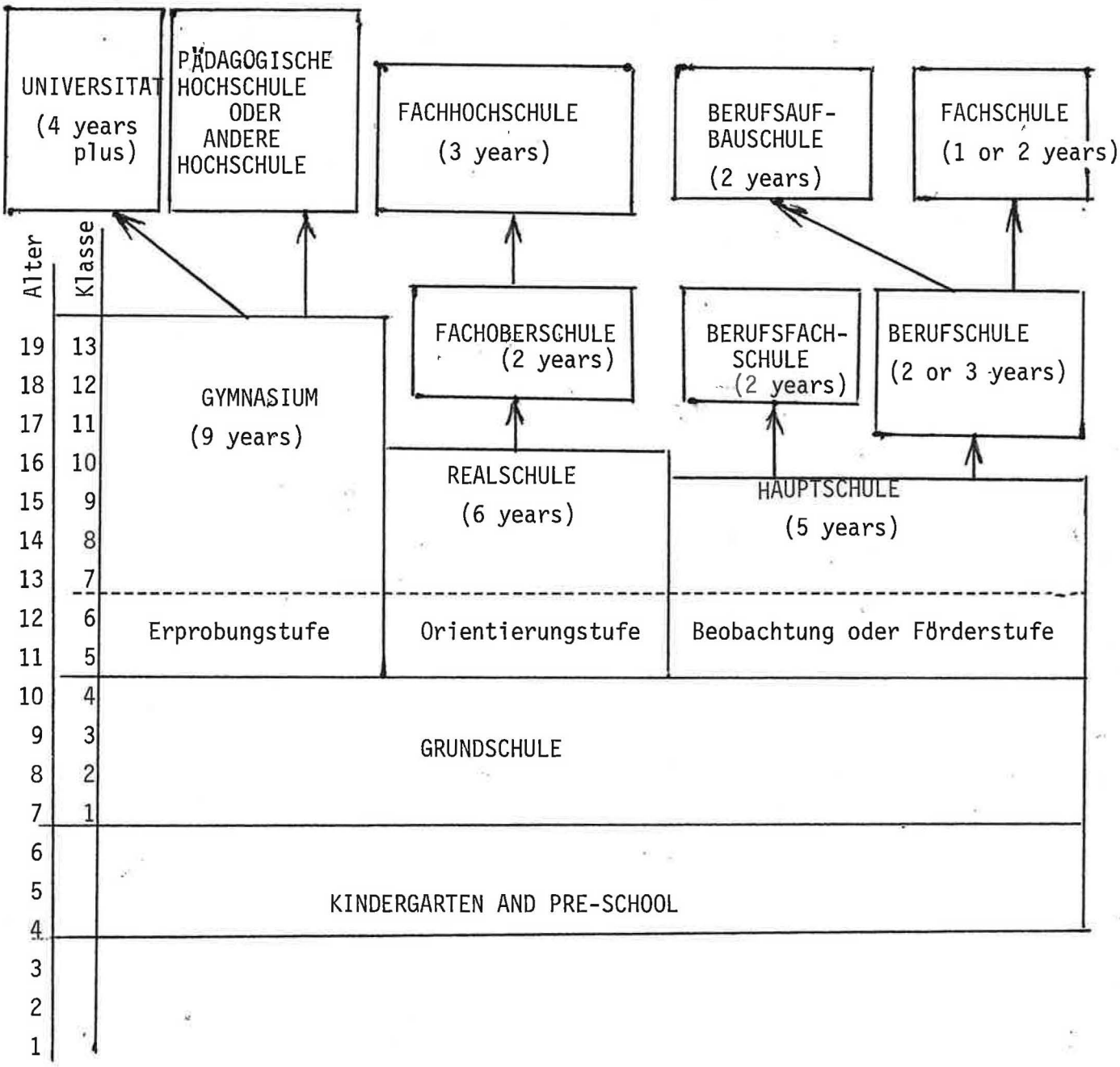
BILDUNGSWEGE IM GEWERBLICHEM SCHULWESEN

(Routes to Professional Instruction)



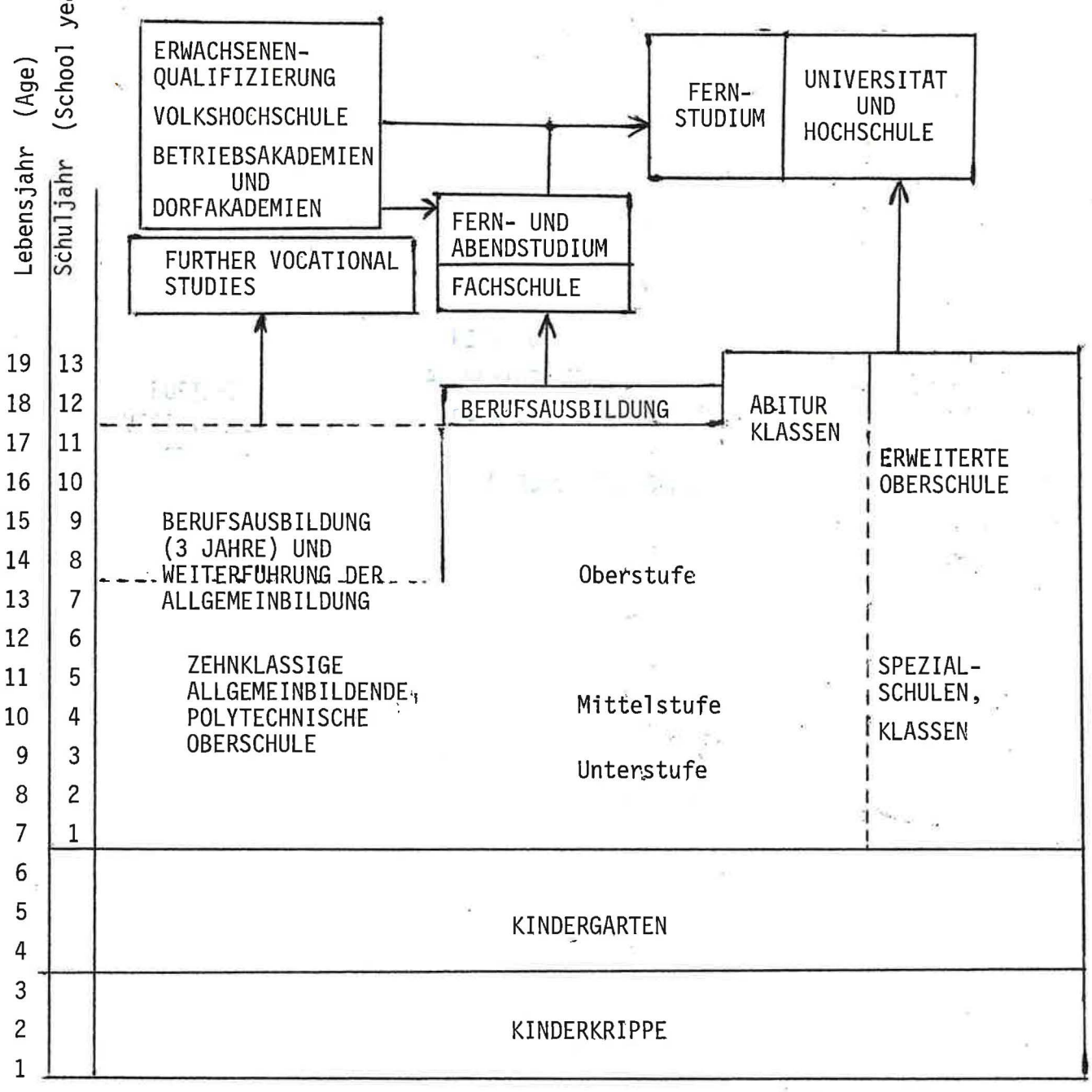
BILDUNGSWEGE IN DER BUNDESREPUBLIK DEUTSCHLAND

(Education Tracks in the Federal Republic of Germany)



BILDUNGSWEGE IN DER DEUTSCHE DEMOKRATISCHE REPUBLIK

(Education Tracks in the German Democratic Republic)



Some curious comparisons between West Germany (Federal Republic) and East Germany (Democratic Republic):

Item	BDR (Federal Republic)	DDR (Democratic Republic)
Area (km^2)	248 588	108178
Population (1974)	62 million	17 million
Density of population (per km^2)	249	156
Population (1950)	50 million	18 million
SCHOOLS		
Children of Kindergarten age enrolled	61%	75%
Distribution of other students:		
Grund- und Hauptschulen	66%	96%
Sondernschulen	4%	3%
Realschulen	12%	--
Gymnasien	18%	2%
Schüler je vollbeschäftige Lehrkraft (no. of students per full-time teacher)	24.7	17.5
Absolventen mit Hochschul- und Fachhochschulreife (Graduates of academies and technical schools)	100 000	51 000
Schüler aller Fachschulen je 10 000 Einwohner (Number of students in all professional schools per 10 000 inhabitants)	31.9	91.2
Hochschulen (similar data as above) (Universities)	127.2	80.6
Education stipends (monthly)		
Gymnasien und Berufschulen ab Klasse 11 und Fachoberschulen	200-380 DM	50-80 M
Abendhauptschulen, Berufsaufbauschulen, Abendrealschulen und Gymnasien sowie Fachschulen	390-480	
Höhere Fachschulen, Akademien und Hochschulen	500	190 Hochschulen 160 Fachschulen
Per cent of students receiving some sort of stipend	50%	86%
1974 State expenditure in education expressed per inhabitant:		
Elementarbereich, allgemeinbildene Schulen, Berufsaus- und Berufsortbildung, ausserschulische Jugendbildung, Erwachsene qualifizierung	614	330
Hochschulwesen, einschliesslich Ingenieurschulen	207	68

During the winter months I worked on the translation into English of an early history of California. The book was written by Miguel del Barco, a Jesuit priest who intended it to be a supplement and amendment to an earlier history published by Jesuit colleagues. The manuscript lay collecting dust in archives in Bologna and Rome before it was finally brought to light by a publishing company in Mexico City in 1973 (del Barco wrote his notes in the 1780's). The book gives a realistic picture of what California (the present Baja California) was like just prior to the dawn of the conquest and colonization of Alta or Upper California. Del Barco spent thirty years as missionary in California. His mission of San Javier still stands in the heart of the Sierra de la Giganta. Thanks in part to its isolation, it is one of the best preserved monuments of this period of Spanish life in California. The author's literary style is far from polished, but he was certainly a keen observer of nature and he enjoyed giving detailed descriptions of Indian customs and costumes, the plants, animals, and minerals of the land. As a brief example, I will transcribe a brief passage of his (he is speaking of the different types of cockroaches that existed in California):

> "Cockroaches are a type of domestic insect that is also found in California. There are two kinds of them, large ones and small ones. The large ones are as long as the widths of two fingers put together, and as wide as one finger. But the thickness of their body is not in proportion, as they are almost flattened out, and this allows them to enter a place through any crack..."

Again, on the subject of California's bountiful desert flora, del Barco speaks of cholla thusly:

> "The second kind of tasajos is the kind commonly called cholla. This is a plant so small that it grows scarcely a handbreath or a little more

above the ground. However, it has a multitude of arms so intertwined with each other that the foot or trunk cannot easily be seen. Its development is similar to that of the small tasajo of which we have been speaking, that is, in small sections. But these are thinner than a finger and are so thickly covered with thorns, that one can scarcely see the little section from which they originate, and which they are defending. These little sections are of lesser length than a finger, and they break off from the rest of the plant with the same ease as I have already said about the other tasajos. For this reason it is easy to step on some of these that have fallen on the ground if one is not careful where he plants his foot. If this latter is shod and the sole of the shoe lands flatly on top of the whole little section, the thorns will get flattened and will do not harm, but if one steps on its edge or in such a manner that part of it is squashed under the sole and part remains outside, some of the thorns are immediately stuck into the foot, going through the leather with such swiftness as if it were made of a weak cloth. It is necessary then to take a small stick or some such object and tear off the little section of cholla because it cannot be touched with one's hands..."

If the above passages seem prosaic, the reader should be warned that I selected some of the more innocuous parts. There are some lengthy descriptions of locust plagues and boring discourses of the improbability of someone's report of having seen totally naked Indian women in California, plus unlikely home remedies against snakebite. However, the book has plenty to merit a translation, not the least of which is a detailed chronicle of the missionaries who worked those often sterile fields two hundred years ago. Dawson's Book Shop

in Los Angeles will publish the translation, probably in two volumes. I have already finished the first one and have a good start on the second.

With the warming spring weather we left our lower Rhine hibernating station in Rastatt and headed for the Côte d'Azur.

Universidad Complutense de Madrid

Founded in the year 1498 by Cardinal Cisneros in the city of Alcalá de Henares (ancient Complutum--large and important in Roman times), this university was transferred to Madrid relatively recently (in 1836). The Biblia Complutensis or Polyglot Bible, printed with parallel texts in Hebrew, Latin, Greek, and Chaldean, was one of the accomplishments that lent notoriety to this Spanish university in the 16th century. In the last quarter of the 20th century the campus, in a spacious and park-like quarter of Madrid, was filled with students who were on strike protesting who-knows-what. Their restlessness could have been a reflection of the state of the country as a whole. Spain was scheduled to hold its first democratic elections in forty years the following June. Meantime, there was a bewildering proliferation of parties and candidates, and the students are traditionally very involved in politics.

I was fortunate to be able to interview Enrique Outerelo Dominguez, Vicedecano of the Department of Mathematical Sciences. He told me a great deal about their program for math majors and arranged for me to visit their computer center.

The university offers a major in Fundamental Mathematics. It is a five-year course with heavy emphasis on Analysis, Topology, Algebra, and Geometry. In the fifth year the student can select courses from Functional Analysis, Measure Theory, Harmonic Analysis, Differential Operators, and Theoretical Mechanics. The department also offers majors with concentration in Statistics and Operations Research. The first two years are about the same as those for the major in Fundamental Mathematics. In the third year, the student takes Math Analysis, Topology, Programming, and Calculus of Probability and Statistics. Mandatory and common to both concentrations in the fourth year are courses in Functional Analysis, Decision Theory, and Calculus of

Probabilities. Then the Statistics major branches out to take information Theory and Sample Theory, while the Operations Research major takes courses in Methods of Mathematical Programming, Programming of Compilers, and Simulation. In the fifth year, the Statistics major takes Stochastic Processes, Regression Methods, and Multivariable Analysis, Design of Experiments, Decision Theory, Biometric and Biographic Models. The Operations Research major takes Operations Research (Model Construction), Systems Theory, Theory of Games, Macroeconomics, and Economics of a Business, Cybernetic Models, and Automata.

The Department of Mathematical Sciences of the Complutense University of Madrid also offers a major in Computer Science. Again, the first two years are common to the majors which have already been described. In the third year the student takes Information Theory, Logic, and Algebraic Structures. In the fourth year the branching continues, the student selecting either pure or applied computer science. In the pure tract the student continues with courses in Logic and Algebra, while in the applied track he takes Operations Research and Theory of Games. In the fifth year the students pursuing this major take mandatory courses in Theory of Computability and Design of Languages and Compilers. Those following the pure computer science track take courses in Automata Theory, Theory of Programming, and Theory of Models. Those students whose major is applied computer science take courses in Systems of Operators, Artificial Intelligence, and Treatment of Non-numerical Information.

In addition to the above, the Mathematical Sciences Department also offers a major in Astronomy, Geodesy, and Mechanics. The students selecting these majors take the common first two years, and begin branching off into their specialty beginning with the third year. Specialized mathematics courses

here include Partial Differential Equations and Error Theory. The university also offered several courses in Cartography, Celestial Mechanics, Relativistic Mechanics and its applications to Cosmology. Lastly, there is a major for those who intend to become teachers of mathematics. The courses involved are about the same for most of the other majors during the first three years. The courses in methodology and the practical aspects of teaching are included toward the end. Apparently the objective is to turn out teachers who are well-versed, not only in mathematics, but also in realted sciences, as Astronomy and Physics are part of the required courses in the fourth and fifth years.

Portugal

In Coimbra, site of one of Europe's old universities, I had the good fortune of meeting Graciano Neves de Oliveira of the Instituto de Matematica. He explained that the students were on strike, so he was relatively free to chat and answer my questions. Naturally, I expressed curiosity about the reason for the strike. He said that there was a crisis precipitated by the open-door policy of admissions which had been instituted a few years previously. Evidently it had not worked out satisfactorily. Students crowded into the university and were often unprepared to do university-level work. Then the government decided to thin their ranks by requiring a year's "civic service" before a prospective student could be admitted to the university. It seems the labor unions joined the students in protesting this move, as it adversely affected them. Moreover, it was not always easy to find enough civic service jobs for all the students who wanted them, so they went on strike to make the government rescind the requirement. I don't know how the problem was finally resolved, it in fact it ever was.

Mr. Oliveira explained to me that they have a three-year Bachelor's Degree program. The first year the student takes Groups and Algebraic Structures, Analysis, and Linear Algebra. The second year he continues the above courses, adding Differential Geometry and Numerical Analysis. The third year the student takes Rational Mechanics, Advanced Analysis, History of Mathematical Thought, Introduction to Differential Equations, Logic, and Statistics. Two more years of study enable a student to qualify for Licenciatura en Matematica (a degree which would seem comparable to our MA). I also learned that there were about four thousand students enrolled in the sciences division, which included not only Mathematics, but also Physics, Chemistry, Biology,

Mineralogy, and Engineering. Of the fifty or so faculty members, perhaps "nine or ten" had earned a PhD.

In Portugal we also visited Henry the Navigator's famous Escola de Sagres, which was the source of many fifteenth and sixteenth-century advances in cartography, astronomy, and navigation. Men such as Pedro Nunes and Fernão de Magalhães (first circumnavigation of the world) widened horizons and showed others the way through previously uncharted seas.

Paris

The Institut National de Recherche Pédagogique of the Ministere de l'Education was one of the few places that had responded to my mail inquiries prior to my arrival in the French capital. They welcomed me very warmly in their office at 29, rue d'Ulm. I toured their building, which was replete with displays about the development of modern French education. There were busts of many influential people, among them Voltaire, Jean-Jacques Rousseau and Descartes. Since I had expressed a desire to visit a classroom under actual instruction conditions, the secretarial staff of the office of the above institute contacted a school and made arrangements for me to visit it. Since it was to be the following day, I went to see the Louvre in the afternoon. This famous museum, dating from the turbulent days following the French Revolution, houses a vast collection of Egyptian antiquities in addition to many galleries of oil paintings from nearly all representative periods. I particularly admired the Victoire de Samothrace ("Winged Victory") which dated from the third century before Christ. Equally enthralling was Venus de Milo, Leonardo da Vinci's La Gioconda ("Mona Lisa"), and the fantastic array of Egyptian and Middle East monumental sculpture.

The next day I reported early in the morning to Lycee "Chaptal", located at 45, boulevard des Batignolles. There I met Monsieur Le Proviseur, who introduced me to the teacher I was to observe. The teacher was a young man, probably under thirty, who collected his class from the yard where they had apparently been on a break. The students, all of them young men perhaps seventeen or eighteen years of age, were busy learning analytic geometry. The classroom was spartan by our standards. There were graffitti on the walls ("A BAS LA POLICE, VIVE LE CANABIS"). Pupil cooperation was good and rapport with the teacher was exceptional. Individuals came up to the front of the class and demonstrated certain points that others did not fully understand. The teacher was directing the show, but the students were obviously very actively involved. Afterward I had a conference with the teacher. He asked me if perhaps our students were not better off when I told him that most of our boys were not that advanced. He felt too much was demanded of his pupils by a rigid and often unrealistic curriculum. Yet, his students formed a group which had been screened from the early grades; they were all headed for the university, and so comparisons with our typical groups are not easy to make.

I should make mention of the new Paris glass palace called Georges Pompidou Center. Many Parisians have dubbed it with less reverent names, and I heard Germans comment that they would like to see it with its scaffolding removed (the "scaffolding" is part of the designer's plan, and will not be removed). Other Parisians are very proud of this vast cultural center which has a modern library with up-to-date audio visual stock on just about any popular subject one should wish information about.

Bureau International des Poids et Mesures

The International Bureau of Weights and Measures in Le Pavillon de

Breteuil in Sèvres (now a suburb of Paris) houses the original kilogram and meter adopted in France in 1799 and which later became accepted as international standards of mass and length respectively. A research employee, Jean Marie Chartier, gave me a very informative tour of the laboratories after I explained my mission and occupation (the Bureau is not open to visitors).

The Bureau today conducts active research into such basic questions as the determination of a precise value of g (the constant of gravitational attraction) and ever more exacting definitions of the meter. Though the original metal meter is kept as a relic, it no longer suffices as a standard, having been supplanted by a certain number of Krypton light wavelengths. The Bureau is experimenting with red lasers and have defined the meter with a precision of four parts of the order of 10^{-11}m. A Japanese researcher had plotted the variation of g induced by the changing positions of the sun, earth, and moon, and had measured g to a precision around 10^{-9} cm/sec^2.

In addition to being the official "last word" on the kilogram, meter, and second, the International Bureau of Weights and Measures sets the units used in electrical measurements, temperature, power, and light. With the coming of metrication to this country, the SI (Système Internationale) units will loom ever larger in our technology and industry. As teachers, we have the responsibility to ease the transition for our students so that the change is smooth and painless.

Switzerland

In Zürich I had the good fortune of hearing an address by Nobel Prize winner Dr. Manfred Eigen of the Universität Göttingen. He was lecturing at the Eidgenössischen Technischen Hochschule, or ETH, on the momentous subject of the Origin of Life. Though the topic was clearly out of my field and the

lecture was delivered in German, I nevertheless was glad to have had the opportunity to hear him. He talked about metabolism, mutation, "Selbst-reproduktion," pre-biotic chemistry, t-RNA molecules, but he also put equations on the board which I could at least partly understand. Example:

$$\text{Ratenansatz} \qquad \bar{x}_i = (w_i - E_i)x_i + \sum_{i \neq k} \phi_{ik} x_k$$

Manfred Eigen was awarded his Nobel prize about ten years ago for his work dealing with the speed of certain chemical reactions. He shared the honor with several other colleagues. He is a vigorously active researcher even today, as his fame preceded him to Zürich, where the lecture hall at the ETH was packed with an interested audience. Incidentally, this technical university is a European focus point of research in organic chemistry and attracts talent from the foremost universities of the world.