LETTERS

Engineer in France

IN PARIS last summer Franklin Thomas, Dean of Students and Professor of Civil Engineering, stopped a student on the stairs of the Ecole Nationale des Ponts et Chaussees to ask directions of him. The student answered his questions and then—when he found out who Dean Thomas was—loosed a barrage of questions of his own about engineering education in America in general, and Caltech in particular. Dean Thomas came up with more about the same in France. This exchange of information was continued in a sporadic correspondence after Dean Thomas returned to Caltech in the fall. The letter below is part of this correspondence—a lively account of what it's like to be an engineering student in Paris today.—*Ed.*

SIRS: I'd be happy to tell our American fellow-students of Caltech, and its alumni, something about technical education and training in France.

Most of our engineering and scientific schools have grown up independently, and they are still in a somewhat independent position. They are, and they carefully keep themselves, apart from the actual universities. They are the Grandes Ecoles—the Great Schools.

Most of them are in Paris, and most of them are now state-sponsored. Each has its own individuality, guards it zealously, and tries to label its students with exclusive habits and traditions. Because students do their preparatory studies elsewhere, the Great Schools have only two- or three-year courses. Their students are few; an average class numbers about 50.

The oldest and most renowned of these schools, which give training of a high scientific level but still cover a wider field than the specialized schools, are the Ecole Nationale des Ponts et Chaussées (Bridges and Roads) and the Ecole Nationale des Mines. These century-old names are now somewhat misleading. Actually the first covers architecture, electrotechnics, and all the branches of civil and structural engineering. The second is devoted to mechanical and

CONTINUED ON PAGE 23

PICTURE CREDITS
p. 7—Ross Madden-Black Star
p. 8—Drawings: Alice Mimi Muller
p. 9—Ross Madden-Black Star
pp. 10-13—Richard Jahns
p. 14—Pacific Air Industries
pp. 18-19—Ross Madden-Black Star
p. 21—Edison Hoge

Letters CONTINUED FROM P. 2

electrical engineering, mining and geology.

The specialized schools include the National Aeronautical School, the Superior School of Electricity, the National School for Telecommunications (electronics and radio), the National School of Naval Building, the National School of Agronomy, and the National School of Arts (architecture, painting, and sculpture). These are all in Paris. In Grenoble there are the Hydraulic and Electrotechnic Institutes.

In a third class come the "practical" technical schools such as the School of Arts and Manufactures, the School of Building and Public Works, etc. Most of these are private institutions, and (as a financial consequence) admit many more students, with classes of 200 or 300.

In making any comparison with the States, remember that our industrial development and all activities requiring engineers are on a smaller scale here. There is more variety than mass production, more centralization than independent departments and compartments and hardly any two engineers have the same job to do.

We think of an engineer as an individual who comes to his position with all the faculties to adapt himself to it in not too long a time, rather than as one who rises from his mould, and whom a unilateral training has prepared for just one job. (I don't think the United States system is basically different; I should refer, rather, to technical training in the U.S.S.R., where I understand there are engineers graduating in Reinforced Concrete, Foundations, or Steel Structures, who know little or nothing of each other's subjects of study.)

The standing of our engineers is based chiefly on "quality." Those who are able to form broad conceptions and to survey more than the narrow field of one subject are called to leading positions, as well as to major planning and drafting. They are few, of course. To train such men is the purpose of the first-mentioned schools, which, incidentally, also carry on the greatest amount of research.

Admission into these schools is determined by competitive entrance examinations which are more difficult for the top schools. Candidates for these examinations are young men between 20 and 24 who have completed their secondary studies. They have to continue by doing two to four years of additional studies which emphasize analysis, superior algebra, analytical and projective geometry, descriptive geometry—in France much emphasized for its educational value—rational mechanics and kinematics, some branches of physics and chemistry, as well as English and German. The work is hard and steady. These two to four years (according to the student's capacities) require intellectual stamina, and allow little time for leisure.

The competitive examinations take place every year in the May-June period. They are scheduled to permit the candidates to take the examinations of several Great Schools. If a student is accepted by more than one, he naturally chooses the top-ranking one.

The two highest on the list I have not previously mentioned, as they are exclusively scientific rather than engineering schools: The Ecole Normale Supérieure and the Ecole Polytechnique. The former is the basic school for training college and university professors, and is connected with the university system, which in France is entirely state-supported. The Ecole Polytechnique is a military school providing high-level scientific training. In some cases students take their first year of study here, and then transfer to one of the Great Schools. (This is the case with most French state engineers, who are civil servants.) Competition is always stiff, and may reach a ratio of fifteen candidates to one admission in the top schools.

In France, then, one may be a smart engineer or an ordinary one—according to the Great School one has attended. Is this a good system? Some drawbacks are immediately apparent. One my say, for example, that a good engineer is not necessarily a good scientist, and that the present system of competitive examinations may bar from the best schools many young men showing practical ability or particular aptitude for industrial leadership and business management. The answer may be that theoretical work is and should always be done first in the training of an engineer, that our admission system is thus justified, and that there may be a greater statistical probability of success in both scientific and practical engineering among those who have successfully survived the arduousness of our competitions. In any case I think there is matter here for an interesting discussion.

Ponts et Chaussées

The Ecole Nationale des Ponts et Chaussées—my own school—is fairly old. Two years ago it celebrated its second centenary. In its early days the school was a preparatory institution for civil servants of the Public Road Administration. During the Napoleonic era it gradually enlarged its field and reached a high scientific level.

Today, about half the students here become engineers in government services. Most of them come from the Ecole Polytechnique under state contract; they are given free training and a salary, and after graduation they are automatically placed on civil service. The other half—20 to 30 students a year—are preparing to enter private industry. These students pay a tuition of about 8,000 francs a year, which is $30 at the official rate of exchange.

The school building is a renovated mansion of the nineteenth century, situated in the heart of Paris not far from the Louvre. The laboratories are elsewhere in Paris, and brand new. The school is thus only an academic institution; it bears little resemblance to the American campus with its resident students and professors. None of this is possible in the crowded center of Paris. A modern student hostel provides living quarters for some of the students who are not residents of Paris.

Curricula

The curricula cover a three-year period. The school year lasts from October 15 to July 15, with short vacations at Christmas and Easter. For reasons which I hope I have made apparent, the curricula are uniform and compulsory, with no option whatever for the student. Each course is covered by a general examination at the end of the year, and sometimes by partial examinations during the term. Courses in physics, electrotechnics, testing of materials, and geology involve laboratory work, which also counts in the student's record.

But the most important and profitable additions to the main courses, I believe, are the so-called projects. Practical engineering problems are assigned to the students. A complete solution is required, as well as the calculations for the design of structures. In some cases cost estimates must be given too.

These projects are designed to give the student experience with real engineering problems. He also gets actual practical experience during the two compulsory summer practice periods, when, for two months, he works in the service of the State Administrations of Roads, Canals, Harbors, or Electricity—or with private firms or contractors. Sometimes these practice periods help the student to decide on his future field of activity.

As our system of instruction suggests, most of our professors are also practising engineers. They are graduates of the school themselves, and they have outside professional positions—some of them very important ones. The courses are conducted as lectures, and comprehensive textbooks and notes are issued to accompany the lessons and help the student prepare for the final examinations.

All examinations, laboratory work, projects, etc. receive grades of from 1 to 20, which are multiplied by coefficients (of from 1 to 15) according to their importance. An average of 13/20, or 65%, is required to pass into the superior year and to graduate. A grade of 7/20, or 35%, means the test must be taken again.

Textbooks are frequently revised to keep up with the newest theory and prac-

tice. As the present tendency is to bring professors and students into closer contact, some assistant professorships have recently been created and assigned to young engineers of the school. Another innovation consists of group visits to factories, manufacturing plants, and various construction projects in the Paris area, as well as longer trips to important harbors, canals, dams, etc.

What about our out-of-school life? We have always had good rugby and football teams, and last year we won the Paris University Championships. There are plenty of cultural opportunities, such as lectures and much-appreciated free or half-price theater and concert tickets. A few dancing parties are arranged during the term. The social event of the year is the Great Bal of the school, which is honored by the presence of the President of the Republic. Another event is the yearly School Revue, a comic play acted by the students, and based on school events and the biases and whims of the professors.

For many years the school has had an alumni association, and I think the fact that neither the alumni nor students are numerous contributes to a real and active solidarity. One of the purposes of the association is to help find positions in private industry for young graduating engineers. Actually, those students who are going to be in government service already have contracts with the state while they are in school. For the others there is always a large choice of jobs.

In the French technical education system, there are of course as many similarities to the system in the United States as there are differences. Whatever the differences may be, though, I think you will agree with me that the two systems at least have a common aim, to which we all look forward—the engineer's career, which is, we are sure, a very grand one.

Valentin Letia

Paris