As another departure from convention, the panel report proves to be well written, refreshingly free of either education-journal jargon or the flabby depersonalized prose of the ordinary government report. The authors and editors even dare to use humor to make a point or two.

The section on music education is based mainly on a 2-week seminar at Yale, which seems to have been devoted largely to an exploration of whether techniques of curriculum reform developed for the sciences—essentially, getting school teachers and research scholars to work together—can be adapted to education in the arts. Music teachers and administrators were mixed with professional musicians, including jazzmen, and the verdict seems to have been that both sides thought it would be both possible and desirable to break down the barriers between the groups which make music education in most schools a stuffy, closed-shop affair.

Breaking Barriers

In discussing the major recommendations of the report, Zacharias traces the need for model school systems and improved teacher education to the same source. "Both programs," writes Zacharias, "develop out of the circumstances that our modern school systems have evolved largely in a middle class context. The task of bringing the deprived and segregated into larger society is difficult. And despite some modest efforts and some modest successes, we really know very little about how to accomplish this task. Of course, more classrooms and teachers are an important part of the answer, but as the two proposed programs indicate, the panel does not believe that simply offering more of the same is the full solution."

In the report, the basic flaw in teacher education is described this way.

"A vast number of institutions are now busy offering instruction in pedagogy and related matters. But formal instruction in these institutions makes little connection with the problems that the teacher actually faces when he is teaching in a school, largely because of the abstract approach and the level of generality at which the material is taught."

While the panel's recommendations on teacher education are only sketched in, they emphasize that it is necessary to develop more rapid ways of disseminating new ideas, such as the modernized curricula, and that reforms are needed not only for the student who is training to teach and the teacher in service but also for the teacher of teachers.

One suggestion the panel makes for moving teacher education nearer to the realities of teaching is to develop films which will impart a knowledge not only of subject matter but also of techniques needed in special situations.

"Films," says the report, "can help prepare teachers for meeting recurrent teaching problems common to many courses—although the teacher in the film should be teaching a particular subject. Among recurrent teaching problems are these: How do you teach students who are convinced they cannot do the work? How do you teach students who are always sure they are right? How do you teach slow students? How do you teach students who are brighter than you are? There are special problems, too; for example: What do you do with the child who freezes when asked a question? How does a teacher get out of such a situation and how does he avoid getting into it in the first place?"

The fact is that films of the kind the panel advocates do not at the moment exist. The experience of PSSC in producing films of a kind that had not been available before, however, persuaded the people behind the report to believe that, given the present "state of the art," the development of such films is a possibility.

Reform Through Technology

While the report puts a fair amount of stress on the potentialities of these films, there is little sign that the panel members are bemused by technology, as some educational reformers have been. Educational television and programmed learning, for example, have in many places been robbed of maximum impact because they were used out of overoptimism or desperation.

The education panel, incidentally, is not dominated by scientists and engineers, but rather is recruited almost entirely from among what could fairly be called the national establishment in American education. It numbers among its members such hierarchs as the president of Teachers College, Columbia, the general superintendent of schools in Chicago, and the president of the American Council of Learned Societies, plus a sprinkling of foundation and association notables and university scholars and Washingtonians implicated in educational reform.

The educators and administrators and the professionals from other fields involved in the meetings, however, represented a much broader spectrum of prestige and a wider geographic spread than the panel, and in this sense give the panel a broader base.

Asking how effective the panel will be is like asking how effective the Conant evaluations or the Rickover obiter dicta are. For educational reform is very much a matter of little drops of water or little grains of sand.

Major experimentation in education along lines suggested by the panel would clearly require a substantial infusion of federal funds. Both the Office of Education and NSF appear hospitable to programs designed to improve specific aspects of education, so long as this can be done without aid's being interpreted as interference. But the panel's prospects of exerting direct influence on legislation are dim, since the group has only a tenuous connection with the White House and no visible link at all with Congress.

The best immediate chance for obtaining new federal funds for such panel projects as model school systems and special teacher training seems to lie in the Economic Opportunity Act of 1964, more widely and candidly known as the Poverty bill. The bill has a section on Urban and Community Action programs, under which it would apparently be possible to implement some of the panel's ideas.

President Johnson has put the Poverty bill on a list of five priority measures, but its fate will be influenced, in more than one way, by the outcome of the debate on civil rights legislation.

—JOHN WALSH

Lie Detectors: Sleuthing by Polygraph Increasingly Popular; Claims of Accuracy Are Unproved

According to information turned up by a House Government Operations subcommittee,* the American Battle Monuments Commission does not use lie detectors. Neither do the Indian Claims Commission, the Federal Aviation Agency, the St. Lawrence Seaway Development Corporation, or 35 other

* *Use of Polygraphs by the Federal Government: A Preliminary Study, by the Foreign Operations and Government Information Subcommittee.* The chairman of the subcommittee is Representative John Moss (D–Calif.).

agencies, including the National Science Foundation and the Smithsonian Institution. Nineteen major government agencies, however, have found these controversial gadgets handy for a variety of security, criminal, and other misconduct investigations, and for personnel screening—so handy, in fact, that last year they administered the tests 19,122 times. (That figure excludes the thousands of routine preemployment tests given job applicants by the CIA and the National Security Agency, as well as other tests administered by these sensitive agencies. The numbers are classified.) Even the figures do not reflect the true veneration in which the lie detector or polygraph is held. It was announced last February, for example, that the Pentagon had taken to using portable lie detectors in Vietnam, to flush out Viet Cong agents infiltrating the government forces. The model in question, about the size of an electric razor, is far less complex than standard equipment; it is regarded, even by real proponents of lie detection, as better suited to parlor games than to criminal interrogation. And when there was a leak to the press during congressional investigation of the TFX award last year, the impulse of the Pentagon was to make even some very high officials submit to a lie detector test to discover whodunit.

In the opening subcommittee hearings 2 weeks ago, witnesses representing both the lie detector industry and the Pentagon—the heaviest known government user of lie detectors—could come up with no statistics, studies, or figures to indicate why they believed the instrument was so satisfactory. Eleven years ago the Atomic Energy Commission conducted one of the few studies of the lie detector yet made—an analysis of its utility in enhancing the security of AEC operations at Oak Ridge. Despite the claims of the polygraph operator at Oak Ridge that its results had been sensational there, the commission concluded that "such a program could be expected to result in only an indeterminate marginal increase in security beyond that which is currently afforded by established AEC procedures for personnel, physical and document security. Against such indeterminate marginal increase in security, consideration was given not only to the substantial dollar costs of a polygraph program but also the intangible costs in employee morale, personnel recruitment, etc. It was concluded that such costs outweigh the benefits which might accrue to the AEC security program at this time."

Subsequently, with no apparent bad consequences, the AEC has been very sparing in its use of the machine, conducting only one lie detector test last year. The space agency, too, has used the machine infrequently—only twice in its history. Other agencies, however, have been far less restrained; the Army alone conducted 12,500 tests last year; the FBI, 2314. In private industry, also, use of the polygraph is growing; no exact figures are available, but the major firms that specialize in polygraph examinations say their business is nearly ten times what it was a decade ago. Although the chief use in business is still, as in police work, investigation of specific incidents or individuals, another kind of use more akin to that of government security programs is also growing up. Many businesses now use lie detectors for routine screening of all job applicants; others use it as a prophylactic, making periodic checks on the honesty of their employees. This enthusiasm for the polygraph is not shared by courts, who have generally ruled the results of lie detector tests to be inadmissible as evidence.

Watching the Watchers

The circumstances of use of the lie detector are extremely unpleasant. It appears to be standard practice, both in and out of government, to assign watchers to watch the watchers: interrogations take place in rooms equipped with two-way mirrors and special recording equipment so that the examination is overheard by others, invariably without the subject's knowledge. Within the government, practices vary: in some agencies the results of lie detector examinations become a part of the subject's permanent record; in others, they are destroyed. Most agencies claim that the results of lie detector examinations are considered as only one part of a total investigation, and that decisions affecting a person's welfare would never be made on the basis of a lie detector test alone. But while favorable polygraph results can no doubt be outweighed by other evidence, it is far harder to overcome the suspicions arising from a polygraph finding of deception.

In some agencies refusal to take a test may be interpreted as indicating guilt or bad character; others claim that refusal is accepted without prejudice to the subject. Though most practitioners would deny it, there is no doubt that at least one use of the lie detector borders on intimidation, on the hope that fear of the machine will induce confessions. One chapter heading of the latest book by Fred Inbau and John Reid, two of the leading advocates of the polygraph, reads: "Ask the Subject Whether He is Willing to Take a Lie-Detector Test. The Innocent Person Will Almost Always Steadfastly Agree to Take Practically Any Test To Prove His Innocence, whereas the Guilty Person Is More Prone to Refuse to Take the Test or to Find Excuses for Not Taking It, or for Backing Out of His Commitment to Take It."

The amazing thing is that all these practices have been developing on little more than the claims of the polygraph promoters that the tests are extremely accurate. Congress is usually perfectly willing to let the executive branch look foolish and even extravagant (the 512 polygraphs known to be owned by the U.S. cost about $428,000; the annual salaries of polygraph operators come to a bit more than $4 million; each polygraph examination is thought to cost between $20 and $30 dollars). But more complaints from constituents have apparently been coming in, citing use of the instrument in ridiculous circumstances; the AFL–CIO, which has been influential in getting laws passed in Massachusetts, California, Oregon, and Alaska forbidding the use of the lie detector in personnel screening, is extremely interested in further limiting its use; and, finally, all this fuss over a gadget many people regard as no more efficacious than sheep's entrails for divining deception has begun to make some congressmen a little nervous. A feeling is beginning to emerge that the possible dangers of lie detectors may exceed their utility, and if no evidence is presented in the course of the hearings that proves otherwise, some curbs on their use may be forthcoming.

Sleuthing

Standard lie detectors are combinations of three types of scientific instruments: a pneumograph, which records breathing patterns; a galvanograph, which records changes in the skin's resistance to electricity; and a cardiosphygmograph, which measures pulse rate and changes in blood pressure. These are attached to a fourth device which moves the chart paper under recording pens at a regular rate and produces the final record. As a measure

of physiological reactions, the instrument is generally thought to be reliable; in fact, it is used by NIH and other research institutions in many animal experiments and other studies. Its use as a lie detector, however, rests on the assumption that attempts to deceive will be accompanied by distinctive physiological changes that are recorded by the machine and interpreted by the examiner.

The general line taken by most polygraph supporters (these include the handful of manufacturers, officials of the four U.S. schools of instruction in lie detector techniques, and the police and government departments, and businesses, who use the polygraphs) is that the examiner, not the instrument, is the actual "lie detector." According to a statement by the head of the Keeler Polygraph Institute in Chicago (a major polygraph school associated with one of the major polygraph producers), "the polygraph is a scientific, diagnostic instrument. Through the proper use of the polygraph, the properly trained, skilled examiner can diagnose truth or deception just as the skilled roentgenologist can diagnose hair-line fractures or the internist can diagnose aortic regurgitation. No instrument can diagnose anything by itself; neither can the untrained or unskilled person diagnose even with the aid of instruments."

Schism in the Ranks

This statement would be defended by virtually all the advocates of scientific lie detection. Predictably, however, the advocates are divided—sometimes rather bitterly—on what constitutes the all-important proper training. The Keeler Institute runs a course of several weeks' duration; so does the Army, which trains a large proportion of the government's polygraph operators but relies on techniques developed by private practitioners. Both these schools feature a combination of academic subjects (psychology, physiology, and law) and practical training in the mechanics and operation of the machine. However, another Chicago outfit, John Reid and Associates, emphasizes experience as well. Reid believes that a 6-month program is essential, and fears that quickie courses are giving scientific lie detection a bad name. Reid and Keeler also favor slightly different methods of questioning the subject: Reid *interviews*, Keeler *interrogates*. The differences are vital to them but difficult for an outsider to grasp. All proponents of scientific use of the polygraph by trained operators are united in their disapproval of the quacks and charlatans who, in the absence of state and federal regulation, are permitted to purchase a machine, along with a how-to-do-it handbook, and set themselves up in business; a fairly large proportion of the "lie detectors" in business today are thought to fall into this category. *Business Week* reported in 1960 that one self-trained examiner who advertised polygraph tests said, "I have lie detectors to back me up but usually I can look applicants straight in the eye and tell whether they're lying or not."

In addition to training, defenders of the polygraph stress integrity and maturity of the examiner as essential to accurate findings. They readily admit that fear, anger, and other emotions, as well as sickness, drugs, or alcohol, can influence the examination, and they insist that in such cases the reliable operator either will not conduct the test or will re-test the subject enough times to validate his findings. How many polygraph operators measure up to this ideal is an open question. Both in and out of government, standards vary; and maturity and judgment are slippery qualities to measure. What *is* measurable is the fact that although in some government agencies polygraph operators are highly skilled and high-ranking employees, in others they are persons with very little experience or status. It would not be impossible, for example, to find instances of a person's being examined for truthfulness by a 23-year-old high school graduate making under $5000 a year.

More important than the problem of qualifications is the problem of evidence of accuracy, even when the machine is in the hands of a trained examiner. Promoters of the polygraph have frequently made claims of over 95-percent accuracy in detecting deception. John Reid told the House subcommittee that his own organization had a capability of "upwards of 90 percent decisiveness." Reid's estimates, however, turned out to rest on very doubtful reasoning. It was based on a review of 4280 cases of subjects who had taken lie detector tests. Of the 4280, 2759 (64.5 percent) were reported as truthful, and 1334 (31.1 percent) were reported as not telling the truth; in 187, or 4.4 percent of the cases, the results of the polygraph examination were indecisive. Because a decision had been reached in 95.6 percent of the cases, the study was interpreted to mean that the machine was 95.6 percent conclusive in its determinations. It appears, however, that few of these determinations were subsequently corroborated. Of the 1334 people judged not to be telling the truth, the Reid organization later interrogated only 791: of these, only 486, or roughly 35 percent, ever confessed. Similarly, of the 2759 judged truthful, innocence was established for only 323, or in 11.7 percent of the cases. Representative Henry Reuss (D–Wis.), one of the committee members most skeptical about lie detectors, did his own arithmetic. Reuss compared the total number of confirmations of the instrument's diagnosis (819 in all—323 confirmed innocent plus 496 confirmed guilty) with the original 4280 subjects and came up with the conclusion that the lie detector was only 18.9 percent accurate in its findings. Other witnesses at the hearings had

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Travel to the AAAS Montreal Meeting

National Science Foundation Director Leland Haworth has sent the following communication to AAAS Executive Officer Dael Wolfe, regarding travel of U.S. scientists to the AAAS meeting in Montreal:

"In response to an inquiry regarding travel to the forthcoming meetings of AAAS which are to be held in Montreal, Canada from December 26 to 31, 1964, the National Science Foundation wishes to point out that 'international travel' is defined by the Foundation as 'travel to points not contained within the United States, its possessions, or the North American continent.' Thus, reimbursement for travel and subsistence costs of U.S. scientists attending meetings in Canada may be treated by Foundation grantees on the same basis as domestic travel."

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their own figures of accuracy: the Navy, for example, held that the instrument was 70-percent reliable. But since no evidence was brought forth to support any of these claims, they had more the appearance of mystical revelation than of reliable fact.

Not only is there a lack of evidence to support claims that the machine is reliable, there is some positive evidence that it confuses more than it clarifies. In an article in the May 1963 issue of the *American Journal of Psychiatry*, called "Unconscious Motivation and the Polygraph Test," H. B. Dearman and B. M. Smith reported the case of a young bank vice-president referred to them for psychiatric aid. During the course of a routine polygraph examination of all bank employees, the patient had reacted violently to the question, "Have you ever stolen any money from the bank or its customers?" The patient denied having taken money, but in four tests the reaction was consistent, and finally, convinced that he could not "fool the machine," the patient broke down, confessed that he had stolen money from the bank, and provided a description of how he had done it. When the bank's books were audited, however, it was discovered "not only that he had not used the method that he had stated but that no shortage of that amount had occurred in his branch since he had been employed there." The explanation for the false confession, as developed by Dearman, was that, for reasons deep in his past, the patient felt strong guilt feelings toward his wife and mother, both of whom were customers of the bank, and with both of whom he had some financial involvement, about which he also felt guilty. Dearman and Smith assumed that the identification of the patient's wife and mother with the phrase "customers of the bank" was responsible for the patient's reaction. They emphasized that many combinations of psychological factors, other than conscious deception, could produce false results on the polygraph, and they concluded that "the application of . . . the technique is fraught with too many variables and sources of error for it to be used as it is currently being used in business and industry. Its use in criminal investigations and in other situations involving the commonweal (such as screening employees for sen-

sitive government positions) should be carefully and continually scrutinized lest we find that George Orwell's *1984* is upon us."

Nonetheless, though skepticism may be growing in some quarters, the device continues to have some strong advocates. To quote from an endorsement supplied the manufacturer of Keeler Polygraphs by the sheriff of Ouachita Parish, Louisiana, "The lie detector's use in law enforcement is becoming more widespread every day, and we here in the Ouachita Sheriff's Office feel that its effective use as a scientific aid is limited only by our imaginations, and its application is unlimited."—ELINOR LANGER

Announcements

The Committee on the Undergraduate Program in Mathematics (CUPM) of the Mathematical Association of America has prepared a draft of recommendations for the **mathematical preparation of students** in the biological, management, and social sciences (BMSS). The committee's BMSS panel is making these recommendations available to interested persons, and invites their comments on the report's appropriateness and feasibility. Copies of these recommendations can be obtained from the CUPM, P.O. Box 1024, Berkeley, Calif. 94701.

Case Institute of Technology has established a Ph.D. program in "**organizational behavior**," headed by Herbert A. Shepard, director of the Organizational Behavior Group in the school's Division of Organizational Sciences. The program will emphasize the "process of social adaptation in an era of rapidly changing technology, particularly as it affects human behavior in organizations." Candidates will be chosen on the basis of their academic records and personal interviews; the equivalent of a year's college work in statistics is required. (H. A. Shepard, Case Institute of Technology, Cleveland 6, Ohio)

Meeting Notes

New techniques in the use of the motion picture as a research tool, a means of communication of research findings, and as an instrument for science education will be discussed at