

trained scientists and engineers selected for employment are highly motivated and talented. About 20% of these, or 10% of the total, have both the ability and the desire to do creative work." It will not do simply to let the youths do their own choosing. They do not know enough about themselves and the many professions; they are liable to be swayed by their parents, who may know less; and boy and parent are liable to be attracted by the glamor (as many see it) of the profession of *inventor*. Every entrance examination, NSF scholarship test, etc., postulates that people are *not* fully competent to rate their own capabilities and select their own schooling. Logically this should apply to people aiming too low, as well as too high or in the wrong direction. President DuBridge of Cal. Tech. says⁶³⁴ that the brightest high school graduates in science should not be permitted to go to the lower grade colleges; and indeed half of the National Merit Scholarship winners did choose the half-dozen best colleges.

[633] In our selecting we should bear in mind all the many and peculiar psychological traits mentioned in chapter 12, and others which Government-paid psychologists are now digging out, and particularly the facts that the boys we seek are often of middle or lower class origin, and *not* the best regarded by their teachers, and usually *not* of the highest though still of good scholarship (see ftN 603, p. 192) (§ 609). MacKinnon's⁵⁷⁹ psychological tests of engineering students⁶³⁵ for originality and creativity, found a 0 correlation with their professors' judgments. These latter were supposed to be on "creative originality," but correlated about 0.8 with grades, and 0.77 with faculty rating of scientific productiveness. Evidently their professors were quite unable to determine their inventiveness, and could report little more than their scholastic aptitude. So MacKinnon recommends less attention to our present tests for "engineering aptitude" and intelligence, and to seek some that will show "a relative absence of repression or suppression as mechanisms for the control of impulses and images," since these make unavailable to the inventor large aspects of his experience. He must be free to use his subconscious, which works more by symbols than by logic. An inventor needs intuitive thinking, rather than sense-perception, and learning of facts unrelated. The knowledgeable man is not just full of facts, but "has the capacity to have sport with what he knows." He can manipulate ideas. Essay-type examinations are better for revealing such, than objective tests.

[634] After selecting out such students, their instruction, MacKinnon thinks,⁶³⁶ should aim at freedom. There should be a paper or other problem in every course, with some liberty to select it, and a hard goal and a strong motive. To encourage intuitive thinking we should seek common elements, principles, analogies, similes, imaginative play. We must often judge, but not prejudge, rule out of consideration. Even fantastic ideas of students should be sometimes listened to. We may find our creative students hard to get along with, but must realize that they are trying to "reconcile opposites in their nature, and (we should) tolerate large quantities of tension as they strive for a creative solution to difficult problems they have set themselves."

⁶³⁵ On 40 seniors, mostly honor students, from central California, volunteers to take the elaborate tests. Their professors' judgments were not known to the psychologists. MacKinnon, N 579, his p. 139, etc.