



THE  
CALTECH  
STUDENT

— His Aptitudes and Limitations

## A critical look at the technical student in general —and the Caltech student in particular

By HUNTER MEAD

*The special advantages, disadvantages—and just plain differences—of a technical education are subjects for continuous discussion. In Engineering & Science last month, Earnest Watson, Dean of the Faculty at Caltech, discussed “Liberal Education in Our Engineering Colleges.” Here, Hunter Mead, Professor of Philosophy and Psychology at Caltech, presents some provocative ideas concerning students in technical schools. Dr. Mead’s may, indeed, be a minority viewpoint; but it is one which certainly deserves to be heard.*

THE BELIEF THAT CALTECH students are a peculiar breed of humans is so widespread that it is worth examining. Even those of us who work with them constantly are sometimes moved to wonder just how “different” our students really are. We may loyally defend them to off-campus folk who raise an occasional quizzical eyebrow when newspaper publicity spotlights some campus personality or activity, but in the inner recesses of our souls we frequently raise the same quizzical eyebrow, or perhaps feel a slight uneasiness as to whether or not we really understand Techmen.

So, assuming that when we observe such puffs of smoke here and there on the campus there must be some fire, let us look at the situation. To do so we must risk some generalizations and extrapolations, but they are ones which we can document at least partially.

We can begin by verifying the popular impression that Techmen are intelligent, whether we compare them with the general population or with the college student population. Several years ago it was my interesting privilege to administer intelligence tests to a large part of the senior class during two successive years. There are difficulties in determining the I.Q. of adults, and also difficulties in working out scales for individuals who vary widely from the general population median. Granting these difficulties (and the caution which they

suggest), it is still worth recording that an intelligence test, given to many thousands of subjects drawn at random from the general population, produced a median score of approximately 100; but the Caltech seniors’ average was 142. It should be underlined that this is the average (median) score; this means that one-half of the group are higher than this. On this particular test I found only three students (from a group of about 160) lower than I.Q. 130. The bottom score (122) was that of an Oriental student with a severe language handicap!

What does all this mean, in terms of other intelligence groups? For one thing, it means that the poorest Techman is at, or slightly above, the median for American college seniors as a group. It also means that the poorest Techman is quite a cut above the median for all American college students. In terms of the general population, it means that all Tech students are in the top few percentiles, and the best of our students are in the top fraction of one percent.

Since the subjects for this particular test were all seniors, we cannot conclude that all Techmen are quite this high in raw intellectual aptitude. It is probable that we sometimes get freshmen who, if they did not flunk out, would pull this figure down if we tested their particular class—with them still in it—in its senior year. But, by and large, it seems safe to make the generalization that whatever else our students bring with them when they come to the Institute, they certainly bring intelligence adequate to the requirements of our undergraduate work.

They also bring with them exceptionally high motivation. This is a generalization which it is harder to document, since we have no satisfactory test to measure motivation accurately. We can only judge it in functional terms—that is, in terms of how hard our students work and the load they carry. While some Techmen do not work as hard as they tell their families and friends they do, they certainly work harder than the average college undergraduate.

I think it is inevitable that anyone joining the Caltech faculty after teaching in a non-technical institution will be impressed by the motivation and work-habits of our students. These work-habits may not be of maximum efficiency, but any student who survives our curriculum for more than a term or two has necessarily established the pattern of working hard and regularly. The present writer (who admittedly meets Techmen mostly as seniors and fifth-year students) is perpetually impressed with the motivation and ambition of most of our student body. Such a statement obviously ignores some of the flunkouts and transfers, whose motivation may be either insufficient or along other lines than technical, but I believe that we can safely generalize that the motivation of Techmen rates extremely high.

### The limitations

However, all is not sweetness and light in a best of all possible academic worlds: the Tech student usually brings with him some very definite limitations which are both frustrating and challenging to his teachers, particularly those who instruct him outside his major fields—and doubly so to those of us who work with him in our Humanities program.

Probably the most serious limitation, at least as it concerns the general education of technical students, lies in the fact that such students are top-heavy in quantitative and spatial thinking ability, and relatively deficient in what the psychologist calls verbal thinking or linguistic ability.

Within the individual's own field this limitation may not be serious, since any Tech student has at least enough verbal capacity to acquire facility in the terms and concepts of some particular field where he works constantly. Then too, in engineering and the physical sciences, most of the basic ideas of the field are expressible in quantitative terms, as formulae or equations, or they can be presented in visual terms as models or diagrams of some sort. Hence the verbal statement is greatly aided by non-verbal symbols, so that a verbal deficiency may be compensated for or masked. But when the student moves to another field, particularly one where quantitative-mathematical concepts are secondary or non-existent, we frequently find a different situation. Again the Humanities represent the most obvious example. But even a comparatively precise science like biology seems to prove a stumbling-block to some of our students who are so quantitative-minded that they are at ease only in physical science or engineering.

This same quantitative- and spatial-mindedness is usually accompanied by another characteristic which, while it is not necessarily a limitation, nevertheless produces many academic problems and student frustrations. I refer to the tendency of our students to be at ease only in clearly-organized, well-structured intellectual situations. Of course, all humans have a prejudice in favor of such situations, but technical students, as a result of both their intelligence and their training, apparently require a higher degree of intellectual organization to

make them feel secure in the presence of any given situation.

This insistent "demand for structure" (if we may coin a phrase) has two consequences, one pedagogical and the other more serious, in that it will probably accompany our graduates throughout life. As far as their course work at Tech is concerned, this demand means that our students are bitterly critical of courses and teachers which they feel lack organization, logical presentation, and clearly-seen goals.

In the several polls taken on our campus in which the students have rated their instructors, this fact has become strikingly obvious. Students will apparently overlook a multitude of inadequacies and personal idiosyncrasies in a teacher, provided his presentation is logical, his course organized, and his explanations clear. On the other hand, Techmen plainly refuse to consider personal charm, light assignments, and even fair grading as substitutes for organization and clarity in a teacher.

Here we can safely risk another generalization: if the course is well-organized and logically presented, all is forgiven; if it lacks these qualities, nothing can save the teacher from damnation in the eyes of his students.

It might be argued that this constant demand for lucid explanation and rigorous intellectual structure reflects the student's quest for an easy path to knowledge and professional competence. I personally see it as something else. While admittedly students do not like to have unnecessary obstacles to understanding thrown in their way, their insistence upon logic and lucidity seems to me to represent an assumption (often probably unconscious) that degree of organization equals degree of understanding and intellectual power. However, I believe that the student is thinking of his own understanding and power when he makes this assumption, rather than that of his instructor. On the rating polls referred to above we commonly find comments like these regarding a poor instructor: "Knows his subject but can't get it over to the class," or "Knows the stuff but can't organize his lectures or demonstrations." It is rather that the student feels that he personally cannot grasp the subject thoroughly until he perceives its organization and relationships.

### Logic and system

I think there is also a common tendency for students to assume that the subject matter of science and engineering courses (i. e., nature or natural phenomena) is logical and systematic, and hence that any course which has nature and its behavior as the subject should also be logical and systematic. I carefully refrain from becoming involved in a discussion as to whether the student is warranted in making either assumption, but I am certain that he very frequently makes one or both.

To my mind the more serious consequence of technical students' demand for lucid structure in situations is something else—something which constitutes a real limitation of many Techmen, in terms of both their

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present intellectual development and their later adjustments to life and to society. Here I refer to the almost ferocious tendency of many of our students to impose organization upon situations at almost any cost.

On the strictly intellectual level this may lead to nothing more serious than oversimplifying problems and situations, although oversimplification can of course be serious at times. On a deeper intellectual level it may lead to genuine blind spots—that is, to a tendency to dismiss genuine problems as unreal because they resist formulation in clear-cut terms, or even to shrug off whole fields of human endeavor because they are not “scientific.” This really amounts to saying (although our students seldom verbalize it) that if a field is less structured than the sciences are, its subject matter is either trivial or unreal. To my mind this self-imposed limitation which many of our students make constitutes the most serious intellectual deficiency of technical students as a class. Perhaps the faculty in the division of the Humanities is most aware of this limitation in a large percentage of our students, but I believe any thoughtful person who works with technical-minded and technical-trained persons finds this to be a characteristic blind-spot.

Of course, as long as Techmen work and associate largely with other individuals whose possible limitations are likely to be similar to their own, serious social consequences seldom follow from even drastic instances of over-structuring intellectual situations. But when our students leave the campus, either socially during their student days, or permanently with a degree or two, real trouble may arise.

It is all too common for Techmen to carry their Tech-ness into every human situation, seeking to impose the same rigor and logical organization upon people and society that they find (or attempt to find) in their technical subjects.

### The slide-rule tells all

We have all heard remarks about the Tech student “trying to figure people out by slide-rule” or “seeking a formula for getting along with women.” Apparently there is as much truth as wisecrack in such remarks. The Techman is prone to handle people in general as he handles tools and equipment, and in social situations where relationships are not clear on the surface he is likely to be baffled and irritated in the extreme.

In the case of our students this is more than youth’s characteristic demand for candor and the elimination of hypocrisy in social situations. There is, in addition, an insistent need for clear-cut organization, obvious cause and effect relations, and for opportunities to frame inductive social generalizations. Since people are too complex and society too devious to permit this very often, our bright but sometimes limited students are



*Isn't there a formula for this kind of thing?*

frequently at a marked social disadvantage. While we manage to keep all but a few from crawling into an antisocial shell of research laboratory isolation, it seems to me that the Institute must keep seeking for more effective ways to teach our students how to get along better with people.

We share this problem with all technical schools, and we pride ourselves that Tech has pioneered efforts toward humanizing scientists and civilizing engineers. Because a high percentage of our graduates eventually assume supervisory and managerial positions of some kind, in which working with people becomes of greater importance than working with things and physical forces, the problem is particularly urgent on our campus.

The Humanities Division, together with the Institute administration, constantly seeks better ways of meeting the problem, and suggestions from alumni are particularly welcomed. There is every indication, however, that any real solution will be far in the future. Both by nature and by nurture, technical students are too habituated in rigorous, highly-organized types of thinking to acquire facility easily in other types of thought. Yet some facility in this secondary type of thinking must be acquired if one is to be a good citizen, a tolerable neighbor, and a socially-integrated person. Hence, it seems obvious that the Institute has obligations in this direction which are just as compelling as our obligations to give the student professional competence.