

THE DEVELOPMENT OF A MECHANICAL APTITUDE TEST
DESIGNED FOR THE WESTERN REGION OF NIGERIA

Thesis for the Degree of Ed. D.

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Frank S. Scott

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This is to certify that the

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ABSTRACT

THE DEVELOPMENT OF A MECHANICAL APTITUDE TEST DESIGNED FOR THE WESTERN REGION OF NIGERIA

by Frank S. Scott

The Problem

The purpose of this study was to describe the development of a Mechanical Aptitude Test for the Western Region Government, Nigeria. The test questions were presented by line drawings, with tape recorded instructions and were based on Nigerian culture. This test was of an exploratory nature. The main hypothesis was that students selected to enter the trade centers of the Western Region, Nigeria who scored higher on the Mechanical Aptitude Test would achieve better workshop records at the trade centers. Two years (1960-1962) were spent in Nigeria in developing the test.

Methodology

The procedure used to develop the test was to: (1) establish an understanding of Nigerian culture; (2) visit villages, towns, and cities and design test items on observations made; (3) develop an initial form of the test; (4) pre-test and analyze; (5) revise the test; (6) administer the revised test a second time; and (7) establish the reliability and validity of the revised test.

The main criterion for the validation study was the workshop scores made by students in the trade centers at the

time of mid-term evaluation. The arithmetic and English scores were to be subsidiary criteria. Four variables were used as predictors of relationship to the criteria: (1) the Mechanical Aptitude Test, (2) the Ibadan Verbal Test and the Ibadan Arithmetic Test, (3) The United States Agency for International Development-American Institute of Research tests, and (4) responses received from a questionnaire.

Findings

A sub-study of graduates of the trade centers showed a high correlation between first term grades and graduation grades. As a result of this high correlation, it was decided to expedite the study and use mid-term evaluations as criteria scores.

The reliability study resulted in a reliability coefficient of .80 for the combined parts of the test. The validation study was made by examining the data in two ways: (1) by trade centers and (2) by specific trades. The validation study showed: (1) a minimum relationship between the Mechanical Aptitude Test and the workshop criterion scores, but no relationship with the arithmetic or English criteria scores; (2) no single predictor variable to be consistently successful in any trade center or trade; (3) the USAID-AIR tests to have scattered relationship with the criteria and the Mechanical Aptitude Test; (4) the Ibadan Verbal Test and the Ibadan Arithmetic Test to have very limited success in identifying those students rated high in English and

arithmetic at the time of the mid-term evaluations; and (5) items on the questionnaire to be generally inconsistent in the relationships with the criteria and other predictor variables.

There were certain limiting conditions to the effectiveness of the study. These included: (1) the varying conditions at the trade centers involving staff, facilities, and the educational and cultural background of the students; (2) the pre-selection; (3) the use of mid-term scores instead of end-of-term scores as criteria; and (4) the collection of criteria by overseas mail which limited the knowledge of the conditions and methods of student evaluation.

It was recommended that the test of mechanical aptitude be validated again using criteria available at the end of the first term. Every effort should be made to refine the criteria measures at that time.

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by

Frank S. Scott

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CHAPTER I

BACKGROUND

Introduction

The purpose of this paper is to describe the development of a mechanical aptitude test for the Western Region, Nigeria. The need for a test of this nature in a growing nation such as Nigeria will be apparent from a brief study of the country, its educational philosophy, and its method of student selection.

Nigeria

Nigeria is a country of contrasts and extremes. Its topography ranges from moist tropical forest on its coast to dry sands on its northern border. The country lies 400 miles north of the equator, is six times as large as the state of Michigan, and has a population of over 40,000,000. Nigeria is the most populous country in Africa.

Conceived at the turn of the century by the British, Nigeria remained a British colony until 1960. On October 1, 1960, it was granted its independence. The training and preparation of Nigeria for its independence by the British was extensive. Consequently, the change to an independent nation was smooth and a credit to those concerned.

The dominant race in Nigeria is Negro, with a Negro-Mediterranean mixture in the North. There are ethnic similarities, but Nigerian society, according to Land,¹ is very complex:

No accurate classification of tribes--many of which have their own languages, histories and customs--has ever been made, but it is generally agreed there are at least 150. Religious differences also abound. Muslims dominate the North; the main Christian Churches are established in the East and West; and innumerable animistic pagan groups are scattered throughout.

The typical Nigerian is a farmer, trader, or an unskilled worker, as indicated by Land's² statement:

. . . the bulk of the population live as small, poor farmers or in towns as unskilled manual workers or clerks, with an average annual income of £ 30 (\$84). For the healthy there is usually enough to eat but most tropical diseases are endemic, housing is insanitary and life expectancy low.

The economy of Nigeria is essentially agricultural, with palm products, ground nuts and cocoa beans comprising most of the country's exports. Other natural resources include tin, coal, oil, and timber.

Technology has arrived in Nigeria, as it has in most of Africa; however, this technology is found mainly in urban centers. The large cities of West Africa are modern in many respects, while the villages and towns are still developing.

Nigeria is one of the countries in which the United States has become interested through its State Department's

¹Colin Legum, Africa, A Handbook to the Continent (London: Anthony Blond, Ltd., 1961), p. 239.

²Ibid., p. 239.

Agency for International Development (USAID). USAID has a number of projects in Nigeria involving agriculture, education, research, and industrial advancement. The writer's association began during the years of 1960-1962 when he was invited by the USAID to assist in establishing a technical college in Ibadan. The assignment was negotiated through a contract with Western Michigan University, USAID, and the Western Region Government, Nigeria.

Nigerian Education

Early Philosophy

Historically, Nigerian education was patterned after the British educational system of the past. Nigerian education has tended to be formal, academic and inclined to emphasize the liberal arts and professions. Lewis,³ when reviewing the influence of the English on early Nigerian education stated:

In the initial stages . . . demands put a premium upon a literary education, and the result was a "bookish" training that had little bearing on indigenous conditions. In most areas such attempts as were made to give an agricultural, mechanical or technical bias to education foundered because there were few opportunities for gainful employment.

The United Africa Company,⁴ in a report surveying education in Nigeria further explained the limitations of this early

³Ibid., p. 434.

⁴Anon., Statistical and Economic Review, The United Africa Company Limited, No. 22 (January, 1959), p. 8.

concept of education thus:

Education has traditionally opened the way to higher paid jobs but, in Africa in particular, those jobs have been mainly white collar jobs. In the early years following the introduction of formal education anyone who learnt to read and write could feel assured of a white collar job awaiting him in commerce, industry, the civil service, the church or in teaching.

Until World War II no serious consideration was given to the problem of training West Africans for life in a modern economy.⁵ One reason for this lack of training, other than the basic preparation for white collar jobs, was that little industry existed in Nigeria prior to World War II. A second reason was that industry engaged in those occupations which required skilled labor, technicians and engineers brought such personnel from Europe; consequently, the opportunity for the Nigerian to reach a level of work beyond the classification of unskilled or semiskilled was virtually nonexistent. As a result, the young Nigerian grew up in an atmosphere that had an "absence of a mechanical tradition and lacked familiarity with tools and technical terms."⁶ Trade or technical training existed only in limited quantities. Taylor⁷ summarized the situation as:

Facilities for technical education in Nigeria and Ghana are . . . limited, partly due to historical

⁵Marjorie Nicholson, "Training Africans for Life in a Modern Economy," Civilizations, VIII (1958), No. 2.

⁶Anon., Statistical and Economic Review, op. cit., p.1.

⁷Andrew Taylor, Educational and Occupational Selection in West Africa (London: Oxford University Press, 1962), pp. 177-178.

circumstances growing out of the initial type of education provided in West Africa, partly due to the limited opportunities for skilled workers which have existed up till recently, and partly due to the comparatively low status of artisans in the community.

In summary, Nigeria's early philosophy of education was academically-oriented. To be able to read and write was a considerable achievement in itself--to be among the selected few to graduate from the colleges and universities was a privilege and an honor.

The Influence of Technology

Shortly after World War II Nigeria began to change. Independence was to become a reality and foreign capital began to take an increasing interest in the industrial potential of Nigeria.

By the time Nigerian independence arrived in 1960, industrialization was beginning to be of some significance in Nigeria. Land⁸ stated:

Industrialization is . . . mainly confined to processing local products, palm oil and kernels, ground nuts, cotton and rubber, or assembling imported goods . . . there is a textile factory . . . and in both the Eastern and Western Regions cement is produced. . . . A number of secondary industries have been set up in recent years--making furniture, tiles, soap, margarine, plastics, beer and cigarettes.

Industrialization brought an increasing demand for skilled labor of a Nigerian origin--not expatriate. This need for indigenous skilled labor was emphasized by a recent

⁸Legum, op. cit., p. 246.

manpower survey made by Harbison,⁹ in conjunction with the Ashby Commission report. The survey predicted that the manpower requirements by 1970 for various areas of management, professional, and administrative personnel would have to double (13,675 to 28,875) and triple for technical and supervisory personnel (11,075 to 37,275). A more recent report on manpower needs by Cottier and Caunce¹⁰ predicted that an annual output of 5,000 technicians would be necessary by 1970.

The increased demand for technical manpower focused attention on the need for more facilities to train skilled and technical workers. The Ashby Commission¹¹ supported the need for additional facilities when it wrote:

. . . we are in no doubt that a great expansion of the facilities for technical education at all levels will be required if Nigeria is to produce from among her own people the technically trained manpower needed to enable her to take her rightful place as an independent nation in the modern world. Indeed, we are convinced that this is one of her most urgent educational needs.

A New Philosophy of Education

Developments of the past ten years have caused Nigeria to re-examine her educational needs and philosophy. The former concept of a narrow academic education has changed

⁹Eric Ashby et al., Investment in Education, The Report of the Commission on Post-School Certificate and Higher Education in Nigeria, Federal Ministry of Education, Nigeria, 1960, pp. 61-62.

¹⁰M. Cottier and F. Caunce, "Report on the Development of Technical and Commercial Education in the Federation of Nigeria, 1961-76," Federal Government of Nigeria, 1961 (unpublished),

¹¹Ashby et al., op. cit., p. 94.

to a broader philosophy. This change in philosophy was expressed by a former Minister of Education,¹² Western Region, Nigeria, in a talk before a joint session of Obas and Chiefs:

Our aim . . . is to educate all children including the clever and the dull, and to equip them so that they grow to become useful citizens of our community. To ensure that there are as many courses and avenues of progress as possible into which the various grades of children can be diverted, the government has endeavored to develop various institutions . . .

Some of the objectives of Nigeria's new philosophy of education were expressed in the Ashby Commission Report:¹³

(1) the need to revise curriculum and text books based on Nigerian culture, (2) the importance of raising the quality of education at the primary and secondary modern levels, (3) the necessity of upgrading the teacher-training institutes, (4) the need to stabilize the teaching profession, (5) the importance of emphasizing agricultural education, and (6) the necessity of increasing the opportunities for trade and technical education.

As a result of these basic objectives, education in Nigeria received high priority in the total national budget, as evidenced by the Ashby Commission Report:¹⁴

It is impossible to give accurate figures for the total recurrent expenditure on education; it is of the order of ~~£~~ 20 million (\$56 million). The bulk

¹²Speech by the Honourable Minister of Education, Western Region, Honourable Ayo Okusaga, before a conference of Obas and Chiefs held in Ibadan, Nigeria, May 17-19, 1960 (unpublished).

¹³Ashby et al., op. cit., pp. 12-21.

¹⁴Ibid., p. 4.

of this (certainly over £ 18 million) comes from the Federal and Regional Governments. Indeed in one Region over 40 per cent of the budget appropriation is for education.

Nigeria, during the past ten years, has changed both economically and politically. Education has had to keep in tune with these changes, and a new philosophy on educational policies emerged. Of particular interest to this report was the realization of the need for increased education in the trade and technical schools.

The Structure of Education

Education in Nigeria begins with the primary schools, grades one through six. After primary school a selected minority of students enter the grammar school (college preparatory). If the student is not able to qualify for the grammar school, he may enter a secondary modern school (pre-high school). The secondary modern schools vary in length and content from region to region in Nigeria. They are from two to three years in length, and have as their purpose the intent of furthering the primary graduates' general education. A vast majority of young Nigerians fail to progress in their formal education beyond the secondary modern level.

The Organization of Trade and Technical Education, Western Region

After World War II, trade and technical training was introduced in Nigeria and patterned after the British system prevailing in the United Kingdom. The syllabi for trade and

technical education were similar to those prepared by the City and Guilds of London, an institution chartered by the United Kingdom to establish syllabi and systems of examinations "to set nationally recognized standards of attainment . . . especially for artisans and craftsmen."¹⁵ The City and Guilds of London were the accepted standard for trade and technical training in Nigeria, though there was an indication that these standards were soon to be revised to meet Nigerian needs.

The three major regions of Nigeria, as well as the Federal District, have varying types and degrees of trade and technical education. Since this report is primarily limited to the Western Region of Nigeria, only the conditions associated with the Western Region will be described.

Vocational education (trade training) in the Western Region is offered in several trade and handicraft centers. Currently, there are four trade centers for boys and one for girls in the Western Region. The trade centers and their respective course offerings are given in Table 1. Courses in all schools vary from two to three years in length, with the total enrollment ranging from 1,000 to 1,500. Students usually enter as secondary modern graduates. They board and room at the centers and are generally taught by expatriate teachers from the United Kingdom. The region has relatively few handicraft centers.

¹⁵Anon., City and Guilds, Its Aims and Work, City and Guilds of London Institute, 1959.

TABLE 1

TRADE OFFERINGS OF THE TRADE CENTERS
WESTERN REGION, NIGERIA

Trade Center	Trade Offerings
Sapele (Boys)	Brick Layers Carpenter-Joiners Electricians Fitters-Machinists General Welders Motor-Mechanics Painter-Decorators Sheet Metal Workers Wood Machinists
Ijebu-Ode (Boys)	Brick Layers Cabinet Makers Carpenter-Joiners Coach Builders Plumbers
Oshogbo (Boys)	Electricians Fitter Machinists Motor Mechanics Painter-Decorators
Oyo (Boys)	Agricultural Mechanics General Welders Motor Mechanics
Abeokuta (Girls)	Domestic Training Homemaking Pre-Nursing Sewing

Technical education is pre-engineering in nature. One technical institute (college) is located in the Western Region at Ibadan, and offers curricula in Mechanical, Electrical, and Civil Engineering Technology. Students are selected from the class referred to as the fifth form (high school graduates) of the grammar schools who are not selected to continue their education at the sixth form level.

A few local industries, such as the Nigerian Railways, Shell Oil--B. P., Nigerian Tobacco Company, and the United Africa Company, offer their own trade training. Visits to the industrial schools found them to have well-organized course outlines, frequent administrations of tests and examinations, and staff who were qualified both academically and with practical work experience.

The Training Methods and Facilities of
Trade and Technical Education,
Western Region

Trade Centers. The first year of training at the trade center emphasizes arithmetic and English. The last year(s) stresses workshop and laboratory experiences. The academic classes are conducted primarily by the lecture method, while the shop and laboratory classes employ the demonstration technique. Skapski¹⁶ reported that in the trade centers the ratio of instructor to student varies from

¹⁶Adam Skapski, "The Development of Technical Education and Its Relation to the Educational System in Western Nigeria, 1962-1970," Special Report for USAID and Western Region Government, Nigeria, 1962, p. 37. (Unpublished.)

one instructor for twenty to thirty students in the lecture classes to one instructor for fifteen to twenty-five students in the workshops and laboratories. Facilities and equipment at the trade centers are adequate in most areas that require basic and fundamental training. However, shortages in supplies and materials do exist and often cause hardship on both instructor and pupil.

The trade centers may differ among themselves as to equipment, materials, supplies, dormitory, and recreation facilities. For example, Sapele, which is the oldest, largest and most firmly established school may have certain priorities in terms of requisition of materials and supplies. Newer and smaller schools such as Oyo may not rate such priorities. On the other hand, the equipment and classroom facilities at Oyo (the newest of the trade centers) is apt to be more up to date and functional in design.

Course offerings (see Table 1) may differ considerably among the trade centers according to local needs. Course content within specific subject areas may be more dependent on the availability of equipment, materials and supplies than on a particular sequence of instruction as outlined in a syllabus. The instructor's background, both academic and work experience, may cause courses to differ in their emphasis on workshop and classroom activity. Therefore, although the trade centers use a common syllabi the actual course content may differ because of personnel, facilities, and location.

Technical Centers. The technical center stresses mathematics, English, science, and limited workshop experience during the first year of training. The second year is devoted to specialized training that concentrates on the technical field selected by the student. Teaching techniques in the classrooms are similar to those found in the trade centers. Facilities and equipment at the technical center are adequate for the first year's training, but equipment in the areas of specialization offered during the second year of training are often lacking or incomplete.

Selection Techniques at Trade and Technical Centers

Selection Procedure, 1960-1962

The method of selecting students for the trade and technical centers of the Western Region, Nigeria, during the years 1960-1961 was to administer the standard battery of tests in English and arithmetic to be followed by an interview. The need for proficiency in a language basic to the country as well as a fundamental knowledge of arithmetic was essential to any developing country. Since these were skills that could be measured with some degree of accuracy and subsequent tests could be developed with comparative ease, it was only natural that selection instruments of this nature would be the first to evolve. The specific tests used in the Western Region in the general areas of English and arithmetic were:

1. Ibadan Verbal Test¹⁷
2. Ibadan Arithmetic Test¹⁸

The selections gave considerable weight to the interview. Usually the principal and his staff would interview an applicant for a period varying from ten to thirty minutes. An attempt was usually made to ascertain the applicant's ability to identify tools and to give him an opportunity to explain his reasons for wanting to attend the school.

The selection methods of industry, where trade training was being conducted, also emphasized the interview as a chief means of evaluation. Here, however, a system of pre-screening prevailed, for those applicants related to successful employees of the organization were given high priority in these interviews. Intelligence and aptitude tests were then being used on an experimental basis in some of the larger industries throughout the Western and Eastern Regions of Nigeria.

Limitations of the Selection Procedure

One of the chief limitations of the entrance examination at the trade centers was its almost exclusive reliance on the English language. As stated by Schwarz:¹⁹

The most crucial factor is proficiency in the English language. Even the arithmetic tests that are usually given include work problems requiring a high degree of

¹⁷M. A. Brimer, Ibadan Verbal Test 1 (Test for Primary 6 Graduates, undated).

¹⁸M. A. Brimer, Ibadan Arithmetic Test 1 (Test for Primary 6 Graduates, undated).

¹⁹Paul A. Schwarz, Aptitude Tests for Use in Developing Nations (Pittsburgh: American Institute for Research, 1961), p. 5.

language comprehension. The applicant who has a good knowledge of English can probably qualify for any vocational training program in Nigeria today.

Another criticism of the practice of selection was the reliance placed on the interview. Biesheuvel,²⁰ in an article written for the Conference on Educational and Occupational Selection in West Africa, 1960, seriously questioned the value of these interviews held in conjunction with the entrance examination. It is recognized, that as a part of this study, the interviews associated with the selection of the applicants to the trade schools should have been analyzed for the techniques and methods used. However, the interview records were not available in the short time remaining between the administration of the standard test battery at the trade center and the author's time of departure from Africa. The interview will not be explained in detail anywhere in the study.

Research did not reveal any attempt to validate the Ibadan Verbal and Arithmetic Tests or the interview. The tests and the interview had obviously served a temporary purpose but selection techniques were outmoded. This was substantiated by Wickert,²¹ when he wrote:

. . . since the end of World War II, Britain graciously extended to colonial areas the examination system developed for its own secondary school

²⁰Taylor, op. cit., pp. 152-153.

²¹Frederic R. Wickert, "Selection of Students and Employees in West Africa," News Bulletin, Institute of International Education, Vol. 3, No. 3 (November, 1960), p. 27.

and university entrance needs. This system introduced honest, careful, thorough, though often cumbersome and somewhat inappropriate, school selection testing to West Africa. However, as African education itself began to pull away from the earlier British model and to become more attuned to African conditions, school selection methods also had to draw away and change.

Problems Inherent in the Selection Procedure

One problem that was inherent in the selection of trade and technical students was the stigma accompanying anyone who worked with his hands. Somehow the idea had been fostered that to do manual labor as a farmer, mechanic, or technician was degrading. The white collar attitude prevailed and education was essentially thought of as a means of going beyond the level of work that would require the use of one's hands.

In the past, the technicians and engineers had been nearly all expatriates. Though many of these technical occupations were opening up for the first time to Nigerians, the old belief still existed that labor was undignified. There was still little positive motivation for the student emerging from the secondary and grammar schools to enter a trade or technical school.

Students in Nigeria generally aspired to attend the universities, not the trade and technical centers. The grammar school and the university were still the zenith of education. Sam Epelle²² reflected a similar viewpoint when he stated:

²²Sam Epelle, The Promise of Nigeria (London: Pan Books Ltd., 1960), p. 53.

Dignity should attach (itself) to studies leading to the acquiring of a technical skill. It is not enough to send a boy to a technical school or, to use the familiar Nigerian term trade centre, without providing an atmosphere which does not make him feel inferior to the boy who left the primary school at the same time as he did, but went on then to the secondary grammar school.

The failure to associate dignity with the trade and technical centers often caused the best students graduating from the grammar and secondary schools to apply elsewhere for advanced education or work opportunities. This was particularly true in the large urban centers. As a consequence, those who did apply to the trade and technical centers were often the students who for reasons of scholarship, economics, or other factors had been rejected by the universities, colleges or firms offering first-class job opportunities.

Regardless of the adverse reasons for not attending the trade and technical colleges, the technical and trade centers were deluged with applications. Perhaps the reason for this was best described by Wickert²³ when he said:

Africans apply, often by the thousands, for every opportunity which might mean increased status, perquisites, money, and security. They often seem to have little or no interest in the type of work they are going to do, and many are repeaters who have applied earlier and have failed to be accepted.

The experience at the Technical College, Ibadan, fully substantiated this surplus of applicants. The school opened early in 1961 with an enrollment set for thirty students.

²³Wickert, op. cit., p. 29.

Over 4,000 applied.

With the emphasis on technology throughout the world today, waste in terms of dropouts was difficult to accept. The United Africa Company's²⁴ report on Technical and Vocational Education showed dropouts ranged from 16 per cent to 33 per cent in their diverse trade programs during the year 1957. Significantly enough, these were students who were highly screened. The USAID Technological College staff's visit to the U.A.C. and other industrial training centers in 1961 indicated that the problem of dropouts was still a serious one and made effective selection procedures all the more necessary.

Another problem complicating the selection process was associated with the government's support of schools. Once an African student was admitted to a school, there was considerable disgrace attached to his failing and dropping out. Great loss-of-face occurred and the student could be literally abandoned by his village or family. This was particularly true if the village made a local effort to collect money to pay the student's fees. Consequently, principals of government schools were most reluctant to "drop" a student for academic reasons.

In the United States, one expected a certain percentage of dropout during the first semester of a planned curriculum. In Nigeria it often took several semesters to convince the

²⁴Anon., Statistical and Economic Review, op. cit., p. 45.

principal, parent, village elder or chief (to say nothing of the student) that a boy was a misfit and not capable of continuing in the school.

Recommendations

Recommendations to improve the selection of students for trade and technical education were prescribed by the Conference on Educational and Occupational Selection in West Africa²⁵ as follows:

- a. The development of selection procedure, especially tests of achievement and potentiality, and reporting procedures designed to throw light on motivation, taking account of the desirability of progressive selection in preference to the early allocation of young workers to specific occupations.
- b. The fostering of a comprehensive view of vocational guidance, and the development of closer relations between schools, employers, training instructors and appropriate government agencies.
- c. The arrangement of attitude surveys designed to elucidate problems of various kinds--including administrative problems--thrown up by these activities.
- d. Research on matters arising under proposals (a), including at an early age studies of ways in which people think about jobs, working conditions and rewards.
- e. The provision of training courses to ensure full use of the advances made possible by the adoption of the foregoing proposals; and the devising of ways of spreading information about the research finds of the organization proposed.

Of particular interest to this report was the frequent reference made by the Conference on Educational and Occupational Selection in West Africa²⁶ for the need of developing

²⁵Taylor, op. cit., p. 200.

²⁶Ibid., pp. 60, 126, 145-149, 158-159, 179-180, 182, 189, 200.

a series of tests in the general area of attitude and aptitude.

A New Battery of Entrance Tests

The problems of selection of students for the trade and technical centers were given top priority by the United States Agency for International Development--American Institute of Research (USAID-AIR). Schwarz,²⁷ head of a USAID-AIR group working with Nigeria, was instrumental in developing a series of new intelligence and aptitude tests to be used at the trade and technical centers of Nigeria. The tests were based on Nigerian culture.

One of the areas not covered by Schwarz's battery was a test of mechanical aptitude. Tests of this nature had been found to be useful in the United States and were often included in a general battery of intelligence and aptitude tests. Since a mechanical aptitude test was considered to be of real significance in selecting students for the Ibadan Technical College, the writer accepted the responsibility to develop such a test.

Summary

Nigeria has the potential to become one of the leading countries of Africa. As one means of achieving this potential, it had made the decision to emphasize the development of the nation's educational facilities. This decision to

²⁷A detailed account of Schwarz's findings is available in the AIR booklet, Aptitude Tests for Use in Developing Nations, op. cit.

give education top priority reflects, in many ways, Nigeria's total philosophy of social progress, and the part education plays in it.

For a variety of reasons, the influence of technology on the country's economic growth has emphasized the need for skilled tradesmen and technicians. Trade and technical schools are at a minimum in Nigeria today. Therefore, their resources should be utilized to the highest degree of efficiency possible.

One problem in making full use of Nigeria's educational resources is its method of selecting students who will attend the trade and technical centers. The selection techniques are inadequate in many ways and need improvement. However, there are certain limitations and inherent problems that need to be recognized before any new recommendations are considered. These limitations and problems are a part of Nigeria's economic and educational growth and often reflect the influence of former colonial rule.

One possible method for improving the selection techniques used at the trade and technical centers is the development and introduction of a new battery of intelligence and aptitude tests based on Nigerian culture. One potentially valuable part of the new battery of tests might be a test of mechanical aptitude.

CHAPTER II

THE PROBLEM

The study required an introduction to Nigeria's background, its educational philosophy, and the method used to select students at the trade and technical centers. Using this background information as a basis, the next step was to define the problem.

The Problem and Objectives

The purpose of this study was to describe the development of a mechanical aptitude test for the Western Region Government of Nigeria. The test was specifically designed as a unit of a new battery of tests to be used in the selection of candidates for trade and technical schools. The development of such a test had not been attempted before; consequently, the study was exploratory in nature.

To provide a guide for planning the construction of such a test, the following objectives were identified:

1. To develop a mechanical aptitude test based on Nigerian culture.
2. To determine the reliability and validity of the constructed test.
3. To analyze the interrelationship of the constructed test with other tests being used in order to detect any overlap that may have occurred among the tests.

Working Hypotheses and Assumptions

The following working hypotheses were formulated in carrying out the plan of operation.

The main hypothesis was that students accepted in the trade centers who scored higher on the mechanical aptitude test would achieve a better workshop record.

The secondary hypotheses were:

1. That students' scores made on the test of mechanical aptitude would have a low correlation with scores made on the Ibadan Arithmetic Test and the Ibadan Verbal Test.

2. That the Ibadan Arithmetic Test and the Ibadan Verbal Test might overlap each other to a very limited degree.

3. That a test of mechanical aptitude based on Nigerian culture could be developed that would complement other tests of a general battery being used to select candidates for trade and technical schools.

4. That a comparison of the existing student selection system of tests to the new battery of tests would show the effectiveness of each.

In addition to the stated working hypotheses, three assumptions were made:

1. That it would be possible for an outsider to become familiar enough with Western Nigerian society to construct a test appropriate to Western Nigerian culture.

2. That although wide cultural differences did exist between Western Nigerian villages, towns, and cities, certain

natural phenomena and mechanical devices could be found common to all three places.

3. That successful criteria for the study could be acquired by overseas correspondence with trade centers.

The Variables

Criteria

The scholastic achievement scores made by students during the first semester in trade centers were selected as criteria for the study. These scores were based on achievement in workshop, English, and arithmetic classes of students who entered the trade centers in September, 1962. The workshop scores were to be the main criterion and the English and arithmetic scores were to be subsidiary criteria that would act as checks on the workshop scores.

Since the courses at the trade centers were three years in length, it was considered impractical to extend the study over a three-year period to confirm class rank at time of graduation. Therefore, a substudy was proposed of the past graduates of trade centers in the Western Region, Nigeria. The purpose of the substudy would be to investigate the possibility that a correlation did exist between a student's rank in class at the end of Term I and his corresponding rank in class at the time of graduation.

Predictor Variables

The variables to be used as predictors of relationship to the criteria scores were as follows:

1. The Mechanical Aptitude Test.¹
2. The Ibadan Verbal and Arithmetic Tests.²
3. Schwarz's USAID-AIR tests on intelligence and aptitude.³
4. Questionnaire responses.⁴

Limiting Conditions

A few limiting conditions should be considered when examining the criteria. The trade and technical centers were in themselves complex organizations. Government budgets for these centers allowed only for the bare essentials. The instructional staff, being primarily expatriate, varied considerably in individual backgrounds, education, and formal teaching experience. Therefore, to make comparisons within or among trade and technical centers could be hazardous. Schwarz⁵ expressed a similar viewpoint when he said:

So long as these schools will continue to show their present variability in the quality of facilities and instruction, it will be difficult to compare applicants educated in different locations. Their performances on an achievement test may be less a function of their abilities than the particular school districts in which they happen to live.

Specific conditions in the trade and technical education centers that might limit the effectiveness of the criteria were as follows:

¹See Appendix IV.

²See Appendix VI and VII.

³See Appendix VIII.

⁴See Appendix IX.

⁵Schwarz, op. cit., p. 6.

1. The staff was apt to be academically-oriented. Teachers were often hired with most of the required academic qualifications but only limited applied work experience. As a result, achievement scores were likely to reflect a staff academically-inclined and not too sympathetic to the practical side of trade or technical education. Skapski⁶ stressed essentially the same idea when he stated:

Both English and mathematics are still taught in a way appropriate for Grammar School boys and not for future craftsmen.

2. The staff turnover and teacher shortage at any given period of time were likely to be significant. Tours of duty for expatriates ranged from twelve to eighteen months and continuity of instruction between classes was often difficult to maintain.

3. The curricula at the trade centers were designed to adhere strictly to the City and Guilds of London syllabi. The content of these syllabi had been developed to meet European standards which in some cases did not apply to Nigeria.

4. The educational background of students at the trade and technical centers was extremely varied. Students arrived at the trade and technical centers with educational levels ranging in quality from grammar schools of excellent repute to secondary modern schools barely recognized or accredited by their own government.

⁶Skapski, op. cit., p. 37.

5. The cultural and economic backgrounds of the students entering the trade and technical centers were as varied as their educational preparation. Life in the small villages of Nigeria lacked even the amenities taken for granted in Western society. The towns and cities were often crowded and many of the inhabitants were too poor to be able to afford such luxuries as electricity and running water. The dormitory life on the school site could require considerable adjustment on the part of some of the boys, regardless of the size of the community they had come from.

Summary

This chapter has presented the purpose, objectives, working hypotheses, and assumptions of the study. The study was of an exploratory nature. The workshop scores made by the students at the trade centers were to be the main criterion, and the English and arithmetic scores were to be subsidiary criteria. The predictor variables included the Mechanical Aptitude Test, The Ibadan Verbal Test, The Ibadan Arithmetic Test, Schwarz's USAID-AIR tests and a questionnaire.

There were certain limiting conditions that could affect the criteria. These conditions, typical of those found in developing countries of Africa, were not so detrimental that an exploratory study such as is described here could not be undertaken with reasonable expectation of worthwhile results.

CHAPTER III

REVIEW OF LITERATURE

Introduction

Past research and literature on psychological testing in West Africa and Nigeria is relatively scarce. What does exist is often the efforts of a few individuals working in geographically-separate areas, much of which remains unpublished. In the past five to ten years, however, attempts have been made to consolidate various studies. Centralization of research has begun, primarily through the efforts of Biesheuvel and the Commission for Technical Cooperation in Africa South of the Sahara (CCTA).

General Sources of Information

A primary source of information for the study was Taylor's¹ book, Educational and Occupational Selection in West Africa. This work reported on the proceedings of the Conference on Educational and Occupational Selection in West Africa held in Accra, Ghana in March, 1960. A number of articles concerning selection techniques, vocational guidance, and counseling as they apply to West Africa were included in the book.

¹Taylor, op. cit., passim.

Taylor,² now Director of the Institute of Education, University College, Ibadan, started his early association with test selection at University College, Ghana. His work in the area of test development is now being continued in Nigeria.

Dr. S. Biesheuvel of the Union of South Africa was a chief contributor to Taylor's³ book, Educational and Occupational Selection in West Africa. Biesheuvel is recognized as the first person to develop an extensive program in psychological research in Africa. Wickert,⁴ in describing the activities of Biesheuvel, said:

By far the largest single operation in industrial psychology is the National Institute for Personnel Research (NIPR), with headquarters in Johannesburg on the campus of the University of the Witwatersrand. . . . A recent report (Biesheuvel, undated) indicates that NIPR has a staff of 110 persons of whom 61 are graduates in psychology, sociology, social anthropology, mathematical statistics, education, or medicine.

Dr. Frederic Wickert, Professor of Psychology at Michigan State University, also attended the conference held in Accra, 1960, and contributed to Taylor's⁵ book. Two of

²Andrew Taylor, Personnel Selection, West African Command Pilot Investigation, Institute of Education, University College, Ghana (undated).

³Taylor, Educational and Occupational Selection in West Africa, op. cit., pp. 123-127, 139-153.

⁴Frederic Wickert, "Industrial Psychology in Africa," The American Psychologist, Vol. 15, No. 2 (February, 1960), p. 165.

⁵Taylor, Educational and Occupational Selection in West Africa, op. cit., pp. 127-138.

Wickert's⁶ publications have been of considerable value to this study.

The Ashby Commission Report⁷ was one of the most influential and thought-provoking reports to come from Nigeria in recent years. The report covered such topics as Manpower Needs, Supply of Children, and the Educational Pyramid. It was a comprehensive survey of Nigerian education from elementary through the university level.

Dr. Paul Schwarz,⁸ American Institute of Research, had brought a team of four American industrial psychologists to assist in his program of developing aptitude tests in Africa. The work of Schwarz and his associates covered most of Africa and was initiated in 1961.

Two surveys on technical education had been conducted by Dr. Adam Skapski, formerly of the Ford Foundation and currently Technical Consultant to USAID. Skapski's surveys were made in 1958 and 1962. They both centered on the Western Region Government and made recommendations to strengthen trade and technical training in the region. The most recent of Skapski's⁹ reports presented a review of the problems facing the trade centers and technical institutes through 1970.

⁶Wickert, "Industrial Psychology in Africa," op. cit., pp. 164-170; Wickert, "Selection of Students and Employees in West Africa," op. cit., pp. 26-33.

⁷Ashby et al., op. cit.

⁸Schwarz, op. cit.

⁹Skapski, op. cit., p. 65.

The Delgado Trades and Technical Institute, New Orleans, had, through a USAID contract with Uganda, developed a series of course outlines employing numerous principles of physics and mechanics as applied to African culture. The series was authored by Mr. William Schultz.¹⁰

The Commission for Technical Cooperation in Africa South of the Sahara (CCTA), had endeavored to coordinate the activities of those countries working in the area of psychological testing. Wickert¹¹ summarized the scope of the CCTA as follows:

This organization founded in 1950, now includes as members the metropole countries of France, Great Britain, Portugal, and Belgium as well as such African countries as Liberia, Ghana, the Federation of the Rhodesias and Nyasaland, and the Union.

Review of Current Tests

One of the initial steps in developing the test of mechanical aptitude for Nigeria was to investigate the possibility of utilizing any of the existing component parts of existing test batteries. Schwarz¹² found that such tests¹³

¹⁰William Schultz, Introduction to Engineering Science (New Orleans: Government of the Protectorate of Uganda, Delgado Trade and Technical Institute, 1959).

¹¹Wickert, "Industrial Psychology in Africa," op. cit., p. 165.

¹²Schwarz, op. cit., pp. 9-25.

¹³Tests mentioned by Schwarz in his initial investigation included: The United States Department of Labor's "General Aptitude Test Battery (GATB)," The Psychological Corporation's "Differential Aptitude Tests (DAT)," and Science Research Associates "Flanagan Aptitude Classification Tests."

were not applicable to less test-sophisticated countries, such as Nigeria.

Investigation did show that there were two main types of mechanical aptitude tests in the United States:

1. Comprehension: A test of one's ability to apply mechanical principles. This type of test was typified by the Mechanical Reasoning test.¹⁴ For example, in the well-known Bennett test two pictures showed a housewife lifting a vacuum cleaner by varying her grip on the handle. The principle of the lever was used, and the person being tested was to decide in which picture the vacuum cleaner was more easily lifted.

2. Information-Interest: Tests of factual mechanical information. Examples of such tests were the Automotive and Electrical Information Tests of the Army Classification Battery.¹⁵ The assumption in this type of test was that the acquisition of incidental information in an area reflected sufficient interest to learn and recall such material.

Finally, a particularly pertinent test published in the United Kingdom combined the features of mathematics and technical knowledge.¹⁶ However, only one portion of the

¹⁴George Bennett, Harold Seashore, and Alexander Wesman, Mechanical Reasoning, Differential Aptitude Test, Psychological Corporation, New York, 1947.

¹⁵Army Classification Battery, Personnel Research Branch, The Adjutant General's Office, Washington, D. C. (undated).

¹⁶J. Luning Prak, Mathematical and Technical Test (London: George G. Harrap and Co., Ltd., 1948).

test was directly related to the problem in Nigeria: Part Number Seven, "Technical Insight." The items consisted of drawings of sets of gears, keys to fit locks, and other devices that would measure one's ability to observe mechanical phenomena.

Unfortunately, most of these tests were not directly applicable to Africa. The tests involved knowledge of mechanical devices and gadgets found in a highly technical society such as the United States or Europe. Most of these same devices were unknown to the typical student in Africa.

Summary

This chapter has described the systematizing and collecting of current research in the fields of personnel administration and industrial psychology in Africa, and has demonstrated that sources and references were still limited at the time that this study was undertaken. Consequently, the available mechanical aptitude tests were of little help, since the mechanical heritage of Western cultures, upon which such tests were based, was very limited in most of Africa.

CHAPTER IV

METHOD OF TEST DEVELOPMENT

Introduction

The purpose of this chapter is to describe the procedure used to develop a test of mechanical aptitude for the Western Region, Nigeria. The results of personal visits made to Nigerian villages, towns, and cities are reviewed, and the technique used to apply this information to the development of specific test questions is explained. A discussion of test and re-test tryout procedure completes the chapter.

Procedure Followed in the Test Development

The test of mechanical aptitude was developed during the following chronology and sequence of actions:

1. July, 1960--May, 1961: A study of existing information relative to batteries of aptitude, interest, and information tests that had been or could be used in West Africa was made. A typical mechanical aptitude test was analyzed to determine what principles of physics and mechanics were used in the test.

2. June--October, 1961: Visits were made to Nigerian villages, towns, and cities for the purpose of observing the

existence of activities and phenomena of a physical and mechanical nature.

3. November, 1961--March, 1962: A test of mechanical aptitude that would reflect the culture(s) visited and studied was constructed.

4. April, 1962: The test was tried out on students likely to become candidates for trade and technical centers. The initial form of the test was analyzed by means of an item analysis technique and necessary revisions were made.

5. May, 1962: The revised test was administered in conjunction with a standard entrance battery to a group of candidates applying for admission to the trade centers.

6. September, 1962--May, 1963: The revised form of the test was checked for reliability. A validation study of the test's ability to predict successful performance was conducted at the trade and technical centers.

Analysis of an Existing Mechanical Aptitude Test

The literature dealing with testing methods pertinent to West Africa was found to be very limited. One test that appeared significant for analysis was the Bennett Mechanical Reasoning, Differential Aptitude Test,¹ since it was similar in nature to the type of test proposed for this study. Test items in the Bennett test were expressed by means of illustrations and dealt with principles of physics and mechanics.

¹Bennett, Seashore, and Wesman, op. cit.

The conclusion was reached that similar principles could be incorporated in the proposed Nigerian test. The assumption was that the principles of physics and mechanics are the same the world over; only the application of these principles would vary from culture to culture.

The Bennett test was analyzed with the aid of two physicists (one American and one Nigerian), two mathematicians (one American and one Nigerian), and eight engineers (two expatriates, three Americans and three Nigerians). The analysis identified the following principles:

<u>Principle Involved</u>	<u>Number of Times Used in Test</u>
1. Pulleys	10
a. Peripheral speeds equal (2)	
b. Ratio and pulleys (8)	
2. Components of force	7
3. Gears and ratio	7
4. Lengths of arcs and circles	5
5. Center of gravity	5
6. Moments of force	5
7. Centrifugal force	4
8. Strength of materials (beams)	3
9. Lever	3
10. Cross sectional area	2
11. Falling bodies and velocity	2
12. Friction	2
13. Heat dissipation	2
14. Angles of reflection	1
15. Coefficient of expansion	1
16. Dew point	1
17. Friction	1
18. Inverse ratio (mechanical advantage)	1
19. Pythagorean theorem	1
20. Density and specific gravity	1
21. Three-point determination of a plane (geometry)	1

Nigerian Culture and Its Relationship
To the Test Development

Preliminary Study

The next step in developing a mechanical aptitude test for Nigeria was to acquire an understanding of Nigerian culture. This was accomplished by actually living in Nigeria, reading its newspapers and books, listening to its radio programs, by observing Nigerian television, plays, and festivals, and enrolling in two courses in social anthropology. These courses were offered by the Department of Extra-Mural Studies, University College, Ibadan. The courses and times involved were: Introduction to Social Anthropology--Fall 1960, and Social Anthropology II--Spring 1961. The courses provided an understanding of the numerous social and ethnic groups found in Nigeria. Of particular value was a study of three primary ethnic groups of Nigeria: The Hausa from the Northern Region, the Yoruba from the Western Region, and the Ibo from the Eastern Region. In the Western Region the Yoruba predominates, with the Hausa and the Ibo present in minority groups.

The year's work of studying the Nigerian culture indicated the necessity of limiting the study to the Western Region or Yoruba land. The inclusion of the Northern and Eastern Regions would have required extensive travel in territory where the cultures vary considerably from that of the Yoruba.

A preliminary examination of the Yoruba culture² showed the material needs of the Yoruba to be: clothing, food, furniture, machines and tools, medicine, shelter, and transportation. Occupations of the Yoruba included:

- Barbering
- Basket making
- Blacksmithing (including gold, silver, and tinsmithing)
- Carpentering (including building and furniture making)
- Domestic labor (including cooking, sewing, sweeping, cleaning, and drawing water)
- Dyeing
- Farming (including planting, weeding, harvesting, and storage)
- Hunting and fishing
- Lumbering
- Mechanic (including bicycle and automobile)
- Palm oil manufacturing
- Palm wine tapping
- Repairing (including shoes and watches)
- Rubber tapping
- Tailoring
- Trading (merchant)
- Weaving
- Wood carving

Natural phenomena that could be expected to influence the Yoruba culture were: rivers and streams; seasons of the year (dry and rainy); stars, moon, and sun; thunder, rain, wind, and lightning; and vegetation including forests and crops.

Detailed Cultural Analysis

As a result of the preliminary examination of the Bennett test, the material needs, the occupations, and the

²The resulting list of material needs of the Yoruba was acquired through the lectures taken in Social Anthropology, University College, Ibadan.

natural phenomena of the Yoruba, a more detailed analysis³ of the Yoruba culture yielded the items shown in Table 2, page 40.

Preparation of a Check List

At this point Yoruba villages, towns, and cities were surveyed. The purpose of the survey was to analyze those factors in the Yoruba culture that were pertinent to the development of the mechanical aptitude test. A check list utilizing the basic elements (see Table 2) of the Yoruba culture was prepared to facilitate the survey of villages, towns, and cities. The check list is shown in Table 3, page 42.

Personal Visits

The months of June through October, 1961, were devoted to a series of personal visits to Yoruba villages, towns, and cities. The objectives of the visits were:

1. To identify the objects and phenomena involving principles of physics and mechanics existing in the villages, towns, and cities.
2. To select a list of possible items that could be used for the mechanical information test.

Villages, towns, and cities were selected on the basis of geographic location (Table 4, page 43) and an effort was

³The detailed analysis of Yoruba culture was made in collaboration with Professor Tunde Oloko, Nigerian anthropologist and instructor for the classes taken in Social Anthropology, University College, Ibadan.

TABLE 2
BASIC ELEMENTS OF THE YORUBA CULTURE

Food	Cooking and House- hold Utensils	Clothing	Shelter
Beans	Calabash	Yoruba dress (one and/or	Mud brick homes with
Cassava	Candles	two piece suit made of	thatched or corru-
Coconut	Cooking fire	loose fitting material	gated tin roof.
Fish, dried	(wood and	for men; blouse and	
Garlic	charcoal)	large piece of wrap-	
Gari	Gari grinder	around material for	Palm leaves laid on
Maize	Mortar and pestle	women).	bamboo frames to
Meat	Kerosene lamp	European clothing	form a simple
Onions	Pots (clay and		shelter.
Oranges	metal)		
Palm oil	Tin cans	Sandals or shoes	
Palm wine	Bottles		
Pawpaw			
Pineapple			
Plantain			
Red pepper			
Rice			
Spinach			
Sugar cane			
Yam			

Table 2--Continued

Tools and Equipment	Farm Implements	Transportation Media
Anvil	Loom	Automobile
Bellows	Mallet	Bicycle
Brace & bit	Nails	Canoe
Calipers	Plane	Cart (hand)
Center punch	Plumb line	Lorry (busses and trucks)
Charcoal	Rule	Train
Chisel	Saw	
Clamps	Screws	
Crowbar	Screwdriver	
Draw knife	Sewing machine	
File	Scissors	
Funnel	Snips	
Hack saw	Spanner	
Hammer	Square	
Hinges	Torch	
Level	Tongs	
Lock	Trowel	
	Ax	
	Calabash (gourd)	
	Cutlass	
	Hoe	
	Machete	
	Pick	
	Spade	
	Woven vine (rope)	

TABLE 3

CHECK LIST OF ASPECTS OF YORUBA CULTURE
PERTINENT TO THE DEVELOPMENT OF A
MECHANICAL APTITUDE TEST

Date: _____

Village, town, or city: _____

<u>I. Communications</u> Drums _____ Radio _____ Telephone _____ <u>II. Cooking and Domestic Life</u> Method of cooking: Cook fire _____ Wood stove _____ Electric stove _____ Electricity available: _____ Utensils: _____ Water facilities: _____ Sanitation facilities: _____ Medical facilities: _____ Other: _____ <u>III. Buildings</u> Type (construction material): Walls _____ Roofs _____ <u>IV. Methods of Hunting & Fishing:</u> Weapons _____ Boats _____ Fishing equipment _____ Comments: _____	<u>V. Farming (lumbering)</u> Tools: _____ Equipment: _____ <u>VI. Transportation</u> Automobile _____ Bicycle _____ Lorry _____ Railroad _____ Roads _____ Gas station _____ <u>VII. Tools and Equipment</u> Tools: _____ Machines: _____ Equipment: _____ <u>VIII. Village Laborers</u> (Occupations) Blacksmith _____ Bicycle repairer _____ Carpenter _____ Weaver _____ Other _____
--	---

made to sample communities in all areas of the Western Region. Since social customs varied within the Yoruba culture itself, it was necessary to take these cultural differences into consideration when the visits were planned.

The town and city visits were relative easy to arrange; visits to the smaller villages, located off the regular roads, were more difficult. Professor Tunde Oloko arranged for these visits and often went along as interpreter. The usual procedure, particularly in the small villages, was first to establish contact with the village chief or elder and make arrangements to visit his village at a future date.

TABLE 4

LIST OF VILLAGES, TOWNS, AND CITIES VISITED IN
THE WESTERN REGION, NIGERIA

Villages Less than 5,000	Towns 5,000 to 50,000	Cities More Than 50,000
Basari	Akure	Abeokuta
Burutu	Asaba	Ibadan
Igolo	Benin City	Ife
Iperu	Ede	Ilesha
Iware	Fiditi	Ogbomosho
Kapolo	Ijebu-Ode	Oshogbo
Ligun	Ikire	Oyo
Omi	Ondo	
Orile-Odo	Sapele	
	Shagamu	
	Warri	

A visit involving a survey and use of the check list would take from four to six hours to complete. Those

villages visited along the Niger River and near the Eastern Region of Nigeria required a total of three days; one day for traveling to the village, one day for visiting several villages, and one day for the return trip to Ibadan. Towns, villages, and cities which were visited are shown in Table 4.

Comparison of Yoruba Villages,
Towns, and Cities

The surveys made in the villages, towns, and cities yielded considerable information pertinent to this study. A comparative analysis of the findings is shown in Table 5, page 45.

An examination of the comparative analysis (see Table 5) indicated noticeable differences between the Yoruba villages, towns, and cities. For example, radio (both battery and electrical powered) were found in all large Yoruba cities, but only a few in villages. In addition, there was no electricity in 95 per cent of the small villages, which made it necessary to eliminate the use of electricity in any of the test questions. On the other hand, most of the common carpenter tools were found in the villages, towns, and cities. Usually a small group of boys would be gathered around watching the carpenter at work. When questioned, some of the boys could identify specific tools, demonstrate their use and tell how they should be properly cared for. In such cases as this, where similarities did exist between villages, towns, and cities, potential items for the mechanical aptitude

TABLE 5

COMPARATIVE ANALYSIS OF SELECTED ASPECTS OF THE CULTURE
AND OCCUPATIONS IN YORUBA VILLAGES,
TOWNS, AND CITIES

Category	Village	Town	City
<u>1. Communications</u>			
Telephone, telegraph	No	Rarely	Usually
Radio (battery)	Rarely	Few	Yes
Drums	Yes	Yes	Yes
<u>2. Cooking and domestic life</u>			
Cooking by cook fires	Yes	Yes	Yes
Cooking by wood stove	No	Rarely	Sometimes
Cooking by gas or electricity	No	Rarely	Few
Utensils of calabash, clay, tin cans, and glass bottles	Yes	Yes	Yes
Utensils of porcelain and crockery	No	Few	Sometimes
Electricity	No	Rarely	Usually
Water	Well or stream	Rarely pumped	Usually pumped
Sanitation facilities	No	Limited	Yes
Kerosene lamps	Yes	Yes	Yes
<u>3. Buildings</u>			
Houses made of mud brick	Yes	Yes	Yes
Houses made of cement blocks	No	Limited	Yes
Corrugated roof	Yes	Yes	Yes
Thatched roof	Yes	Yes	Yes
<u>4. Hunting and fishing</u>			
Spears, snares, Dane guns, nets, and dugout canoes	Yes	Yes	Yes
Modern (European equipment)	No	Rarely	Limited
<u>5. Farming</u>			
Hoe, spade and basically manual labor	Yes	Yes	Yes
Modern (European) equipment	No	Rarely	Limited
Lumbering using modern equipment	Limited	Yes	Yes

TABLE 5--Continued

Category	Village	Town	City
6. <u>Transportation</u>			
Automobile	Rarely	Yes	Yes
Lorry (truck)	Few	Yes	Yes
Bicycle	Yes	Yes	Yes
Bicycle bell	Yes	Yes	Yes
Railroad	No	Few	Usually
Petrol station	Rarely	Few	Yes
Paved road	No	Few	50%
7. <u>Tools, equipment, and machines</u>			
Organized business (ten employees or less)	No	Few	Yes
Carpenter tools	Yes	Yes	Yes
Blacksmith tools	Yes	Yes	Yes
Farm tools	Yes	Yes	Yes
Gari grinder	Rarely	Few	Yes
Sewing machine (pedal)	Yes	Yes	Yes
Use of simple machines:			
pulley, block and tackle, wheel and axle	Very limited	Few	Yes
Torch (flashlight)	Yes	Yes	Yes
Mirror	Yes	Yes	Yes
8. <u>Village laborer</u>			
Blacksmith (goldsmith and silversmith)	Yes	Yes	Yes
Bicycle repairer	Yes	Yes	Yes
Carpenter	Yes	Yes	Yes
Palm tapper	Yes	Yes	Yes
Watch repairer	Yes	Yes	Yes
Weaving and dyeing	Yes	Yes	Yes
9. <u>Schools and hospitals</u>			
Primary school	Yes	Yes	Yes
Beyond primary school	No	Yes	Yes
Medical facilities	No	Limited	Yes
Hospital	No	Rarely	Limited

test began to materialize. In general, the following conclusions were reached as a result of the visits:

1. Few actual devices involving physical and mechanical elements existed in the bush villages. When found, they were usually limited to bicycles, kerosene lanterns, looms, sewing machines, and torches (flashlights).

2. Most villages had a blacksmith, a carpenter, and a bicycle repairman.

3. Test items for the mechanical aptitude test would have to be kept simple if they were to be of any value in the testing of those who grew up outside the large urban centers.

Test Development

A list of over 200 ideas that could be used for test items resulted from the visits. The specific ideas are listed in Appendix I.

Schwarz and his team of psychologists aided in the refinement of the 200 ideas and the eventual design of the test itself. Schwarz,⁴ in his past research in Nigeria, had established nine general principles or rules to follow in constructing tests for use in Africa. These were:

1. The testing procedure should not pre-suppose any response as being automatic on the part of the examinee. It should include explicit provisions for teaching him every response that he will be expected to make.

⁴Schwarz, op. cit., pp. 14-22.

2. The design of the test booklet should minimize the number of constraints imposed on the examinee's performance in working from the first page to the last. Insofar as possible, instructions and cautions irrelevant to the solution of the problems should be eliminated.

3. The test should not rely on any printed instructions for teaching or controlling the responses to be made. The test booklet should include no such instructions.

4. The most effective means of teaching the test is through the use of visual aids, supplemented by active demonstration. These aids should replicate as closely as possible the exact operation to be performed.

5. Explanations necessary to supplement the demonstrations should be given through oral instructions. Such instructions must take account of idiosyncrasies in local patterns of speech and expression.

6. The training session should include supervised practice in doing the test problems, with a specific provision for feedback to the examiner. Such practice and feedback must cover not only the basic task, but also any variation that may be incorporated in certain of the test items.

7. To get maximum examinee cooperation, the testing procedure should differ sharply from the routines to which they are normally accustomed in school. Elements of the dramatic or flamboyant inspire the peak effort that is necessary for effective aptitude measures.

8. It is seldom possible to predict on logical grounds which tasks foreign examinees can and cannot do. Each new test should be subjected to thorough experimental investigation.

9. Preference should be given to items that are reasonably independent of individual differences in the tactics or strategies of the examinees. It is usually not possible to enforce a uniform strategy that will be followed by the entire group.

In developing the mechanical aptitude test the rules or principles listed by Schwarz for test construction in Africa were observed. In addition, due cognizance was given to the following:

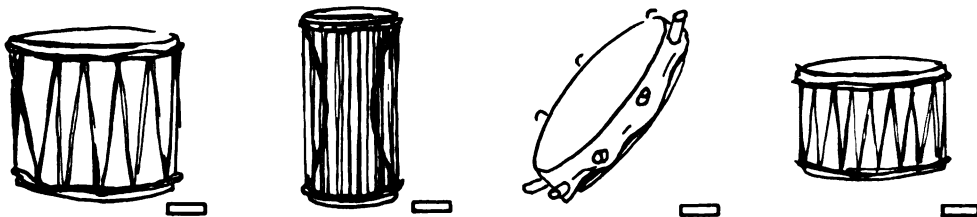
1. Was it possible that the examinees might previously have been exposed to the scientific and mechanical principles involved in the item?

2. Did the active behavior required to answer the item appear to indicate an interest in things scientific or mechanical?

3. Were there scientific and mechanical elements involved in some of the items that were generally accessible to the examinee but such that the examinee must go out of his way to experience or observe them?

4. If an item involved problem solving, was it posed in such a manner that passive exposure was insufficient to provide the correct answer?

The 200 ideas were first roughly sketched in a manner that might be usable for the test. For example, the first item to appear in Appendix I explained the fact that the size and shape of a drum determined its pitch and tone. As a potential test item, a series of drums were sketched to represent the numerous shapes and sizes of Yoruba drums. One drum was drawn large enough to indicate it would sound very deep if beaten. The item, as it finally evolved depicting the various size and shape of drums, is shown below:



Question: Look at the four drums. Which drum sounds deep and most like thunder? Mark the one that sounds most deep.

Occasionally it was necessary to eliminate certain items because of their irrelevancy or the difficulty in depicting an existing situation. For example, it was observed that wells varied in shape and size but all were designed to slope at one end to allow water to collect during a dry spell. Numerous sketches were drawn in an effort to see if the item could be presented so as to catch the significance of this phenomenon. Different size buckets were tried, as well as various shapes of wells, but a suitable question could not be formulated to convey the proper response.

As the test began to develop, the items compiled were divided into two categories: (1) Mechanical Comprehension--those dealing with general principles of physics and mechanics; (2) Mechanical Information--those dealing with specific tools and equipment.

The next step was to design the test questions. The decision was made to have the items shown pictorially. Biesheuvel⁵ supported this decision when he wrote:

The use of concrete presentation and pictorial answers, which reduces the influence of verbal ability on performance in this test, (Test of Interests) is an advantage for African use.

However, there was also the possibility that the African might misinterpret the picture or its perspective when it was drawn in two dimensions. Considerable care would have to be taken in drawing the pictures to keep them as simple and uncomplicated as possible.

⁵Taylor, op. cit., p. 148.

The illustrations for the items were drawn by two artists⁶ (one American and one Canadian) who were familiar with African culture. At this stage, consideration was given to the best possible method of presenting the test items to the students. To avoid any possibility of misinterpreting the English language, it was decided to eliminate written instructions and present each question orally by means of a brief and carefully worded introductory statement (see Appendix II). The oral presentation was tape recorded.

Since English was the accepted basic language of Nigeria, the recordings were made in English. An experiment was conducted using a Nigerian radio announcer to record the instructions; however, his "learned" English was so rapid and had so many inflections that a trial sample of testees became confused when listening to him. In order to achieve better speed control, diction, and emphasis, an American was selected for this purpose. No attempt was made to record the instructions and questions in native dialects, as these were so varied as to have had only limited application in any one section of Nigeria.

The initial form of the test (see Appendix II) contained eighty questions and was divided into three parts. Parts I and II were essentially questions relative to mechanical comprehension applying the general principles of physics and mechanics. Part III emphasized mechanical information based on knowledge of care and use of tools and equipment.

⁶The two artists were Mrs. Jacqueline Schwarz and Mrs. Anita Davis.

Each question was designed with four responses. The reasons for confining the responses to four were:

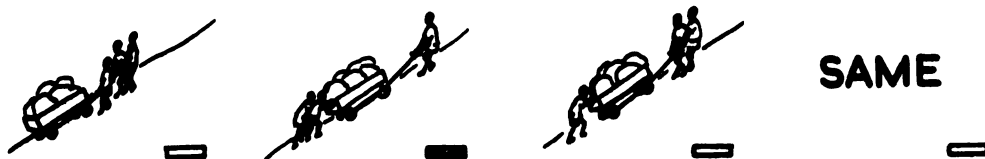
1. Many of the questions limited themselves in the degree to which they could be pictured. A typical example was question six concerning the plantains (native banana) shown below:



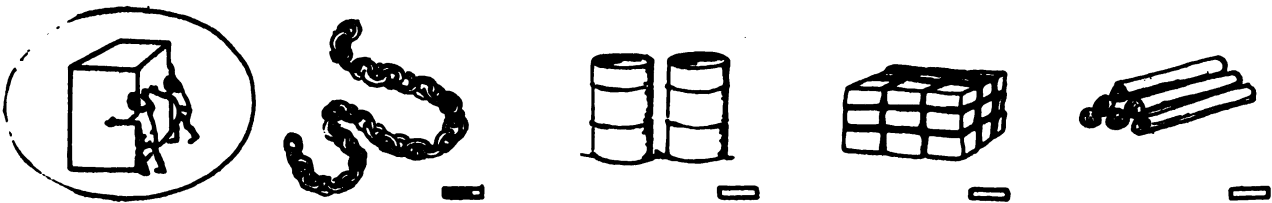
Question: Three plantains are cut for cooking. Which plantain will cook the quickest in a pot of boiling water? .. the first..the second..the third..or will the time for cooking all be the same? Mark the one answer that is best.

To show the plantain sliced in different proportions other than the ones drawn above would accomplish little except to repeat an idea already fully illustrated.

2. The size of the pictures themselves was important. If the illustrations were made any smaller, to accommodate more than four responses, details would become too intricate and confusion might result for the young African taking the test. The test item illustrated below demonstrates the minimum size picture that could be used and still adequately portray the concept involved:



3. A few of the questions needed an introductory picture to further explain the concept being portrayed. This, too, had a limiting effect on the number of response items that could be effectively drawn. An example would be test question 12. In this question, an introductory picture was provided to aid in understanding the question. The item is shown:



Question: Two men are trying to move a very heavy box. Which of these will best help the men to move the very heavy box? ..the chain..the barrels..the bricks..or the timbers? Mark the one which will best help to move the box.

Experimentation showed that fifteen seconds between questions was sufficient time for the testees to answer questions. The questions were arranged in order of difficulty, from least to most difficult. A practice sheet was developed containing six practice questions (see Appendix II). This practice sheet was determined to be a necessary requirement to test administration, as previously indicated in Schwarz's rules and principles for test construction in West Africa. It was planned to provide a minimum of ten minutes to acquaint the testees with the test.

The test was printed in Lagos with the cooperation of the USAID--American Institute of Research and was ready for use by the end of March, 1962.

Original Test Tryout

The need for a representative sample of schools to try-out the new test of mechanical aptitude was discussed early in April, 1962 with the Ministry of Education, Western Region. These schools would have to be those that would eventually supply applicants to the trade and technical centers. Since the level of scholastic achievement varied so greatly, even within a limited geographical area such as Ibadan, the necessity of selecting typical schools became apparent. Accordingly, through the cooperation and advice of the Ministry of Education⁷ three primary schools (sixth grade), two secondary modern schools (pre-high school), and one grammar school (pre-college) were chosen in the near-Ibadan area. This phase of the testing required two weeks to accomplish. Norms and other data resulting from the first test tryout appear in Table 6, page 55.

Once the testing of the original form of the test was completed, an item analysis (see Appendix III) was made of the 461 students involved. The purpose of the item analysis was to assess the difficulty of the items and their discriminating power.

The level of difficulty was obtained by calculating the percentage of students who gave the correct responses to that item. Discrimination value was obtained by determining the scores of the top 29 per cent and the bottom 29 per cent

⁷Essentially, the advice and cooperation of Mr. H. M. B. Somade, then Chief Inspector, Ministry of Education, Western Region Government.

TABLE 6

NORMS RESULTING FROM ORIGINAL TEST SAMPLE OF
461 STUDENTS, IBADAN AND NEAR VICINITY

Per- centiles	Raw Scores				
	Primary School Grade 6	Secondary Modern Schools			Grammar Schools
		Class I	Class II	Class III	
99%	53	52	60	55	64
95%	44	47	53	51	61
90%	41	40	47	48	59
85%	39	38	42	45	58
80%	38	37	39	43	56
75%	36	36	38	42	53
70%	35	34	37	41	52
65%	33	33	35	40	51
60%	32	32	34	37	49
55%	31	31	33	36	48
50%	30	30	32	35	45
45%	29	30	31	34	43
40%	28	30	29	32	42
35%	27	29	28	31	41
30%	26	28	27	30	39
25%	24	26	26	29	38
20%	23	25	25	28	37
15%	21	24	24	27	35
10%	19	23	21	24	33
N	125	52	122	68	94
Mean	30.9	31.0	34.6	36.0	47.0
SD	8.6	7.9	9.8	8.7	9.8

NOTES:

Raw Scores represent a total number correct out of a possible score of 80.

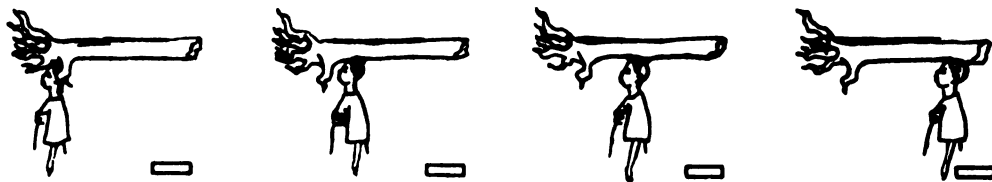
Primary Schools (sixth grade) included Saint Patricks-Abebi and Saint Patricks-Oke Padi, Ibadan.

Secondary Modern Schools (grades 7, 8 and 8 plus) included Anglican Secondary Modern and the Ibadan City Council Secondary Modern, Ibadan.

Grammar School (pre-college, grades 7 and 8) was Saint Luke's Grammar School, Ibadan.

in each school group tested. (The top 9 per cent and bottom 9 per cent were scored double.) The weighted ratio of the top 29 per cent to the bottom 29 per cent was calculated for each response to the items. As a result of the item analysis, seven questions were eliminated and twenty-two questions revised.

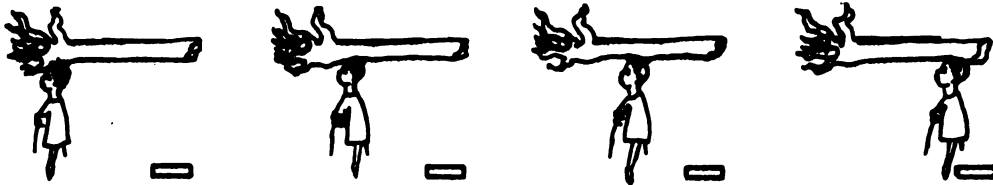
The item analysis produced several significant results, especially with the questions that needed revision. For example, question number one showed a Nigerian woman carrying a log on her head. The problem was to identify which response was the proper way to carry the log.



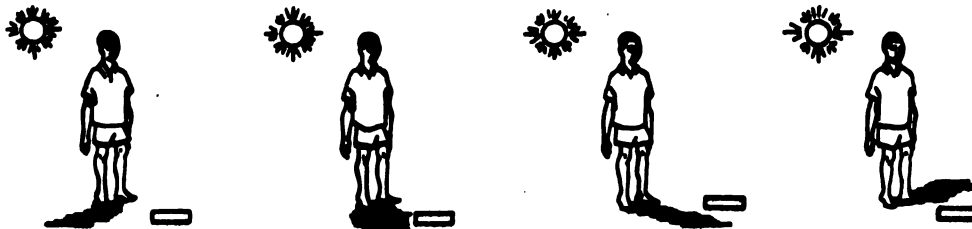
Question: Look at the four women carrying the timber. Which woman can best carry the timber? Mark the one best answer.

This question was presumed to be the least difficult in the test. The item analysis indicated it was a relatively difficult question. Upon interrogating the Nigerian students at the Technical College, it was learned that the artist had unfortunately drawn the roots of the log to appear to be growing out of the lady's ear in response A. Response B, the correct answer showed the roots hanging down in front of the lady's eye obstructing her view. The Nigerian students at The Technical College indicated that the testees probably felt

that an effort was being made to deceive them in responses A and B; accordingly, the majority picked response C, an incorrect answer. In revising this question, the log and its roots were rotated 180 degrees.



The responses to question number two were also interesting. The question showed a boy standing in the sun with his shadow cast in four different positions:

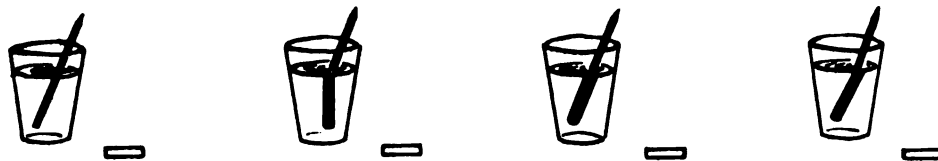


Question: A boy is standing in the sun. Which of the four pictures shows the correct shadow on the ground?
Mark the one in which the shadow is correct.

This question was considered to be extremely easy. The item analysis denied this fact. Again in questioning the Nigerian students at The Technical College, the point was made that the test assumed that the sun was behind the boy in all the responses; but actually in its two dimensional portrayal, it could be interpreted to be either in front or behind the boy. Here was an example of the previously mentioned concern--misinterpretation brought about by the two dimensional

perspective of the drawings. The confusing factor was eliminated by changing the verbal information accompanying the question to read: A boy is standing in the sun. The sun is behind him. Which of the four pictures shows the correct shadow on the ground? Mark the one in which the shadow is correct.

Question twenty-nine involved the principle of refraction in physics: an object tends to appear to bend and become slightly thicker as it enters water. The test question appears below:



Question: If you put a pencil into a tumbler of water, how does the pencil look? Mark the one that best shows a pencil in the water.

The level of difficulty indicated it to be a very difficult question, either because of something learned in the classroom that seemingly had no application value or because it was too academic in nature. The question was discarded.

The questions that eventually were eliminated were those that proved to be too academic in nature or too difficult to illustrate in two-dimensioned effects, or those which required too lengthy verbal instructions. Accordingly, the second form of the test was reduced to seventy-three questions.

Second Tryout

Late in April, 1962 permission was received from the Ministry of Education, Western Region, to use the revised form of the Mechanical Aptitude Test, in conjunction with other selection procedures, on the annual group of applicants for the four trade centers⁸ of the Western Region, Nigeria. Originally over 3,000 boys applied for entrance to these trade centers. After a preliminary screening, based on age and qualifications, some 800 boys were invited to sit for a series of entrance examinations at the four centers. The actual number of boys eventually completing the examinations totaled 661. These were boys who had graduated from the secondary modern schools (pre-high school). The boys came from all sections of the Western Region and averaged 16.5⁹ years in age.

The entrance examination consisted of a standard battery of the Ibadan Verbal Test and Ibadan Arithmetic Tests (see Appendix VI and VII), and an interview. Three of Schwarz's USAID-AIR tests (see Appendix VIII) and the revised form of the Mechanical Aptitude Test were also administered at this time. All but the Mechanical Aptitude Test were to be used in the selection of the new candidates for the trade school.

⁸Sapele, Ijebu-Ode, Oyo, and Oshogbo.

⁹The average age of the applicants was determined from information collected by the questionnaire administered at the time of the testing and may not be too dependable.

A questionnaire was given to each candidate in conjunction with the Mechanical Aptitude Test to provide background information. The purpose of the questionnaire was to establish the degree of relationship between: (1) the questionnaire items and the criterion measure, (2) the questionnaire items and the tests being measured, and (3) the various items on the questionnaire itself. The questionnaire is shown in Appendix IX.

A follow-up item analysis (see Appendix V) was made on the twenty-one questions that had been revised. The same technique of item analysis as was used with the original test was employed in this follow-up analysis.

A frequency distribution and norms of the total number of applicants tested using the revised form of the Mechanical Aptitude Test appear in Figure 1, page 61, and Table 7, page 62.

Conclusions reached from examining Figure 1 and Table 7 were:

1. The distributions represented were approximately normal.
2. A comparison of the original test tryout group of "Secondary Modern, Class III" (see Table 6) with the "Total" column of Table 7 showed enough similarity to conclude that the original sample was somewhat representative of the boys who did enter the trade schools.

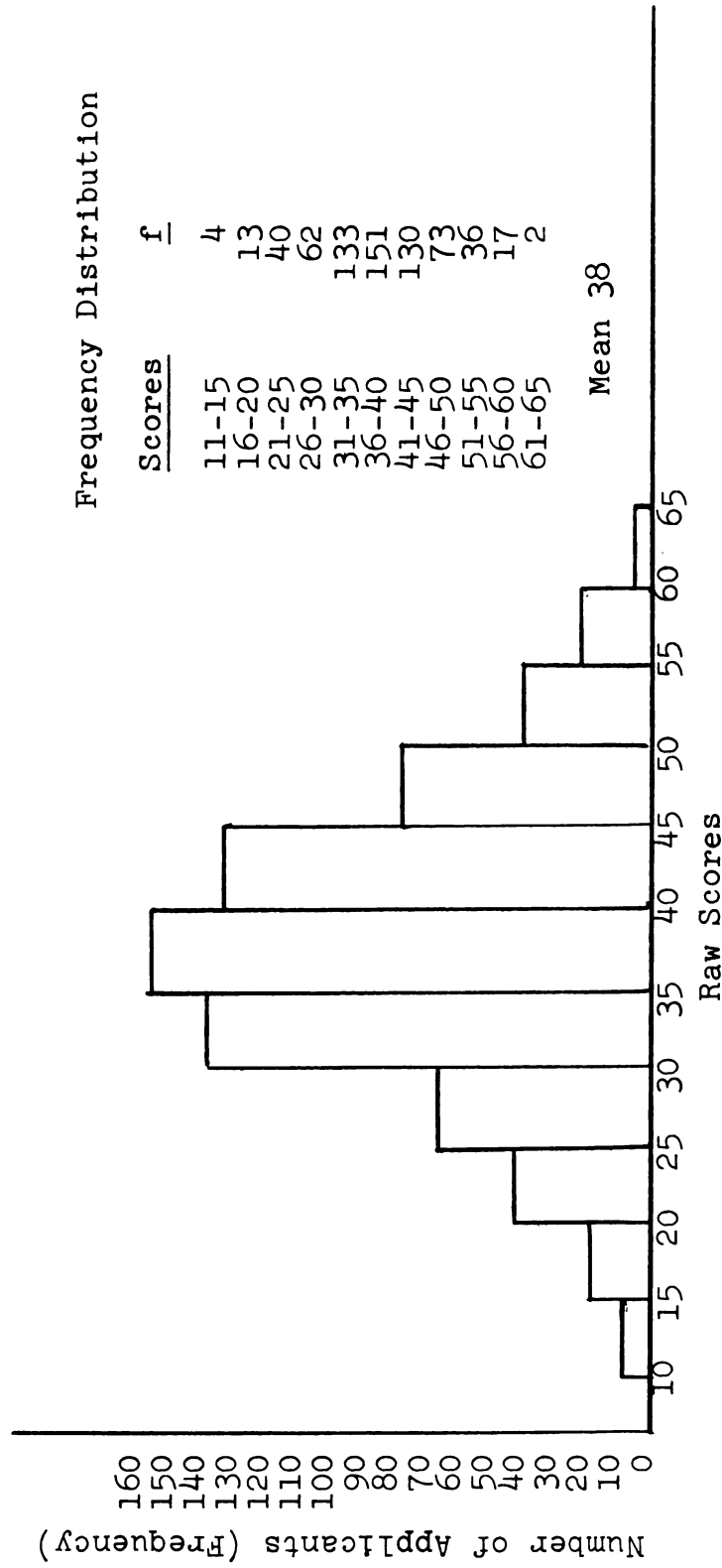


Figure 1. Frequency Distribution and Histogram of Scores Made by 661 Applicants to Four Trade Centers on the Revised Form of the Mechanical Aptitude Test Western Region, Nigeria.

TABLE 7

NORMS RESULTING FROM SECOND ADMINISTRATION OF TEST
TO FOUR TRADE CENTERS OF WESTERN REGION, NIGERIA

Percentiles	Raw Scores ^a				
	Ijebu-Ode	Oshogbo	Oyo	Sapele	Total
99	54	58	60	59	59
98	48	54	54	53	53
90	47	49	52	50	49
85	42	47	49	47	47
80	41	45	47	45	45
75	40	44	46	43	44
70	39	43	45	42	42
65	38	42	44	41	41
60	37	41	43	40	40
55	36	40	42	39	39
50	35	39	41	38	38
45	34	38	40	37	37
40	33	37	39	35	35
35	32	36	38	34	34
30	31	34	36	33	33
25	30	32	35	31	32
20	29	30	34	30	31
15	26	29	31	29	29
10	23	26	29	27	26
N	179	147	96	239	661
Mean	35.3	38.9	41.3	38.4	38.0
SD	8.3	9.0	8.1	8.9	8.8

^aRaw scores represent a total number correct of a possible score of 73.

Summary

This chapter has described the procedure used to develop a test of mechanical aptitude for Nigeria. In general this development involved: (1) analyzing the Bennett Mechanical Reasoning Test of the Differential Aptitude Test Battery for principles of physics and mechanics; (2) acquiring a basic concept of Nigerian culture; (3) designing the test; (4) trying it out; (5) revising it and then trying it out a second time. The work was accomplished during a two year period: 1960-1962.

Visits to Nigerian villages, towns, and cities showed varying degrees of living conditions; as a result, test items were designed and selected with this fact in mind. Every effort was made to incorporate questions suitable to the culture involved.

During the past year, 1962-1963, reliability and validation studies were made. These last two steps are described in the following chapters.

CHAPTER V

RESULTS

Introduction

The purpose of this chapter is to show the results of the study. Included are the following: (1) criterion reliability substudy, (2) reliability study of the predictors, (3) results of the questionnaire, (4) examination of the intercorrelation of the variables, (5) validity study, and (6) multiple regression study.

Criterion Reliability Substudy

The primary function of the substudy was to ascertain the relationship that existed between a student's class rank at the end of his first term at the trade center and his class rank at the time of graduation. If a relationship did exist, then first term scores and class rank could be used with much more assurance than would otherwise be the case, since both would show a close approximation to a commonly used training criterion, namely graduation from a training program. The substudy was conducted at the two trade centers, Ijebu-Ode and Sapele, since they had been in operation long enough to provide graduates.

A Rank-Order Correlation was used in conjunction with the data received, applying the following formula:

$$\text{Rho} = \frac{1 - 6 \sum D^2}{N (N^2 - 1)}$$

Table 8 shows the results of the substudy.

On the basis of the generally high correlations found in the substudy between class rank at the end of Term I and class rank at graduation, it was concluded that a student's first term class rank was indicative of what his class rank would be at the time of graduation.

The main criterion for the study was to be the workshop scores made by those students selected to enter the trade centers. The arithmetic and English scores were to be subsidiary criteria. In order to expedite the study, since term scores would not be available until August, 1963, the decision was made to utilize mid-term scores as criteria. The reasons for using mid-term scores rather than waiting until the end of the term were:

1. It was generally accepted that a student's class rank at mid-term was a strong indicator of his class rank at the end of the term.

2. A high correlation did exist between a student's class rank at the end of the first term and his class rank at graduation; consequently, a similar relationship might be expected to exist between mid-term and first term class rankings.

TABLE 8
CORRELATION OF STUDENT'S RANK AT END OF TERM I
AND RANK AT TIME OF GRADUATION

Trade Center	Course	Date Completed	Number of Graduates	Rank-order Correlation Between Student's Rank at End of Term I and Rank at Time of Graduation
Sapele	Bricklayer-Masons	Feb. 1959	11	.75
	Wood Machinists	March 1959	10	.99
	Blacksmith-Welders	June 1959	11	.99
	Blacksmith-Welders	March 1959	10	.78
	Shipwrights	July 1961	22	.25 ^a
Ijebu-Ode	Carpenters-Joiners	1960	11	.92
	Plumbers	1961	9	.58

^a

Upon graduation, few of these boys were placed in industry. It is possible that the boys knew some time during their training that job opportunities for their particular skills were going to be limited. This fact could have affected their respective scholastic achievements toward the end of their training. The course for shipwrights has since been discontinued and no students enrolled in this course were included in the experimental group.

3. A mid-term probationary evaluation was to be made at the trade centers.¹

Reliability Study of the Predictors

A reliability study was made of the revised Mechanical Aptitude Test. The method used was the odd-even technique, where the test was divided into halves and each half was scored separately for its respective coefficient of reliability. The halves were obtained by letting the odd-numbered items constitute one-half and the even-numbered items the other half. The data utilized for this purpose were those from the testing of the 661 applicants to the trade centers in May, 1961. The formula used to establish the coefficient of correlation between the halves was:

$$r = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{[N \sum X^2 - (\sum X)^2][N \sum Y^2 - (\sum Y)^2]}}$$

An estimate of the reliability of the whole test was made by means of the Spearman-Brown Formula, which corrected the reliability coefficient for artificial shortening of the test required by an odd-even procedure. The Spearman-Brown Formula used was:

$$r = \frac{2 r_{1/2 1/2}}{1 + r_{1/2 1/2}}$$

¹This was an innovation at the trade centers. No previous mid-term evaluations had ever been made at the trade centers; consequently, it was impossible to establish the relationship between mid-term, first term, and graduation performance.

The reliability study produced the following results:

1. Raw coefficient of correlation between halves of the revised form of the test of mechanical aptitude.

Part I $r = .43$

Part II $r = .42$

Part I and II $r = .58$

Part III $r = .53$

Part I, II, III $r = .66$

2. Spearman-Brown estimate of the corrected reliability used in conjunction with the above coefficient of correlation.

Part I $r = .60$

Part II $r = .59$

Part I and II $r = .73$

Part III $r = .69$

Part I, II, III $r = .80$

The conclusions drawn from the above reliability study were:

1. The separate parts of the test were not reliable.
2. The separate parts of the test when combined yielded an estimate of reliability that was acceptable.

Results of the Questionnaire

The questionnaire (see Appendix IX) was administered in May, 1961, in addition to the standard battery of tests. Various aspects of the questionnaire were reviewed as follows:

1. Father's Occupation--With the help of the college staff² at The Technical College the occupations listed by students as representative of their father's work were divided into three categories: (1) non-mechanical, (2) slightly mechanical, and (3) mechanical. Occupations were classified in this manner to show if any relationship existed between the occupation of a boy's father and the boy's scores on the tests. The occupations and their classification are shown in Table 9.

2. Primary School Attended--The primary schools were initially classified as either rural or urban by two Nigerian members³ of the staff at the Technical College. A similar but individual classification was later made by Mr. Joseph Onawunmi, a Nigerian participant studying at Western Michigan University, who independently substantiated the previous classifications. The purpose in analyzing this question was to determine if any relationship existed between the kind of primary school attended by the applicant and his scores made on the entrance tests. The schools were tabulated as (1) rural and (2) urban.

3. Secondary Modern School Attended--The Ministry of Education, Western Region, provided a report listing the region's secondary schools. The report included such

²Those who helped to independently establish the classification of occupations included the five USAID staff members, three expatriates, and five Nigerians.

³The two members of the staff at the Technical College were the Bursar and the Librarian.

TABLE 9

FATHER'S OCCUPATION FOR THE 661 APPLICANTS TO
FOUR TRADE CENTERS, WESTERN NIGERIA

Non-mechanical	Slightly Mechanical	Mechanical
Accountant	Barber	Blacksmith
Buyer	Butcher	Bicycle Repairer
Clerk	Drycleaner	Brick Layer
Civil Servant	Fisherman	Building Contractor
Drug Dispenser	Gardner	Crane Operator
Farmer ^a	Laborer	Carpenter
Messenger	Nurse (Male)	Engineer
Night Watchman	Palm Wine Tapper	Goldsmith
Missionary	Photographer	Lorry Driver
Policeman	Radio Announcer	Mechanic
Postman	Railroad Worker	Printer
Sanitary Inspector	Road Overseer	Technician
Salesman (Merchant-tradesman)	Road Sectionman	Watch Repairer
Tax Inspector	Shipping Clerk	Works Foreman
Teacher	Surveyor	
	Steward	
	Tailor	
	Wood Cutter	
	Weaver	

^aThe typical Nigerian farmer has only limited tools and means of accomplishing his work. His daily labors are often routine and may require little mechanical ingenuity.

information as number of students enrolled, size and qualifications of the staff, and number of streams (classes) being simultaneously offered at the schools. A classification of the schools was made with the aid of the report and the Inspector of Secondary Education, Ministry of Education. These classifications were also later substantiated by Mr. Onawunmi. The purpose here was to establish whether or not a relationship existed between the size of the secondary school attended and an applicant's scores on the entrance examinations. The schools were classified as (1) small and (2) large.

4. Student Ownership of Wrist Watch and Bicycle--The purpose of this question was to establish an index of the applicants' exposure to Western mechanical culture. The assumption here was that the applicant who indicated the ownership of a wrist watch and/or a bicycle would score high on the Mechanical Aptitude Test. The question was tabulated as: (1) does not own a wrist watch or a bicycle, (2) owns either a wrist watch or bicycle, and (3) owns both a wrist watch and a bicycle.

5. Father's Possessions--The purpose of this question was essentially the same as Question 4, i.e., to establish an index of the applicant's exposure to Western mechanical culture. The possibility existed here that the parent's ownership of an automobile and/or a bicycle would afford the applicant the opportunity of becoming more familiar with the mechanical principles. The question was tabulated as

(1) does not own a bicycle or automobile, (2) owns either a bicycle or automobile, and (3) owns both a bicycle and automobile.

6. Electricity in the Village, Town, or City--Electricity was not a common thing in Nigeria, particularly in the villages. Towns and cities were more apt to have electricity, but primarily for commercial use. Only a minority of schools in the towns and cities would be likely to have electricity in the classrooms. Accordingly, schools with electricity had considerable prestige. Such a school might attract a higher caliber of teacher and student; as a result, an applicant's background and scores on the entrance tests might vary according to this factor. The question was tabulated as (1) does not have electricity and (2) has electricity.

7. Use of Tools--The last portion of the Mechanical Aptitude Test was devoted to tools and their use. Accordingly, it was reasoned that applicants claiming high familiarity with tools should score higher on the last portion of the test. The question was tabulated as: (1) not familiar with tools listed, (2) familiar with two of the four tools, and (3) familiar with all the tools listed.

Table 10, page 73, shows the results of these tabulations. The following conclusions were made as a result of the questionnaire:

1. Most of the applicants' fathers worked in non-mechanical occupations.

TABLE 10

TABULATION OF RESULTS OF QUESTIONNAIRE OF
661 APPLICANTS TO TRADE CENTERS
WESTERN NIGERIA

Questionnaire Item	Percentage Response				
	Ijebu- Ode	Oshogbo	Oyo	Sapele	Combined (Total)
1. Father's occupation					
Non-mech.	86	86	74	86	84
Slightly mech.	4	3	11	4	5
Mechanical	10	11	15	10	11
2. Primary school					
Rural	40	32	21	49	38
Urban	60	68	79	51	62
3. Secondary School					
Small	22	21	13	26	22
Large	78	79	87	74	78
4. Ownership wristwatch-- bicycle					
None	27	41	44	31	34
Either	43	44	44	38	42
Both	20	15	12	31	24
5. Father's possessions bicycle-car					
None	16	35	13	8	17
Either	83	65	87	90	82
Both	1	0	0	2	1
6. Electricity in village					
No	25	18	56	56	40
Yes	75	82	44	44	60
7. Familiarity with tools					
None	7	7	8	5	6
Some	31	43	29	70	42
All	62	50	63	25	52

2. More applicants attended large urban primary and secondary schools than small rural schools.

3. Most of the applicants owned a bicycle and/or a wrist watch.

4. Most of the applicants' fathers owned bicycles, few owned a car.

5. There was electricity in approximately one-half of the villages, towns, and cities where the applicants lived.

6. Approximately half of the applicants expressed familiarity with a hammer, saw, screwdriver, and spanner (wrench).

Intercorrelation Study of the Variables

The intercorrelation study was made using the scores attained by the total group of 661 applicants and the following variables:

1. Mechanical Aptitude Test.
2. Schwarz's USAID-AIR tests.
3. The Ibadan Verbal test and the Ibadan Arithmetic test.
4. The questionnaire items.

The intercorrelations were calculated by individual trade centers as well as by a cumulative matrix of the total (661) number of applicants tested. Generally there was little difference between correlations found in the individual trade centers and the total cumulative matrix.

Questionnaire as a Variable

The questionnaire, as an instrument for collecting information, was relatively new to the applicants tested. The applicants were observed to be hesitant in marking the questions and items. What seemed to be a relatively simple yes-no question caused much thought. A number of questions were repeatedly asked as to the meaning of many items. It was possible that some applicants answered the questions in terms of what they thought the "officials" wanted.

The seven items on the questionnaire were found to be unrelated to the other aspects of the matrix and generally the correlations were insignificant. Most correlations ranged between $+0.1$ and -0.1 . The two exceptions were as follows:

1. A positive correlation of $.44$ was found to exist between types of primary schools and secondary modern schools attended. This was probably due to the fact that an applicant who attended a rural primary school continued his education at a small rural secondary modern school; correspondingly, an applicant who attended an urban primary school would tend to continue his education at a large urban secondary school.

2. A negative correlation of -0.32 existed between electricity in the villages, towns, and cities and the types of primary and secondary schools attended. In essence, this negative correlation indicates that small schools had electricity and large schools did not. Accordingly, though most of the large schools were found in the large towns and cities, such schools did not automatically have electricity. This was

generally the case, for schools in large towns and cities operated only during daylight hours and the need for electricity for illumination was negligible. On the other hand, in those small villages and towns supporting small schools where electricity was available, the school may have served as a general meeting hall to be used both day and night. Accordingly, electricity might be installed in the school in this situation, if the electricity were available in the first place.

Other Observations

Table 11, page 77, shows the results of the intercorrelation study. The intercorrelations revealed a strong interrelationship among the various parts of the Mechanical Aptitude Test. Schwarz's USAID-AIR tests showed about the same low positive intercorrelations among themselves as they did with the parts of the Mechanical Aptitude Test. A relatively high negative correlation existed between the Ibadan Verbal Test and the Ibadan Arithmetic Test.

Validation Study

The mid-term probationary evaluations were performed by three of the four trade centers.⁴ Oshogbo made a Christmas evaluation in December, 1962 and a second evaluation in March, 1963.

⁴Oshogbo, Oyo, and Sapele.

TABLE 11

INTERCORRELATIONS OF TESTS ADMINISTERED TO 661 APPLICANTS
TO THE TRADE CENTERS, WESTERN NIGERIA

	USAID-AIR Tests			Ibadan Tests			Mechanical Aptitude Tests		
	Boxes	Figures	Similarities	Ibadan Verbal	Ibadan Arithmetic	Part I	Part II	Part III	Combined (Total)
USAID-AIR Tests	Boxes	.33	.20	.01	.17	.33	.33	.29	.39
	Figures		.31	.07	.14	.30	.28	.24	.33
	Similarities			.11	.01	.37	.32	.36	.43
Ibadan Tests	Ibadan Verbal				-.46	.21	.18	.12	.19
	Ibadan Arithmetic					-.08	-.03	-.05	-.06
Mechanical Aptitude Tests	Part I						.47	.51	a
	Part II							.51	a
	Part III								a
	Combined (Total)								

^a The correlation between the parts and the total could not be recorded because they would be spuriously reporting correlations within the test.

The validation study involved those boys that had been selected by the trade center principals for the September, 1962, intake. As will be recalled on page 24, criteria for the validation study consisted of grades received in workshop (main criterion), English and arithmetic. The workshop scores were selected as the main source of criterion since the practical work prescribed in the trade center workshops was directly connected with the student's ability to identify, comprehend, and apply the mechanical principles and information that served as a basis for the test of mechanical aptitude. The English and arithmetic scores were selected as subsidiary criteria in the belief that they represented academic and not trade skills and, therefore, would not necessarily be related to the Mechanical Aptitude Test. The criteria scores were standardized by converting them to z scores. For each trade center the three z scores were averaged as an overall criterion.

The predictor variables consisted of the scores made by the selected students in the Mechanical Aptitude Test, Schwarz's USAID-AIR tests, the Ibadan Verbal Test, the Ibadan Arithmetic Test, and responses to the questionnaire items.

The validation study was made by:

1. Validating the criteria against the school regardless of trades.
2. Validating the criteria against trades regardless of school.

The results of the validity study are presented in Tables 12, 13, 14, 15, and 16. In the method whereby the criteria were validated against the trades, the number of students involved was too small to be considered. However, when three trades--electrician, fitter machinist, and motor mechanic--repeated themselves in two or more centers, the number of students involved was sufficient to merit observation. To aid in the inspection of the data for significant correlations, the formula for standard error of the coefficient of correlation was used.

$$r = \frac{1 - r^2}{N}$$

The summary of the results of the validation study yielded the following:

1. The Mechanical Aptitude Test, Parts I, II, and III as related to each other indicated mild interrelationships where trade centers were combined.

2. The Ibadan Verbal Test as related to the Ibadan Arithmetic Test indicated a generally strong negative relationship.

3. The Mechanical Aptitude Test as related to the Ibadan Verbal Test indicated a mild relationship to Part I of the Mechanical Aptitude Test particularly by trades.

4. The Mechanical Aptitude Test as related to the Ibadan Arithmetic Test indicated there was no relationship by trade center, however, a mild negative relationship was shown by two of three trades.

TABLE 12

VALIDATION STUDY SHOWING RELATIONSHIP OF CRITERIA AND PREDICTOR VARIABLES
AGAINST TRADE CENTERS REGARDLESS OF TRADES

Center	N	Criteria															
		Workshop				English				Arithmetic				Total			
		Oshobbo 12/62	Oshobbo 3/63	Oyo	Sapele	Combined	Oshobbo 12/62	Oshobbo 3/63	Oyo	Sapele	Combined	Oshobbo 12/62	Oshobbo 3/63	Oyo	Sapele	Combined	
Oshobbo 12/62	Oshobbo 12/62	Oshobbo 3/63	Oyo	Sapele	Combined	Oshobbo 12/62	Oshobbo 3/63	Oyo	Sapele	Combined	Oshobbo 12/62	Oshobbo 3/63	Oyo	Sapele	Combined		
Predictor Variable Comb. 157		.01	.16	.19	.04	.11	.05	.10	.15	.00	.02	.09	.06	.10	.04	.00	
	Part I	.00	.17	.34 ^a	.00	.11	.05	.11	.04	.00	.20	.16	.03	.03	.11	.08	
	Part II	.00	.29 ^a	.26 ^a	.00	.07	.23	.25	.05	.04	.11	.11	.23	.11	.05	.00	
	Part III	.00	.26 ^a	.34 ^a	.02	.13	.10	.10	.15	.02	.12	.05	.11	.02	.00	.03	
	Total	.15	.12	.16	.29 ^a	.03	.04	.15	.31 ^a	.00	.17	.11	.15	.19	.29 ^a	.13	
	Boxes	.15	.12	.37 ^b	.21	.09	.28 ^a	.08	.31 ^a	.02	.18	.08	.09	.37 ^b	.20	.15	
	Figures	.15	.04	.14	.03	.01	.30 ^a	.22	.23	.36 ^b	.06	.04	.12	.01	.03	.08	
	Sim.	.12	.14	.12	.02	.24	.16	.12	.12	.10	.20	.11	.01	.30 ^a	.04	.12	
	Id. Ver.	.12	.11	.36 ^b	.13	.20	.12	.19	.45 ^b	.13	.19	.19	.40 ^b	.23	.02	.10	.09
	Id. Arith.	.16	.19	.08	.00	.04	.05	.17	.19	.07	.02	.21	.11	.11	.02	.08	.05
Fr's. Occ.	.05	.04	.19	.01	.04	.02	.16	.01	.01	.02	.04	.03	.02	.15	.05	.01	
Primary	.11	.40 ^b	.06	.06	.17	.03	.02	.01	.05	.05	.05	.19	.13	.07	.24	.17	
Secondary	.25 ^a	.01	.20	.05	.14	.06	.22	.22	.22	.08	.33 ^a	.18	.34 ^a	.13	.24	.06	
Watch-bike	.20	.14	.05	.18	.06	.26 ^a	.15	.18	.13	.17	.30 ^a	.10 ^b	.04	.03	.22	.03	
Fr's. Poss.	.05	.39 ^b	.12	.10	.04	.25 ^a	.05	.06	.18	.24	.13	.38 ^b	.05	.18	.00	.15	
Elec.	.08	.02	.02	.14	.02	.39 ^b	.22	.35 ^b	.07	.11	.16	.21	.30 ^a	.24	.13	.24	
Tools																	

^a > .25 needed to reject null hypotheses at 5% level of confidence.

^b > .35 needed to reject null hypotheses at 1% level of confidence.

TABLE 13

VALIDATION STUDY SHOWING INTERCORRELATIONS BETWEEN PREDICTOR VARIABLES
WHERE TRADE CENTERS ARE COMBINED REGARDLESS OF TRADES

	USAID-AIR Tests			Ibadan Tests			Mechanical Aptitude Tests		
	Boxes	Figures	Similarities	Ibadan Verbal	Ibadan Arithmetic	Part I	Part II	Part III	Combined (Total)
USAID-AIR									
Tests									
	Boxes	.37 ^b	.21	-.14	.41 ^b	.19	.26 ^a	.12	.23
	Figures		.33 ^b	-.07	.27 ^a	.25 ^a	.27 ^a	.12	.27 ^a
	Similarities			.05	.13	.26 ^a	.24	.30 ^b	.35 ^b
Ibadan									
Tests	Ibadan Verbal				-.59 ^b	.22	.06	.00	.12
	Ibadan Arithmetic					-.06	.03	.03	.00
Mechanical									
Aptitude	Part I						.31 ^b	.36 ^b	
Tests	Part II							.46 ^b	
	Part III								
	Combined (Total)								

^a >.25 needed to reject null hypotheses at 5% level of confidence.

^b >.30 needed to reject null hypotheses at 1% level of confidence.

TABLE 14

VALIDATION STUDY SHOWING INTERRELATIONSHIP OF CRITERIA AND PREDICTOR
VARIABLES COMBINING TRADES REGARDLESS OF TRADE CENTERS
TRADE -- ELECTRICIANS (N = 42)

	Criteria			USA ID-AIR				Ibadan Tests		Mechanical Aptitude Test		
	Workshop Score	English Score	Arithmetic Score	Average of z	Boxes	Figures	Similarities	Ibadan Verbal	Ibadan Arithmetic	Part I	Part II	Part III
Criteria												
Workshop Score	-.10	.35 ^a	-.07	.68 ^b	.19	.22	-.05	.06	-.01	.04	.09	.17
English Score				.45 ^b	-.12	-.15	-.15	.03	.10	-.16	-.16	.03
Arithmetic Score				.55	-.08	.06	.24	.18	.43 ^b	-.01	-.06	.06
Average of z					-.01	.07	.02	.14	.29	-.07	-.07	.14
Boxes						.33 ^a	.23	.09	.11	.29	.12	.00
Figures							.31 ^a	.15	-.03	.29	.36 ^a	.12
Similarities								.65 ^b	.14	.37 ^a	.27	.29
Ibadan Verbal									.13	.40 ^b	.25	.38 ^a
Ibadan Arithmetic										-.35 ^a	-.19	-.12
Part I											.34 ^a	.37 ^b
Part II												.68 ^b
Part III												
Total												

^a > .3 needed to reject null hypotheses at 5% level of confidence.

^b > .4 needed to reject null hypotheses at 1% level of confidence.

TABLE 15

VALIDATION STUDY SHOWING INTERRELATIONSHIP OF CRITERIA AND PREDICTOR
VARIABLES COMBINING TRADES REGARDLESS OF TRADE CENTERS
TRADE -- FITTER MACHINIST (N = 24)

	Criteria										
	Workshop Score	English Score	Arithmetic Score	Average of z	Boxes	Figures	Similar- titles	Ibadan Verbal	Ibadan Arithmetic	Mechanical Aptitude Test	
Criteria	.59 ^b	.03	.76 ^b	-.16	-.25	-.33	-.01	.25	.11	.06	.09
USAID-AIR Tests	English Score	.06	.78 ^b	.11	-.05	.04	.02	-.07	.09	-.07	.05
	Arithmetic Score		.53 ^b	.30	.23	.00	-.40 ^a	.42 ^a	-.27	.03	-.27
Ibadan Tests	Average of z			.12	-.03	-.14	+.19	.05	-.03	.01	-.06
	Boxes				-.39 ^a	.18	.19	.19	.03	-.06	-.25
Mechanical Aptitude Test	Figures					.30	.18	.56 ^b	-.27	-.18	-.26
	Similarities						.18	.30	.07	.09	.04 ^a
	Ibadan Verbal						.18	.51 ^b	.48 ^b	.20	.44 ^b
	Ibadan Arithmetic							-.54 ^b	-.58 ^b	-.34	-.74 ^b
	Part I									-.23	.62
	Part II										
	Part III										
	Total										

^a > .35 needed to reject null hypotheses at 5% level of confidence.

^b > .45 needed to reject null hypotheses at 1% level of confidence.

5. The Mechanical Aptitude Test as related to the USAID-AIR tests indicated limited and scattered relationships.

6. The Ibadan Verbal Test as related to the English criterion scores indicated there was no relationship except in the one trade of motor mechanics.

7. The Ibadan Arithmetic Test as related to the arithmetic criterion scores indicated there was relationship in one of the trade centers and a mild relationship by trades.

8. The Mechanical Aptitude Test as related to the English and arithmetic criteria scores indicated there was no relationship.

9. The Mechanical Aptitude Test as related to the workshop criterion indicated that Part III and Total scores show mild relationship by trade centers.

10. The questionnaire variables as related to the criteria indicated considerable fluctuation from center to center and a high number of negative correlations.

Multiple Regression

To establish which of the predictor variables could best be combined in the selection of applicants to the trade centers, the Wherry-Doolittle technique of determining multiple regression was used. Two sets of correlations were calculated, one using the main criterion of workshop scores and the other using the standard score average of the three scores in workshop, English, and arithmetic. The predictor

variables selected were Scharz's USAID-AIR tests, the Ibadan Verbal Test, the Ibadan Arithmetic Test, and the Mechanical Aptitude Test. The questionnaire data were not used as a predictor variable in this analysis. The results of the multiple regression prediction correlations are shown in Table 17.

The Wherry-Doolittle multiple regression illustrated the considerable difference that currently existed between the three trade centers involved. There was no evidence of a combination of tests suitable for all centers; however, the Mechanical Aptitude Test and USAID-AIR tests were included in the multiple regression selections with some consistency.

Summary

The criteria reliability substudy showed a generally high correlation between class rank at the end of Term I and class rank at graduation. Primarily on the basis of this high correlation, it was decided to expedite the study and use the mid-term scores of the students in workshop, English, and arithmetic as criteria.

The reliability study of the revised form of the Mechanical Aptitude Test produced a coefficient correlation of .80 for the combined parts of the test.

The questionnaire disclosed a number of aspects related to the applicants' backgrounds. Of interest were the findings that most of the applicants' fathers worked in non-mechanical occupations and that there was electricity in approximately

TABLE 17

RESULTS OF THE WHERRY-DOOLITTLE SELECTION METHOD

Trade Center	Criterion #1: Average of Arithmetic, English and Workshop Scores				Criterion #2: Workshop Score			
	N	Variable	Multiple R	Beta Weight	Regression Equation Constant	Variable	Multiple R	Beta Weight Regression Equation Constant
Oshogbo	44	Mechanical Information Part III	.31	.34	-1.23	Mechanical Information Part III Boxes Figures	.25 .27 .28	.35 .19 .16 -3.17
Oyo	52	Figures Ibadan Arithmetic Boxes Mechanical Information Part II	.47 .55 .57 .58	.45 .24 .17 .19	-3.85	Figures Ibadan Arithmetic Mechanical Information Part III	.35 .44 .48	.43 .24 -.10 -4.13
Sapele	66	Boxes	.30	.32	-.36	Boxes	.26	.29 - .43

half of the communities where the testees lived. However, no questionnaire variables showed consistent relationship with the criteria and other predictor variables used in the study.

The intercorrelation study based on the 661 original applicants showed some reasonable intercorrelations between the USAID-AIR tests and the Mechanical Aptitude Test. A relatively high negative correlation was shown to exist between the Ibadan Verbal Test and the Ibadan Arithmetic Test.

The validation study was made by examining the data by trade centers and by specific trades. The validation study showed no single predictor variable to be consistently successful in any trade or trade center. The Mechanical Aptitude Test showed a minimum relationship with the workshop criterion score in one of the three centers but no relationship with arithmetic or English criterion scores. The USAID-AIR tests showed scattered relationships with the criteria and the Mechanical Aptitude Test. A relatively high negative correlation was found to exist, as was also found in the intercorrelation study based on the 661 applicants, between the Ibadan Verbal Test and the Ibadan Arithmetic Test. The multiple regression correlation revealed only one center where a combination of tests could be used as predictors of success.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Review of Background

The early philosophy of Nigerian education was to concentrate on the academically oriented subjects. Since Nigeria's independence in 1960, industrialization and technology had become increasing factors in the country's economic growth. Technology required skilled labor and trained technicians. To help meet this need, trade and technical centers were being expanded to supply manpower required.

The method of selecting students for entrance to trade and technical centers had certain limitations and problems. A basic problem to the selection process was the young Nigerian's lack of motivation to enter the trade centers.

One means of helping to improve the selection methods at the trade and technical centers was the development of a new battery of tests based on Nigerian culture. One part of this new battery was a test of mechanical aptitude.

Restatement of the Problem

The primary purpose of this study has been to describe the development of a Mechanical Aptitude Test for the Western Region Government of Nigeria. The test was to be based on

Nigerian culture. The reliability, validity, and intercorrelations of the test were to be determined.

The main criterion for the study was to be the workshop scores made by students selected to enter the trade centers. The arithmetic and English scores made by the students were to be subsidiary criteria. Four variables to be used as predictors of relationship to the criteria scores were: (1) the Mechanical Aptitude Test, (2) the Ibadan Verbal Test and the Ibadan Arithmetic Test, (3) the USAID-AIR tests, and (4) responses received from a questionnaire.

The criteria and the predictor variables involved conditions that might limit their effectiveness. These were conditions probably common to many developing nations; however, in an exploratory study such as this, the conditions were not so serious that the study could not be undertaken.

Sources and Procedure

Relatively few pertinent sources and references exist to aid in the development of such a study. Consequently, a great deal of the information needed to conduct the study resulted from contacts with Nigerian and expatriate educators and psychologists.

The procedure used in developing the test of mechanical aptitude was to: (1) establish an understanding of the Nigerian culture, (2) visit villages, towns, and cities and design test items based on observations made, (3) develop an initial form of the test, (4) pre-test and analyze the initial

form of the test, (5) revise the test, (6) administer the revised test a second time, and (7) establish the reliability and validity of the revised test. Two years were spent in Nigeria in developing the test. One year was spent in the United States in analyzing the data.

Summary of Results

The test of mechanical aptitude based on Nigeria's culture was developed. The test was pre-tested, revised, and administered a second time to 661 applicants to the four trade centers in the Western Region for the September, 1962 intake. A reliability study of the revised form of the test resulted in a reliability coefficient of .80 for the combined parts of the test. The high interrelations among the parts of the Mechanical Aptitude Test furthered the idea that it would be acceptable to use the total score of the test.

A substudy of graduates of the trade centers showed correlations that ranged from .58 to .99 between first term grades and graduation grades. As a result of this high correlation, it was decided to expedite the study and use mid-term evaluations as criteria scores for a validation study.

A study of the intercorrelations involving the 661 applicants to the trade centers and the variables involved showed some relationships among the various parts of the Mechanical Aptitude Test and Schwarz's USAID-AIR tests. There was a high negative correlation between the Ibadan Verbal and Ibadan Arithmetic Tests. Items on the questionnaire were generally unrelated.

The validation study was made using two methods of investigation. In one method, the criterion was used against the trade schools regardless of trades and in the second method the criterion was used against the trades involved regardless of the schools. The Mechanical Aptitude Test was only mildly related to the scores made by the students in the workshops. The expected relationships among and between the predictor variables were not very satisfactory. The expected relationship of the predictor variables against the criteria was only mildly successful. Many of the correlations found in the validation study involving the predictor variables and the criteria were not consistent, and when strong correlations were found, they tended to be scattered. Schwarz¹ had similar scattered low correlations as shown in the results of studies made involving new tests developed for Africa. Further remarks about the validation study in relation to the predictor variables and the criteria will be found in this chapter under Conclusions and Recommendations.

The validation study also showed, with few exceptions, that most of the significant correlations from questionnaire data were negative. The original questionnaire data were scored so that these correlations logically should have been positive. For example, higher numerical scores were used to indicate greater familiarity with a mechanical culture, and low scores were assigned to those who indicated little

¹Schwarz, op. cit., Appendix B, Supplementary Data, Tables 3B, 4B, 5B, 6B.

familiarity with a mechanical culture. If the negative relationships were to be accepted, the assumption must be made that the mechanically unsophisticated and rural oriented student had a better chance of being successful in the trade centers. This was especially noticeable in conjunction with the arithmetic criterion score. One explanation of this phenomenon would be that villages were poor, and by necessity, the combined wealth of the village could be just enough to send only their "best" boys for higher education. Those selected might be the boys who were good at their sums but not necessarily mechanically inclined.

In the towns and cities the opposite could be happening. Here the "better" boys in terms of general knowledge and academic ability were often destined for pre-college education or selected for the choice job opportunities. The trade center applicants from the towns and cities were more likely to be those boys who had experienced difficulty in finding work of any nature. It was possible that these boys had acquired enough of the rudiments of English and arithmetic to pass the trade center entrance examinations, but were not necessarily those who had shown interest or had been aware of the mechanical world that existed around them.

The multiple regression study showed the Oyo Trade Center as the only center where a combination of tests could be used as predictors of success. The questionnaire data were not used in the multiple regression study as there was

concern about the logic of the data involved and a reluctance to rely on negative information in a selection process.

Limitation of Results

The results of the study had certain limitations that should be identified. These were as follows:

1. The 661 students who participated in the entrance examinations at the four trade centers were pre-selected. Though thousands applied for permission to take the entrance examinations, only those who met the basic requirements of completing the application blank correctly, remembering to attach a photograph, listing proper references and other necessities were invited to take the examination. This process of elimination was certainly necessary when so many applied for so few openings; however, from a research viewpoint it did add a certain amount of pre-selection and consequent narrowing of the range before the battery of selection tests was ever administered.

2. The 157 students used in the validation study were further pre-selected. These students were admitted to the trade centers on the basis of their performance on every predictor variable discussed in the study except the Mechanical Aptitude Test and the questionnaire. The applicants who were finally admitted to the trade centers were most likely those who scored high in English and arithmetic tests as well as in the interview and Schwarz's USAID-AIR tests. As mentioned before, from a research viewpoint pre-selection of this nature

was not a desirable factor as it limited the applicants to a selected group which may not be representative of the total population involved.

3. The use of mid-term scores in workshop, English, and arithmetic as criteria for the validation study instead of end-of-term scores could have been based on a weak assumption. Since mid-term evaluations were not standard practice at the trade centers, such evaluations might not prove to be a valid estimate of the student's progress.

4. The criterion data were collected by overseas mail from Nigeria. There was no way of knowing the methods used by the instructors to evaluate the students. Varying conditions at the trade centers such as shortage of workshop supplies, loss of instructors or uncertain emphasis given to classroom performance versus workshop performance could have produced criterion data errors. If such factors did exist, they might have explained, in part, the limited success of the predictor variables.

Conclusions

On the basis of the evidence secured from the recorded data, the following conclusions seemed appropriate:

1. The working hypothesis that the Ibadan Arithmetic Test and the Ibadan Verbal Test would overlap each other to a limited degree was not supported. The conclusion was that the two tests were acting independently.

2. The expected relationship between the Ibadan Verbal Test and the English criterion scores was found in only one trade. The conclusion was that the Ibadan Verbal Test was not identifying those students who were rated high in English at the time of the mid-term evaluation.

3. The expected relationship between the Ibadan Arithmetic Test and the arithmetic criterion scores was found to be only mildly evident. The conclusion was that the Ibadan Arithmetic Test was only mildly successful in identifying those students rated high in arithmetic at the time of the mid-term evaluation.

4. The working hypothesis that student scores made on the test of mechanical aptitude would have a low correlation with scores made on the Ibadan Arithmetic Test and the Ibadan Verbal Test was essentially supported. The conclusion was that the tests involved were working independently and not overlapping.

5. The main hypothesis of the study--that students accepted at the trade centers who scored higher on the Mechanical Aptitude Test would achieve a better workshop record--was only very mildly supported. The conclusion was that the lack of a strong correlation here tended to emphasize the limitations of the study including: (1) pre-selection; (2) the use of mid-term scores instead of end-of-term scores as criteria; and (3) collecting the criteria data by overseas mail, thus limiting the knowledge of the conditions and methods of student evaluation made by the instructors.

6. The working hypothesis that a test of mechanical aptitude could be developed that would compliment other tests of a general battery being used to select candidates was only mildly successful. The multiple regression study was able to predict the best combination of tests for only one trade center. The conclusion was that the results of the multiple regression study should be considered with caution.

7. The questionnaire used in conjunction with the study proved to be inconsistent in its measures. The conclusion was that the understanding and use of the questionnaire was new to many of the applicants and the accuracy of their responses was to be questioned.

Recommendations

1. To develop a test of mechanical aptitude such as described in this study requires time and patience. Test development in an emerging nation such as Nigeria cannot be hurried. Ample time should be allotted for becoming thoroughly acquainted with the culture and the communities represented by its villages, towns, and cities. Test items should reflect this culture.

2. The Mechanical Aptitude Test, as described in this study, needs the following considerations:

- a. The reliability of the Mechanical Aptitude Test should be enhanced by adding more items to the various parts of the test.
- b. The criteria used in the validation study should be collected first-hand and not by

overseas mail. The conditions under which the criteria evolve need to be observed directly and considered accordingly. Every effort should be made to refine the criteria measures.

3. There is need for further study to examine the influence that the culture in a developing country may have on the effectiveness of tests similar in design and format to the one described in this study. The use of paper and pencil tests is still relatively new to countries such as Nigeria, and there may be cultural factors restricting the usefulness of such tests that have not been identified or considered to date.

4. In future studies, serious effort should be made to plan a validation study in which the predictor variables have not entered into any pre-selection decisions.

5. Should the use of a questionnaire be required in future studies, its content and construction should be carefully considered. Africans are not familiar with questionnaires and their use, as are those who use them consistently in Western cultures; consequently, the questionnaire format, wording, and method of administration need to be prepared with the utmost care.

Problems for Further Study

1. A study is needed that will validate the Mechanical Aptitude Test using criteria available at the end of the trade centers' current term, July-August, 1963.

2. The Mechanical Aptitude Test should again be analyzed for questions that are not significantly contributing to the total test performance. The test questions need to be reorganized into a more progressive sequence of difficulty.

3. Further work is needed in the development and application of questionnaires, perhaps utilizing pictures to replace words that may be meaningless or misinterpreted by the African.

4. When the Mechanical Aptitude Test is refined and further validation is accomplished with the trade centers, it should be tried in other cultures and societies. One possibility would be to administer to similar groups one form of the test as developed for Western Nigeria and a second form that has been revised and adapted to the specific culture involved. The purpose would be to test the hypothesis that tests of this nature should be culturally oriented.

APPENDICES

APPENDIX I

POTENTIAL ITEMS FOR MECHANICAL APTITUDE TEST

Communication

The size and shape of a drum determines its pitch and tone.

A voice carries farther across a barren field than it does in a forest.

Cooking and Domestic Life

A well should be dug so that the bottom of the well slopes to one end; accordingly, water will collect in the deep end during a dry spell.

A pulley is sometimes used to help lift a water bucket from a well. A little oil makes the pulley run more easily.

The size of the orifice of a funnel is directly proportional to the amount of liquid that can be poured through the funnel in a given amount of time.

A piece of paper or banana leaf can be made into the shape of a cone and thus facilitate the pouring of liquids from one container to another.

A stone will sink faster in a bucket of water than it will in a similar bucket of heavy oil.

An empty drinking cup with a handle will float in water but it dips slightly toward the side with the handle.

The water in a glass tumbler will curve up where the water touches the sides of the glass.

Cloth will absorb water faster than leaves or grass.

Newly washed clothes will dry faster in the sun when they are spread over grass six inches high than when they are laid directly on bare ground.

Newly washed clothes laid out to dry will dry faster if a wind is blowing.

The bigger the cooking pot, the longer it takes water to reach the boiling point.

If hot maize (corn) is spread out on a large leaf it will cool more quickly than if kept tightly bunched on a small leaf.

A yam cut up into small pieces will cook more rapidly than a yam cooked whole and not cut up.

The contents of a cooking pot will remain hot longer if the lid is left on than if the lid is taken off.

A thick shelled calabash pot will keep the contents hot longer than a thin shelled pot of the same size.

Palm oil will float on water.

A pencil placed in a tumbler of water appears to bend slightly as the pencil enters the water.

A four inch diameter by four inch high candle will burn longer than a one inch diameter by six inch high candle.

To dim the light on a kerosene lamp, you lower the wick.

A wick in a kerosene lamp that is turned up too high will cause the lamp to smoke.

A piece of paper catches fire more easily and burns more quickly when lighted at the base of the paper than when lighted at the top of the paper.

If there is a handle on a broom the person using the broom does not become as fatigued as when using a broom without a handle.

Buildings

Smoke and heat rise to the top of a house; accordingly, openings to allow the smoke to escape are made near the peak (top) of the roof.

A tin roof becomes hotter in the sun than a mud or grass roof.

The greater the pitch of a roof, the less likely it is that rain will remain on it.

Corrugated roofs are placed with the grooves sloping vertically.

The handles to doors should be placed as far as possible on the opposite edge of the door from where the hinges are found.

For maximum support, the braces that join a heavy wooden awning to a house are best placed at an angle of approximately ninety degrees from the awning to the side of the house.

Staircases should be built at an angle of approximately forty-five degrees.

To force a key to turn in a lock, a nail or spike can be used as a torque to give added leverage.

Houses with mud walls are cooler to live in than houses with walls made of corrugated tin.

A brick wall is laid so that the layers of bricks overlap.

Hunting and Fishing

In using a bow and arrow, the farther away you are from a target the higher you must aim (proportionately) to hit the target.

The trigger of a Dane gun causes the hammer of the gun to fire.

A man standing in the middle of his canoe is less likely to tip over when casting his fish net than a man standing in the very rear of the canoe.

As the width of a stream of water decreases, the rate of the flow of water increases.

The lighter (less dense) the wood used for a fishing "bobber," the higher it will float in water.

Farming

The blade of a farmer's hoe is designed to angle back at approximately thirty degrees to permit maximum efficiency in digging rough ground.

In using cocoa scales to weigh bags of raw cocoa, the heavier the cocoa the farther the pointer (indicator) will travel along the bar.

A field covered with grass will retain moisture longer than a field left bare.

A vine (for drying purposes) stretched taut between two trees is apt to break if an extra load is added to it; conversely, a vine that is loosely strung between two trees will bear considerably more load before it breaks.

A large rock can be pried out of the ground with a pole if a smaller rock is placed near the large rock and used as a fulcrum for the pole.

A farmer has two sacks, one twice as large as the other. The large sack is filled with wood shavings and the second sack with maize. The smaller sack will be the heavier.

A dead goat lying in the sun tends to become bloated.

A piece of rope may be cut in half by laying the rope on a rock and pounding it with another rock.

Large mahogany logs will slide down a hill more easily if the hill is made slippery and muddy by first pouring water down it.

Water-soaked logs that have lain in the forest for years will sink deeper into a stream when attempting to float than dry logs of similar wood.

The act of splitting a log can be facilitated by the use of a wedge or old ax head.

To lift a sack weighing 100 pounds you must exert a force equal to and opposite of at least 100 pounds.

Natural Phenomena

The pawpaw tree sprouts new twigs at the beginning of the rainy season.

The closer the low, overhanging branches of a tree, the less likely you are to get wet during a sudden shower.

It is rain that causes the tin roof to rust.

You see lightning before you hear the accompanying thunder.

The greater the interval between the lightning and resultant thunder, the farther the lightning is away from you.

Wireless (telephone) poles made of steel are more apt to be struck by lightning than those made of wood.

Wood poles are more susceptible to termites than are concrete poles.

A rainbow may appear when it is raining and the sun is still shining.

When the sun is behind you, your shadow is usually cast forward in front of you.

Smoke drifting across a village from left to right indicates that the prevailing wind is from left to right.

Water collects in the bottom of gullies, not on top of the hill.

At the bend of the river, the water is deeper at the inside of the bend than at the outside of the bend.

Lizards are able to walk on ceilings.

Transportation

A log seven feet long has an eighteen inch diameter at one end and a six inch diameter at the other. To balance the log on one's head will require placing the eighteen inch end closer to one's body than the smaller end.

When two people carry a load suspended on a pole between them, the load must be suspended in the exact middle of the pole to evenly distribute the weight between the two people.

When carrying a load suspended on a stick over your shoulder, the farther away from your body the load is placed on the stick, the more effort it will take to carry it.

A man is taking a steer to market. The man has a rope attached to the steer's leg. When the man and the steer are pulling in opposite directions and going nowhere, they are in equilibrium.

If a wheel on a rolling cart sticks and does not turn, it tends to get hot.

A cart will push more easily along a path of small stones than it will along a path of sand.

A push cart with wheels of four feet in diameter will start more easily from a standstill than a cart with wheels of six inches diameter.

It is easier to push a loaded wagon up a hill than to pull it.

The pedal of a bicycle is the initial source of mechanical power in the bicycle.

The chain of a bicycle transmits the initial force created by the pedal to the gears located on the rear wheels.

The spokes of a bicycle wheel give it support and strength.

By tightening various spokes on a bicycle wheel one can realign the wheel rim and make it true.

The bigger a bicycle wheel the more distance it will travel in one revolution.

To find the small leak in a bicycle tire, the punctured tube can be inflated and dipped in a bucket of water. The escaping air bubbles will indicate where the hole is.

A bicycle pump when used tends to generate heat at the end of the pump where the air is being forced directly into the tire.

Bicycle tires pumped up to authorized pressure will enable the rider to pedal more easily than will tires that are almost flat.

A lorry converts chemical energy (petrol) into mechanical energy.

More men are needed to initially get a stalled lorry rolling than are needed to keep it rolling.

The greater the spread between the wheels (the longer the axle) of a lorry the more stable it will be.

A lorry piled very high with produce is more apt to tip over going around a sharp curve than a lorry that is empty.

A discarded tire may be placed on the ground beneath the bed of a lorry and thus used to absorb the shock of unloading heavy boxes as they are lowered from the lorry.

When a lorry suddenly stops, its tires will leave black marks on the road. The faster the lorry is going before it comes to the sudden stop, the longer the black marks will be that are left on the road.

A rock or a split log will prevent a lorry from rolling down a hill when wedged in front of the wheels.

A heavily loaded lorry will roll farther down a steep hill than will an empty lorry.

A plank can be used to roll a heavy barrel up and onto a lorry bed.

A series of boxes piled on a lorry going forward will tend to continue their direction forward if the lorry suddenly comes to a stop.

Smooth automobile tires have less grip than new ones.

Rubber tires roll smoother and faster than steel tires.

When a train stands still its smoke is apt to go straight up if there is no wind, but when moving forward the smoke blows back to the rear.

A train going up hill uses more coal than a train going down hill.

The tracks on a railway steer the train, not the wheels nor the engineer controlling the wheels.

Railway rails expand during the hot season and contract during a cooling rain.

Tools, Equipment, and Machines

The plane iron in a carpenter's plane can be removed and sharpened, replaced and adjusted by a screw mechanism.

Screws should be put into wood by use of a screwdriver, not by pounding with a hammer.

A chisel is not the proper tool to use with screws.

A crowbar can be used to pry out nails.

A pair of scissors is an example of a first order lever.

A crescent wrench can be adjusted to a number of settings.

A carpenter's square is used to "square-up" things, not as a hammer.

Calipers can be used to measure inside and outside diameters.

Pinchers (electrician's pliers) can be used to cut wire.

A hack saw is used to cut metal, not wood.

A ball peen hammer cannot be used to take out nails.

A hammer prying out nails is an example of a fulcrum.

The handle for a chisel or screw driver is designed to take the best advantage of torque.

A nut will not fit on a bolt unless its threads are cut the same as the bolt's threads.

To make a round hole square, one can use a key hole saw.

The circumference of a funnel is approximately three times its diameter.

Hot wax or tallow will sometimes help loosen a nut that has become stuck on a bolt.

Wood screws have a special purpose and are tapered.

Hinges with countersunk holes should use screws machined to fit these holes.

The batteries of a torch (flashlight) must be placed in a certain sequence to make the torch operate.

The bulb of a common torch has threads on it, not pins, as do other light bulbs.

Part of the mechanism of a kerosene lantern has two simple gears with teeth that the wick rolls over. The wick is forced upward on downward as the gears are rotated.

A sewing machine has a large fly wheel that is connected to the foot treadle by a simple mechanical linkage mechanism.

There are numerous natural associations one makes with tools and machines; a few of these are as follows:

Hammer--nails	Tire pressure gauge--tires
Carpenter's rule--pencil	Plane--board
Brace--bit	Lorry--battery
Blacksmith tongs--anvil	Claw hammer--nail
Screwdriver--screw	Nuts and bolts--spanner
Trowel--bricks	Motor--spark plug
Anvil--ball peen hammer	

The internal mechanisms of a number of articles can be viewed by the inquisitive in the typical Nigerian village. They include: wrist watch, bicycle bell, the motor under a

lorry hood, torch (flashlight), kerosene lamp, sewing machine, lock, carpenter's plane, bicycle tire valve, bicycle pump.

Village Labor (Occupations)

Carpenter

A diagonal strip of wood added to a sagging door frame can pull the frame back into alignment and give it added strength.

A screw will hold a hinge more securely and for a longer time than a nail.

A little palm oil or fat added to a squeaky hinge will make it open more efficiently and with less noise.

A tumbler of water can be used to determine whether or not a table is level.

Supporting guy wires to wireless (telephone) poles and other structures should be placed at angles of between thirty and forty-five degrees.

To find the middle of a board, a long piece of twine can be used.

A ladder tilted against a wall at anything less than a thirty degree angle can be dangerous.

It is easier to pound a stake into the ground if its end is cut to form a point.

Blacksmith

In shaping iron, the first thing the blacksmith does is to heat the iron.

Bellows are used to make the fire grow hotter.

Iron is heavier than aluminum, but lighter than gold.

When a red hot piece of metal is dipped into water it is apt to become harder.

Watch Repairer

When wound, the main spring of a watch stores energy to make the watch run.

The back of a clock can often be removed to reveal a number of gears and springs placed in a particular order.

Weaver and Tailor

To adjust the tension of the loom, a stone is placed on the sledge that holds the thread.

The thicker the cloth, the more difficult it is for the needle to penetrate the cloth.

Others

As a palm wine tapper climbs a palm tree, his legs and arms brace the tree at an angle of approximately forty-five degrees, not seventy-five or fifteen degrees.

When backing a cart with its front wheels on a pivot point into a shelter, the front wheels are pivoted clockwise to make the cart turn counterclockwise.

To move a heavy box, round poles of approximately two inch diameter can first be placed under the box. The box can then be slowly rolled to its destination.

Village Life in General

Words will appear backward when viewed in a quiet pool of water or a mirror.

The farther a mirror is held from one's nose, the smaller the mirror's image of the nose becomes.

A cigarette will burn faster if its lighted end is held down rather than up.

The minute hand on a clock makes more revolutions per day than the hour hand.

A circle can be drawn with an empty tumbler by tracing its rim with a pencil.

A circle can be drawn with a piece of twine, using the twine as the radius.

If two stones of equal size, shape, and weight are dropped simultaneously off a cliff, and one is thrown out and the other dropped straight down, both will hit the ground at the same time.

A heavy boy will swing in a larger arc than a boy of lesser weight.

A boy can throw an orange farther than he can throw a peanut.

It takes a feather longer to fall to the ground than it does a stone which has been released at the same height and the same time.

APPENDIX II

ORIGINAL FORM OF MECHANICAL APTITUDE TEST

--Examiner's Instructions

--Practice Sheet

--Mechanical Aptitude Test

Part I

Part II

Part III

EXAMINER'S INSTRUCTIONS

Mechanical Aptitude Test

1. Before test begins . . . Make rough sketch of three sample problems on blackboard--layout same as on sample test page.
2. When examinees arrive in room and are seated . . . introduce self and explain that they will take a test unlike any other ever taken before. Ask them to listen very carefully so that everybody will know exactly what to do.
3. Distribute pencils.
4. Distribute sample papers.
5. DOES EVERYBODY HAVE A PAPER THAT LOOKS LIKE THIS? (Hold up sample page.) WHO DOES NOT HAVE A PAPER LIKE THIS? (Pause.) LET US LOOK AT THE TOP OF THE PAPER. AT THE TOP OF THE PAPER ARE THREE PROBLEMS (point). PROBLEM ONE . . . PROBLEM TWO . . . PROBLEM THREE . . . THEY LOOK A LITTLE BIT LIKE THE PROBLEMS I HAVE DRAWN ON THE BLACKBOARD. . . (point). PROBLEM ONE . . . PROBLEM TWO . . . PROBLEM THREE . WE WILL DO THESE THREE PROBLEMS TOGETHER SO THAT EVERYBODY WILL UNDERSTAND EXACTLY HOW TO DO THIS TEST. WE WILL DO THEM TOGETHER.

EVERYBODY, LOOK AT PROBLEM NUMBER ONE. NUMBER ONE. (Point to paper and also to drawings on blackboard) IN PROBLEM NUMBER ONE, THERE ARE FOUR PICTURES . . . EACH PICTURE SHOWS A BOY STANDING UNDER A TREE . . . DOES EVERYBODY SEE THE BOYS UNDER THE TREES IN PROBLEM NUMBER ONE?

LISTEN TO THE QUESTION FOR PROBLEM NUMBER ONE. . . THIS IS THE QUESTION . . .

NUMBER ONE. IT IS RAINING . . . IT IS RAINING AND FOUR BOYS ARE STANDING UNDER FOUR DIFFERENT TREES. LOOK AT THE BOYS AND AT THE FOUR TREES. WHICH ONE OF THE BOYS WILL BE THE MOST DRY IN THE RAIN? . . . WHO CAN TELL ME WHICH ONE BOY WILL BE THE MOST DRY? (Raise own hand to ask for show of hands.)

Get answers until correct one is given. Then say,

THAT IS CORRECT. THE BOY UNDER THE FOURTH TREE (Point to blackboard drawing) WILL BE THE MOST DRY. THE REASON THAT HE WILL BE THE MOST DRY IS THAT THE TOP OF THE TREE IS BOTH VERY LARGE AND VERY NEAR TO THE TOP OF HIS HEAD . . . BECAUSE IT IS BOTH LARGE AND NEAR, THE RAIN CANNOT GET IN TO MAKE HIM VERY WET, AND HE WILL BE THE MOST DRY. SO THE CORRECT ANSWER IS NUMBER FOUR.

To show that the correct answer IS NUMBER FOUR, I TAKE MY PENCIL AND FILL IN THE SPACE UNDER PICTURE NUMBER FOUR. (Do so on blackboard.) I MAKE A HEAVY LINE IN THE SPACE UNDER THE FOURTH PICTURE TO SHOW THAT IT IS CORRECT. EVERYBODY MARK THE FOURTH PICTURE TO SHOW THAT IT IS CORRECT. (Have proctors check to insure all know how to mark answers.)

6. NOW LET US DO PROBLEM NUMBER TWO. LOOK AT THE PICTURES AND I WILL ASK YOU THE QUESTION.

NUMBER TWO . . . LOOK AT THE PICTURES OF THE FOUR TOOLS. WHICH ONE DOES THE FARMER USE TO PLANT HIS CROPS? WHO CAN TELL ME WHICH ONE THE FARMER USES TO PLANT HIS CROPS? (Raise hand to ask for show of hands.)

Get answers until correct one is given; then say,

THAT IS CORRECT. THE SECOND PICTURE SHOWS A HOE . . . AND THIS IS WHAT THE FARMER USES TO PLANT HIS CROPS.

TO SHOW THAT THE HOE IN THE SECOND PICTURE IS CORRECT, I TAKE MY PENCIL AND FILL IN THE SPACE BENEATH PICTURE NUMBER TWO. (Do so on blackboard.) EVERYBODY PICK UP YOUR PENCIL AND FILL IN THE SPACE BENEATH THE SECOND PICTURE JUST LIKE THIS. EVERYBODY MARK THE SECOND PICTURE TO SHOW THAT IT IS CORRECT. (Have proctors check quickly that all students mark correctly.)

Everybody listen carefully. . . this is very important . . . each problem in this test has only one answer. You must mark only ONE ANSWER FOR EACH PROBLEM . . . ONLY ONE. NOW LET US DO PROBLEM NUMBER THREE.

NUMBER THREE . . . A BOY WANTS TO DRAW A CIRCLE ON A PIECE OF PAPER. WHICH ONE OF THESE THINGS WILL HELP HIM TO DRAW THE BEST CIRCLE ON THE PAPER? . . . THE TUMBLER . . . THE GOURD . . . THE ORANGE . . . OR WILL THEY ALL HELP HIM THE SAME? WHICH IS THE ONE ANSWER THAT IS BEST? (Get response.)

THAT IS CORRECT. DOES EVERYBODY SEE THE BOY DRAWING THE CIRCLE ON THE PIECE OF PAPER? THIS FIRST PICTURE HERE (point to blackboard) IS TO HELP YOU TO UNDERSTAND THE PROBLEM. THE ANSWER IS THE TUMBLER BECAUSE IF YOU PUT THE TUMBLER ON THE PAPER LIKE THIS (demonstrate) YOU CAN DRAW A GOOD CIRCLE.

YOU CANNOT DRAW A GOOD CIRCLE WITH EITHER THE GOURD OR THE ORANGE BECAUSE NEITHER IS EXACTLY ROUND. SO THEY ARE NOT THE SAME (point). IT IS NOT THE ORANGE (point). IT IS NOT THE GOURD (point). IT IS THE TUMBLER . . .

EVERYBODY MARK THE TUMBLER ON YOUR OWN PAPER (proctors check).

NOW EVERYBODY PUT YOUR PENCIL DOWN AND LISTEN
 AT THE BOTTOM OF YOUR PAPER RIGHT HERE (point) ARE
 THREE PROBLEMS MORE . . . THESE THREE PROBLEMS ARE
 FOR PRACTICE AND DO NOT COUNT THIS TIME
 WHEN I ASK A QUESTION . . . DO NOT RAISE YOUR HANDS
 AND DO NOT SHOUT OUT THE ANSWER . . . THIS TIME. WHEN
 I ASK A QUESTION . . . PICK UP YOUR PENCILS AND MARK
 THE ONE CORRECT ANSWER ON YOUR OWN PAPER . . . AND WHEN
 WE HAVE FINISHED ALL THREE PROBLEMS . . . I WILL TELL
 YOU THE CORRECT ANSWERS SO THAT EVERYBODY CAN CHECK UP
 ON HIS OWN WORK. READY?

PICK UP YOUR PENCILS AND LOOK AT THE PICTURES IN PROBLEM
 NUMBER ONE AT THE BOTTOM OF YOUR PAPER.

NUMBER ONE . . . WHICH ONE OF THESE THINGS WILL
 BURN MOST QUICKLY? . . . THE STICK . . . THE
 CIGARETTE . . . THE PAPER . . . OR THE BOX?
 MARK THE ONE THAT WILL BURN MOST QUICKLY. EVERY-
 BODY. (Wait ten seconds.)

NUMBER TWO . . . LOOK AT THE PICTURE IN THE CIRCLE.
 WITH WHICH ONE OF THE FOUR OTHER THINGS IS IT USED?
 MARK THE ONE WITH WHICH IT IS USED. (Wait ten seconds.)

NUMBER THREE . . . A BOY IS DROWNING IN THE WATER
 BECAUSE HE CANNOT SWIM. WHICH ONE OF THESE THINGS
 WOULD HE MOST LIKE TO FIND IN THE WATER TO HELP HIM
 NOT TO DROWN? THE BAMBOO STICK . . . THE WOOD DOOR
 . . . THE BICYCLE TIRE . . . OR THE UMBRELLA? MARK
 THE ONE THAT WILL BEST HELP HIM NOT TO DROWN. (Wait
 ten seconds.)

STOP! EVERYBODY STOP . . . PUT YOUR PENCILS DOWN.

NOW LET US CHECK UP ON THE CORRECT ANSWERS . . . IN PROBLEM
 NUMBER ONE . . . WHICH ONE WILL BURN MOST QUICKLY? (Get
 response) THAT IS CORRECT, THE PAPER WILL BURN MOST
 QUICKLY. YOU SHOULD HAVE MARKED THE SPACE BENEATH THE
 PAPER.

PROBLEM TWO . . . WHICH ONE IS USED WITH THE PICTURE IN
 THE CIRCLE? (Get response) THAT IS CORRECT . . . THE
 PICTURE IN THE CIRCLE IS A SCREW AND THE CORRECT ANSWER
 IS THE SCREWDRIVER . . . THIS ONE RIGHT HERE (point).

PROBLEM THREE . . . WHICH ONE WOULD THE BOY MOST LIKE TO
 FIND IN THE WATER SO THAT HE WILL NOT DROWN? (Get response)
 THAT IS CORRECT . . . THE WOOD DOOR RIGHT HERE (point) WILL
 FLOAT IN THE WATER . . . AND IT IS LARGE ENOUGH TO KEEP THE
 BOY ON TOP OF THE WATER SO THAT HE WILL NOT DROWN.

IN THE TEST IT WILL BE EXACTLY THE SAME AS WE HAVE DONE HERE (point). FOR EACH PROBLEM . . . I WILL ASK THE QUESTION AND YOU WILL PUT THE ONE CORRECT ANSWER ON YOUR OWN PAPER . . . REMEMBER . . . EACH PROBLEM HAS ONLY ONE ANSWER. SOMETIMES THE CORRECT ANSWER WILL BE THE FIRST PICTURE . . . SOMETIMES THE SECOND PICTURE . . . SOMETIMES THE THIRD PICTURE . . . SOMETIMES THE FOURTH PICTURE . . . AND SOMETIMES THE CORRECT ANSWER WILL BE THE SAME (Point to sample problem on blackboard). MARK THE ONE ANSWER THAT IS BEST.

WE WILL NOW PICK UP YOUR PAPERS AND GIVE YOU THE TEST PAPERS. WHEN YOU GET YOUR PAPER KEEP IT CLOSED UNTIL EVERYBODY IS READY TO BEGIN.

Collect sample papers. When all are collected, distribute test papers for Part I. Wait until everybody has paper. Then say:

THIS TEST HAS THIRTY PROBLEMS. WE WILL DO THEM JUST LIKE THE PRACTICE PROBLEMS. BUT THIS TIME I WILL NOT ASK YOU THE QUESTIONS WITH MY OWN VOICE. INSTEAD I WILL PUT A TAPE MACHINE IN THE BACK OF THE ROOM AND THE TAPE MACHINE WILL ASK YOU THE QUESTIONS THE SAME WAY. LISTEN CAREFULLY TO EACH QUESTION AND PUT THE ANSWER ON YOUR VERY OWN PAPER.

READY? PICK UP YOUR PENCILS. LOOK AT THE PICTURES FOR NUMBER ONE . . . (Start tape) . . . (On Number One only . . . repeat . . .) EVERYBODY MARK THE ONE THAT IS THE BEST ANSWER.

When finished collect papers, distribute Part II, do tape, collect Part II; distribute Part III, start tape, collect Part III--finish.

MECHANICAL APTITUDE TEST

PART I

- Number one . . . Look at the four women carrying the timber.
Which woman can best carry the load?
Mark the one that can best carry the load.
- Number two . . . A boy is standing in the sun.
Which of the four pictures shows the correct shadow on the ground?
Mark the one in which the shadow is correct.
- Number three . . . Look at the smoke coming out of the four trains.
Which train looks like it is moving forward?
Mark the one that is moving forward.
- Number four. . . Look at the four drums.
Which drum sounds most like thunder?
Mark the one that sounds like thunder.
- Number five. . . Which one of these things can the boy throw the longest distance?
. . the banana . . the ground nut . . the orange . . or the pineapple?
Mark the one the boy can throw the longest distance.
- Number six . . . Three plantains are cut for cooking.
Which plantain will cook the quickest in a pot of boiling water? . . the first . . the second . . the third . . or will the time for cooking all be the same?
Mark the one answer that is best.
- Number seven . . . Which one of these things will take the longest time to drop from the boy's hand down to the ground? . . the feather . . the ground nut . . the stone . . or will they all drop the same?
Mark the one answer that is best.
- Number eight . . . Look at the newspaper and the four matches.
Which is the best way to burn the newspaper with a match?
Mark the one best way to burn the paper.
- EVERYBODY . . . OPEN YOUR PAPERS . . . FIND PROBLEM NUMBER NINE.
(Hesitate)

- Number nine . . . Three different men are pushing down on a strong stick trying to lift up a heavy stone.
Which man can most easily move the heavy stone? . . the first man . . the second man . . the third man . . or can they all move it the same?
Mark the one answer that is best.
- Number ten . . . Look at the three lamps.
Which lamp will make the brightest light?
. . the first lamp . . the second lamp
. . the third lamp . . or will the light from all lamps be the same?
Mark the one answer that is best.
- Number eleven . . A man and a woman are carrying a heavy load.
In which picture is the woman carrying the most load? . . the first picture . . the second picture . . the third picture . . or is the woman's load in all three pictures the same?
Mark the one answer that is best.
- Number twelve . . Look at the four pieces of wood.
You want to pound them into the ground until no wood remains above the ground.
Which piece of wood is the easiest to pound into the ground with a stone?
Mark the one that is the easiest to pound all the way into the ground.
- Number thirteen . Look at the roof on the four houses.
The first roof is made of mud . .
The second is wood . .
The third is grass . .
The fourth is tin . .
Which roof will get the hottest from the sun?
Mark the one that will be the most hot.
- Number fourteen . Look at the pots.
Which is the fastest way to boil one gallon of water? . . to put the water into three pots . . to put it into two pots . . to put it into one pot . . or will the time for cooking all be the same?
Mark the one answer that is best.

- Number fifteen. . Three men are carrying a load on a stick.
Which man can most easily carry his load?
. . the first man . . the second man
. . the third man . . or can all three
men carry the load the same?
Mark the one answer that is best.
- Number sixteen. . Look at the four lorries.
If all the lorries turn a corner very
fast, which one will fall over?
Mark the one that will fall over.
- Number seventeen. Look at the three piles of bricks.
Which pile of bricks is the heaviest? . .
the first pile of bricks . . the
second . . the third . . or do they
all weigh the same?
Mark the one answer that is best.
- Number eighteen . Look at the three candles.
Which candle will burn for the longest
time? . . the first candle . . the
second candle . . . the third candle
. . . or will the time they finish
all be the same?
Mark the one answer that is best.
- Number nineteen . Three men are moving a heavy cart to the
top of a hill.
Which three men can most easily move the
heavy cart to the top of the hill?
. . . the men in the first picture . .
the men in the second picture . . the
men in the third picture . . or will
all the men move the cart the same?
Mark the one answer that is best.
- Number twenty . . Look at the pictures of the four cups
floating in the water.
Which picture shows the only way that a cup
will truly float?
Mark the one that shows the way a cup will
float in the water.
- Number twenty-one If you pour palm oil into a tumbler of
water, where does the palm oil go?
Look at the four pictures.
Does the palm oil remain on top of the
water . . . does it sink to the bottom of
the water . . . does part of it remain on
the top and part of it sink to the bottom
. . . or do the palm oil and the water mix
all together?
Mark the one that best shows the palm oil in
the water.

Number twenty-two. It is raining and there is lightning and thunder in the sky.

Look at the four pictures.

Which will the lightning hit first? . .
the grass roof . . the lorry . . the
man . . or the tree?

Mark the one that the lightning will hit first.

Number twenty-three. The three pots are filled with boiling water.

In which pot will the water remain hot the longest time? . . in the first pot . . in the second pot . . in the third pot . . or will the water stay hot in all three pots the same?

Mark the one answer that is best?

Number twenty-four. Look at the wheels on the four carts. Which cart is the best for a very rough road?

Mark the one cart that is best for a very rough road.

EVERYBODY . . . TURN YOUR PAPERS OVER . .
FIND PROBLEM NUMBER 25

Number twenty-five. Look at the three funnels.

Through which funnel can you pour water most quickly? . . through the first funnel . . through the second funnel . . through the third funnel . . or can you pour water through all three funnels the same?

Mark the one answer that is best.

Number twenty-six. The man in front of the school is raising the flag to the top of the pole.

Three girls are standing in back of the school waiting for the flag to come up above the roof.

Which girl will be the first to see the flag? . . the girl closest to the school . . the middle girl . . the girl farthest from the school . . or will all three girls see the flag at the same time?

Mark the one answer that is best.

Number twenty-seven. Which one of these four things makes a tin roof rust and become brown? . . the sun . . the rain . . the lightning . . or the fire for cooking?

Mark the one answer that is best.

Number twenty-eight. Look at the four carts.

If you push back on the four carts,
which one will move around the bend
toward the building?

Mark the one that will move around the bend.

Number twenty-nine. If you put a pencil into a tumbler of
water, how does the pencil look?

Mark the one that best shows a pencil in
the water.

Number thirty. . . A boy is looking at his nose in a mirror.
In which mirror will his nose appear the
biggest? . . in the first mirror . .
in the second mirror . . in the third
mirror . . or will his nose in all
three mirrors appear the same?

Mark the one answer that is best.

STOP

EVERYBODY STOP . . . PUT YOUR PENCILS DOWN.

1



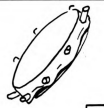
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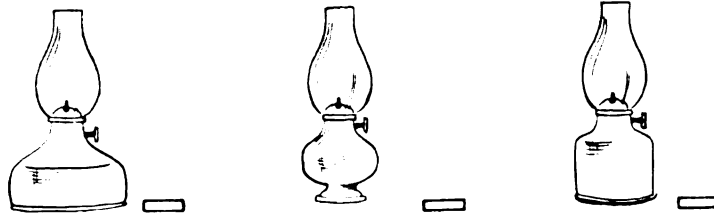
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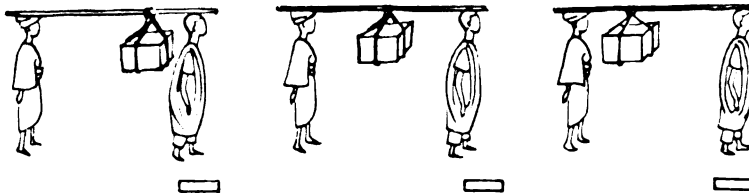
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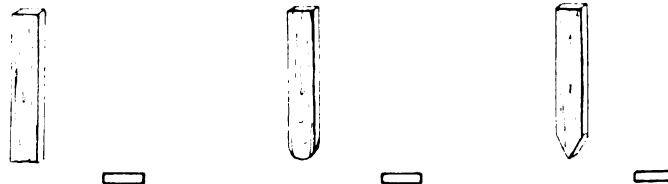
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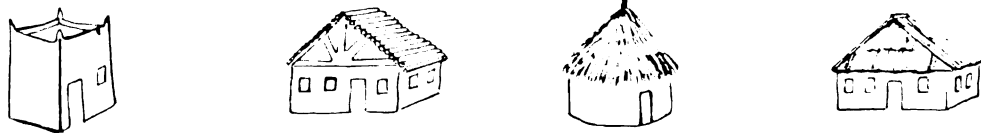
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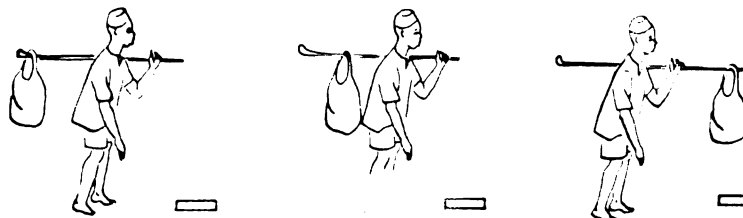
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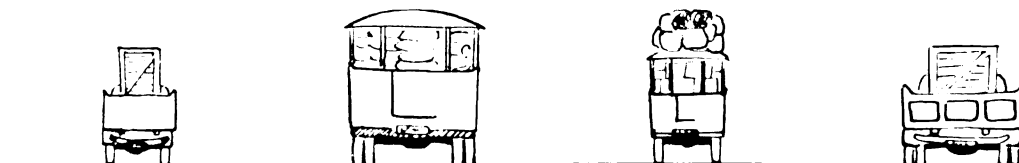
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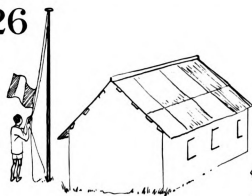
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SAME



26



SAME



27



28



29



30



SAME



PART II

- Number one . . . You want to make a long rope into two short pieces.
Which one of these things will most help you to make the long rope into two short pieces? . . the stone . . the key . . the tin . . or the calabash?
Mark the one that will best make two pieces of rope.
- Number two . . . Look at the three trains.
Which train is burning the most fuel?
. . . the one going up the hill . . the one going on the level . . the one going down the hill . . or will all three trains burn fuel the same?
Mark the one answer that is best.
- Number three . . The boy has the word AFRICA written on his hat.
When he looks into a mirror, how will the word AFRICA look?
Mark the one that shows how the word AFRICA will look in the mirror.
- Number four. . . What is it that makes a train turn when it comes to a bend? . . the train signal . . the steering wheel . . the railway track . . or the electric wire?
Mark the one that makes a train turn.
- Number five. . . The lorry is stopped on a hill and something must be put in front of the wheels so that the lorry will not roll down the hill and crash.
Which one of these things is best to put in front of the wheels? . . the bottle . . the stick . . the tin . . or the stone?
Mark the one that is best to put in front of the wheels.
- Number six . . . Two boys are carrying a heavy box filled with sand. Look at the handles on the three boxes.
Which box is the best to carry the sand? . . the first box . . the second box . . the third box . . or can sand be carried in all three boxes the same?
Mark the one answer that is best.

- Number seven . . . Look at the three tin roofs.
Which roof is the best to use on a house?
. . the first roof . . the second roof
. . the third roof . . or can all three
roofs be used the same?
Mark the one answer that is best.
- Number eight . . . You want to make a long rope into two
short pieces.
Which one of these things will most help
you to make a long rope into two short
pieces? . . the piece of twine . . the
comb . . the bell . . or the matches?
Mark the one that will make two pieces of
rope.
- Number nine . . . A tree is falling to the ground. Which
one of these four things will it hit
first? . . the pail . . the box . .
the bicycle . . or the barrel?
Mark the one the tree will hit first.
- Number ten . . . You want to load a full barrel onto the
back of a lorry.
Which one of these things will most help
you to put the barrel on the lorry? . .
the wood plank . . the timber . . the
rope . . or the tire?
Mark the one which will help most to put
the barrel on the lorry.
- Number eleven. . . Two men are trying to move a very heavy box.
Which of these will best help the men to
move the very heavy box? . . the wood
planks . . the barrels . . the bricks
. . or the timbers?
Mark the one which will best help to move
the box.
- Number twelve. . . Look at the four doors.
The hinges for the doors are at the top.
Which black handle is in the best place to
open the door?
Mark the one that has the best handle to
open the door.
- Number thirteen. . Three boxes are on the back of a lorry that
is moving very fast. Suddenly the lorry
stops.
Which picture shows what will happen to the
three boxes when the lorry stops quickly?
. . will they slide to the front . . will

they fall to the front . . will they
slide to the back . . or will they
fall to the back?

Mark the one that shows what will truly
happen to the boxes when the lorry
stops.

Number fourteen. . You need to find out if a table is level.
Which one of these things can you use to
see if the table is level or if it is
tipped to one side? . . the plate . .
the spoon . . the tumbler of water . .
or the candle holder?
Mark the one you can best use to check if
the table is level.

Number fifteen . . Look at the four pieces of iron.
Which one piece of iron is the most heavy?
Mark the one that is heaviest.

Number sixteen . . If you want to pour water from a large
pail into a gourd, which one of these
things will most help you to keep from
spilling the water? . . the umbrella
. . the paper . . the cloth . . or the
spoon?
Mark the one that will help you not to
spill the water.

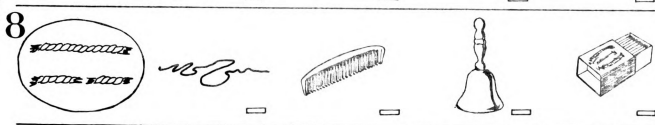
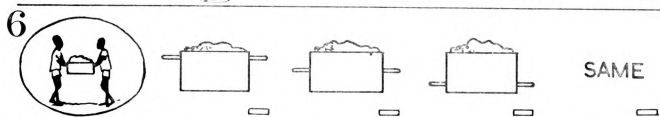
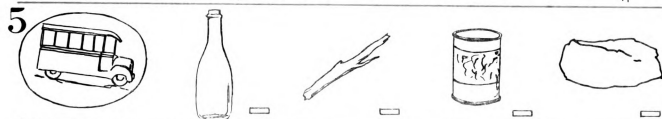
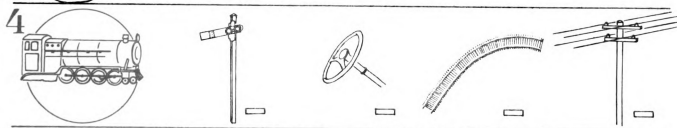
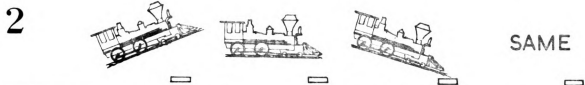
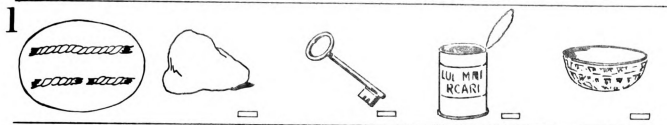
Number seventeen . You want to find the exact center of a
piece of wood.
Which one of these things will most help
you to find the exact center of the
wood? . . the brick . . the pipe . .
the scale . . or the twine?
Mark the one that will help you find the
exact center of the wood.

Number eighteen. . The key is tight in the lock and you can-
not turn the key with your fingers.
Which one of these things will best help
you to turn the key? . . . the knife
. . the nail . . the mallet . . or the
candle?
Mark the one which will help you turn the
key.

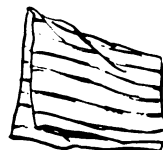
Number nineteen. . Look at the smoke holes in the roof of the
four houses.
Which hole is the best for letting out the
smoke from the cooker fire?
Mark the one that is best for letting out
the smoke.

Number twenty. . . Look at the small roofs over the four
windows.
Which roof is best fastened to the house?
Mark the one that is best fastened to
the house.

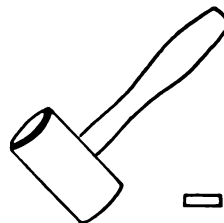
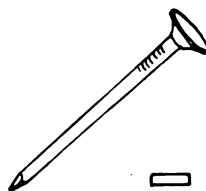
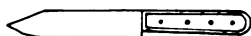
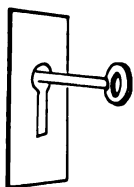
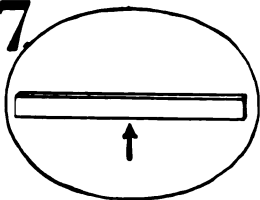
STOP! EVERYBODY . . . STOP PUT YOUR PENCILS DOWN



16.



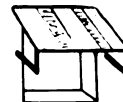
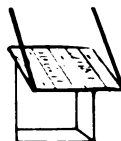
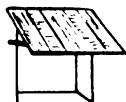
17.



19



20



PART III

- Number one . . . Which is the proper tool for both putting in and taking out nails?
Mark the one best answer.
- Number two . . . Which one of these is the proper tool for cutting tin?
Mark the one best answer.
- Number three .. Which one of these tools can be used to make tight all of the different bolts on a bicycle?
Mark the one best answer.
- Number four. . . Which one of these tools can check up to see if the corner of a door is square?
Mark the one best answer.
- Number five. . . Which one of these tools can cut a long piece of iron pipe into two short pieces?
Mark the one best answer.
- Number six . . . Which one of these tools will help most to split open a timber?
Mark the one best answer.
- Number seven . . Which one of these tools can best make a machette sharp?
Mark the one best answer.
- Number eight . . When a blacksmith shapes brass, which one of these things does he use first?
. . the water . . the hammer . . the anvil . . or the fire?
Mark the one best answer.

EVERYBODY . . OPEN YOUR PAPERS AND FIND PROBLEM NUMBER NINE

- Number nine. . . Look at the four brick walls
Which one of the four walls is the most strong?
Mark the one brick wall that is most strong.
- Number ten . . . The door does not fit properly. It scrapes on the bottom.
Which one of these tools can best be used to make the door fit.
Mark the one best answer.

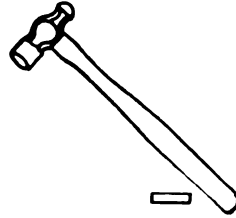
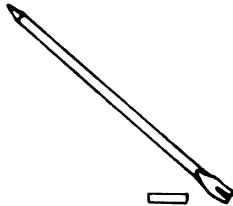
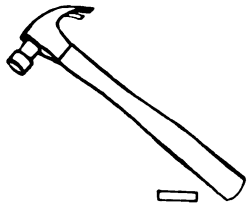
- Number eleven . . The bicycle tire has a puncture.
Which one of these things will best help
to find exactly where the puncture is
in the tire?
Mark the one best answer.
- Number twelve . . You want to make a funnel like the one
inside the circle.
Which piece of tin can you bend to make
the funnel?
Mark the one best answer.
- Number thirteen . If you remove the back of a clock and
look inside, which picture best shows
what you would see?
Mark the one which best shows the inside
of the clock.
- Number fourteen . Which picture shows the proper way to put
batteries inside a torch? . . the
first picture . . the second . . the
third . . or will all three ways to
put batteries in a torch make the
torch light up the same?
Mark the one best answer.
- Number fifteen. . If you remove the top of a bicycle bell,
which picture best shows what you
will see?
Mark the one best answer.
- Number sixteen. . Look at the four arrows that point to dif-
ferent parts of the bicycle tire pump.
When you use the pump to put air into a
tire, which arrow shows the part of
the pump that will be the most hot?
Mark the one best answer.
- Number seventeen. Look at the picture inside the circle.
With which one of the other four things is
it used? . . the electric wire . . the
light bulb . . the motorcycle . . or
the bicycle tire?
Mark the one best answer.
- Number eighteen . Look at the picture inside the circle.
With which one of the other four things is
it used? . . the air bellows . . the
level . . the plane . . or the padlock?
Mark the one best answer.

- Number nineteen. . . Look at the picture inside the circle.
 With which one of the other four things is
 it used? . . the torch . . the lorry
 . . the electric wire . . or the sewing
 machine?
 Mark the one best answer.
- Number twenty. . . Look at the picture inside the circle.
 With which one of the other four things is
 it is used? . . the wrist watch . . the
 vise . . the lamp . . or the cramp?
 Mark the one best answer.
- Number twenty-one. Look at the picture inside the circle.
 With which one of the other four things is
 it used? . . the tool . . the padlock
 . . the hinge. . or the torch?
 Mark the one best answer.
- Number twenty-two. Look at the first picture.
 With which one of the other four things is
 it used? . . the train . . the lorry
 . . the motorcycle . . or the sewing
 machine?
 Mark the one best answer.
- Number twenty-three. Look at the picture inside the circle.
 With which one of the other four things is
 it used?
 Mark the one best answer.
- Number twenty-four. Look at the picture inside the circle.
 With which one of the other four things is
 it used? . . the pail . . the timber
 . . the building blocks . . or the rubber
 tree?
 Mark the one best answer.
- EVERYBODY . . TURN YOUR PAPERS OVER . . FIND PROBLEM TWENTY-FIVE
- Number twenty-five. Look at the picture inside the circle.
 With which one of the other four things is
 it used? . . the wrist watch . . the
 bicycle tire . . the shoes . . or the
 anvil?
 Mark the one best answer.

- Number twenty-six. Look at the picture inside the circle.
 With which one of the other four things is
 it used? . . the pencil . . the saw . .
 the level . . or the knife?
 Mark the one best answer.
- Number twenty-seven. Look at the picture inside the circle.
 With which one of the other four things is
 it used?
 Mark the one best answer.
- Number twenty-eight. Look at the picture inside the circle.
 With which one of the other four things is
 it used? . . the brace . . the hinge . .
 the spanner . . or the mallet?
 Mark the one with which it is used.
- Number twenty-nine. Look at the picture inside the circle.
 With which one of the other four things is
 it used? . . the barrel . . the tire . .
 the battery . . or the sewing machine?
 Mark the one best answer.
- Number thirty . . Look at the picture inside the circle.
 With which one of the other three things is
 it used? . . is it used with the first
 picture . . with the second picture . .
 with the third picture . . or is it used
 by all three pictures the same?
 Mark the one best answer.

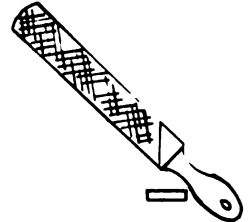
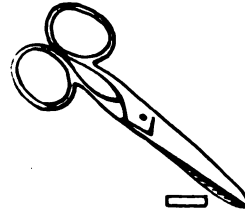
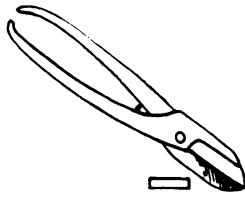
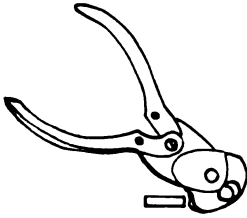
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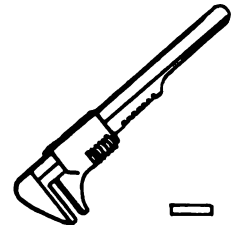
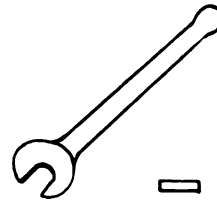
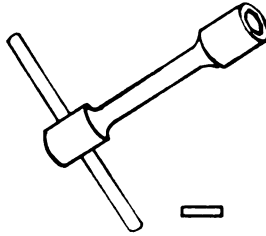
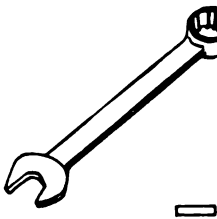


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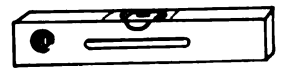
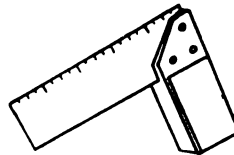
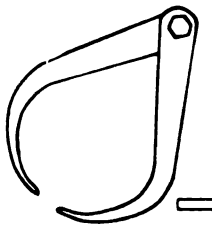
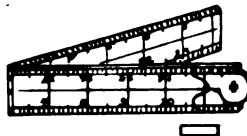
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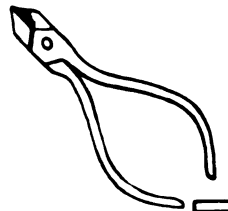
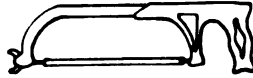
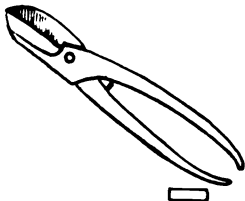
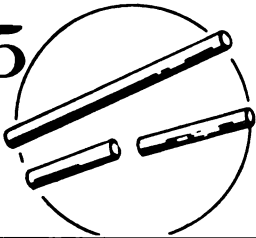
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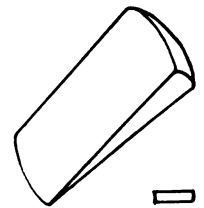
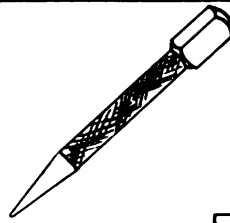
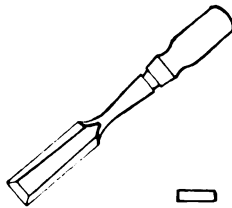
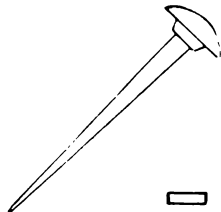
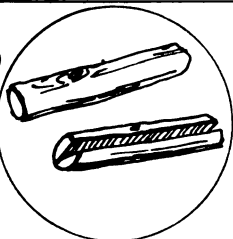
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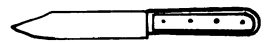
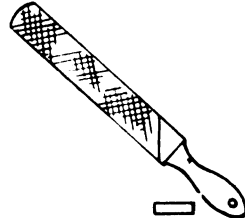
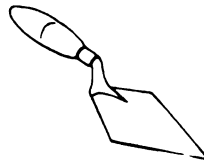
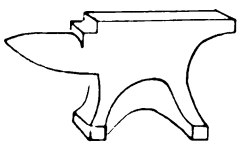
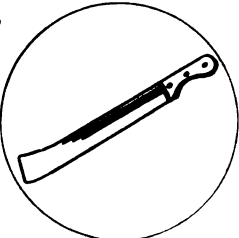
5



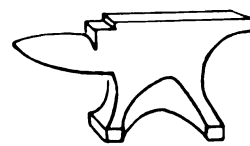
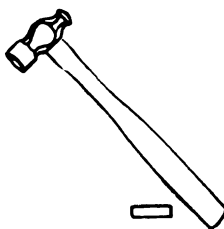
6



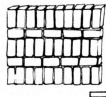
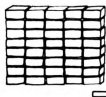
7



8



9



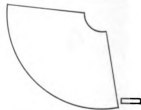
10



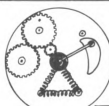
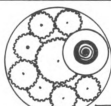
11



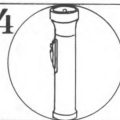
12



13



14



ALL SAME

15



16



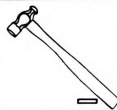
25



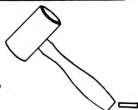
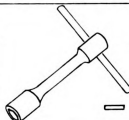
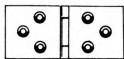
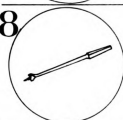
26



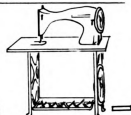
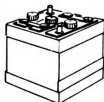
27



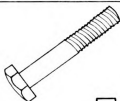
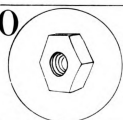
28



29



30

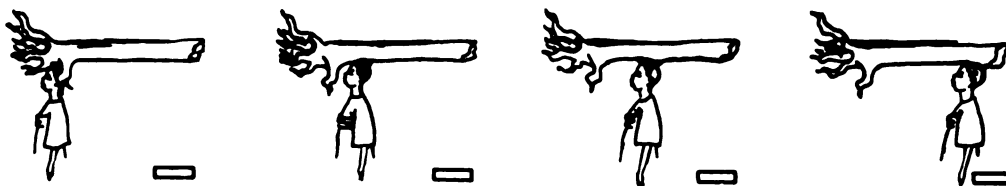


ALL SAME

APPENDIX III

ITEM ANALYSIS OF ORIGINAL FORM OF
MECHANICAL APTITUDE TEST

1



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	9%	0	9 ^a	3	5	42	24	1	8
Secondary:									
Modern I	13%	0	0	2	2	17	17	0	0
Modern II	17%	0	1	11	2	34	40	0	2
Modern III	23%	0	0	8	5	18	20	0	1
Grammar I	55%	0	1	21	7	0	13	0	0
Grammar II	63%	0	0	13	9	1	5	0	0

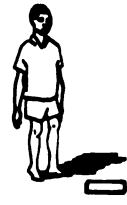
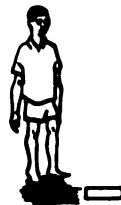
Comment: Too difficult for lower grades, good for grammar schools...needs revision.

^aTest scores are arranged from highest to lowest score. 0...9 represents a ratio of those students in the top 29% who chose the response as compared to those students in the bottom 29% who chose the response. The top and bottom 9% were double weights. This ratio is the same as expressed in all the following pages.

HI-LOW RATIO FOR EACH SCHOOL

School	Hi	Low
Primary 6	46	46
Secondary:		
Modern I	19	19
Modern II	45	45
Modern III	26	26
Grammar I	21	21
Grammar II	14	14

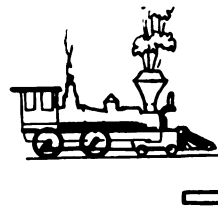
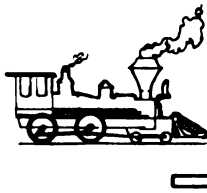
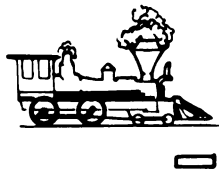
2



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	29%	12	6	4	16	22	10	8	14
Secondary:									
Modern I	28%	3	1	4	11	8	2	4	5
Modern II	40%	2	5	6	15	21	14	16	11
Modern III	53%	0	0	2	15	18	8	6	3
Grammar I	25%	0	8	3	9	5	3	13	1
Grammar II	32%	0	1	1	1	8	6	5	6

Comment: Good at middle levels. Check oral presentation on position of the sun.

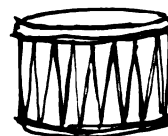
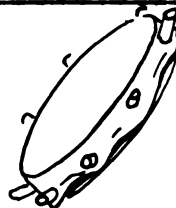
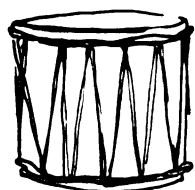
3



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	57%	1	9	5	12	9	4	31	21
Secondary:									
Modern I	66%	0	0	4	2	2	3	13	14
Modern II	66%	1	9	6	8	5	6	33	22
Modern III	65%	1	1	3	14	0	4	22	7
Grammar I	84%	0	3	0	2	0	2	21	14
Grammar II	82%	0	1	1	3	0	3	13	7

Comment: Good for lower and middle levels, but little discrimination. OK.

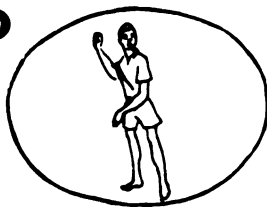
4



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	39%	26	12	14	21	1	5	5	8
Secondary:									
Modern I	32%	6	6	1	8	7	4	5	1
Modern II	34%	27	6	16	30	2	5	0	4
Modern III	39%	12	7	10	11	2	5	2	3
Grammar I	54%	14	8	2	6	3	6	2	1
Grammar II	32%	4	3	7	5	3	1	0	5

Comment: Fairly difficult, good at the lower levels, fair above. OK.

5



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	45%	6	8	5	5	30	26	5	7
Secondary:									
Modern I	47%	2	0	3	1	14	15	0	3
Modern II	46%	7	2	3	10	33	25	2	8
Modern III	51%	5	3	2	6	19	15	0	2
Grammar I	53%	2	0	1	1	16	20	2	0
Grammar II	55%	3	1	0	2	9	11	2	0

Comment: Discrimination weak, does not show much. Change distractor in A to stick of wood.

6



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	58%	1	5	32	19	11	20	2	2
Secondary:									
Modern I	64%	0	1	12	15	5	2	2	1
Modern II	52%	1	4	29	15	8	26	7	0
Modern III	52%	0	5	16	11	7	10	3	0
Grammar I	48%	0	2	13	11	2	4	6	4
Grammar II	45%	0	0	14	5	0	5	0	4

Comment: Fair at all levels. Oral presentation might be better if changed from boiling water to boiling oil.

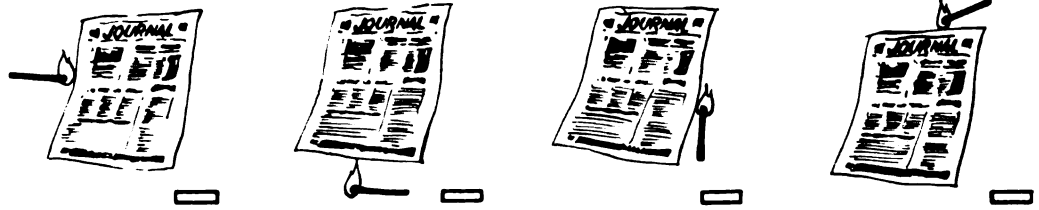
7



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	47%	24	16	12	13	10	17	0	0
Secondary:									
Modern I	38%	15	3	1	8	3	8	0	0
Modern II	52%	29	18	4	14	11	13	1	0
Modern III	53%	18	9	3	11	5	5	0	1
Grammar I	50%	13	4	2	4	5	8	1	5
Grammar II	73%	14	8	0	0	0	4	0	2

Comment: OK at all levels. Change distractor in D from "SAME" to picture of penny with hole in it.

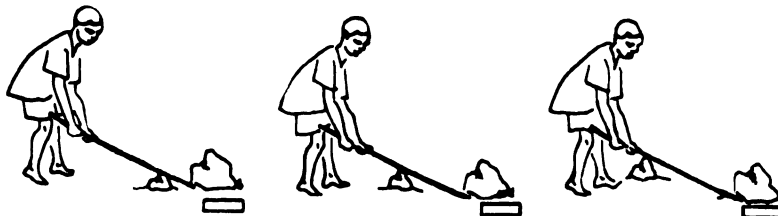
8



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	63%	1	5	36	19	3	14	6	8
Secondary:									
Modern I	39%	5	7	11	5	2	5	1	2
Modern II	51%	4	7	31	16	2	17	8	5
Modern III	52%	3	1	20	8	1	10	2	7
Grammar I	80%	0	1	20	15	0	1	1	4
Grammar II	76%	0	2	13	7	1	2	0	3

Comment: OK at lower levels; easy at higher levels.

9

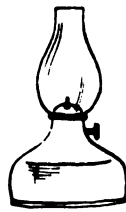


SAME

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	24%	16	4	7	6	22	29	1	7
Secondary:									
Modern I	21%	3	2	5	4	4	12	7	1
Modern II	27%	8	7	14	19	16	15	7	4
Modern III	30%	9	7	4	5	6	13	7	1
Grammar I	41%	6	5	8	9	3	6	4	1
Grammar II	24%	8	1	1	4	3	9	2	0

Comment: Relatively difficult at all levels. In oral introduction, emphasize words, "push down".

10

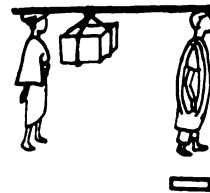
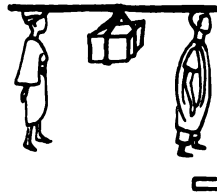
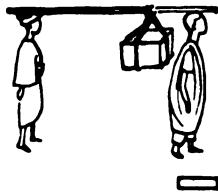


SAME

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	18%	14	18	9	17	6	11	17	0
Secondary:									
Modern I	15%	3	6	5	9	4	4	7	0
Modern II	17%	17	24	5	15	5	4	18	2
Modern III	12%	14	13	3	7	3	6	6	0
Grammar I	54%	3	10	0	4	0	4	19	3
Grammar II	40%	2	5	1	6	1	2	10	1

Comment: Difficult at the lower levels. May need revising in future. OK.

11



SAME

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	39%	0	4	30	24	16	17	0	1
Secondary:									
Modern I	40%	0	2	8	9	10	7	1	1
Modern II	34%	2	7	18	29	24	7	1	2
Modern III	35%	0	1	11	21	13	4	2	0
Grammar I	68%	0	0	2	13	19	8	0	0
Grammar II	76%	0	0	0	0	14	12	0	2

Comment: Fair at all levels. Response B getting too much attention. Difficult concept. May want to eliminate.

12



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	49%	2	9	0	5	30	14	14	18
Secondary:									
Modern I	47%	2	3	1	2	12	8	4	6
Modern II	49%	4	13	4	4	28	15	9	13
Modern III	57%	1	4	0	3	19	8	6	11
Grammar I	52%	2	5	0	0	16	12	3	4
Grammar II	55%	0	0	0	1	10	9	4	4

Comment: Good at lower levels, fair at higher levels. OK.

13



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	58%	4	5	3	13	2	8	37	20
Secondary:									
Modern I	69%	1	2	1	2	2	4	15	11
Modern II	60%	7	8	2	16	3	4	33	17
Modern III	61%	5	5	4	5	0	5	17	11
Grammar I	73%	1	6	2	2	0	4	18	9
Grammar II	76%	1	1	1	0	0	1	12	12

Comment: Good at all levels except Grammar II. OK.

14

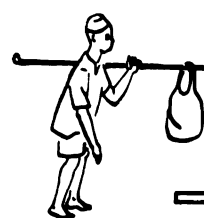


SAME

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	18%	8	6	6	14	32	26	0	0
Secondary:									
Modern I	15%	6	2	0	2	12	15	1	0
Modern II	17%	13	5	1	5	28	33	3	2
Modern III	12%	7	1	2	1	14	24	3	0
Grammar I	25%	13	0	0	2	4	17	4	2
Grammar II	20%	4	1	0	0	9	10	1	3

Comment: Too difficult. Concept OK. Change pictures to show pots on grill, all with equal fire. Change shape of pots.

15

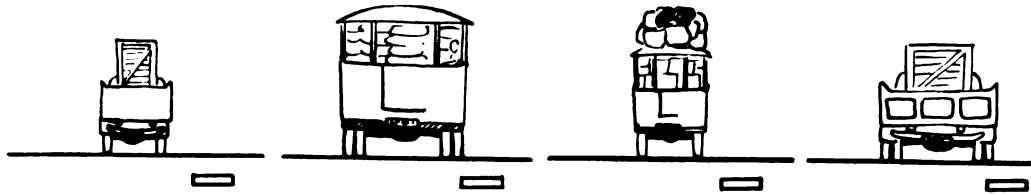


SAME

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	63%	9	16	37	24	0	6	0	0
Secondary:									
Modern I	64%	2	3	17	7	0	8	0	1
Modern II	65%	10	17	33	23	2	5	0	0
Modern III	73%	0	6	24	16	2	4	0	0
Grammar I	81%	1	2	20	19	0	0	0	0
Grammar II	98%	2	2	12	12	0	0	0	0

Comment: OK at lower levels, no good at upper levels. OK.

16



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	28%	7	8	8	21	23	8	8	9
Secondary:									
Modern I	12%	7	2	5	7	3	4	4	6
Modern II	20%	8	14	11	21	17	3	9	7
Modern III	36%	4	4	2	11	20	3	0	8
Grammar I	61%	1	4	2	8	18	7	0	2
Grammar II	61%	0	4	0	3	13	5	1	2

Comment: Difficult at lower levels but good discrimination.
OK.

17



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	20%	3	7	16	24	10	13	17	2
Secondary:									
Modern I	7%	1	1	5	9	10	9	3	0
Modern II	17%	1	4	11	14	18	26	15	1
Modern III	13%	4	0	6	11	12	13	4	2
Grammar I	59%	0	0	0	7	1	8	20	6
Grammar II	53%	0	2	2	2	3	7	9	3

Comment: Too difficult at lower levels, good at upper
levels. OK.

18

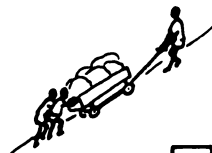
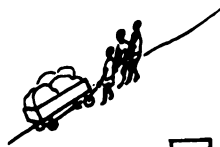


SAME

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	45%	24	11	0	8	22	27	0	0
Secondary:									
Modern I	48%	12	9	0	1	7	9	0	0
Modern II	46%	28	16	1	6	10	23	6	0
Modern III	54%	22	7	0	1	4	18	0	0
Grammar I	43%	15	6	0	2	5	12	1	1
Grammar II	50%	7	7	0	3	5	4	2	0

Comment: OK at all but the highest levels. Change distractor in response D to two candles, similar in size.

19



SAME

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	70%	3	12	32	18	5	13	6	3
Secondary:									
Modern I	69%	0	4	19	8	0	6	0	1
Modern II	89%	0	7	42	36	2	0	1	2
Modern III	88%	2	4	22	22	0	0	2	0
Grammar I	68%	2	5	16	12	3	3	0	1
Grammar II	82%	0	1	13	12	1	1	0	0

Comment: Relatively easy, only fair discrimination. May want to consider discarding in the future. OK for now.

20



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	6%	2	2	11	6	14	16	19	22
Secondary:									
Modern I	12%	8	1	2	3	2	6	7	9
Modern II	14%	11	2	16	23	9	4	9	16
Modern III	23%	13	2	3	12	2	4	8	8
Grammar I	49%	15	6	5	2	1	5	0	8
Grammar II	45%	5	3	5	1	2	8	2	2

Comment: Too difficult at the lower levels, OK at higher levels. Add introductory picture to show full shape of cup. Change response item C to show cup riding deeper in water.

21



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	31%	25	7	3	10	5	6	13	23
Secondary:									
Modern I	21%	7	2	3	3	3	2	6	12
Modern II	42%	30	7	4	11	2	7	9	20
Modern III	61%	23	6	1	2	2	5	0	13
Grammar I	71%	17	8	1	2	2	7	1	4
Grammar II	87%	14	9	0	0	0	4	0	1

Comment: Good discrimination but difficult at lower levels. OK.

22



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	10%	15	7	20	24	7	12	4	3
Secondary:									
Modern I	12%	4	0	5	11	8	6	2	2
Modern II	21%	13	7	7	17	13	12	12	9
Modern III	22%	12	3	4	11	4	8	6	4
Grammar I	36%	2	1	3	6	6	11	10	3
Grammar II	73%	1	3	3	2	0	4	10	5

Comment: Too difficult at lower levels. Revise response A and show umbrella to replace roof and dog to replace boy.

23

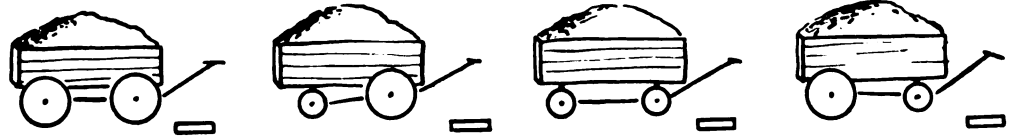


SAME

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	49%	27	15	15	20	4	9	0	2
Secondary:									
Modern I	36%	8	10	7	4	1	5	3	0
Modern II	57%	29	19	12	22	3	3	1	1
Modern III	68%	21	11	2	12	1	2	2	1
Grammar I	63%	21	11	0	9	0	0	0	1
Grammar II	92%	14	10	0	0	0	2	0	2

Comment: No good at highest levels. OK otherwise.

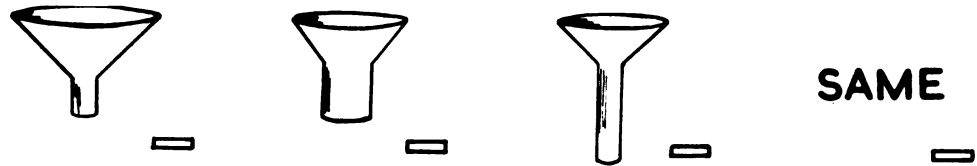
24



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	50%	22	24	7	9	11	6	6	7
Secondary:									
Modern I	52%	14	10	2	4	2	0	1	5
Modern II	63%	28	22	1	1	4	5	12	17
Modern III	85%	18	15	0	5	0	3	8	3
Grammar I	77%	17	15	0	1	2	3	2	2
Grammar II	71%	11	10	2	1	0	0	1	3

Comment: Little discrimination; easy at top levels.
Concept of size of wheels weak. Eliminate.

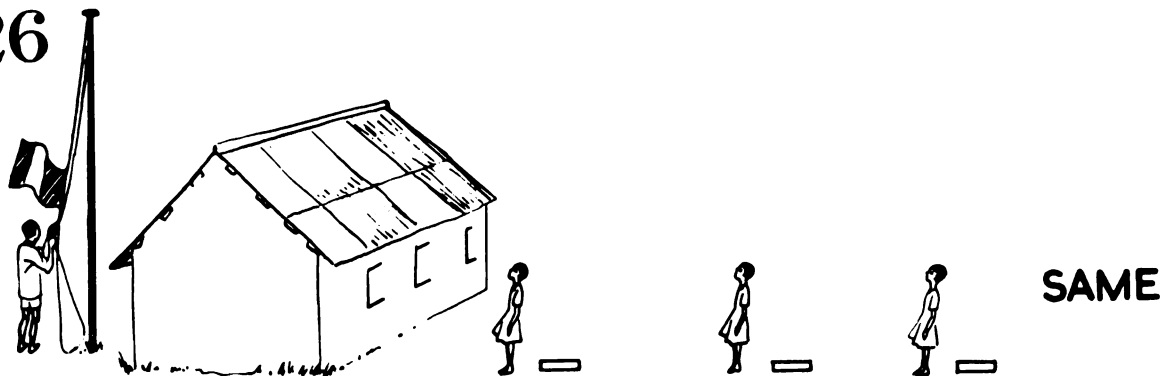
25



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	37%	16	13	18	14	7	13	5	6
Secondary:									
Modern I	45%	3	7	11	8	4	3	1	1
Modern II	49%	7	8	29	14	8	16	1	7
Modern III	51%	9	19	17	4	0	3	0	0
Grammar I	79%	1	3	20	12	0	4	0	2
Grammar II	84%	0	1	12	12	2	0	0	1

Comment: Fair most levels. Distractors working. Add an introductory picture showing boy pouring into jar with aid of funnel.

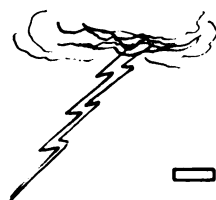
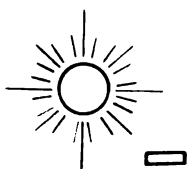
26



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	60%	3	23	3	3	38	16	2	4
Secondary:									
Modern I	83%	2	9	1	1	16	9	0	0
Modern II	77%	3	8	2	7	40	29	0	1
Modern III	96%	0	4	0	2	26	20	0	0
Grammar I	98%	0	0	0	0	19	19	2	2
Grammar II	95%	0	0	0	0	14	13	0	1

Comment: Too easy at top levels but good at lower levels.
OK.

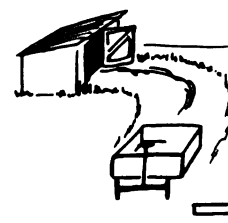
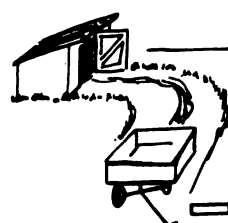
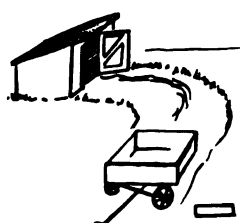
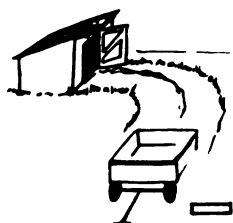
27



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	25%	10	16	14	9	4	7	18	14
Secondary:									
Modern I	28%	0	8	7	7	1	0	11	4
Modern II	27%	8	12	18	10	6	10	13	13
Modern III	33%	2	11	12	7	2	6	10	2
Grammar I	38%	0	7	7	8	0	4	14	2
Grammar II	40%	0	0	6	6	0	3	8	5

Comment: Relatively difficult, may need to revise oral presentation.

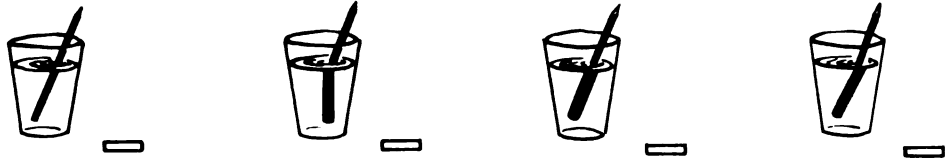
28



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	33%	7	16	25	9	11	12	3	9
Secondary:									
Modern I	41%	4	4	12	6	0	6	3	3
Modern II	31%	8	18	28	7	5	14	4	6
Modern III	30%	3	6	17	2	4	10	2	8
Grammar I	39%	4	7	16	1	0	7	1	6
Grammar II	34%	1	2	7	6	6	4	0	2

Comment: Good at all levels. OK.

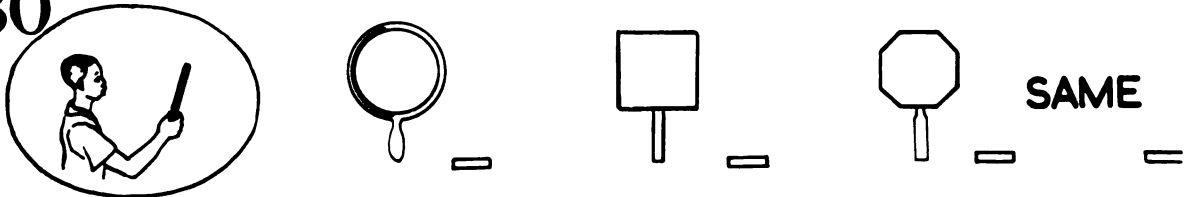
29



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	13%	24	31	9	7	10	7	3	1
Secondary:									
Modern I	9%	4	12	4	3	6	2	5	2
Modern II	6%	12	24	13	5	16	16	4	0
Modern III	10%	7	16	14	4	4	6	1	0
Grammar I	18%	6	10	4	6	5	4	6	1
Grammar II	11%	5	6	2	6	4	2	3	0

Comment: Too difficult. Eliminate.

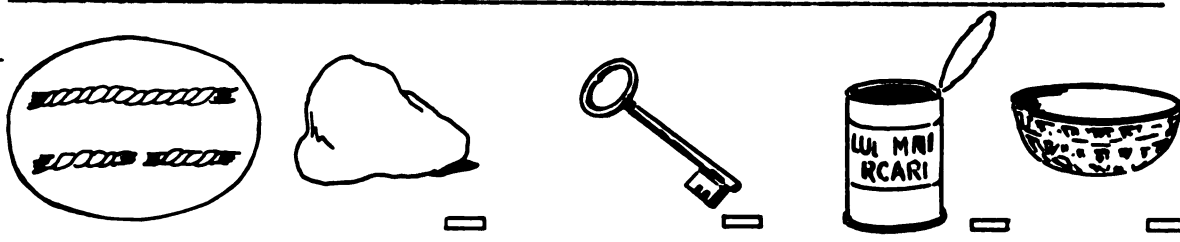
30



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	11%	21	26	8	15	4	4	13	1
Secondary:									
Modern I	17%	10	5	3	11	0	2	6	1
Modern II	21%	20	18	9	22	2	2	14	3
Modern III	19%	9	12	10	8	0	6	7	0
Grammar I	54%	2	6	1	8	1	1	17	6
Grammar II	58%	2	5	4	2	0	0	8	7

Comment: Very difficult for lower levels. Change response B and C to show frame of hand mirror outlined as in response A.

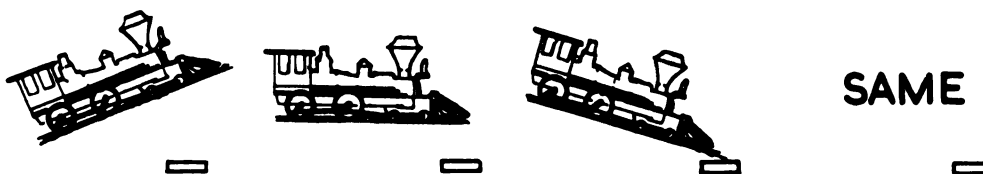
1



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	33%	16	14	13	21	17	8	0	3
Secondary:									
Modern I	32%	6	8	3	5	9	5	1	1
Modern II	29%	8	17	9	20	26	3	2	5
Modern III	59%	15	8	2	11	8	6	1	1
Grammar I	34%	7	12	2	4	10	5	2	0
Grammar II	39%	4	8	4	0	5	2	1	4

Comment: Distractors need revision. Change response A from rock to piece of twine and response D from calabash bowl to comb. This may help level of difficulty.

2



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	14%	12	3	23	27	11	12	0	4
Secondary:									
Modern I	2%	2	0	10	15	7	4	0	0
Modern II	12%	12	0	29	36	3	8	1	1
Modern III	16%	6	2	13	21	6	3	1	0
Grammar I	36%	16	5	2	11	1	5	2	0
Grammar II	53%	12	5	0	4	2	2	0	3

Comment: Difficult item at lower levels, good discrimination. Change verbal introduction to state "use of coal" instead of "fuel".

3



AFRICA

AFRICA

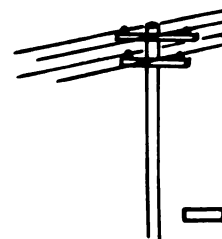
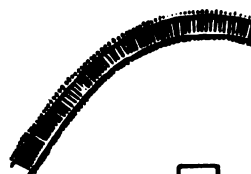
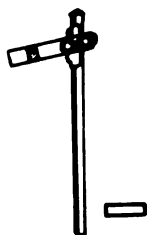
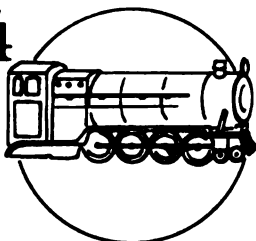
AFRICA

AFRICA

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	25%	27	41	17	4	0	0	2	1
Secondary:									
Modern I	51%	3	12	14	6	0	0	2	1
Modern II	45%	14	30	26	13	0	1	5	1
Modern III	64%	2	14	23	12	1	0	0	0
Grammar I	75%	2	4	17	14	0	0	2	3
Grammar II	87%	0	0	13	13	0	1	1	0

Comment: Good at middle levels. OK.

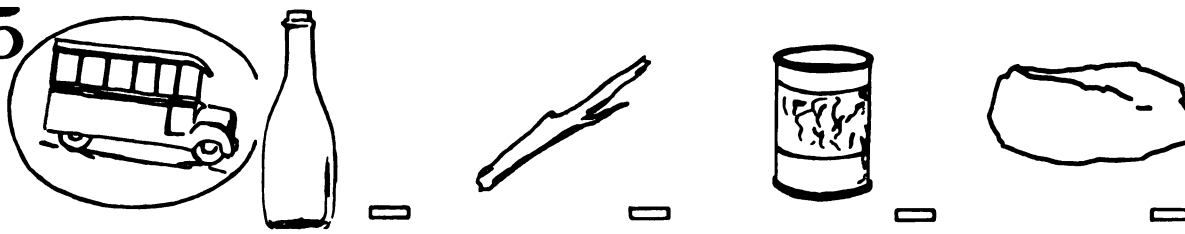
4



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	46%	4	10	10	18	32	10	0	8
Secondary:									
Modern I	38%	2	6	7	5	10	4	0	4
Modern II	57%	7	8	6	19	31	14	1	4
Modern III	52%	6	5	6	5	13	8	1	8
Grammar I	55%	2	1	4	8	14	8	1	4
Grammar II	42%	1	2	6	7	7	4	0	1

Comment: Good at all levels. OK.

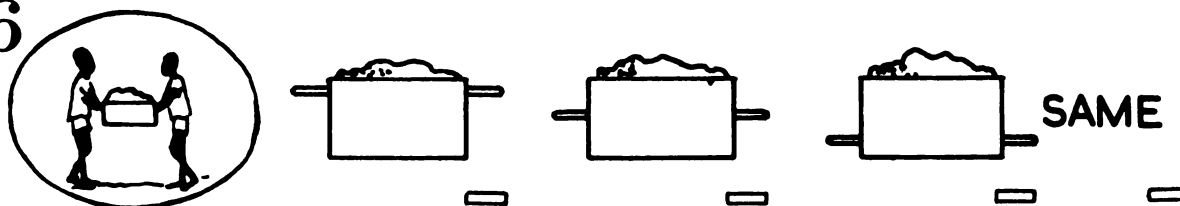
5



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	60%	1	6	11	8	1	8	33	24
Secondary:									
Modern I	57%	0	4	5	1	2	5	12	9
Modern II	59%	0	2	8	17	2	10	35	16
Modern III	81%	0	3	4	7	1	0	21	16
Grammar I	78%	0	0	1	6	0	0	20	15
Grammar II	76%	0	0	0	5	0	0	14	9

Comment: Good at all levels. Change response D to show rock more wedge shaped.

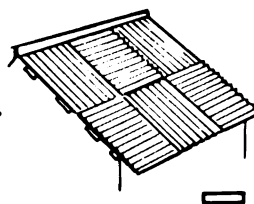
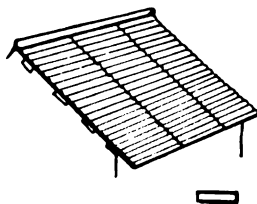
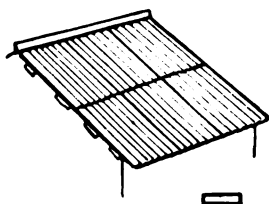
6



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	57%	32	21	10	16	4	9	0	0
Secondary:									
Modern I	70%	14	6	5	4	0	7	0	2
Modern II	57%	25	22	18	17	2	4	0	2
Modern III	58%	12	18	12	8	2	0	0	0
Grammar I	57%	13	8	7	13	0	0	1	0
Grammar II	55%	7	5	7	9	0	0	0	0

Comment: Discrimination weak. Difficult to convey principle involved. Eliminate.

7

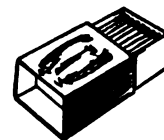
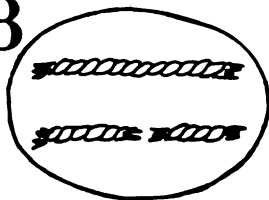


SAME

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	32%	19	8	12	24	9	12	6	2
Secondary:									
Modern I	28%	7	4	9	12	2	3	1	0
Modern II	40%	29	8	4	24	5	10	7	3
Modern III	33%	13	2	8	10	3	10	2	4
Grammar I	48%	19	5	1	3	1	9	0	4
Grammar II	50%	11	4	2	3	0	5	1	2

Comment: Good at all levels. Distractors working. OK.

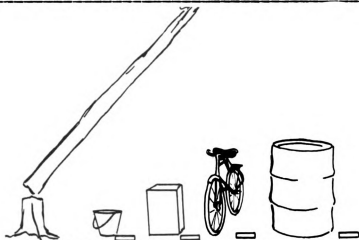
8



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	52%	16	16	3	7	0	5	27	18
Secondary:									
Modern I	41%	5	4	0	5	0	1	14	9
Modern II	53%	8	17	7	4	2	3	28	21
Modern III	69%	4	6	3	1	0	4	19	15
Grammar I	62%	3	4	0	6	0	0	18	11
Grammar II	68%	4	2	1	0	0	1	9	11

Comment: Too similar to Question # 1. Concept the same.
Eliminate.

9



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	41%	3	4	0	2	16	20	27	20
Secondary:									
Modern I	23%	1	2	0	0	0	6	18	11
Modern II	27%	3	3	1	2	10	13	31	27
Modern III	22%	1	4	0	2	9	4	16	16
Grammar I	18%	0	1	0	0	7	0	14	20
Grammar II	21%	0	2	0	0	4	2	10	10

Comment: Too difficult to show concept. Response D too close a distractor. Eliminate.

10



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	36%	25	8	2	5	11	5	8	28
Secondary:									
Modern I	21%	7	2	1	4	4	4	7	9
Modern II	52%	32	15	5	11	3	2	5	17
Modern III	43%	20	6	1	6	4	4	1	10
Grammar I	76%	17	12	0	3	2	4	2	2
Grammar II	61%	13	7	0	0	1	6	0	1

Comment: Ok at all levels. Good discrimination.

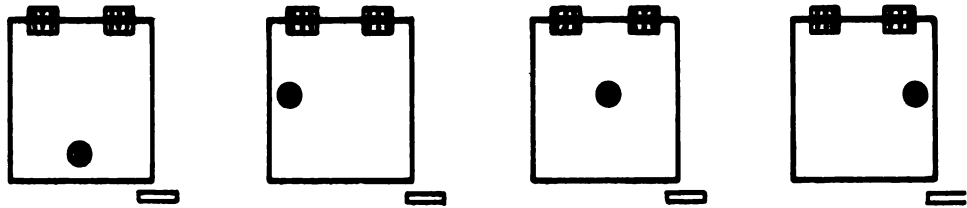
11



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	25%	15	21	10	12	1	6	20	7
Secondary:									
Modern I	32%	8	4	3	9	0	2	8	4
Modern II	23%	20	14	12	13	2	12	11	6
Modern III	14%	10	14	11	7	1	3	4	2
Grammar I	20%	10	6	7	5	0	2	4	8
Grammar II	21%	7	7	3	3	2	2	2	2

Comment: Relatively difficult. Change response D to show smooth, round poles smaller in diameter.

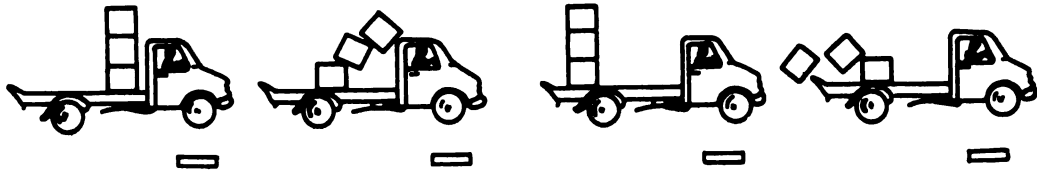
12



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	20%	24	9	12	17	2	9	8	11
Secondary:									
Modern I	19%	7	4	5	11	1	3	6	1
Modern II	38%	29	5	8	19	2	13	6	8
Modern III	36%	18	1	5	5	1	12	2	8
Grammar I	59%	21	8	0	7	0	3	0	3
Grammar II	45%	13	2	0	10	0	2	1	0

Comment: Good discrimination. OK.

13



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	18%	10	8	15	6	6	9	15	23
Secondary:									
Modern I	24%	2	3	7	4	0	5	10	7
Modern II	20%	4	8	16	8	3	4	22	25
Modern III	29%	1	6	12	4	0	8	13	8
Grammar I	54%	3	0	15	7	0	1	3	13
Grammar II	61%	0	0	12	7	0	3	2	4

Comment: Difficult at lower levels, OK at higher levels.
OK.

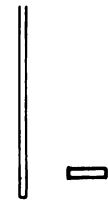
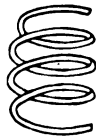
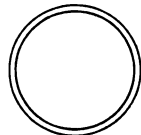
14



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	35%	11	17	5	7	20	13	10	9
Secondary:									
Modern I	28%	6	2	2	5	5	4	6	8
Modern II	35%	9	10	6	10	20	11	10	14
Modern III	29%	7	1	4	6	11	10	4	9
Grammar I	68%	4	6	0	2	17	11	0	2
Grammar II	68%	0	4	1	2	12	5	1	3

Comment: Change response A from plate to box of matches.
OK.

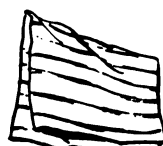
15



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	54%	6	18	32	15	2	4	6	9
Secondary:									
Modern I	45%	4	8	15	5	0	4	0	2
Modern II	49%	9	19	26	16	5	2	5	8
Modern III	61%	3	6	15	15	1	0	7	5
Grammar I	57%	3	7	16	10	0	3	2	1
Grammar II	71%	1	6	13	7	0	0	0	1

Comment: Discrimination good at lower levels. OK.

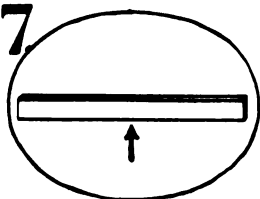
16.



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	10%	3	10	3	3	14	15	26	18
Secondary:									
Modern I	15%	3	3	2	4	7	2	7	10
Modern II	29%	0	2	16	10	12	14	17	19
Modern III	19%	2	4	4	5	5	6	15	11
Grammar I	14%	6	2	1	4	7	5	7	10
Grammar II	21%	0	0	4	2	7	8	3	4

Comment: Too difficult to illustrate concept. Eliminate.

17



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	15%	3	4	0	4	34	34	9	4
Secondary:									
Modern I	49%	1	2	1	2	7	10	10	5
Modern II	30%	2	0	2	5	19	35	22	5
Modern III	45%	1	2	0	4	10	12	15	8
Grammar I	68%	0	0	0	1	4	8	17	12
Grammar II	53%	0	2	0	0	4	5	10	7

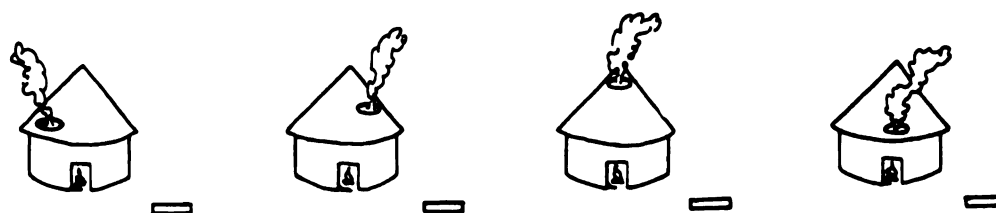
Comment: Too difficult at Primary level. OK elsewhere.
Change introductory picture to show board vertical instead of level so as not to confuse with scale.



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	56%	2	12	34	18	9	12	1	4
Secondary:									
Modern I	62%	2	4	11	9	5	6	1	0
Modern II	64%	1	3	32	22	12	18	0	2
Modern III	69%	0	3	25	11	1	12	0	0
Grammar I	80%	0	0	21	10	0	11	0	0
Grammar II	71%	0	2	14	6	0	6	0	0

Comment: OK at all levels. Change response D from candle to a piece of twine.

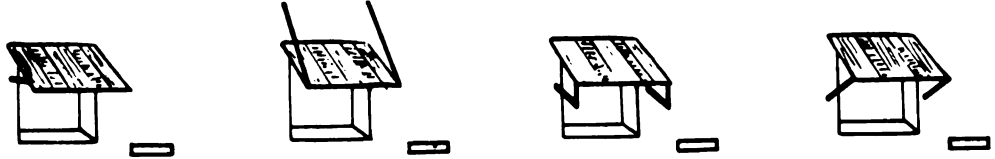
19



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	70%	4	9	1	6	31	22	10	9
Secondary:									
Modern I	60%	0	5	1	2	17	5	1	7
Modern II	41%	5	7	2	4	21	30	17	4
Modern III	68%	4	4	1	1	17	15	4	6
Grammar I	57%	0	0	1	2	15	11	5	8
Grammar II	55%	2	1	1	4	10	5	1	4

Comment: Difficulty increases at higher levels ? Change location of smoke hole in response b and put two smoke holes in response A.

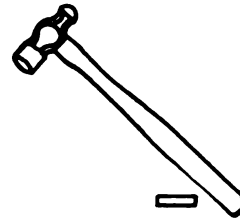
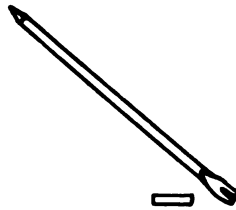
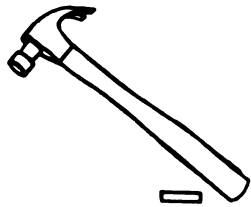
20



School	Level of Diff..	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	46%	9	5	1	7	7	16	29	18
Secondary:									
Modern I	34%	1	7	2	3	4	6	12	3
Modern II	39%	11	11	0	8	12	19	22	7
Modern III	30%	5	10	5	4	7	6	9	6
Grammar I	39%	4	5	2	0	2	6	13	10
Grammar II	34%	3	5	0	1	6	3	5	5

Comment: Slightly difficult item. Discrimination good at lower levels. OK.

1

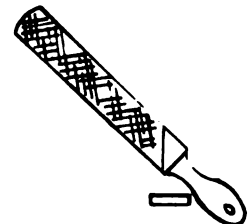
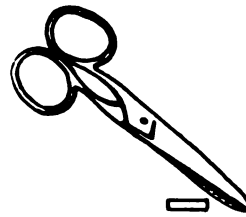
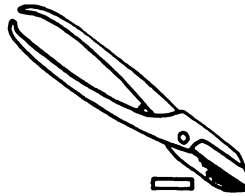
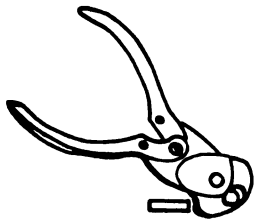


ALL SAME

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	77%	41	30	5	7	0	9	0	0
Secondary:									
Modern I	81%	19	11	0	2	0	6	0	0
Modern II	89%	42	32	1	2	2	11	0	0
Modern III	96%	25	21	0	2	1	3	0	0
Grammar I	100%	21	21	0	0	0	0	0	0
Grammar II	89%	14	11	0	3	0	0	0	0

Comment: Very easy, but good for introduction to this part of the test. OK.

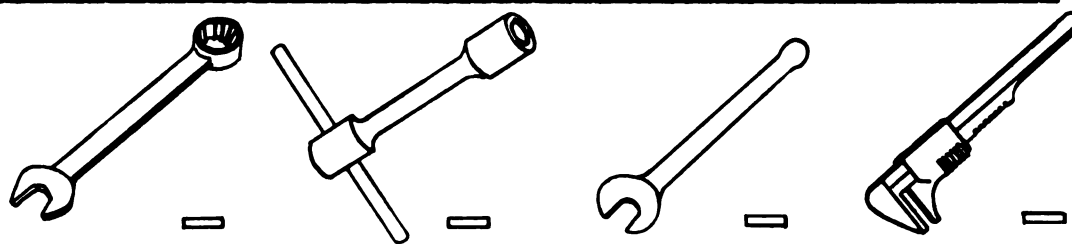
2



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	48%	3	12	35	13	7	11	1	10
Secondary:									
Modern I	47%	1	7	14	6	2	4	2	2
Modern II	48%	11	18	27	7	7	11	0	9
Modern III	52%	9	3	17	9	0	7	0	7
Grammar I	68%	0	6	21	6	0	9	0	0
Grammar II	71%	3	6	11	8	0	0	0	0

Comment: OK at all levels. Good discrimination.

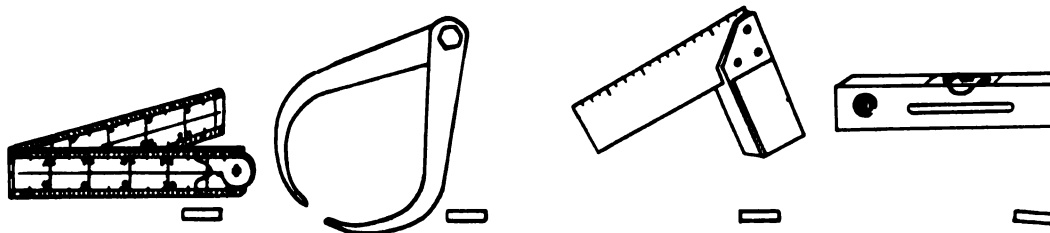
3



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	30%	21	28	1	4	10	3	14	11
Secondary:									
Modern I	40%	5	8	1	0	4	6	9	5
Modern II	25%	20	18	4	2	2	16	19	9
Modern III	45%	13	3	1	0	0	11	12	12
Grammar I	43%	7	4	0	1	0	7	14	9
Grammar II	39%	1	9	0	0	3	5	10	0

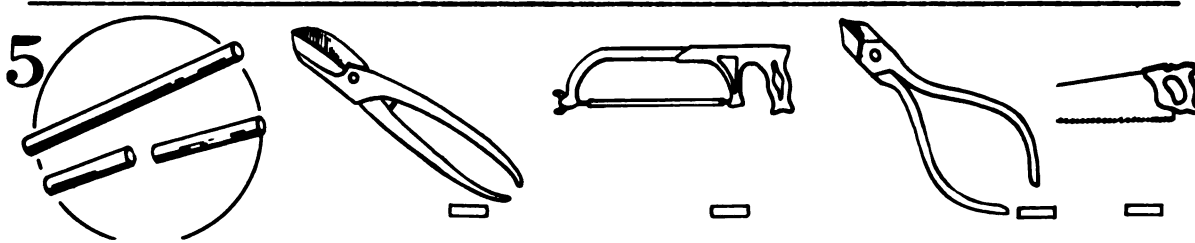
Comment: Good discrimination. OK.

4



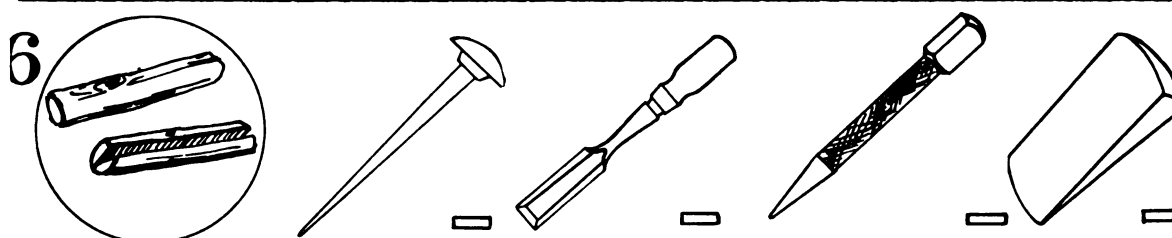
School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	39%	8	27	1	3	22	11	15	5
Secondary:									
Modern I	72%	1	6	0	0	15	13	3	0
Modern II	78%	2	4	0	0	38	28	5	13
Modern III	78%	0	5	0	0	18	18	8	3
Grammar I	84%	0	4	0	0	20	11	1	6
Grammar II	79%	1	2	0	3	11	8	2	1

Comment: OK at lowest levels, too easy at upper levels.
May need revision in the future.



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	48%	1	1	31	14	0	5	14	26
Secondary:									
Modern I	40%	2	5	12	3	0	0	5	11
Modern II	60%	0	1	31	20	0	0	14	24
Modern III	61%	0	2	20	9	0	0	6	15
Grammar I	78%	0	3	20	9	0	0	1	9
Grammar I	71%	1	2	13	7	0	4	0	1

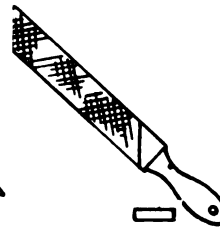
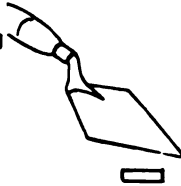
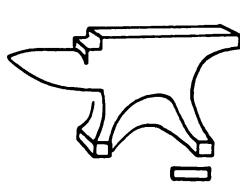
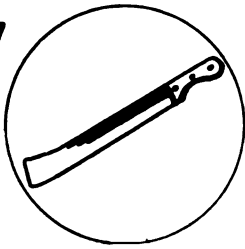
Comment: Good discrimination. Particularly good at lower and middle levels. OK.



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	37%	0	2	16	21	1	12	29	11
Secondary:									
Modern I	34%	1	3	8	11	0	2	10	3
Modern II	34%	2	5	17	25	0	7	26	8
Modern III	23%	1	7	14	15	0	3	11	1
Grammar I	55%	0	0	4	17	1	0	16	4
Grammar II	45%	1	0	3	10	1	3	9	1

Comment: Good discrimination. Distractors working well. OK.

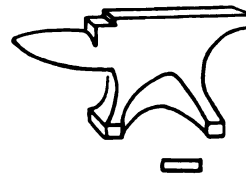
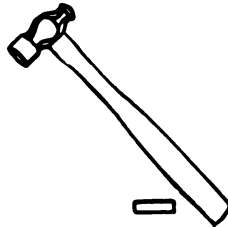
7



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	46%	11	13	1	12	27	11	7	10
Secondary:									
Modern I	44%	6	1	1	6	12	5	0	7
Modern II	59%	6	12	5	8	33	14	1	11
Modern III	68%	4	6	0	1	21	13	1	6
Grammar I	70%	1	3	0	2	20	8	0	8
Grammar II	79%	1	3	0	2	13	8	0	1

Comment: Good at lower and middle levels. OK.

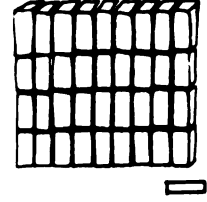
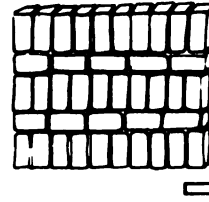
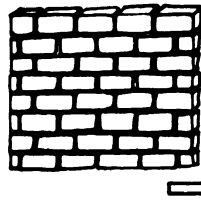
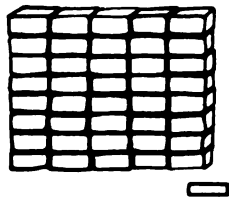
8



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	42%	12	24	5	7	5	2	24	13
Secondary:									
Modern I	32%	3	2	3	7	5	6	8	4
Modern II	26%	16	23	6	9	8	6	15	7
Modern III	41%	4	7	2	9	6	4	14	6
Grammar I	36%	4	6	1	8	0	4	16	3
Grammar II	45%	0	2	0	8	5	2	9	2

Comment: Relatively difficult. OK.

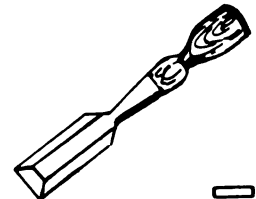
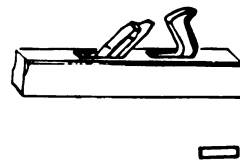
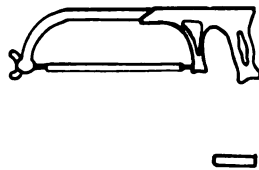
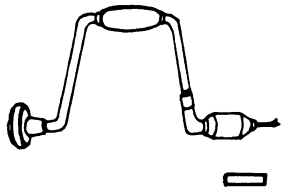
9



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	70%	4	11	37	20	3	3	2	12
Secondary:									
Modern I	81%	4	3	15	16	0	0	0	0
Modern II	78%	3	16	41	24	0	3	1	2
Modern III	74%	7	10	19	15	0	0	0	1
Grammar I	89%	0	1	20	16	0	4	1	0
Grammar II	84%	1	0	13	13	0	0	0	1

Comment: Not too difficult, but OK for lower levels.
May need revision in future.

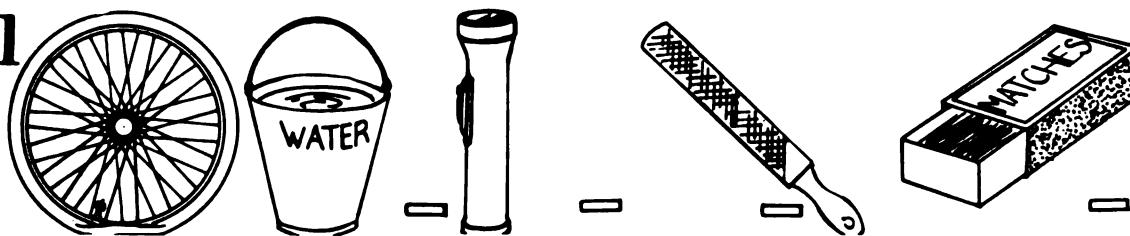
10



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	40%	9	22	0	2	31	22	6	0
Secondary:									
Modern I	21%	11	14	1	0	2	5	5	0
Modern II	39%	19	23	3	1	16	18	7	3
Modern III	35%	13	14	0	0	10	9	3	3
Grammar I	52%	2	11	0	1	17	7	2	2
Grammar II	37%	1	7	0	0	9	5	4	2

Comment: Discrimination weak. Should be revised in future if discrimination does not improve.

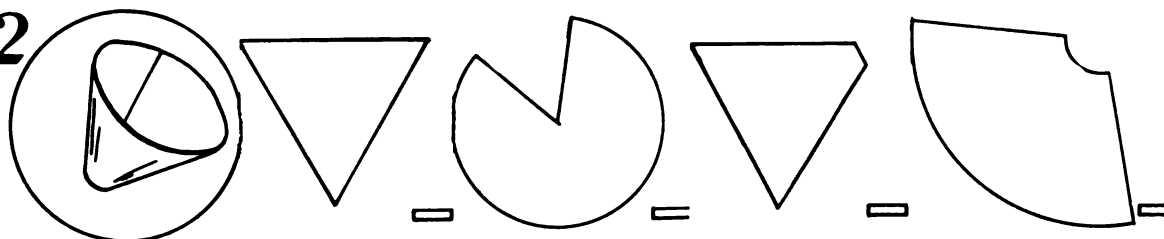
11



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	36%	28	3	13	33	5	8	0	2
Secondary:									
Modern I	70%	16	15	0	4	3	0	0	0
Modern II	68%	43	17	1	19	0	6	1	3
Modern III	84%	23	15	3	5	0	5	0	1
Grammar I	91%	21	14	0	5	0	2	0	0
Grammar II	98%	14	14	0	0	0	0	0	0

Comment: OK, except for higher levels.

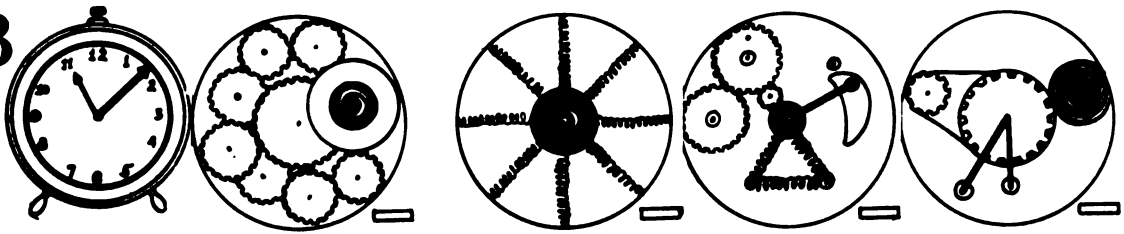
12



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	28%	13	11	13	16	3	6	17	13
Secondary:									
Modern I	21%	4	8	6	7	2	3	7	1
Modern II	38%	8	15	17	14	2	6	18	10
Modern III	32%	4	3	11	6	2	7	9	10
Grammar I	47%	1	4	3	5	2	7	15	3
Grammar II	50%	0	3	3	3	0	4	11	4

Comment: OK at all levels.

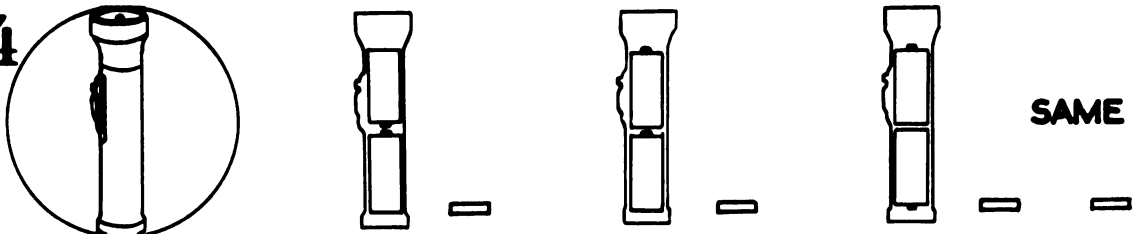
13



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	35%	24	14	5	10	12	6	5	16
Secondary:									
Modern I	55%	18	5	0	5	0	2	1	7
Modern II	30%	17	6	2	10	22	15	4	14
Modern III	33%	18	3	2	5	3	8	3	10
Grammar I	39%	8	8	0	2	13	8	0	3
Grammar II	37%	2	4	0	0	8	7	4	3

Comment: OK for lower levels. Upper levels are reading unintentional meaning into question.

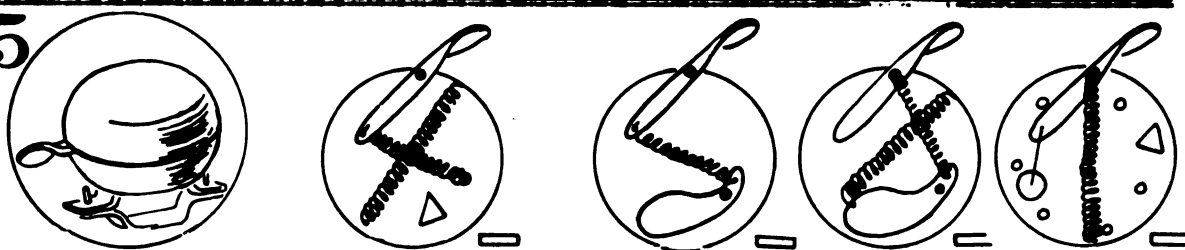
14



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	64%	2	13	38	20	6	7	0	6
Secondary:									
Modern I	62%	1	6	14	5	4	6	0	2
Modern II	66%	1	7	35	20	4	13	5	5
Modern III	65%	2	7	20	11	2	7	2	1
Grammar I	84%	0	4	21	10	0	4	0	3
Grammar II	84%	0	2	14	6	0	1	0	5

Comment: OK for lower and middle levels. Discrimination good.

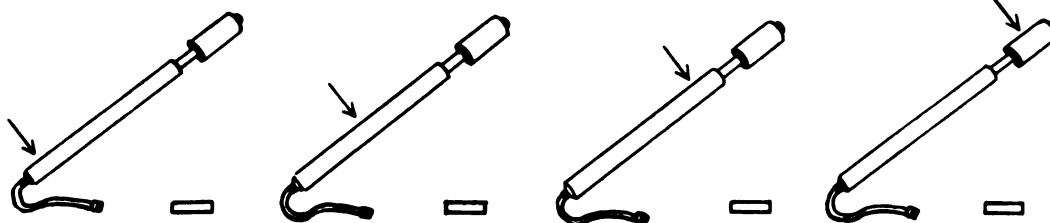
15



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	25%	4	9	14	14	12	9	16	14
Secondary:									
Modern I	32%	2	4	11	8	4	2	2	5
Modern II	24%	4	13	15	7	9	11	17	14
Modern III	17%	0	11	5	2	12	5	9	8
Grammar I	9%	2	2	4	0	6	13	9	6
Grammar II	15%	1	2	3	3	3	6	7	3

Comment: Difficult item. Discrimination weak. Distractors working against question. OK for present.

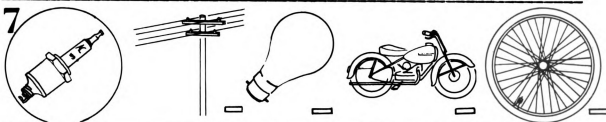
16



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	26%	17	7	5	12	5	4	19	23
Secondary:									
Modern I	47%	6	4	1	4	2	6	10	5
Modern II	48%	10	10	7	9	1	9	27	17
Modern III	40%	17	3	3	5	0	2	6	16
Grammar I	63%	17	9	1	2	0	2	3	8
Grammar II	63%	12	5	1	0	0	2	1	7

Comment: OK at all levels.

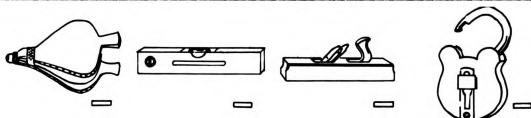
17



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	59%	5	5	5	15	33	24	3	2
Secondary:									
Modern I	36%	2	1	2	9	13	5	2	4
Modern II	52%	7	7	5	16	25	18	8	4
Modern III	44%	3	7	3	10	16	6	4	3
Grammar I	46%	3	5	1	6	13	4	4	6
Grammar II	45%	0	1	0	2	7	7	7	4

Comment: OK at all levels, particularly middle groups.

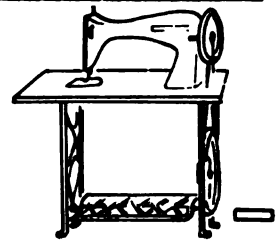
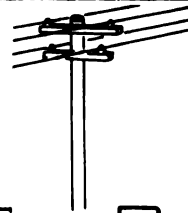
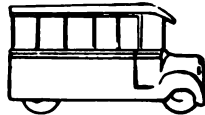
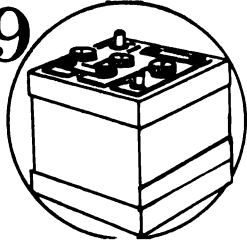
18



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	26%	2	16	8	7	17	7	19	16
Secondary:									
Modern I	17%	3	10	5	2	7	0	4	7
Modern II	30%	1	5	9	17	28	5	7	18
Modern III	33%	2	9	4	1	17	4	3	12
Grammar I	50%	0	6	2	6	18	2	1	7
Grammar II	53%	0	3	1	6	10	2	3	3

Comment: Difficult at lower levels. OK.

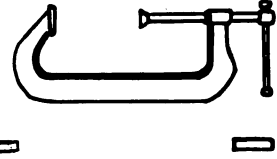
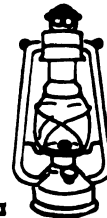
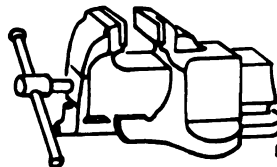
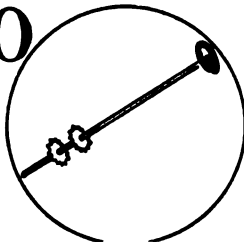
19



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	70%	0	5	41	21	4	8	1	12
Secondary:									
Modern I	64%	0	1	17	9	2	1	0	8
Modern II	83%	1	2	44	29	0	4	0	10
Modern III	75%	0	5	24	10	1	3	1	8
Grammar I	82%	0	1	21	11	0	6	0	3
Grammar II	76%	0	4	14	3	0	3	0	4

Comment: Discrimination good, though relatively an easy question.

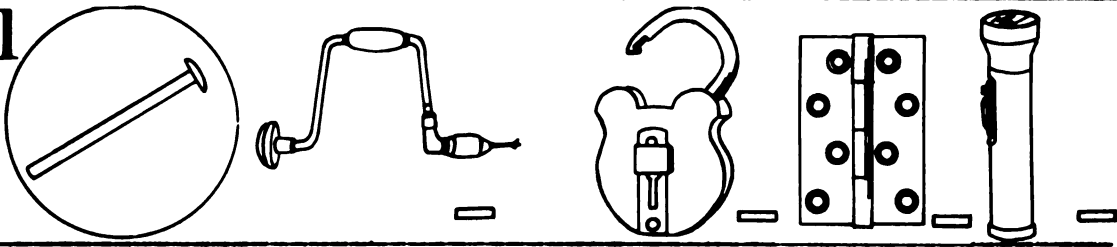
20



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	51%	10	23	2	5	34	17	0	1
Secondary:									
Modern I	55%	3	7	0	3	16	6	0	3
Modern II	66%	4	14	1	7	39	18	1	6
Modern III	55%	8	6	0	3	18	11	0	6
Grammar I	57%	5	7	0	4	16	6	0	4
Grammar II	79%	0	4	0	4	14	5	0	1

Comment: OK at all levels.

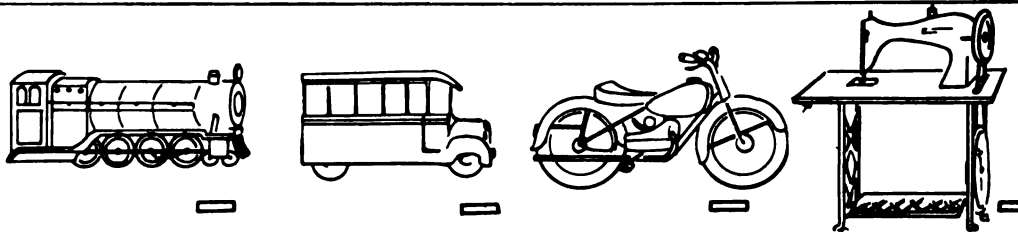
21



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	54%	4	9	0	2	38	17	4	18
Secondary:									
Modern I	47%	0	8	2	5	17	5	0	1
Modern II	66%	5	13	2	7	37	19	1	6
Modern III	65%	3	7	2	5	21	11	0	3
Grammar I	87%	0	2	4	3	17	16	0	0
Grammar II	66%	3	6	0	2	11	6	0	0

Comment: OK at lower and middle levels.

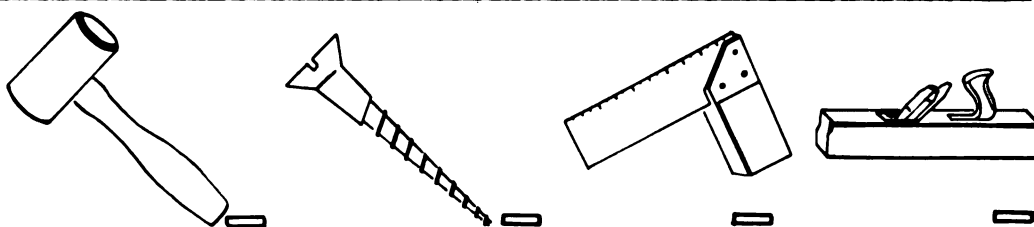
22



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	54%	6	19	2	7	1	5	37	15
Secondary:									
Modern I	58%	2	3	0	8	0	4	17	4
Modern II	66%	3	13	0	9	0	8	42	15
Modern III	81%	6	3	0	4	0	2	20	17
Grammar I	87%	1	4	0	2	0	2	20	13
Grammar II	79%	0	3	0	0	1	2	13	9

Comment: OK at lower and middle levels.

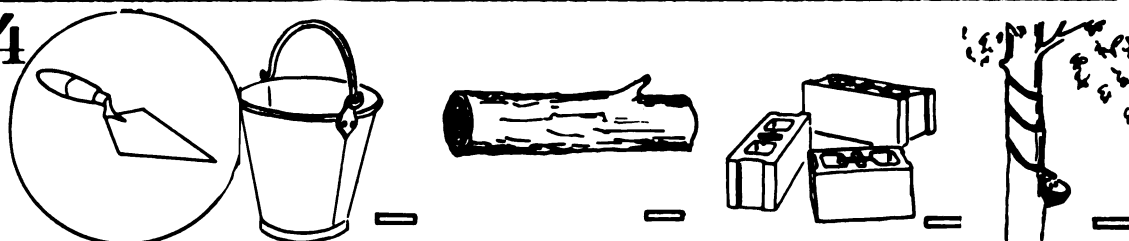
23



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	46%	24	12	12	10	1	6	9	18
Secondary:									
Modern I	42%	10	8	4	5	1	4	4	2
Modern II	44%	25	12	16	7	0	6	4	21
Modern III	49%	20	9	5	5	0	1	1	11
Grammar I	52%	13	8	5	5	1	4	2	4
Grammar II	54%	11	3	2	4	0	2	1	5

Comment: OK at all levels.

24



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	72%	2	19	0	4	44	22	0	1
Secondary:									
Modern I	79%	3	5	0	1	14	13	2	0
Modern II	88%	2	13	0	2	43	27	0	3
Modern III	90%	3	1	0	0	23	24	0	1
Grammar I	86%	2	2	0	1	19	18	0	0
Grammar II	95%	0	2	0	0	14	11	0	1

Comment: Very easy question but OK for lower levels.

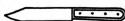
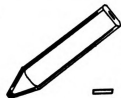
25



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	10%	21	15	10	17	6	12	9	2
Secondary:									
Modern I	13%	9	7	6	8	2	3	2	1
Modern II	20%	17	12	10	19	3	10	15	4
Modern III	16%	12	9	8	7	1	6	5	4
Grammar I	23%	5	8	7	4	3	6	6	3
Grammar II	26%	4	7	4	4	0	2	6	1

Comment: Very difficult question. Distractors may need revision in future.

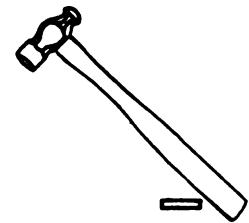
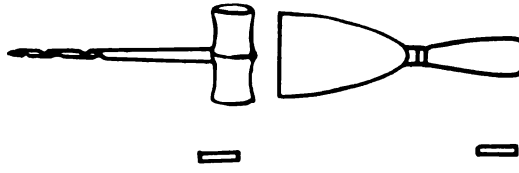
26



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	41%	24	13	3	9	19	14	0	10
Secondary:									
Modern I	24%	11	2	3	5	5	10	0	2
Modern II	51%	32	13	8	11	5	19	0	2
Modern III	52%	14	7	7	3	5	10	0	6
Grammar I	59%	18	5	1	8	2	8	0	0
Grammar II	68%	10	7	1	4	3	3	0	0

Comment: OK at all levels.

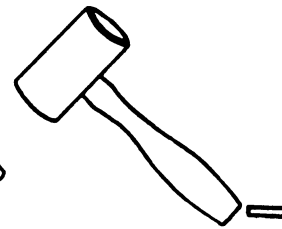
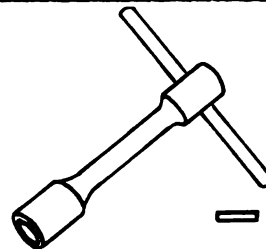
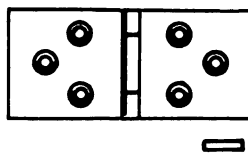
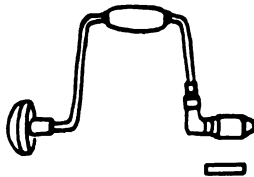
27



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	26%	19	20	6	11	9	9	12	6
Secondary:									
Modern I	26%	6	6	1	5	3	5	9	3
Modern II	35%	9	10	5	10	8	15	23	10
Modern III	48%	1	7	5	5	1	6	19	8
Grammar I	52%	3	3	1	5	2	8	15	5
Grammar II	53%	3	4	0	4	0	0	11	6

Comment: OK at all levels.

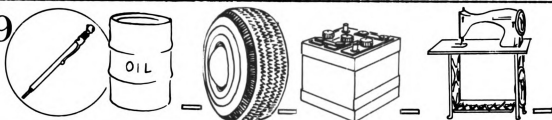
28



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	57%	40	17	3	13	3	9	0	7
Secondary:									
Modern I	66%	16	13	3	4	0	1	0	1
Modern II	71%	40	19	1	16	3	5	1	5
Modern III	72%	20	12	4	6	2	6	0	2
Grammar I	64%	19	6	0	9	0	2	2	4
Grammar II	68%	12	8	1	4	1	1	0	1

Comment: OK at all levels.

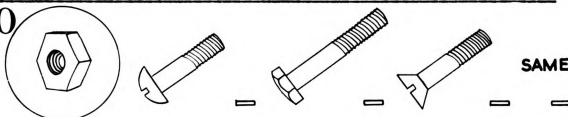
29



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6	23%	5	15	22	4	8	10	11	17
Secondary:									
Modern I	23%	2	3	8	0	3	9	6	7
Modern II	27%	3	3	21	10	10	13	11	19
Modern III	30%	0	1	13	10	9	7	4	8
Grammar I	39%	1	0	9	4	4	8	7	9
Grammar II	68%	0	0	7	0	3	2	4	12

Comment: Relatively difficult at lower and middle levels. Discrimination good. OK.

30



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Primary 6.	25%	7	12	12	20	5	8	22	6
Secondary:									
Modern I	27%	5	5	7	8	3	3	4	3
Modern II	39%	4	10	15	21	0	4	26	10
Modern III	36%	1	8	9	11	0	5	16	2
Grammar I	63%	2	5	3	2	1	1	15	13
Grammar II	53%	0	1	3	6	0	2	11	5

Comment: Relatively difficult at lower levels, good at top level. OK.

APPENDIX IV

REVISED FORM OF MECHANICAL APTITUDE TEST

--Examiner's Instructions

--Practice Sheet

--Mechanical Aptitude Test
Part I

Part II

Part III

EXAMINER'S INSTRUCTIONS

Mechanical Aptitude Test

The examiner's instructions for the revised test were not changed. However, the questions were rearranged and a new one, number two, was added. The purpose of this question was to demonstrate the concept of using SAME as a possible answer. The questions now read as follows:

Number one. . . It is raining . . it is raining and four boys are standing under four different trees.
Look at the boys and at the four trees.
Which one of the boys will be the most dry in the rain? . . Who can tell me which one boy will be the most dry?

Number two. . . Look at the pictures of the alarm clocks at three different times of day . . 11 o'clock . . 11:15 . . 11:30.
Who can tell me on which clock the hands are moving the fastest or are they all moving the same.

Number three. . Look at the pictures of the four tools.
Which one does the farmer use to plant his crops? Who can tell me which one the farmer uses to plant his crops?

Number one. . . Which one of these things will burn most quickly? . . the stick . . the cigarette . . . the paper . . . or the box?
Mark the one that will burn most quickly.
Everybody. (Wait ten seconds.)

Number two. . . A boy wants to draw a circle on a piece of paper.
Which one of these things will help him to draw the best circle on the paper? . . the tumbler . . the gourd . . the orange . . or will they all help him the same?
Which is the one answer that is best?
(Wait ten seconds.)

Number three. . Look at the picture in the circle.
With which one of the four other things is it used?
Mark the one with which it is used. (Wait ten seconds.)

1



2



3



4



5



6



SAME

7



8

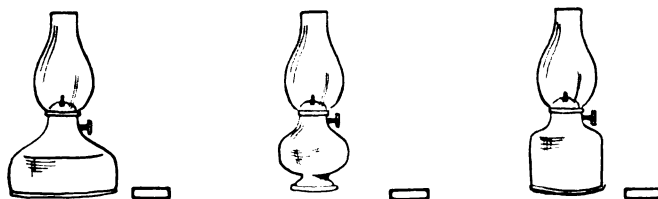


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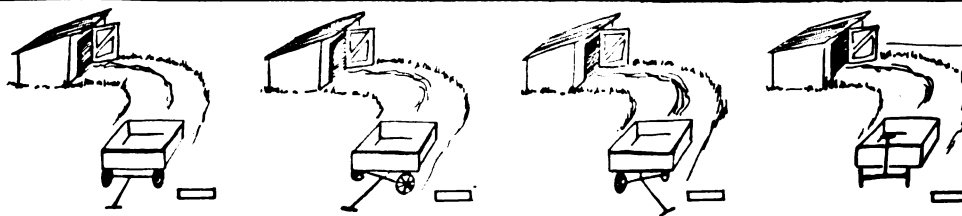
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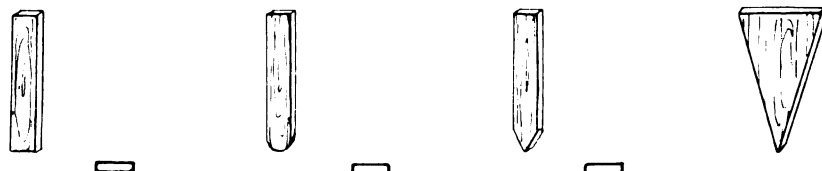


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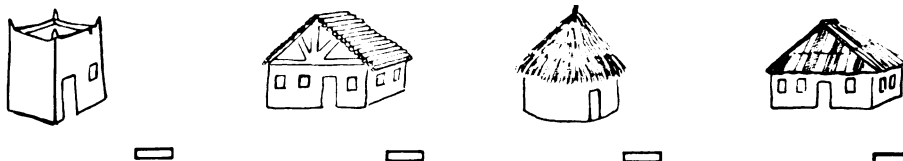
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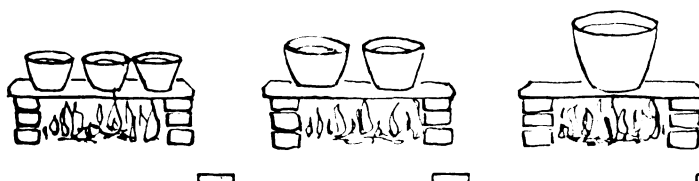
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13

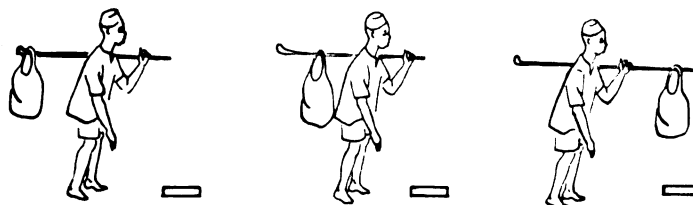


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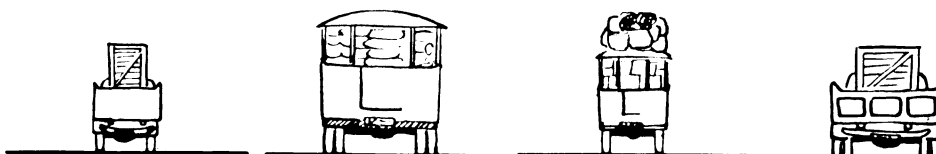
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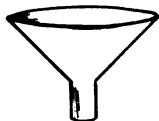


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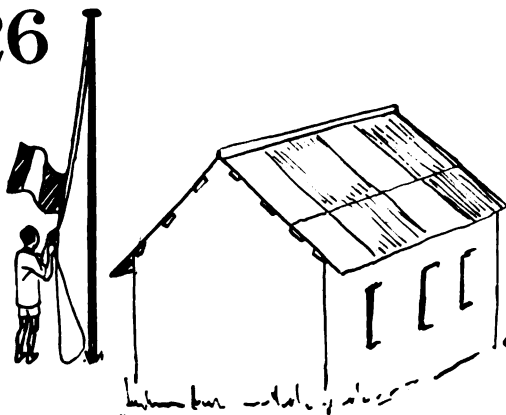


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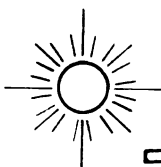


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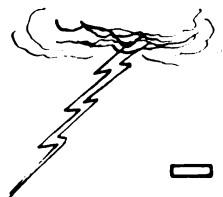
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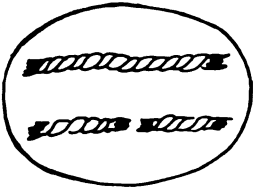


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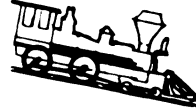
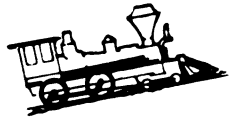


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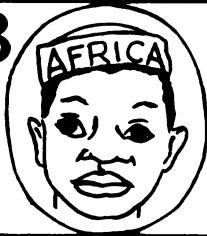


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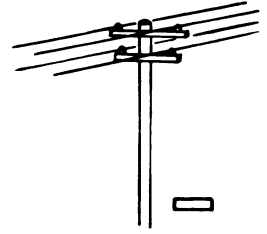
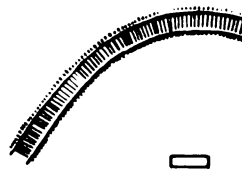
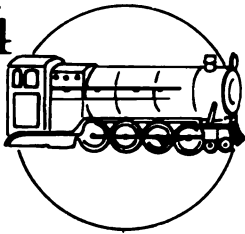
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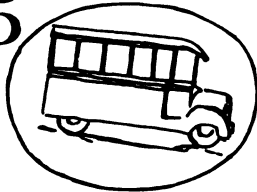
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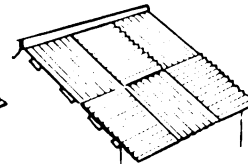
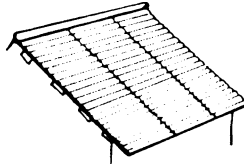
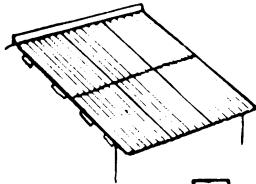
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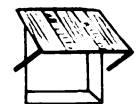
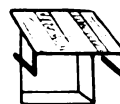
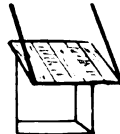
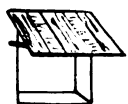


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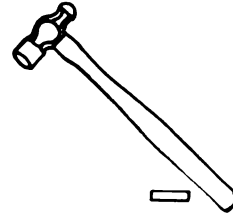
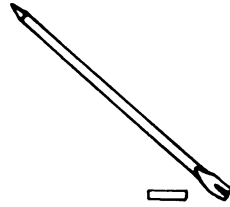
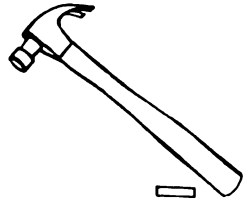


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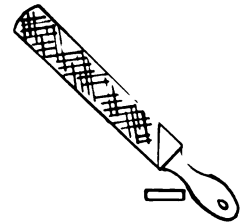
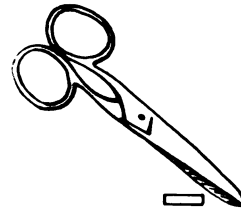
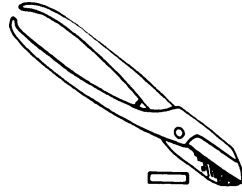
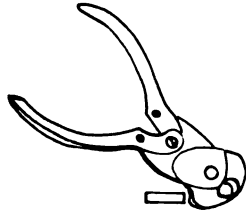
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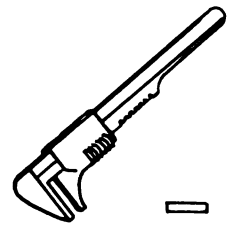
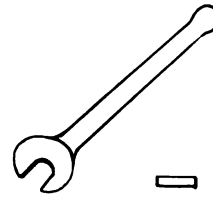
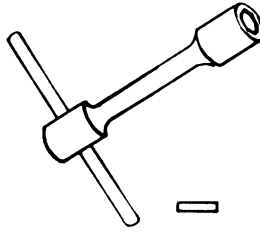
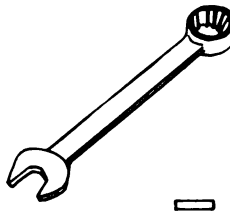


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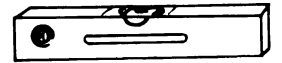
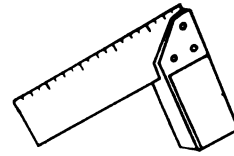
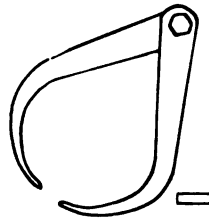
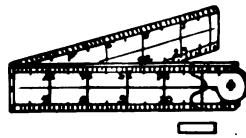
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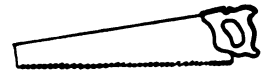
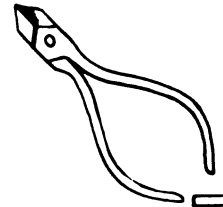
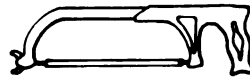
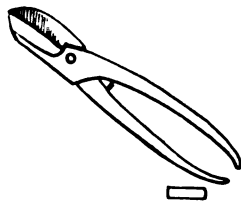
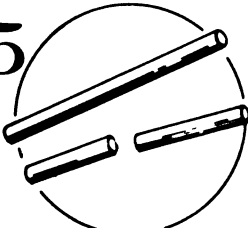
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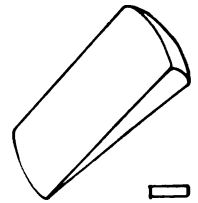
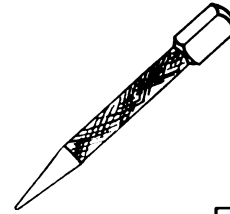
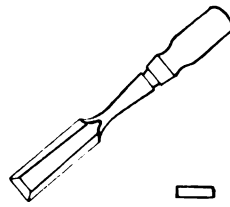
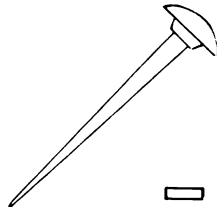
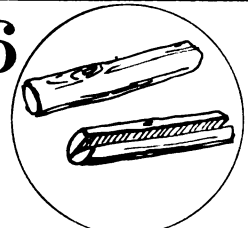
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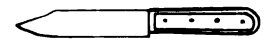
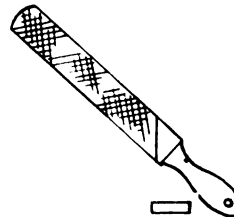
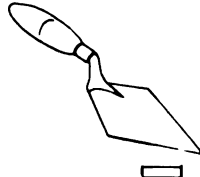
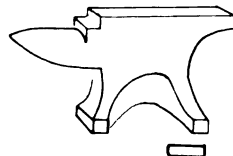
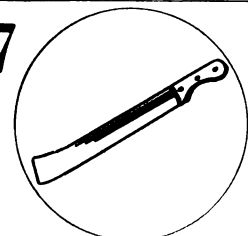
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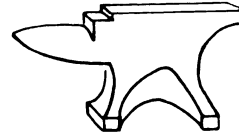
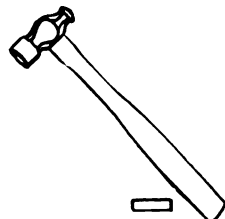
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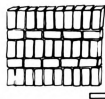
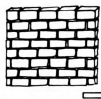
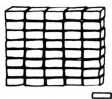
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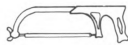
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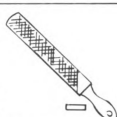
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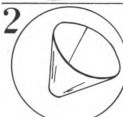
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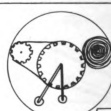
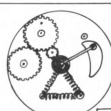
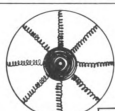
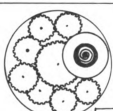
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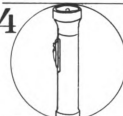
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14



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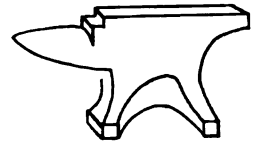
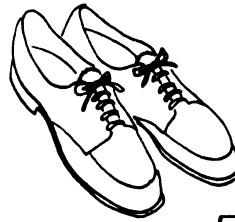
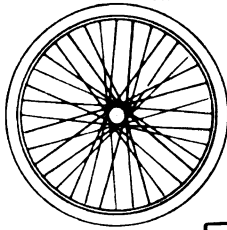
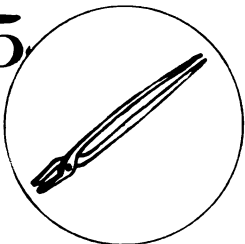
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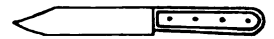
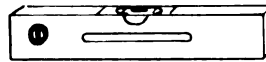
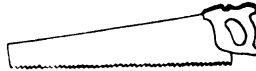
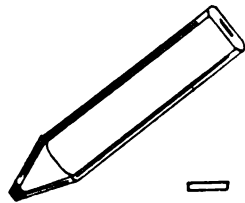
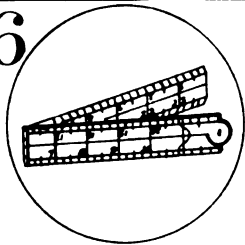
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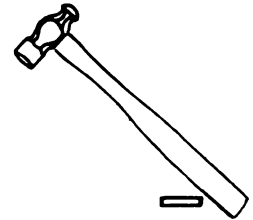
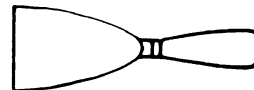
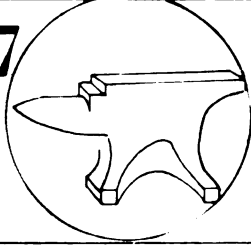
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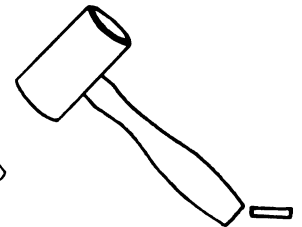
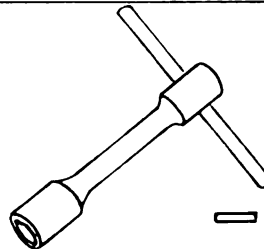
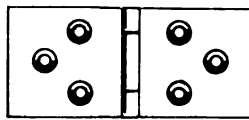
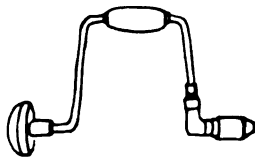
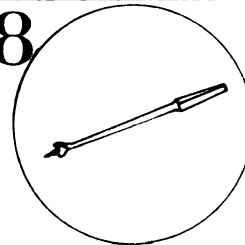
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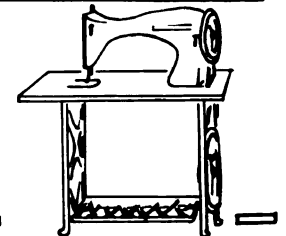
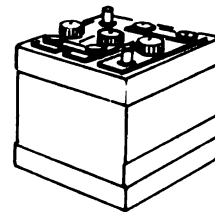
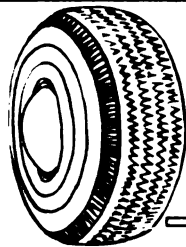
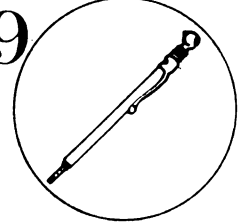
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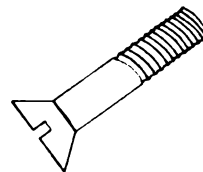
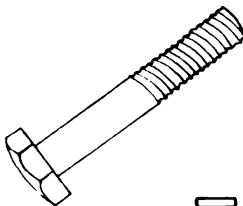
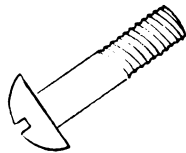
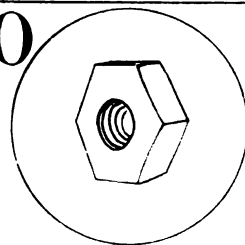
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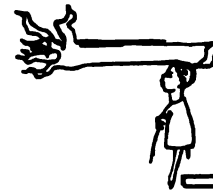
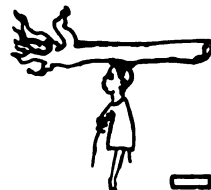
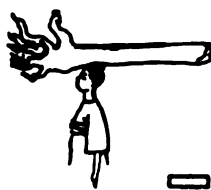
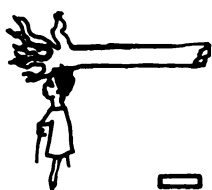


ALL SAME

APPENDIX V

ITEM ANALYSIS OF THE REVISED QUESTIONS OF
MECHANICAL APTITUDE TEST

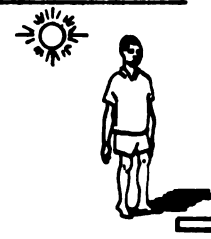
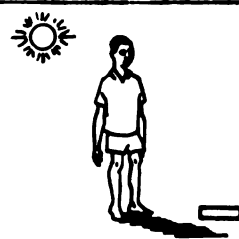
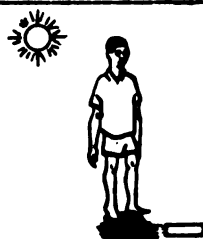
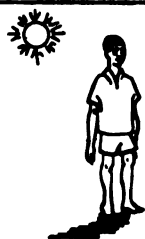
1



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	23%	3	7	33	11	33	48	0	3
Oshogbo	28%	0	0	23	11	33	44	0	1
Oyo	40%	0	0	22	10	15	22	0	5
Sapele	38%	3	4	60	24	27	55	2	9

Comment: Level of difficulty improved, discrimination good. OK.

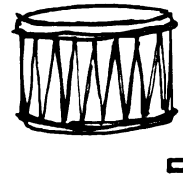
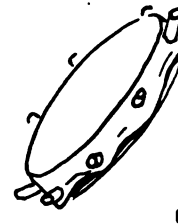
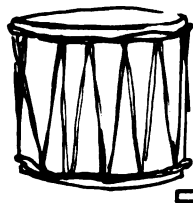
2



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	36%	1	4	20	30	34	18	14	17
Oshogbo	37%	2	6	5	13	26	11	23	26
Oyo	31%	2	7	13	12	13	8	9	10
Sapele	36%	6	8	20	36	48	20	18	28

Comment: Level of difficulty up, discrimination satisfactory. OK.

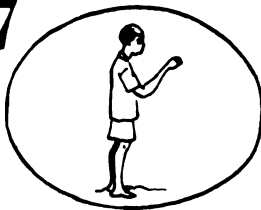
4



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	48%	42	28	16	21	8	14	3	6
Oshogbo	58%	42	20	12	25	2	9	0	2
Oyo	50%	26	14	7	18	1	0	3	5
Sapele	57%	53	51	18	23	14	10	7	8

Comment: Level of difficulty much improved. Discrimination fair. OK.

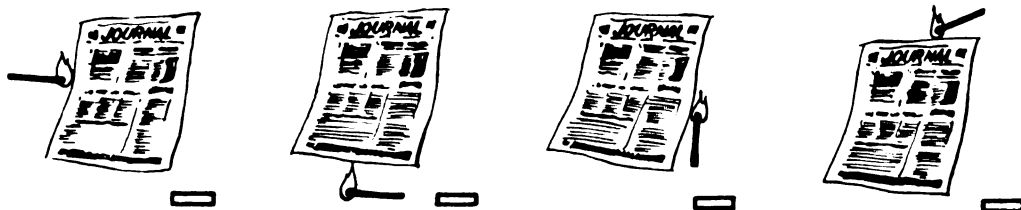
7



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	31%	31	8	2	3	17	6	19	52
Oshogbo	42%	33	13	1	4	13	7	9	32
Oyo	46%	23	9	2	2	1	6	11	20
Sapele	40%	44	33	2	1	17	7	29	51

Comment: Level of difficulty down a little. Discrimination OK. New response D working very well.

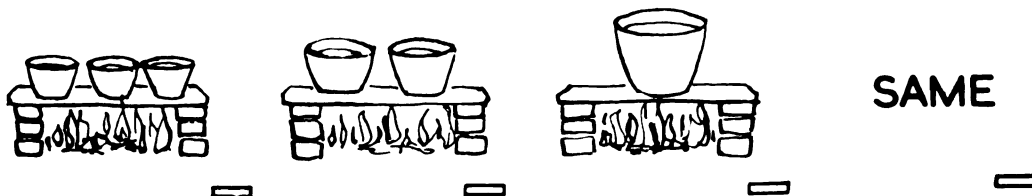
8



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	46%	3	18	50	16	8	19	8	16
Oshogbo	46%	6	10	44	14	2	12	4	20
Oyo	68%	0	8	35	12	1	10	1	7
Sapele	45%	5	17	76	14	2	26	9	35

Comment: Level of difficulty much improved. Discrimination very good. OK.

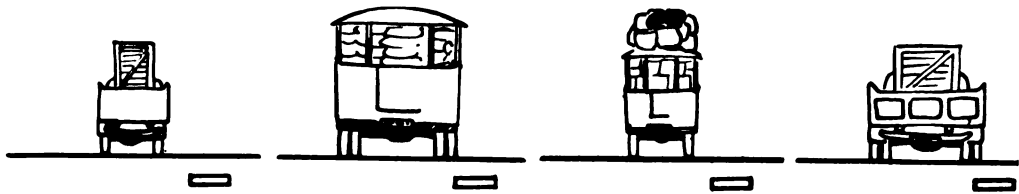
14



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	39%	37	14	1	10	27	28	4	17
Oshogbo	30%	17	13	0	2	14	24	25	17
Oyo	39%	24	10	0	0	4	11	9	16
Sapele	42%	60	21	2	3	7	22	23	46

Comment: Level of difficulty much improved. Changing picture considerable help. Ok.

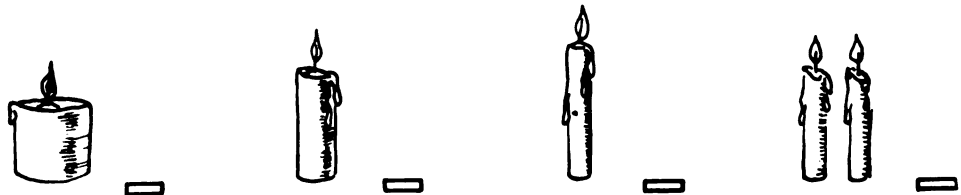
16



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	46%	7	11	13	8	45	28	4	22
Oshogbo	56%	8	17	4	11	42	23	2	5
Oyo	74%	1	8	4	9	32	18	0	2
Sapele	53%	8	27	3	24	76	23	5	18

Comment: Level of difficulty OK. Very good discrimination. OK.

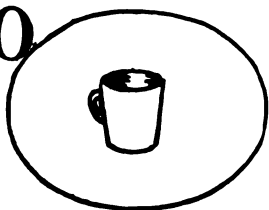
18



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	58%	47	36	2	10	12	16	8	7
Oshogbo	56%	39	23	0	4	17	15	0	14
Oyo	60%	27	17	1	1	8	14	1	5
Sapele	56%	62	43	1	5	28	27	1	17

Comment: OK for difficulty and discrimination. Response D much better as a distractor than previous picture.

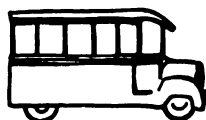
20



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	15%	22	8	19	19	4	5	24	37
Oshogbo	16%	17	0	18	11	10	7	11	38
Oyo	17%	10	0	15	15	6	2	6	20
Sapele	15%	32	10	38	22	4	10	18	50

Comment: Still a very difficult question. Introductory picture apparently did not help much. Needs further revision.

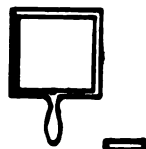
22



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	25%	16	15	12	24	12	18	29	12
Oshogbo	39%	16	15	10	24	7	8	23	9
Oyo	49%	0	7	13	13	2	7	22	10
Sapele	37%	17	19	22	32	4	20	49	21

Comment: Level of difficulty OK. Discrimination good. Change in response A only fair improvement. Change in response C better.

24



SAME

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	40%	9	24	20	28	6	11	34	6
Oshogbo	59%	5	19	8	13	1	4	42	20
Oyo	70%	3	4	5	7	0	4	29	22
Sapele	70%	4	10	5	24	0	6	81	52

Comment: Considerably improved in terms of level of difficulty. Discrimination good. OK.

25

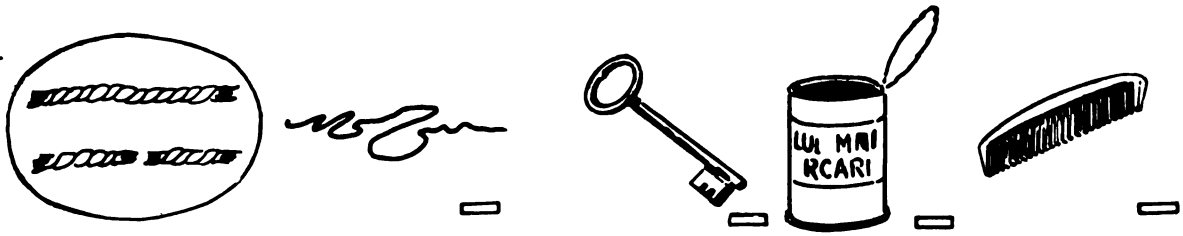


SAME

School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	54%	19	29	47	29	3	7	0	4
Oshogbo	65%	11	12	40	31	2	5	3	8
Oyo	84%	4	6	31	28	0	3	2	0
Sapele	70%	21	37	71	33	0	8	0	14

Comment: Level of difficulty up. Adding introductory picture apparently helped. Discrimination only fair. Distractors working.

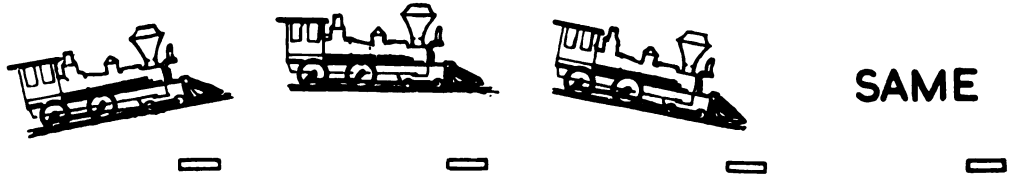
1



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	30%	29	41	2	11	36	11	2	6
Oshogbo	31%	26	26	6	12	23	13	1	5
Oyo	33%	14	19	1	8	20	8	2	2
Sapele	25%	37	63	4	11	40	9	11	9

Comment: Level of difficulty remains about the same.
Discrimination good. Change in responses A and C somewhat improved as distractors.

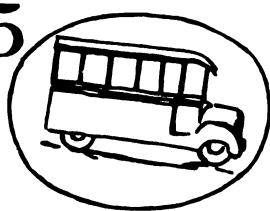
2



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	25%	21	8	15	21	23	31	10	9
Oshogbo	29%	18	10	8	11	14	25	16	10
Oyo	48%	21	14	1	5	2	6	13	12
Sapele	31%	44	10	3	12	25	43	20	27

Comment: Level of difficulty up and improved. Good discrimination. Changing verbal instructions from fuel to coal obvious help.

5



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	75%	0	2	14	19	0	10	55	38
Oshogbo	75%	0	1	9	24	1	0	46	31
Oyo	76%	1	5	0	10	1	0	35	22
Sapele	60%	2	10	30	30	0	2	60	50

Comment: Question did not change too much. Level of difficulty too high and discrimination is weak. Needs further revision.

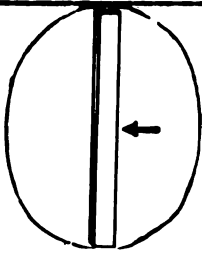
6



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	51%	9	37	5	2	50	25	5	5
Oshogbo	52%	19	22	2	2	32	27	3	5
Oyo	55%	14	15	1	2	21	13	1	7
Sapele	45%	29	47	0	4	54	36	9	5

Comment: Level of difficulty OK. Discrimination fair. Changing response A and B some improvement.

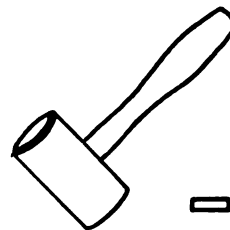
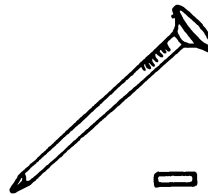
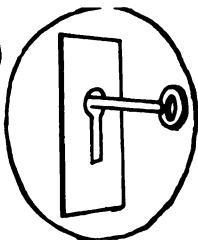
9



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	66%	1	11	0	7	6	23	62	28
Oshogbo	65%	0	0	0	6	5	18	51	32
Oyo	75%	0	2	0	0	9	10	28	25
Sapele	60%	5	11	1	11	15	37	71	33

Comment: Level of difficulty OK. Good discrimination changing introductory picture helped in improving response C as a distractor.

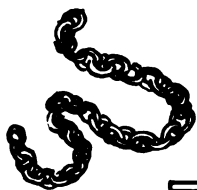
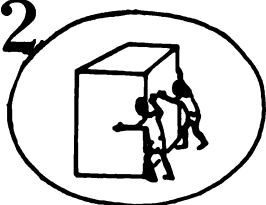
10



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	75%	0	2	65	40	4	23	0	4
Oshogbo	81%	1	4	53	33	2	15	0	4
Oyo	71%	0	3	31	26	6	8	0	0
Sapele	70%	0	8	76	49	13	31	3	4

Comment: Too easy and discrimination only fair. Changing response D not too helpful as a distractor.

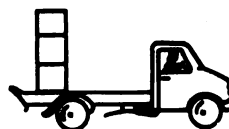
12



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	20%	34	54	6	4	1	5	28	6
Oshogbo	21%	34	47	1	3	2	3	19	3
Oyo	25%	23	29	3	1	0	0	11	7
Sapele	23%	50	65	5	9	0	5	37	13

Comment: Still too difficult. Changing picture for response D improved discrimination.

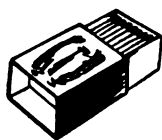
14



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	27%	8	14	27	12	8	10	26	33
Oshogbo	35%	2	7	33	9	1	10	20	30
Oyo	31%	1	2	15	7	5	4	16	24
Sapele	45%	0	4	67	16	0	8	25	64

Comment: Slight improvement in difficulty level. Discrimination very good. OK.

15



School	Level of Diff.	Response A		Response B		Response C		Response D	
		Hi	Low	Hi	Low	Hi	Low	Hi	Low
Ijebu-Ode	25%	25	27	14	13	25	16	5	13
Oshogbo	34%	14	26	4	12	37	6	1	12
Oyo	45%	11	14	2	1	22	13	2	9
Sapele	32%	22	38	14	10	39	26	17	18

Comment: Level of difficulty OK. Discrimination fair.
Changing response A did not help improve it as
a distractor.

APPENDIX VI

IBADAN VERBAL TEST

APPENDIX VI

50 Minutes

1050

IBADAN VERBAL TEST 1.

By

M. A. BRIMER, M.A.

Surname.....

First Names.....

School attended.....

Age.....yearsmonths. Date of Birth.....19..

PAGE	1	2	3	4	5	TOTAL
RIGHT						
WRONG						

(80)

Read these instructions carefully:

- Many of the kinds of questions you are going to do will be new to you, so you must read how to do them very carefully before you answer.
- Write your answers as clearly as possible.
- If you make a mistake, cross out the error neatly and put the correct answer above or at the side.
- You must work quickly; more quickly than you usually do.
- If you come to a question that you cannot do, after trying very hard, leave it and go on to the next.
- You will have 50 minutes in which to work the test and you will be warned how time is passing. **DO NOT TURN OVER UNTIL YOU ARE TOLD.**
- When you are told to begin, turn over the first page, read the instructions for yourself and begin working at once.
- When you have finished one page go on to the next without waiting to be told.

PAGE 1

Four of the words in each of the lines below have something in common, but one is different. Put a line under the ONE word which is different from the others. Underline only ONE word in each line. The first has been done for you.

One / ten / six / add / two

- | | | |
|----|---|---|
| 1. | Penny / shilling / halfpenny / florin / ounce | 1 |
| 2. | Car / aeroplane / truck / bus / lorry | 2 |
| 3. | Table / cupboard / wall / chair / stool | 3 |
| 4. | Bowl / rice / fish / egg / meat | 4 |
| 5. | Orange / banana / grape / yam / pawpaw | 5 |

In each row below there are two sums in which the answer is given but the + or - signs are missing between the numbers. Put a + or - sign between each pair of figures to make the answer correct. The first has been done for you.

- | | | | |
|-----|----------------|------------------|----|
| | $1-5+6=2$ | $5-1-2=2$ | |
| 6. | $4\ 5\ 8 = 1$ | $5\ 4\ 5 = 4$ | 6 |
| 7. | $3\ 5\ 4 = 2$ | $6\ 2\ 3 = 1$ | 7 |
| 8. | $3\ 6\ 2 = 11$ | $4\ 5\ 6 = 3$ | 8 |
| 9. | $4\ 7\ 5 = 6$ | $8\ 9\ 6 = 5$ | 9 |
| 10. | $2\ 6\ 4 = 4$ | $11\ 7\ 16 = 20$ | 10 |

In each sentence below, put lines under the two words that should change places to make the sentence sensible. The first has been done for you.

The chair sat on the man

- | | | |
|-----|---|----|
| 11. | I kicked the left with my ball foot | 11 |
| 12. | He ate the table and set the plate on the yam | 12 |
| 13. | He ago out five minutes went | 13 |
| 14. | With ate he his spoon. | 14 |
| 15. | The bicycle bit the man riding the dog | 15 |

TOTAL	15
-------	----

GO STRAIGHT ON TO THE NEXT PAGE.

PAGE 2

In each row below, put a line under the ONE word in the brackets which completes the sentence. The first has been done for you. Underline only ONE word in each line.

- BLACK is to WHITE as WRONG is to (bad / worse / better / right / cross)
16. SHEEP is to LAMB as DOG is to (*calf* / horse / wool / puppy / field) 16
17. OCEAN is to SEA as CONTINENT is to (*land* / lake / country / water / town) 17
18. LAGOS is to NIGERIA as ACCRA is to (*city* / Ghana / country / Takoradi / Ashanti) 18
19. WOOD is to CHAIR as STEEL is to (*table* / coat / tree / knife / coal) 19
20. HORSE is to FOAL as HEN is to (*goat* / chicken / wings / foal / feather) 20

In each pair of crossing words below, ONE letter is missing. Write the missing letter to make real words reading down and across. The first has been done for you.

- | | | | | | | | |
|------------------|-----|-----------------------|-----|------------------------|-----|------------------------|----------------|
| T
OP(E)N
A | 21. | T
G()ME
N
K | 22. | R
L()VE
A
D | 23. | L
O
O
()NOW | 21
22
23 |
| | | 24. | | S
V()SIT
N
G | 25. | S
O
B()ING
E | 24
25 |

In each row below put a line under TWO words, ONE in each set of brackets, which mean the opposite of each other. The first has been done for you.

- | | | |
|---------------------------------|----------------------------|----|
| (pretty / <u>good</u> / gentle) | (red / high / <u>bad</u>) | |
| 26. (hard / stone / light) | (sink / narrow / soft) | 26 |
| 27. (tall / deep / far) | (short / big / empty) | 27 |
| 28. (up / high / thick) | (broad / thin / top) | 28 |
| 29. (mend / stop / work) | (draw / break / drop) | 29 |
| 30. (ask / jerk / pull) | (throw / win / push) | 30 |

TOTAL 15

GO STRAIGHT ON TO THE NEXT PAGE

PAGE 3

In each row below put a line under TWO words, ONE in each set of brackets, which mean most nearly the same. The first has been done for you.

	(big / heavy / top)	(wide / tall / large)	
31.	(move / start / wind)	(stop / hurry / begin)	31
32.	(poor / joyful / healthy)	(clever / happy / generous)	32
33.	(love / like / need)	(want / ask / seek)	33
34.	(hope / idle / sleep)	(dream / lazy / tired)	34
35.	(ugly / beautiful / rich)	(lovely / tall / like)	35

In each of the rows below, put lines under Two words, ONE from each set of brackets, which will complete the sentence. The first has been done for you.

TWO is to FOUR as (one / five / nine) is to (six / eight / two)

36.	RING is to FINGER as (watch / circle / necklace) is to (leg / strap / wrist)	36
37.	MAN is to WOMAN as (husband / lady / boy) is to (daughter / aunt / girl)	37
38.	SAW is to CARPENTER as (axe / spade / pen) is to (clerk / painter / electrician)	38
39.	SUN is to MOON as (star / day / dark) is to (night / rain / wind)	39
40.	I is to ME as (you / she / he) is to (they / my / him)	40

In the space against each of the following words, write them as they would look if they were reflected in a mirror. The first has been done for you.

	PILL	(JJ19)	
41.	SEND	(.....)	41
42.	FORK	(.....)	42
43.	BAG	(.....)	43
44.	JUMP	(.....)	44

TOTAL 14

Four of the words in each line below have something in common, but two are different. Put a line under the TWO words that are different from the others. The first has been done for you.

Lagos / Enugu / Kano / Ibadan / Nigeria / London

- | | | |
|-----|---|----|
| 45. | <i>peaceful / rough / calm / still / tranquil / angry</i> | 45 |
| 46. | <i>ache / hard / pain / hurt / sore / sharp /</i> | 46 |
| 47. | <i>lake / river / mountain / pool / valley / sea</i> | 47 |
| 48. | <i>water / earth / oil / wine / tree / milk</i> | 48 |
| 49. | <i>John / Mustapha / Joseph / Ann / Frederick / Lucy</i> | 49 |

The numbers in the line below have been arranged in some order, but one of the numbers is missing. Find out what the order is and write in the missing number. The first has been done for you.

- | | | | | | | | | |
|-----|----|----|----|-------|----|----|-----|----|
| | 2 | 4 | 6 | (8) | 10 | 12 | 14 | |
| 50. | 3 | 7 | 11 | () | 19 | 23 | 27 | 50 |
| 51. | 2 | 4 | 8 | () | 32 | 64 | 128 | 51 |
| 52. | 27 | 24 | 21 | () | 15 | 12 | 9 | 52 |
| 53. | 1 | 6 | 11 | () | 21 | 26 | 31 | 53 |

In each of the rows below, put lines under three words, one from each set of brackets, which will complete the sentence. The first has been done for you.

GIVE is to (take / send) as (do / ask) is to (question / answer)

- | | | |
|-----|---|----|
| 54. | SHIRT is to (coat / man) as (blouse / cloth) is to (woman / boy) | 54 |
| 55. | EYE is to (head / see) as (ear / face) is to (hear / touch) | 55 |
| 56. | BITE is to (food / teeth) as (lick / hear) is to (nose / tongue) | 56 |
| 57. | PENCIL is to (write / paper) as (chalk / pencil) is to (paint / blackboard) | 57 |
| 58. | TON is to (lb. stone) as (mile / hour) is to (time / ft.) | 58 |

In the lines below the letters of the alphabet have been arranged in some order. Find out what the order is and then write the two letters that would come next in that order. The first one has been done for you and the alphabet is printed to help you.

A C E G I K M

(O) (Q)

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

- | | | |
|-----|-------------------------------------|----|
| 59. | B A D C F E H G J I.....() () | 59 |
| 60. | A B B C D D E F F G H.....() () | 60 |
| 61. | Z Y W V T S Q P.....() () | 61 |
| 62. | A C B D F E G I H J L K.....() () | 62 |
| 63. | A E B E C E D.....() () | 63 |

TOTAL 19

PAGE 5

In each of the lines below, the second word is made from the first, and the fourth from the third in the same way. Find how the second and fourth words are made in each line, and make the sixth word from the fifth in the same way.

	PAT	TAP	:	NIP	PIN	:	MAY.....(YAM)	
64.	TWO	TO	:	ACT	AT	:	ITS()	64
65.	THE	HE	:	TON	ON	:	CUP()	65
66.	RARE	ARE	:	SILL	ILL	:	WEAR.....()	66
67.	RIME	EMIR	:	PART	TRAP	:	LOOP()	67
68.	EAT	TEA	:	REEF	FREE	:	PILLS.....()	68

In the questions below, other letters have been put in place of the real letters of a word to make a code. Use the same code to find the second word in the question. The first has been done for you.

	If XYZ means FIT, what does YX mean? (IF)	
69.	If KLSSBDR means VILLAGE, what does SLKR mean? (.....)	69
70.	If BOUFMPQF means ANTELOPE, what does FMPQF mean?.....)	70
71.	If XZYAB means MONEY, what does XAY mean?	71
72.	If ATMNPCR means DECLINE, what does PCMNPCR mean?.....)	72

In the rows below, the words and numbers on the right go together in the same way as those on the left, but the middle word or number is missing. Write the ONE missing word or number in the space on the right. Each line is different. The first has been done for you.

	light; day; sun	:	dark; (night) moon	
73.	baby; man; boy	:	baby; (.....) girl	73
74.	2; 4; 6	:	5; (.....) 15	74
75.	bird; air; aeroplane	:	fish; (.....) boat	75
76.	8; 3; 5	:	4; (.....) 2	76
77.	spare; pare; are	:	beat (.....) at	77
78.	chair; wood; table	:	window (.....) mirror	78
79.	wire; electrician; electricity	:	pipe (.....) water	79
80.	Ibadan; town; Kano	:	spider (.....) ant	80

TOTAL 17

END OF TEST

Look over your work until time is up

APPENDIX VII

IBADAN ARITHMETIC TEST

APPENDIX VI1

50 Minutes

Primary 6

IBADAN ARITHMETIC TEST 1.

By

M. A. BRIMER, M.A.*Surname*.....*First Names*.....*School attended*.....*Age**years**months*. *Date of Birth*.....19....**Read these instructions carefully.**

1. There are five sections in this test and in each section there are sums and problems.
2. When you have finished one section go on to the next without waiting to be told.
3. No more than ten minutes will be allowed for each section and if you have not finished at the end of that time, you will be told to go on with the next section.
4. If you come to a question you cannot answer, even after trying very hard, leave it and go on with the next.
5. You must work carefully and more quickly than you usually do.
6. If you make a mistake, cross it out neatly and put the correct answer as close to it as possible.
7. Before you do the real test you will work a short practice test to show you how quickly you will need to work in the real test.

DO NOT TURN OVER THIS BOOKLET OR OPEN IT UNTIL YOU ARE TOLD

PRACTICE TEST**2 Minutes**

- 1.
- Add.*

$$\begin{array}{r} 322 \\ 415 \\ 144 \\ \hline \end{array}$$

_____ Ans.

- 2.
- Subtract.*

$$\begin{array}{r} \text{s.} \quad \text{d.} \\ 6 \quad 7 \\ 2 \quad 10 \\ \hline \end{array}$$

_____ Ans.

-
3. I cut a six-inch length from the end of a piece of string one yard long. How long is the piece of string now?

Ans.ft.in.

-
4. How many hours are there in one and a half days?

Ans.hr.

DO NOT TURN OVER UNTIL YOU ARE TOLD.

2

SECTION 1

1. *Add.*

$$\begin{array}{r} 149 \\ + 770 \\ \hline \end{array}$$

Ans. _____

2. *Subtract.*

$$\begin{array}{r} 358 \\ - 279 \\ \hline \end{array}$$

Ans. _____

3. *Multiply.*

$$\begin{array}{r} 386 \\ \times 57 \\ \hline \end{array}$$

Ans. _____

4. *Divide.*

$$48 \overline{) 1104} \quad \text{Ans.}$$

5. $\frac{1}{4} - \frac{1}{8} = \dots\dots\dots$

6. $0.0105 + 0.3068 = \dots\dots\dots$

7. If half of a number is thirteen, what is the number?

Ans.

8. By what number must I divide 69 to get a dividend of 23?

Ans.

9. What is the largest number which will divide exactly into 65 and 117?

Ans.

10. What is a third of half of eighteen?

Ans.

11. Thirty children seated in six rows in a classroom are numbered 1-30 along the rows, starting at the back. There is the same number of children in each row. What is the number of the third child from the end of the front row?

Ans.

GO STRAIGHT ON TO THE NEXT SECTION WITHOUT WAITING TO BE TOLD

SECTION 2

12. *Add.*

£	s	d
5	12	3
1	7	10
2	3	5

Ans. _____

13. *Subtract*

£	s	d
8	2	6½
3	5	10

Ans. _____

14. *Multiply.*

£	s	d
	3	6
		18

Ans. _____

15. *Divide.*

	£	s	d
15)	46	11	3

Ans.

16. $\frac{1}{8}$ of £1 =s....d

17. 0.75 of one shilling =d.

18. I buy a knife for 7/6 and sell it for 9/3. How much profit have I made?

Ans.sd.

19. If I sell six dozen oranges at two for a penny, how much shall I have altogether?

Ans.sd.

20. I go to market with 10/- and buy 3 yams at 6d. each, 4 scoops of rice at 4d. per scoop, $\frac{1}{2}$ lb. of meat at 2/3 per lb. and $\frac{1}{2}$ lb. of butter at 7/- per lb. How much money have I left?

Ans.s.d

21. After I had spent half of my money I spent another 2/6, and had a quarter of my money left. How much money did I have to start with?

Ans.

TURN OVER AND GO ON WITH THE NEXT SECTION WITHOUT WAITING TO BE TOLD

4

SECTION 3

22. *Add.*

yd.	ft.	in.
	2	8
	1	9

Ans. _____

23. *Subtract.*

Miles	yd.
1	60
	120

Ans. _____

24. *Multiply.*

yd.	ft.	in.
3	1	4
		6

Ans. _____

25. *Divide.*

Miles Furlongs

			Ans.
27	)	91	1

26. $\frac{1}{16}$ of one mile =yd.

27. 0.45 of 1 yd plus .05 yd =ft.

28. A six yard length of material is divided up into nine equal pieces. What is the length of each piece?

Ans.ft.

29. A man runs eight times around a 440 yd. track. How many miles has he run?

Ans.miles

30. Seven marks are made at equal distances apart along the whole length of the scale of a foot rule. How many inches along the rule will the third mark be?

Ans.inches

31. Two men start at the same time walking towards each other from places ten miles apart. One walks twice as fast as the other. When the faster walker has travelled two miles, how far are the two men apart?

Ans.miles

GO STRAIGHT ON WITH THE NEXT PAGE WITHOUT WAITING TO BE TOLD

SECTION 4

32. *Add.*

lb.	oz.
1	12
2	5
1	15

Ans. _____

33. *Subtract.*

St.	lb.
5	4
2	9

Ans. _____

34. *Multiply.*

Tons	cwt
2	6
	12

Ans. _____

35. *Divide.*

Tons.	cwt.	st.
16	21	4 0

Ans. _____

36. $\frac{1}{4}$ of one cwt. =lb.

37. 0.25 of 3 lb. =lb.....oz.

38. A lorry can carry up to five tons. It is loaded with sixty-five one hundredweight bags. How many more one cwt. bags can it carry?

Ans.

39. A passenger in an aeroplane has to pay £1 for every 2 lb. of luggage over 42 lb. If his luggage weighs 4st. 6lb. how much does he pay?

Ans. £.....

40. A weighing machine always shows 2 oz. in every pound more than the true weight. What would the machine show for a true weight of one stone?

Ans.....st...lb...oz.

41. The sum of two weights is five stones and their difference is two pounds. What is the larger weight?

Ans.st.lb.

TURN OVER AND GO ON WITH THE NEXT SECTION WITHOUT WAITING TO BE TOLD.

SECTION 5

42. *Add*

hr.	min.	sec.
4	35	20
1	46	50

Ans. _____

43. *Subtract.*

days	hr.
12	6
3	15

Ans. _____

44. 7 a.m. to 6 p.m. on the same day = hr.

45. In October there are days

46. At what number on the clock does the big hand point when the time is 7.45?

Ans.

47. A man spends $\frac{1}{4}$ of each week at work. He works seven hours on each working day. On how many days of the week does he work?

Ans. days

48. A clock loses 3 minutes in every hour. If it is correctly set at 8 a.m., what time will it show at 5 p.m. on the same day?

Ans. p.m.

49. If March ends on a Friday, on what day does it begin?

Ans.

50. A girl was born on the 30th of June, 1948. How old was she in years and completed months on September, 1st, 1957?

Ans. ..yr. ..months

END OF THE TEST

Look over your work until time is up.

	Scale Scores	Process Scores	T	W	L	M	N
Addition			42	32	22	12	1
Subtraction			43	33	23	13	2
Multiplication				34	24	14	3
Division				35	25	15	4
Fractions				36	26	16	5
Decimals				37	27	17	6
Mechanical Arith.	Total						
Mechanical Arith.	Sc. Sc.						
			44	38	28	18	7
			45	39	29	19	8
			46	40	30	20	9
			47	41	31	21	10
			48				11
			49				
			50				
	Total						
Problems	Sc. Sc.						
	TOTAL						
TEST	ST. SC.						

APPENDIX VIII

DESCRIPTION OF SCHWARZ'S USAID-AIR TESTS

DESCRIPTION OF SCHWARZ'S USAID-AIR TESTS*

Copies of Schwarz's tests are not available as they have not been copyrighted.

1. Similarities measures the general ability to learn. It involves "concept formation" in finding a relationship among five pictures, and thus approximates the general intelligence test. Items are presented in roughly ascending order of difficulty, beginning with simple concepts and building up to more subtle ones that only a small proportion of examinees can discover

.

2. Boxes is a new test of three-dimensional visualization. It was developed for use instead of the FATB or TALENT versions which require the examinee to interpret perspective drawings. Boxes replaces these drawings with wooden cubes that are given to the examinees, and that they can use as an aid while working the pencil-and-paper test problems.

.

4. Figures is a third perceptual test in the technical skills area, but is directed at the higher levels. It is based on the well-known "hidden figures" type of item that appears to be related to flexibility and ingenuity in problem-solving operations.

*Paul A. Schwarz, Aptitude Tests for Use in Developing Nations (Pittsburgh: American Institute for Research, 1961), pp. 22-23.

APPENDIX IX

QUESTIONNAIRE FORM

NUMBER _____

NAME _____
(Last name) (First)

AGE _____ YOUR FATHER'S OCCUPATION _____

NAME OF PRIMARY SCHOOL ATTENDED _____
_____NAME OF SECONDARY MODERN SCHOOL ATTENDED _____

DO YOU OWN A BICYCLE? YES _____ NO _____

DO YOU OWN A WRIST WATCH? YES _____ NO _____

DOES YOUR FATHER OWN A BICYCLE? YES _____ NO _____

DOES YOUR FATHER OWN A MOTORCYCLE? YES _____ NO _____

DOES YOUR FATHER OWN AN AUTOMOBILE? YES _____ NO _____

IS THERE ELECTRICITY IN THE VILLAGE OR TOWN WHERE YOU NOW
LIVE? YES _____ NO _____

HAVE YOU EVER USED ANY OF THE FOLLOWING:

HAMMER? YES _____ NO _____

SAW? YES _____ NO _____

SCREWDRIVER? YES _____ NO _____

SPANNER? YES _____ NO _____

BIBLIOGRAPHY

BIBLIOGRAPHY

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