

Each year 180 freshmen are selected for admission to Caltech. Here, the Institute's Dean of Admissions tells how — and why — they are chosen.

## How Caltech Selects Its Students

by L. WINCHESTER JONES

THE CALIFORNIA INSTITUTE catalogue, under the heading of *Educational Policies*, quotes as follows from a statement by the Board of Trustees: "The primary purpose of the undergraduate school is to provide a collegiate education which will best train the creative type of scientist or engineer so urgently needed in our educational, governmental, and industrial development."

Ignoring the remark of one professor who says that the catalogue is his favorite work of fiction, it is obvious that the foregoing objective can be attained only by offering the proper kind of training to people who can use it to the best advantage. Just what constitutes the proper kind of training is fortunately not the subject of this article. The Admissions Committee is concerned only with the problem of deciding who can use it to the greatest advantage.

Leaving out the period immediately following the war when the number of those desiring admission rose into the thousands, the California Institute receives about 600 completed applications a year for admission to the freshman class, out of which must be culled the 180 individuals which the Admissions Committee thinks are most likely to become the creative type mentioned above. Immediately certain questions arise which demand an answer, if only a temporary one subject to change in the light of further experience.

What is meant by a creative type? Are the desire to create and the possession of the ability to learn and the imagination essential to creation enough—or must such qualities as persistence, steadiness, and persuasiveness be included, along with at least some competence in organizing group activities? What are the needs of education, government, and industry in terms of creative scientists and engineers? Is our prospective graduate to work in a laboratory with a small group of equals, or will he be expected to supervise the activities of numerous assistants and to sell his ideas to a board of directors?

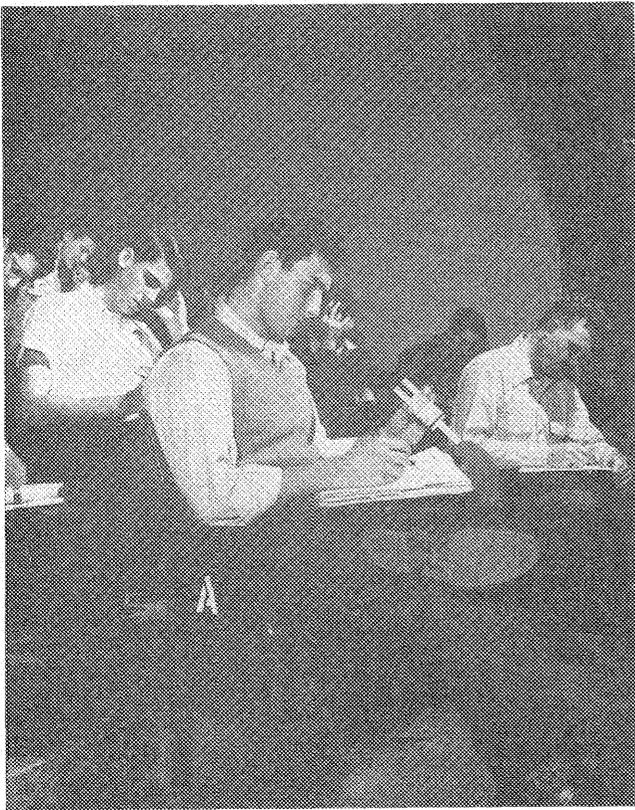
Many would claim that we are talking about two kinds of job responsibilities so widely different that we are not likely to find the qualities necessary for both combined in a single individual. The man who enjoys working individually or in small groups on creative research in the field of ideas and things is not likely to be happy or successful as an organizer, supervisor, or salesman—even of ideas. Conversely, the executive type who likes to work with people will prefer to devote his creative powers to building an organization rather than to solving problems in nuclear physics or thermodynamics.

According to this convenient division the answer to the admissions problem at the Institute is comparatively simple. The creative type of scientist or engineer for whom we are looking is really of two types distinguishable by differences in tastes and interests which will in most cases have become apparent by the last high school year, and which will be revealed by school and entrance examination grades and by information on the application blank covering extracurricular activities and spare time projects. If we supplement this information with personal interviews and discussions with teachers it should not be too difficult to separate the sheep from the goats and admit the proper number of each to make a well-balanced flock.

### A mixed flock — or all one breed?

There are two difficulties with this conception of the problem. First, every aspirant for a bachelor's degree must meet the same rigorous standards in the same basic science subjects, especially in the first two years, regardless of whether he is destined to become a research mathematician or a vice-president in charge of sales. Presuming that the Admissions Committee has done a reasonably good job of selection on the basis of scholastic ability, this should not be too difficult for those whose interests are almost exclusively academic; but those who feel the necessity of expressing themselves in extracurricular activities and to whom college means, at least in part, an opportunity for such expression may find themselves in difficulty. They may have to choose between a degree of concentration on studies which to them appears stale and unprofitable and a transfer to another college where the academic pressure is not so great. Whichever choice they make, they are apt to regard the Institute with mixed feelings, and their experiences create a reputation which discourages applications from others of similar tastes and aptitudes.

The second difficulty is even more fundamental. Not even the most enthusiastic worker in pure research can be sure that he will escape the burdens and responsibilities of the executive. A few may go through life happily concentrating on activities of their own choosing, but to most of those who make valuable contributions to progress in engineering or science there will come opportunities to head important developmental projects in the fields of education, government, or industry involving knowledge and skill which they are perhaps uniquely fitted to furnish. Such opportunities



*The Admissions Committee has been reluctant to abandon that old standby, the subject-matter achievement test.*

often carry with them a kind of obligation to accept which is not easily shrugged off because one might prefer to be let alone. On the other hand, if the man best fitted by technical knowledge and skill to head a project belongs to the type that tends to avoid experiences connected with organization, management, and persuasion his leadership is not likely to be successful if the project is at all extensive. Moreover, the same can be said of leadership in technological developments placed in the hands of those whose executive tendencies have led them to slight the stricter disciplines in scientific fundamentals.

### A combination of talents

What is needed, then, is a combination of thorough technical training underlying genuine scientific aptitude, with an understanding of, and at least some interest in, those qualities which are essential if a man would undertake to direct the efforts of others.

It seems hardly necessary to point out that such a combination of talents in the same individual does exist in a significant number of cases. The technical developments during and since the war have only served to bring to popular notice what has been true for years; namely, that the men who can head our large cooperative enterprises for technological advancement are not only great organizers and great managers, but outstanding engineers and scientists as well. Somehow, somewhere, they learned to be both.

It is certainly not the purpose of the Admissions Committee of the California Institute to ignore the student who by desire and temperament is fitted to work exclusively in the realm of ideas and things. Neither would it be very intelligent to concentrate on the executive type which is unwilling to meet the challenge of scien-

tific discipline; but if we are honestly trying to train the creative type of scientist and engineer so urgently needed in our educational, governmental and industrial development, we must recognize that it is human nature to follow those who know how to beckon attractively and to ignore those who hide their lights under bushels of concentration. It is the object and the hope of the Admissions Committee that those it selects will have the spark that can be kindled into light and that they will know how to emerge from under the bushel that they may give light to all the house.

The realization of this ideal in even a majority of the 180 freshmen selected annually would require a very large amount of available material from which to choose, and an even larger degree of omniscience on the part of those who do the choosing. Neither of these conditions prevails at the California Institute, but the ideal is nevertheless worth striving after by every means we can devise.

### How students are selected for admission

What are some of the means by which students are at present selected for admission to the Institute? First it should be said that they are neither new nor spectacular. The Admissions Committee has studied a number of tests designed to reveal aptitude and interest without examining knowledge in a specific field, which, it is claimed, should be vouched for by the applicant's high school record. Considering the wide variation between secondary schools not only in grading standards but in the content of the courses themselves, and knowing that a firm grasp of mathematics and the sciences at the secondary level is essential to success at the Institute, the Committee has been reluctant to abandon some form of that old stand-by, the subject matter achievement test. The secondary school record is of great importance, but to use it as the sole basis for judging an applicant's ability to handle problems in mathematics and physics, or to organize and present his ideas in writing would, in the opinion of the Committee, incur the risk of too large a number of failures in the first year.

Nevertheless, the secondary school record is the first thing scrutinized by the Committee. If a student has not done well in school there is very little chance that he will suddenly develop the interest or the ability to meet college standards. This does not mean that he must be a "straight A." A "straight A" who was at the same time well adjusted to the life around him would make an ideal candidate. If his grades have resulted mainly from a pious concentration on school work in order to dodge the necessity of making this adjustment, the Committee would greatly prefer a better-rounded individual with a less spectacular classroom record. For the benefit of those who ask, "Are geniuses then excluded?" it should be added that geniuses are not necessarily or often queer, and most certainly queerness is not an infallible sign of genius. Where we are convinced of his genuineness we will gladly welcome the genius, but we are not in the market for freaks. A candidate for admission must present a record showing that, especially in his last two years of high school, he has done better than average work, but he does not have to stand at the very top of his class.

For many years the Institute gave entrance examinations made out and corrected by members of the faculty. As more and more applications were received from points distant from Pasadena the administration of the tests became an increasingly difficult problem. An applicant living too far away to come to the campus had to persuade one of his teachers to proctor the examinations

for six hours on each of two Saturdays—a somewhat excessive demand on the teacher's free time. If an applicant were refused here he could not use the tests for entrance elsewhere, and for this reason a substantial number of good men each year who disliked putting all their eggs in one basket probably preferred to take examinations which had a more universal application. The Institute tests were of a kind which called for careful scrutiny of each problem on the part of those who did the grading, and as the number of examinees grew it became increasingly difficult for a department representative on the Admissions Committee to grade his particular set of papers in the time allowed. To have parcelled this work out among a group of younger assistants would have impaired the quality and uniformity of the grading.

These are among the reasons why the Institute will use the tests of the College Entrance Examination Board, commencing with the class to be admitted in 1950. These tests were selected after careful investigation and after studies had been made which included the administration of College Board Examinations to an entire entering class which had, of course, previously taken the Institute tests. The results of the two sets of tests were compared with the grade-point averages of these men at the end of the first year at Tech, and while both tests proved to be good predictors of the degree of success here, the Board examinations were somewhat better.

### Alumni pitch in

At this point it is appropriate to mention with gratitude the hard and excellent work done by a number of Tech graduates who established examination centers and arranged for supervision of our tests in Boston, Chicago, New York, Philadelphia, San Diego and San Francisco. If our alumni were more widely scattered and if applicants did not sometimes turn up in the most extraordinary places, the administration of our own tests would not be a problem.

It is impossible to predict at this time just what effect the shift to the College Boards will have on applications. It is expected that these will increase somewhat, especially in the East and Midwest, where the Boards are taken as a matter of course by a very large number of those who intend to go to college. The fee of \$12 which the Board charges for the full set of tests required by the Institute may discourage some, but we believe that this defect is outweighed by the far greater convenience with which applicants can arrange to take the examinations.

The College Board tests which an applicant must take for admission to the Institute are the three-hour morning program which consists of an aptitude test in mathematics and in verbal ability, and an afternoon program of achievement tests in physics, chemistry, and advanced mathematics, each requiring one hour. It is regrettable that a special test in English cannot be included, but this subject is perhaps adequately covered in the verbal section of the morning program. The mathematics section of the morning program is not sufficient for our purposes, because it is intended to reveal general aptitude rather than to indicate actual performance at a certain level as does the afternoon achievement test. Moreover, this subject is the one with which most Tech freshmen are likely to have difficulty, and it will be valuable to have this additional information.

The question now arises as to the weight which the Admissions Committee gives to these examinations. Experience with the Institute examinations formerly given

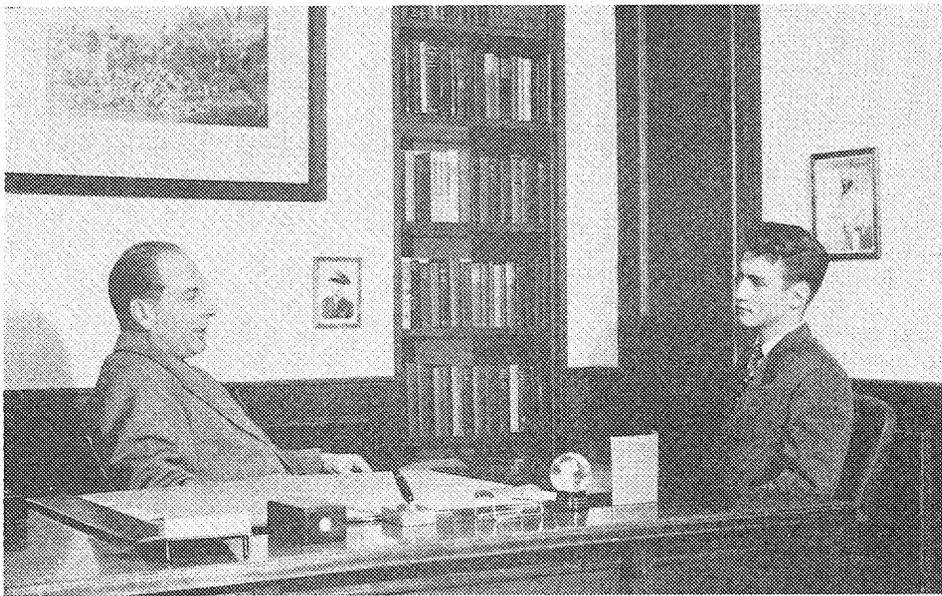
has shown that out of a group of say 500 examinees the lowest 30 percent probably cannot make passing grades at Tech and can be eliminated on the basis of the examination grades alone. The top 10 percent have a good chance of making outstanding records. This leaves 60 percent, or 300 individuals, about whom it is difficult to make predictions solely on the basis of the examinations. Comparisons of test grades and performance in the first year at Tech have shown that while in general those in the upper brackets of this large middle group do better academically than do those near the bottom, there is a large number of individuals whose records at Tech are much better or much worse than the test grades indicated. If in this group the examinations were almost the sole criterion for admission a very significant number would be turned down who, on the basis of actual performance in college, might have made far better records than many who were selected. Concerning those whose test results place them in this category, more information is needed if the best material is to be picked. There is no reason to believe that the switch to the College Boards will materially alter this situation.

The percentages given above are not, of course, exact nor are they constant from year to year, but within the general areas indicated they have proved to be a very satisfactory way of separating those who in all probability could not succeed in our work from those who should be given further consideration. If 30 percent seems like a small number to eliminate by means of the entrance examinations, it should be remembered that the candidates have already been fairly well screened on the basis of secondary school records and by their school advisors, who are likely to discourage the poorer students from making application.

When the examination results are known, the Admissions Committee is still faced with the problem of selecting 180 men from among the top 350 remaining out of our hypothetical 500 examinees. What further information on these men can be secured? One immediately thinks of letters of recommendation, and these can be of great assistance, especially if they come from those who know something of our work and the kind of student for whom we are looking. Of much greater value, however, is a personal interview with the student himself, and not only with the student but also with his teachers who have had an opportunity to observe his characteristics and his aptitudes from day to day over a period of a year or more.

### The interviewer on the spot

The position of the interviewer is a delicate one. In his relations with an applicant he must try to remove, or at least to penetrate as far as possible, the barrier which the student's shyness and anxiety will inevitably raise between them. This shyness can assume a number of outward manifestations, the least difficult of which are the awkwardness and mental numbness usually associated with the word. Last year I interviewed two men at the same school and considerably astonished the principal when I told him something of my conversation with each. The man who the principal had feared would ruin his chances because of the physical and mental awkwardness which came over him in moments of that kind, and who did come into the room looking as though he had been frozen into a cake of ice at a particularly bad moment, loosened up and gave a very good account of himself. The other applicant gave a first impression of possessing far greater poise, but throughout



*Members of the Admissions Committee conduct personal interviews to determine the suitability of candidates for admission to the Institute. Dean Jones is interviewing prospective student at left.*

the interview he refused to emerge from his chosen disguise, an attitude and bearing not unlike those of the British officers in whiskey advertisements, and the grace and affability of a secretary of state about to be photographed with Vishinsky, and he revealed just as little of himself. The first thing an interviewer must get rid of is any susceptibility to prejudice created by first impressions.

In his conversations with teachers and with school administrators the interviewer must likewise be wary. He is trying to do three things: first, to test his own judgement by securing the honest opinions of those who should be in a far better position to know something of an applicant's real qualifications; second, to size up the school and the value to be placed on what he is told; and third, to leave behind him a sufficiently good impression of the California Institute so that in the future more good men will be encouraged to apply.

The first of these tasks will be satisfactorily accomplished only if the interviewer gains the confidence of those to whom he is talking. He must convince them that he is as much interested in the welfare of the applicant himself as they are; otherwise on any issue about which there is doubt he will get non-committal answers at best.

In sizing up the school and the teachers or administrators with whom he comes in contact he must determine whether, for example, in a large school there are really sufficiently close relations between students and faculty to give an opportunity for personal judgements, or whether the student under discussion is just a name in a roll book and a card in an efficiently indexed file. All school administrators are between two fires. Parents who send a child to be prepared for college are not pleased when junior fails of admission. On the other hand, colleges which have had unfortunate experiences with the recommended graduates of a given school are apt to be chary about admitting more. Very few schools indeed will try to play one side at the expense of the other. Most teachers, councilors, and other administrators are sincerely interested in the future success of the student himself, and they are quite properly also sympathetic. They want to give him every chance. When the case is not a clear-cut one either way, the degree of recommendation becomes a nice matter of judgement, and the quality of judgement can vary widely from one school to another.

In trying to create the impression he would like to leave behind, the interviewer himself is in the midst of a number of fires. He cannot trespass unduly on the time of those he meets, and most of the time at his disposal will, of course, be devoted to sizing up the applicant. Yet it is important that those to whom students come for advice should know what kind of man Caltech wants. They should also know that Tech is not beating the bushes for mere numbers of applicants. We have plenty of those. What we have not in plenty—what no college that is worth the price of admission has in plenty—is a throng of applicants all of whom measure up to the ideal. God forbid that we ever should have! When we do, it will mean that we have given up trying and lowered our sights; and when this happens, the average of what we do get will be proportionately farther from the ideal.

For an interviewer to state our attitude in these words would, of course, scare most school authorities out of ever encouraging anyone to apply. What he must make clear is that our ideal is not necessarily the "straight A," not necessarily the genius, but the man who, whatever else he may be, has the brains and the fortitude, and who will someday have the influence necessary to make his creative ideas stick. He must, of course, have demonstrated in his secondary school work that he has sufficient facility in mathematics and physics to do satisfactory work in courses which are as difficult at the California Institute as they are in the engineering or science majors at any other reputable college. Equally important, he must have a real interest in preparing for a career in engineering or science. If there is a reasonable chance that he has these qualifications, we hope that his teachers and advisors will urge him to apply and to see what he can do on the examinations in relation to others who also take the tests. If there remain any doubts, they can be gone into at the time of the interview.

When an interviewer has made all this clear in ten or a dozen words he will find that he is already late for his next appointment a hundred miles away. His most difficult task may, however, still remain to be done if he feels that the student he has just seen will not measure up to admission standards. When this feeling is more or less in tune with what has been expressed during the discussion of the student's qualifications there is no problem, but if there is a strong school recommendation,

the interviewer must tactfully pave the way for the rejection letter he is fairly sure must be sent.

On the way to his next destination he will have time to sort out his ideas. Did the applicants at the last school seem to possess the desired personal qualities already developed or likely to develop in the future? Was there a reason why the low grade earned by student A in the physics examination should not be taken as a measure of his grasp of the subject? Are the standards of this school such that its medium grades are the equivalent of higher grades at other schools? Can the judgments of its staff be relied upon in the face of an unfavorable examination record or a poor impression created by the student? On the basis of the interviewer's impression should applicant B be pushed into the accepted group in spite of a relatively weak academic record, and is applicant C just an examination hound whose only real ability is to regurgitate information on demand, and should he, therefore, be eliminated in favor of a man with a poorer record but better all-around potentialities?

### The final analysis

In attempting to decide questions like these the Admissions Committee meets every day for two weeks after its members have completed the interviews. Every applicant is carefully discussed until the Committee feels it can reach a decision on two points. Can this man use to the best advantage the kind of training afforded at the California Institute? Is he the best man we have available for one of the remaining places in the entering class? That some of those admitted do not turn out to be the best goes without saying, and those who must be turned down should have the satisfaction of knowing that the Committee is far from infallible. In one thing the Committee can take some pride. The California Institute has one of the lowest academic failure rates to be found among the colleges of this country.

It might be thought from the foregoing that Caltech is interested only in applicants for admission to the first year, but transfer students are equally welcome because good men are just as likely to come to us from other colleges as they are directly from high school. To enter the California Institute a transfer must have covered the substantial equivalent of the first year or the first two years at Caltech by June of the year in which he desires admission, and he must have earned good grades. Regardless of the college he has previously attended, he must take the transfer entrance examination given by the Institute early in June of each year. His standing on these examinations will be the largest single factor in determining his admission.

This article has been an attempt to summarize the problems and policies of admissions at Caltech. These problems and policies are intensely interesting, at least to those responsible for them, and they are of fundamental importance to the well-being of the college. But the work of the Admissions Committee is only the middle link of a three-link chain. Before the Committee knows of his existence a student must make application, and even after he has been admitted there may be factors which prevent him from turning up on registration day.

First, what about applications? The reputation of the Institute is such as to assure an adequate supply from which to select 180 good students, even if nothing more were done. But bearing in mind our ideal, what we want each year is 180 better men, and the greater the number and diversity of those who apply, the more chance we have of getting them. To increase the supply we must spread information as to what kind of student

we want, what we can do for him while he is here, and how our particular kind of training will help him after graduation to achieve the objectives in which he is interested. We must sometimes try to dispel illusions such as that only a goggle-eyed grind can hope to earn passing grades, that there is no time or opportunity for extracurricular interests, that we do not offer courses at the undergraduate level, or that we have never won a football game. We must pay particular attention to geographical distribution. Our present ratio of out-of-state and foreign students to those from California is high, but we would like to see it increase. A student body which reflects the ideas, tastes and prejudices of only one locality denies its members a breadth of experience that is an extremely important element in college education.

Fortunately we do not have to sell anything or persuade anyone; we have only to inform. To do this we must, like most colleges which are able to select their students and which are, therefore, faced with similar problems, rely mainly on our alumni and on members of our staff. Any college values its reputation for scholarship and productivity, but this is often not sufficient in itself to encourage further inquiry. To a high school senior such a reputation is vague and somewhat formidable. It conveys no idea of the homely details of undergraduate life in which he is very much interested. It implies great opportunities but does not relate them to the individual. His teachers and advisors sincerely want him to enter the college which will offer him the best chance to develop his particular interests and aptitudes, but they too must have some knowledge of details if they are to be in a position to suggest.

### What scholarships would do

The last link of our admissions chain which begins with the urge to send in an application is the one which ends on registration day. In order to have a freshman class of 180 it is usually necessary to admit about 220. By far the largest number of cancellations result from the final realization that the applicant or his parents just cannot meet the costs and be fair to other members of the family. Too often some of our best selections are included in this group. The further from Pasadena an applicant lives, the greater is the over-all cost of attendance, and this has its effect on geographical distribution. The answer, of course, is more scholarships large enough to make up the difference between attending Caltech and a non-tuition college closer to home—or even to make possible the attendance of a few outstanding men whose only resources are their own earnings. To the members of the Admissions Committee who have seen some of their best prospects prevented from entering because there just wasn't enough money, the matter of increasing scholarships is of primary importance.

The attempt to select students who will make the most of a college education is certainly one of the most stimulating and interesting occupations a man can engage in. If the process is to be successful there must be numbers from which to select, wisdom in selection, the elimination of the financial barrier where outstanding men are concerned, and finally, if the whole thing is to have any meaning, an atmosphere and a quality of training predominant in the college itself which will best enable a man to develop into the kind of engineer or scientist, and the kind of citizen that this world so urgently needs. Of these requisites the Admissions Committee of the California Institute is certain only of the last.