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# MATHEMATICS TEACHING IN THE LYCÉES AND DMA'S OF AFGHANISTAN

62

## 1964

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AND

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OF AFGHANISTAN  
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Kabul, Afghanistan

February 1965

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To the secretarial staff of the Columbia University Team in the Institute of Education, with special credits to Mrs. Dorothy Cole for persevering through the typing of the manuscripts; to Mr. Robert Roll, Fulbright Teacher at Nadiria Lycee in Kabul, for assisting in the preparation of charts and appendices; and to the "soldiers in the line"-the mathematics teachers in the lycees and DMA's.

ERRATA

- page 5, line 10: ENTEP<sup>4</sup> Centers
- 8, line 14: necessary
- 16A, 1964 Graduates Total - 371
- 18, line 7: early
- 27, line 4 of entries: Khoshal Khan
- 40, line 23: Unfortunatly
- 50, line 17: Balkhi
- 54, line 22 of chart: Under "School Grade Completed"  
Completed"  
grade 9 - 1; total for  
grade 9 - 1.
- 64, line 24: cos x;  
line 27: of differential
- 66, last line: 1965
- 68, line 8: "plans."
- 70, line 12: densi-
- 71, line 15: "noteworthy"
- 91, line 12: week,
- 92, footnote number should be 55 re: 23 teach.55
- 94, line 2: Ministry of Education
- footnotes- should be 56 and 57 and footnote 57 is:  
"The Ministry Mathematics Curriculum  
Sub-Committee, in November 1964,  
recommended new curriculum and texts  
be implemented beginning with the 7th  
class (and at the 1st grade level in  
the elementary schools)."

## PROLOGUE

Men judge of everything without knowing anything. Rousseau

## PURPOSE

It was in consonance with the Education Ministry plans for upgrading the mathematics and science teaching in the lycees of Afghanistan that this study was initiated.

The primary aim of this work has been to obtain a detailed up-to-date picture of the mathematics teaching in the Lycees with a look at the Darul Mo' Allamein's of Afghanistan.<sup>1</sup> Secondly, some broader aspects of the lycee have been considered, especially as these pertain to, and affect the teaching of, mathematics.

General objectives were: to determine

- (1) the physical and academic conditions under which mathematics teachers (and teachers in general) must function in the existing lycees;
- (2) the availability and use of mathematics (and some science) texts, teaching materials, and visual aids in the schools;
- (3) the number, location, qualifications, and attitudes of the mathematics teachers in the lycees and DMA's;
- (4) the techniques currently employed in the classroom teaching of mathematics;
- (5) the present curriculum content with emphasis on the mathematics syllabus;
- (6) the appropriateness of the present mathematics curriculum offerings in the light of modern mathematical knowledge and present school mathematics curriculum trends;

---

1 - Primary Teacher Training Schools, hereafter referred to as DMA's.

- (7) the extent and adequacy of present provisions for preparation of lycee-DMA mathematics (and science) teachers;
- (8) subjective correlation of the findings of the survey with the educational goals outlined in the present Five-Year Plan.

With an evaluation of such information as might be obtained, it is then proposed to formulate such recommendations as appear to be necessary and desirable to bring to fruition the lycee educational goals of the Royal Government of Afghanistan as set forth by the Education Ministry.

#### PLANNING

Inquiry was made through the persons and resources of the Institute of Education, Kabul University, and the Office of the Ministry of Education to determine the number and location of lycees, the prescribed curriculum offerings, and the organization of the school year terms.

The Minister of Interior provided the necessary clearances with written authorizations where appropriate. The Chief, Columbia University Team in Afghanistan, made possible the time and travel allowances and gave impetus to the research efforts by his encouragement. The President of the Institute of Education, along with the Chairman, Science Department of the Faculty of Education, cooperated by making available the full-time services of Mr. Hussein Kayhan, who accompanied me in all travels and visits and who made a major contribution to the attainment of our goal.

A questionnaire was prepared, to be completed by teachers in the lycees who taught (at the time of visit) at least one mathematics class of grades 7-12 (see exhibit number 1). To attain a maximum response, it was decided to have the survey questionnaire completed and collected at the time of visit to the lycee. Each visit entailed not only completion of the mathematics teacher survey form but the following as well:

a meeting with all 7-12 grade mathematics teachers (and numerous science teachers as well), wherein a brief talk was given, through the translation of Mr. Kayhan, on the work of the current Education Ministry Mathematics-Science Curriculum Committee; visiting on-going mathematics classes; visiting laboratory and library facilities and checking on utilization of these facilities; gathering of pertinent data through discussion with school administrators and mathematics teachers and examination of school enrollment records and class schedules; and determination of textbook availability for mathematics teaching.

Current literature on the general subject of education in Afghanistan was surveyed and particular study was made of the following:

UNESCO: Report of the Mission to Afghanistan (Educ. Missions IV), C.J. Bucher Ltd., Lucerne, 1952.

Royal Afghan Ministry of Education: Education in Afghanistan (During the last Half-Century), Munchner Buchgewerbehauus, Germany, 1956.

Ministry of Planning, Department of Statistics and Research: Survey of Progress, 1961-62, Kabul, Afghanistan, March 1963.

Ministry of Planning: Second Five Year Plan, 1341-45 (March 1962-March 1967), Kabul, Afghanistan, 1342 (1963)

Ministry of Planning, Department of Statistics and Research: Survey of Progress, 1962-64, Kabul, Afghanistan, 1343 (1964).

Ministry of Education, Royal Afghan Dept. of Secondary Education: Syllabuses, Secondary Schools (Boys & Girls), 1956.

Sleight, G.F., et al: A Survey of Education Within the Framework of Social and Economic Development in Afghanistan, UNESCO Educational Planning Mission, February 1962.

It was decided to complete the study in the shortest time possible; therefore, the months March-June or September-December<sup>2</sup> became the most reasonable alternatives for the time of visits to schools. August 1964 was the time of decision; hence, the period September-December 1964 was chosen.

#### TRAVEL

During the period of the survey, September-December 1964, all of the existing lycees (30) were visited by Mr. Kayhan and the writer. Trips, specifically designed to carry forward the study, were made as follows:

<u>Places</u>	<u>Dates</u>	<u>Comments</u>
Kandahar, Bost	4-17 September	In conjunction with work in Kandahar
Kandahar, Herat, Shendand	10-15 October	
Laghman, Jalalabad, Khama	26-27 October	
Ghazni, Gardez, Khost	28-30 October	
Charikar, Pul-i-Khumri,	7-16 November	

---

2 - All schools are in session during these two three-month periods.

Baglan, Khanabad, Tal-o-qan,  
Faizabad, Kunduz, Mazar-i-Sharif,  
Shibargan, Maimana.

Kandahar, Girishk, Farah

7-14 December

In conjunction  
with work in  
Kandahar

Kabul schools were visited intermittently during the period  
September-December 1964.

The four DMA's were included in the visits and are reported upon  
in a section separate from the lycee findings. In addition, some  
fifteen middle schools were visited and surveyed and a number of  
technical and vocational schools,<sup>3</sup> along with numerous ENTEP<sup>4</sup>  
were included in the itinerary. These non-lycee schools, though not  
included in this study, serve as points of reference for comparison  
purposes. The Military Lycee, a function of the Ministry of Defense,  
though visited, is not included in these findings.

Travel was by air, motor, and foot. Excluding the numerous  
Kabul school visits, some 9,760 kilometers (6,090 miles) was logged,  
60% of which was by motor.

At one time or other Mr. Kayhan and the writer were accompanied  
by Dr's. LaBorde and Simpson and Messrs. Tabibi and Zahir, of the  
Institute of Education. In a number of instances provincial  
directors of education and their assistants aided our work by

---

3 - Including the Technicums at Khost and Kandahar, the Vocational  
Agriculture Schools at Kabul and Baglan, the Industrial School  
and the Sports School in Kabul, and the Cadastral Survey School  
and Air Authority School in Kandahar.

4 - Emergency National Teachers Education Program.

accompanying us to schools in their provinces. A motor chart, a by-product of our work, is included as an appendix.

## TERMINOLOGY

"Schools having the 10th, 11th, and 12th grades are called "lycees". In Afghanistan these schools include the primary and middle schools and, therefore, give instruction from the 1st to the 12th grade. The object of the lycees is to offer education up to the baccalaureate standard and to prepare students for University education."<sup>5</sup> This characterization of the Afghan Lycee, set forth by the Ministry of Education in 1956, must be modified slightly in view of the fact that, in the latter part of the year 1964, 21 lycees included all lower class grades, while 7 lycees did not enroll students in any lower class grades.

For the purposes of this study the following definitions are used:

1. Lycee: A Lycee of Afghanistan is a non-vocational, non-technical school, which includes grades 7-12, is terminal in liberal or general education, and which curriculum is university-preparatory in nature.
2. Upper Class Grades: Upper Class Grades are those grades from 10 to 12, inclusive.
3. Middle Class Grades: Middle Class Grades are those grades from 7 to 9, inclusive.
4. Lower Class Grades: Lower Class Grades are those grades from 1 to 6, inclusive.

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5 - Royal Afghan Ministry of Education: Education in Afghanistan (During the last Half-Century), Munchner Buchgewerbehau, Germany, 1956, page 21.

The 'lycee' definition is, of course, not absolute. With the evolving school system it is possible that the lycee may ultimately include grades 10-12 only. This development in grade structure may become not only necessary but desirable; necessary because of large enrollments in the upper class grades forcing the middle class grades out; desirable in the sense of segregating the older youth from the younger and requiring greater subject-matter specialization on the part of upper class grade teachers.

As for the "non-vocational, non-technical" requirement in the definition, this too may undergo some modifications. At the time of the study, one school (Lashkar Gah High School) included wood-working and rug-weaving in its curriculum; one school (Nangahar) served in the dual function of Lycee-DMA.

Neither the lyceum of Aristotle nor its European or Afghan offspring were designed to provide all things to all men. The lycee's mandate is to offer to the student a general program of studies in the tradition of the liberal arts, "the studies of free men." Within economic and other social demands, it is hoped that the liberal curriculum of the lycee will not be diluted. James B. Conant writes in 1959 in his study The American High School Today, "In European universities there is no equivalent of (the) undergraduate liberal arts college, no provision for general education. European universities are essentially a collection of faculties concerned with the education of future members of the learned professions. The general or liberal education of the doctor, lawyer, theologian, engineer, scientist, or professional scholar is provided

by special secondary schools, admission to which is determined by a highly selective procedure at age ten or eleven." The Afghan institution of higher learning, Kabul University, is patterned after the European system; the purpose of the Afghan lycee is the same as that of the European lycee or "special secondary schools". An understanding of these roles is a sine qua non for an appreciation of the lycee of Afghanistan.

By definition, such schools as the Sports School, Commercial School (boys), and Princess Bilkis School in Kabul do not qualify as lycees. The Ministry classified such schools as "vocational".

During the school visits it developed that the teachers often included such subjects as chemistry, physics, or geology as topics in "mathematics." At the same time, "geometry" was not considered "mathematics." A clarification obviously became necessary as to what was meant by the term "mathematics". It is mentioned here that the term mathematics includes such school studies as arithmetic, algebra, geometry, trigonometry, and calculus; it excludes the topics of geology, chemistry; or physics, which are usually referred to as physical sciences.

As to the confusion in this matter, even the syllabus of the Ministry of Education distinguishes between "mathematics" and "geometry" and "arithmetic." The distinction between "mathematics" and "geometry" may be due to past French influence in the Afghan Lycee, since there existed for many years in the French Academy separate sections of mathematics and geometry. The outstanding French Bourbaki of our day, however, seem to consider, in the

tradition of the Greeks, "arithmetic" and "geometry" to be two of the divisions of mathematics. The Greeks, of course, thought of mathematics as being in four divisions - arithmetic, geometry, music, and astronomy.

PART I

GENERAL LYCEE SURVEY

THE LYCEES

Beginnings

The first lycee in Afghanistan was established in 1903 during the reign of Emir Habibullah Khan. It was located in Kabul and was named Habibia. The original purpose of Habibia Lycee was for "training administrative personnel for the government". The school was staffed predominantly by Indian teachers, especially in science and English teaching.<sup>6</sup> Habibia graduated its first class in 1923 and, according to records of the Ministry of Education, claimed 466 graduates by 1955.<sup>7</sup>

In 1922, 1923, and 1928 Lycees Istiqlal, Nedjat, and Ghazi were established in Kabul. These three schools have strong French, German, and English orientations, respectively, and have received considerable assistance from the Governments of France, Germany, and Great Britain. Habibia Lycee today receives substantial assistance through the AID Program of the United States of America. During the "time of troubles" in Afghanistan, 1929-1931, along with all schools, these lycees were closed; further, the General War of 1939-1945 adversely affected their operations due to the departure of many of the foreign teachers working in the lycees.

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6 - ibid, page 7

7 - " page 7

### Present Lycees

For the period covered by this inquiry, there existed 30 schools which qualify, under the definition cited herein, as lycees. As mentioned earlier, the Military Lycee is not included in the study. Of the 29 lycees to which this study is addressed, the following-listed schools had 10th grade classes for the first time in 1964:

<u>Lycee</u>	<u>Location</u>
Aiashah Durrañi(Girls)	Kabul
Nadiria	Kabul
Murad Ali	Khama (Nangahar)
Khost	Khost (Paktia)
Abu Obaid J'uz Jahni	Maimana (Fahriab)

One school, Jami in Herat, will have its first 10th grade class in March 1965, and is included in this report.

Seven of the twenty-nine lycees are girls schools. The first girls school was established in Kabul in 1921, being staffed primarily by French school teachers. With the advent of the "time of troubles" and the War of 1939-1945, this school, which grew into the present-day Malalai, was unable to produce any graduates of the upper class grades until 1954-1955.<sup>8</sup>

The location and names of the 29 lycees, as of December 1964 (including Jami in Herat), is represented by chart number 1. Examination of the chart reveals concentration of lycees (by province) as follows:

---

8 - ibid, page 47



<u>Province</u>	<u>Number</u>	<u>Boys</u>	<u>Girls</u>
Balkh	2	1	1
Farah	1	1	
Fahriab	1	1	
Ghazni	1	1	
Helmand	1	1	
Herat	3	2	1
Kandahar	3	2	1
Kabul	11	7	4
Laghman	1	1	
Nangahar	2	2	
Paktia	1	1	
Parwan	1	1	
Tal-o-qan	1	1	
	<u>29</u>	<u>22</u>	<u>7</u>

One lycee, Lashkar Gah High School in Bost (Helmand Province), had some 8-10 girls enrolled. On this basis, the administration thereat referred to the school as 'co-educational'. In this study, however, the school is being treated as a boys lycee.

The Second Five Year Plan (beginning 21 March 1962) called for the establishment of 5 new lycees with "completion and expansion of the buildings" of 13 lycees.<sup>9</sup> As of December 1964, all five had been established (the schools listed as having 10th grade classes for the first time in 1964) and plans were going ahead for the establishment of a sixth lycee in 1965 (Jani). At numerous lycees visited construction work was observed:

<u>Location</u>	<u>Work</u>
Maimana - Abou Obaid J'uz Jahni Lycee	New lycee under construction
Kabul - Nadiria Lycee	" " " "
Istiqlal Lycee	Physical Science Laboratory installations underway
Bost - Lashkar Gah High School	New lycee nearly completed; already occupied

Ghazni - Sana'i Lycee

Materials on hand for expansion

Kandahar - Mir Wais Baba Lycee

New building under construction to provide additional classroom space

In addition, plans are proceeding for a new "Ahmad Shah Lycee" in Kandahar as well as provision for new classrooms which will free existing laboratory installations in the very new, modern Habibia Lycee in Kabul. It might be noted that the Second Five Year Plan also sets the establishment of 70 secondary schools as its aim; this goal of 70 newly established secondary schools is called one "of the more important targets of the educational programme." <sup>10</sup>

Everywhere we travelled, the provincial directors of education indicated a clamor by the people for more lycees. Such regions as those around Kunduz, Pul-i-Khumri, Shibargan, Gardez, and Faizabad appear to be the hardest pressed. Recommendations for such schools go beyond the intent of this work, and must be thought out by the political as well as social and educational leaders of the Kingdom. It is a simple matter to want a lycee; it is another to obtain qualified teachers, housing, finances, etc.

### Enrollment

Examination of chart number 2 shows a total of 5,388 upper class and 13,458 middle class matriculants. Of the grades 10-12 total, less than 20% are girls; the girls constitute about 20%

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10 - Ministry of Planning: Second Five Year Plan, 1341-45 (March 1962-March 1967), Kabul, Afghanistan, 1342 (1963).

of the middle class enrollment. The Second Five Year Plan includes an expected increase of enrollment - -

in primary schools:	213,000 to 287,000
in secondary schools:	13,000 to 31,000

According to the UNESCO findings in 1964, this estimate for the primary schools has already been exceeded three years ahead of schedule. Such anticipated expansion in enrollments in the lower and middle class grades is the 'handwriting on the wall' for the upper class grade schools. As a matter of fact, according to the Survey of Progress, 1962-64, which covers the first two years of the Second Five Year Plan, during 1342 (1963), 17 middle schools (including 3 girls schools) were established. This brought the number of middle schools to 101, with an enrollment in excess of 17,000.<sup>11</sup> This more-than-planned-for rapid increase in middle class grades will further add to the pressure on the lycee upper class grades within four years.

Chart number 2 also reflects the following information which should be helpful in planning curriculum revisions, textbook publications, and teacher training programs:

Winter Vacationing Schools (December-March)	- 18
Summer Vacationing Schools (June-September)	- 11
Darri Teaching Schools *	- 18
Pashto Teaching Schools	- 11
Boarding Schools **	- 2

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11 - op cit, page 68

MISCELLANEOUS STATISTICAL DATA FOR LYCEES (Kabul)

SEPTEMBER - DECEMBER 1964

PROVINCE	NAME OF LYCEE	ENROLLMENT		GRADES IN LYCEE	1964 GRAD- UATES	VACATION PERIOD	TEACHING LANGUAGE	AFFILIATION
		7-9	10-12					
KABUL	AIASHAH DURRANI *** (Girls)	1081	77	1 - 10	-	winter	Darri	
	GH. ZI	1551	503	7 - 12	108	winter	Darri	British Aid
	HABIBIA *	1218	924	4 - 12	266	winter	Darri	U.S. Aid
	ISTEQLAL	541	133	1 - 12	34	winter	Darri	French Aid
	KHOSHAL KHAN **	273	103	1 - 12	16	winter	Pashto	
	MALALAI (Girls)	400	129	1 - 12	29	winter	Darri	French Aid
	NADIRIA ***	1387	257	7 - 10	-	winter	Darri	
	NEDJAT	536	181	1 - 12	46	winter	Darri	German Aid
	RABIA BALKHI (Girls)	792	347	1 - 12	77	winter	Darri	
	RAHMAN BABA **	550	234	1 - 12	33	winter	Pashto	
ZARGHONA (Girls)	549	417	7 - 12	150	winter	Darri		
		8878	3305		759			

\* At present phasing out the elementary classes one year at a time.

\*\* Boarding school.

\*\*\* First year lycee (10th class only).

CHART NUMBER 2  
(Sheet 1 of 2 sheets)

MISCELLANEOUS STATISTICAL DATA FOR LYCEES (Provinces)

SEPTEMBER - DECEMBER 1964

PROVINCE	NAME OF LYCEE	ENROLLMENT		GRADES	1964 GRAD* UATES	VACATION	TEACHING LANGUAGE	AFFILIATION
		7-9	10-12					
BALKH	Bakhtar **	417	99	1 - 12	24	summer	Darri	ENTEP
	Sultana Rezhiā (Girls)	237	42	1 - 12	-	"	"	
FARAH	Abu Naser Faraihi	135	54	1 - 12	14	"	Pashto	ENTEP
FAHRIAB	Abu Obaid J'uz Jahni *	285	32	1 - 10	-	winter	Darri	ENTEP
GHAZNI	Sana'i	204	150	1 - 12	36	"	"	ENTEP
HELMAND	Lashkar Gah High School	155	66	7 - 12	13	summer	Pashto	ENTEP
HERAT	Jami ***	248		1 - 9		winter	Darri	
	Meri (Girls)	327	80	1 - 12	12	"	"	
	Sultan Ghias-ud-din Ghori	333	223	1 - 12	75	"	"	
KANDAHAR	Ahmad Shah Baba	377	168	7 - 12	47	summer	Pashto	U.S. Aid
	Mir Wais Baba	259	100	7 - 12	18	"	"	
	Zarghona Ana (Girls) **	174	61	1 - 12	-	"	"	
TAL-O-QAN	Khanabad	233	137	1 - 12	28	winter	Darri	
LAGHMAN	Roshan	381	108	1 - 12	24	summer	Pashto	ENTEP
NANGAHAR	Murad Ali-Khama *	189	63	1 - 10	-	"	"	ENTEP
	Nangahar	639	325	7 - 12	44	"	"	ENTEP & DMA
PAKTIA	Khost *	196	21	1 - 10	-	"	"	ENTEP
PARWAN	Naimon	223	148	1 - 12	36	winter	Darri	ENTEP
		<del>5011</del> 4586	<del>1877</del> 2083		371			

\* First year lycee      \*\* Graduates first class in June 1965      \*\*\* 1st 10th class March 1965

\* Though some efforts are made in several of the foreign-aided schools to teach in the associated foreign tongue at the upper class grade levels, for the most part the teaching is in Dari in these schools.

\*\* Ten lycees have ENTEP centers which usually require boarding facilities for the ENTEP participants and one lycee (Nangahar in Jalalabad) has, in addition, a regular DMA therein; such schools do not provide boarding facilities, as a general rule, for the lycee students and are not considered 'boarding schools' in this work.

### School Program

According to the Ministry's Education in Afghanistan,<sup>12</sup> the school day goes from about 8:00 AM to 1:30 PM during warm weather months and from about 8:30 AM to 1:30 PM during cold weather periods.<sup>13</sup> In Winter Vacationing areas the academic year, according to Education in Afghanistan, is from 22nd March (1 Hamel) to the 8th of December (15 Quas); Summer Vacationing schools are in session from the 9th of September (c. 18 Sombula) to the 5th of June (c. 14 Jowza). Class periods are of 45-minute scheduled duration during warmer times and 40 minutes for colder periods. Normally, there are six instruction periods per school day, with school in session six days per week (Thursday at about noon, classes terminate for the Afghan weekend). Some lycees are required, because of overpopulation, to run double sessions; usually the lower or middle classes meet in the afternoon when this becomes necessary. On the basis of the 8½ month

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12 - op cit, page 65

13 - The boarding school day covers about 7 hours.

academic year, deducting one-sixth of the days (Fridays), we have something just over 210 school days; with some sixteen to twenty-two authorized government holidays,<sup>14</sup> the number of sessions is in the territory of 195. A late, severe winter or such other unforeseen circumstance may tend to postpone the school opening dates.<sup>15</sup> Some winter vacationing schools, on the other hand, begin sessions in early March, weather permitting. According to the UNESCO Report of the Mission to Afghanistan, "one year only yielded 172 school days."<sup>16</sup> Any curriculum projection must be made in light of such facts as these.

#### Attendance

The school day begins usually with an outdoor formation by class. One teacher is assigned to a section of each class and is responsible for morning attendance. It appears, however, that more often than not an outstanding student actually meets the class formation and takes the attendance. The Ministry prescribes that attendance also be taken at the last daily class period by the instructor in charge of the last period instruction; most often, this is not done. The record of attendance is kept in an official attendance book maintained by the clerks.

---

14 - Jeshyn - 3 days; Aled - two 3-day periods; New Year's; First of Ramazan; Pushtunistan Day; Independence Day; King's Birthday; Parliament Day; Teachers Day.

15 - School openings in Kabul were delayed about two weeks in the Spring of 1964; there was also a ten day 'hot weather' vacation period declared for the Kabul City Schools, 15-25 July 1964.

16 - UNESCO: Report of the Mission to Afghanistan (Educ. Missions IV), C.J. Bucher, Ltd., Lucerne, 1952.

## Examinations

Examinations are administered at the end of the first 3 months and at the 6-month point; these examinations may be either oral or written -- in a number of schools surveyed, if the teachers and administrators decide on an oral examination at the three-month's mark, then the 6-month test must be written, and vice versa. These examinations are timed for two consecutive class periods and are given over a period of six consecutive school days.

In addition to the three-and six-month tests, annual examinations are administered during the last two to three weeks of the school year. The annual examination is part oral and part written, each of 50% weight in scoring. Each subject is allotted  $2\frac{1}{2}$  hours for the written test. No specific time limit is set for the orals; the time per student for the oral test varies inversely as the number of students in the class.

In general, examinations are teacher-made. For each subject taught, a number of questions, usually eight to twenty, are submitted by the teacher to the principal; the principal then selects five of the questions and does not indicate which five until the day of the test. Of the five, one is designated as compulsory and the student then has a choice of any two of the remaining four. Exhibits number 2 and 3 are copies of two three-month mathematics examinations which were administered in December 1964.

In the case of the 9th class, annual examination questions are submitted to the respective Provincial Director of Education for



10th Class, Section A

Algebra Questions

Three Month Examination

1. I am thinking of a number. If you double the number, then triple the number, take the sum of the doubled and tripled number and multiply by four, then the result is 52. Find the number. (one unknown)
2. The price of a horse and a wheel is 3,800 afs.  $\frac{5}{6}$  of the wheel price and  $\frac{3}{8}$  of the horse price is 2,800 afs. What is the price of each? (two unknowns)
3. The age of B is four times the age of A. Six years ago the age of B was ten times the age of A. What are their ages? (one unknown)
4. The sum of the digits of a three-digit number is 9. The first digit is twice the third digit. If we add the sum of the digits to 198 we obtain a number with the same digits but in reverse order. What is the original number? (one unknown)
5. Solve the following equations:  
$$5(x + 2y) - (3x + 11y) = 14$$
$$7x - 9y - 3(x - 4) = 38$$
6. Solve the following equations:  
$$\frac{15}{x} - \frac{1}{y} = \frac{9}{2}$$
$$\frac{9}{x} + \frac{2}{y} = 4$$
7. The difference of two numbers is equal to  $\frac{5}{6}$  of the sum of the two numbers. If 15 times the smaller number is subtracted from the larger the remainder is 3. Find the numbers. (two unknowns)
8. A man has some eggs. If he sells one egg for one ana he will lose 6 anas, and if he sells one egg for one ana and six payes he will make 4 anas. Find out the number of eggs and the purchase price.
9. Factor the following three-digit expressions:  
a)  $x^4 - 25x^2 + 136$ ; b)  $a^2 - a - 6$ ; c)  $-x^2 + 6xy - 9ly^2$
10. Factor:  
a)  $mx - ma + nx - na$ ; b)  $2ax^2 - 3axy - 2bxy - 3by^2$

[ Note of Principal ]: These items are fit for the program of 10th grade algebra. Items 2, 3, 6, 8, and 10 are chosen and item 8 is compulsory.

EXHIBIT NUMBER 3

approval;<sup>17</sup> 12th class questions must be approved by the Office of the President of Secondary Education, Ministry of Education, Kabul.

There is some attempt, in the teaching of English, and through the efforts of the English Language Institute of the Institute of Education, to make standardized tests.

### Grading

Thirty-five per cent is the grade required for passing a given course. Mathematics teachers and some administrators reported that most often other evidence such as quizzes, classwork, and limited homework, along with the examination grades, is considered in awarding report card marks. Report card grades are awarded on a scale of one to ten, lowest to highest, and are issued following each examination period. Signature of parent and return of the card to the school is required. A sample report card is illustrated by exhibit number 4.

### Admission and Dismissal

Students are admitted to the lycee middle class grades generally on the basis of their academic performance in the lower class grades. The ages of the 7th graders have been, on the average, higher than in most developed countries; however, there is a clear trend toward a seventh grade average age of 12 to 14, which will likely be attained within the next few years.

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17 - In Kabul, questions are submitted to the President of Secondary Education of the Ministry.

As for academic dismissal, policy varies by school. The two most common reports received are:

- (1) If a student fails a given subject for the year, he may take a make-up examination at the outset of the following school year; failure on the make-up test means that he must repeat the grade, including those subjects which he had passed. Another failure in the same subject the next year results in dismissal.
- (2) Failure of one grade subject and of the make-up examination may lead to an appeal by the student to a committee of teachers, who may waive the failure and permit him to continue.

From reports of teachers and administrators, it appears that every possible means is employed to pass the student on the make-up examination.

In all events, though 35% is passing for any given subject, the student must show a 50% average in all subjects for the year in order to be in good standing. Failure to gain the 50% overall average causes a repeat of the entire year's work. If the 50% average is not gained for the next year's work, the student is dismissed.

Evidence, gained through discussion with principals and headmasters, indicates that academic dismissals are not very common.

This is in contrast with the declaration in the publication of the Ministry in 1956, Education in Afghanistan: "The passing marks established for the lycees are not easy to achieve and many of those who join the 10th grade do not win passing marks and the baccalaureate certificate." <sup>18</sup>

Chart number 3 represents the average yearly grades

(1964) of all students for seven subjects in three provincial lycees.

designated x, y, z, one girls and two boys. Taking an composite

average for each subject, we arrive at the following means:

	Grade		
Subject	10	11	12
Geometry	7.0	7.1	7.6
Algebra	6.9	6.0	
English	6.8	6.5	7.3
Physics	6.7	7.1	6.9
Biology	6.9	6.7	7.2
Chemistry	6.1	6.0	6.9
Persian	7.2	7.5	7.7

Chart number 4 shows the corresponding yearly averages for the three "best" students in lycees x, y, and z. On the other hand, the Kabul lycees appear to have a considerably higher academic failure rate than in the provinces. Of course, the Kabul schools are heavily populated and can afford this luxury.

Subjective data, obtained firsthand at the schools, along with some objective data shown in chart number 5, shows that there is a substantial dropout rate both in the middle and upper classes. It appears, however, that most of the dropouts are motivated by the desire of students to go to work rather than being the result of academic dismissals. In the case of girls, the main reason for dropouts appears to be marriage. The data on dropouts does not include eight lycees which have not been full lycees long enough to have such information. Further, the statistics were compiled

GRADE AVERAGES FOR 3 PROVINCIAL LYCEES, GRADES 10-12

for period ending June, 1964

SCHOOL	GEOMETRY			ALGEBRA			ENGLISH			PHYSICS			BIOLOGY			CHEMISTRY			PERSIAN		
	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12
X	7	7	7.6	7.3	6.4	6.8	6.3	6.1	7	6	6.4	7.1	7.3	5.7	7.3	6	5.6	7.3	6.5	6.4	7.7

SCHOOL	GEOMETRY			ALGEBRA			ENGLISH			PHYSICS			BIOLOGY			CHEMISTRY			PERSIAN		
	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12
Y	7.6	6.9	7.7	6.7	6.4	7.6	7	6.4	7.6	6.9	7.3	6.6	5.9	6.3	7	5.5	6	6.5	5.8	6.8	7.6

SCHOOL	GEOMETRY			ALGEBRA			ENGLISH			PHYSICS			BIOLOGY			CHEMISTRY			PERSIAN		
	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12
Z	6.7	7.4	.	6.7	5.2	.	7.2	6.9	.	7.3	7.6	.	7.6	8.2	.	6.7	6.3	.	9.4	9.3	.

Note: School Z graduates its first 12th class in 1965.

CHART NUMBER 3

GRADE AVERAGES FOR 3 PROVINCIAL LYCEES, GRADES 10-12

FOR PERIOD ENDING JUNE, 1964  
TOP 3 STUDENTS PER CLASS

SCHOOL	GEOMETRY			ALGEBRA			CALCULUS			ENGLISH			PHYSICS			BIOLOGY			CHEMISTRY			PERSIAN			TRIGONOM.	
X	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	11	12
	10	10	10	10	10	.	.	.	10	9½	10	9½	8½	10	10	10	10	10	10	10	10	9	10	10	9	10
	10	9	10	9¼	9	.	.	.	10	8¾	9½	9½	8	9½	10	9¾	10	10	9½	9½	10	9	9½	10	8	10
	9¾	9	10	9	9	.	.	.	10	8½	9	9½	8	9	9½	9¾	9	9½	9	9	10	9	9	10	8	10

SCHOOL	GEOMETRY			ALGEBRA			CALCULUS			ENGLISH			PHYSICS			BIOLOGY			CHEMISTRY			PERSIAN			TRIGONOM.	
Y	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	11	12
	10	10	10	10	10	.	.	.	10	10	10	10	10	10	9½	10	10	9½	10	10	8½	10	10	9½	10	9¾
	10	10	9½	9½	9½	.	.	.	9	8½	10	10	9	10	9½	9	10	9	8½	10	9½	8½	10	10	9½	10
	9	9½	9½	8	9½	.	.	.	8	9	8	8½	9	9½	8½	9½	9½	8	10	9½	9	8	9	9½	8¾	

SCHOOL	GEOMETRY			ALGEBRA			CALCULUS			ENGLISH			PHYSICS			BIOLOGY			CHEMISTRY			PERSIAN			TRIGONOM.	
Z	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	10	11	12	11	12
	10	10	.	10	9	.	.	.	.	10	9½	.	10	10	.	10	10	.	10	10	.	10	10	.	.	.
	10	10	.	9½	7	.	.	.	.	10	9½	.	10	10	.	10	10	.	10	10	.	10	10	.	.	.
	10	10	.	9	7	.	.	.	.	10	9	.	9½	10	.	10	10	.	9	10	.	10	10	.	.	.

CHART NUMBER 4

RATE OF DROPOUTS IN THE LYCEES OF AFGHANISTAN

Grades 7 - 12, December, 1964

NAME OF LYCEE	ENTERED GRADES		GRADUATE or PROBABLE GRADUATE	DROPOUTS BETWEEN GRADES		APPROXIMATE DROPOUT RATE, GRADES	
	7	10		7 - 9	10 - 12	7 - 9	10 - 12
Ghazi	554	121	108	433	13	78%	11%
Habibia	557	367	266	190	101	34%	27%
Istiqlal	270	80	34	190	46	70%	57%
Khosha Jhan	53	25	16	28	9	53%	36%
Malalai (G)	125	46	29	79	17	63%	37%
Nedjat	172	68	46	104	22	60%	32%
Rabia Balkhi (G)	141	88	77	53	11	38%	13%
Rahman Baba	52	38	33	14	5	27%	14%
Zarghona (G)	315	153	150	162	3	51%	2%
Abu Naser Faraihi	28	21	14	7	7	25%	33%
Ahmad Shah Baba	127	64	47	63	17	49%	27%
Bakhtar	109	39	24	70	15	64%	38%
Khanabad	101	29	28	72	1	72%	3%
Meri (G)	47	19	12	28	7	59%	37%
Mir Wais Baba	59	22	18	37	4	63%	18%
Naimon	105	48	36	57	12	54%	25%
Nangahar	146	61	44	85	17	58%	28%
Roshan	87	46	24	41	22	47%	48%
Sanai	83	42	36	41	6	49%	14%
Sultan Ghias-ud-din Gh.	125	61	75	64	-14	51%	-
Zarghona Ana (G)	29	23	24	6	-1	21%	-

Dropout Rate =  $\frac{\text{number of withdrawals/dismissals}}{\text{original class enrollment}}$

CHART NUMBER 5

by taking the enrollments of the beginning 7th classes of 1958, which then became the beginning 10th classes of 1961, and subsequently the graduating classes of 1964. Clearly there are inherent defects in such a set of data; however, it is assumed this compilation is reasonably representative of the dropouts in the lycees.

### Personnel

The usual lycee staff consists of a principal, headmaster, clerks, <sup>19</sup> storekeepers (tahwildars), janitors (shaperasis), and classroom teachers. Among this group of type-personnel, it appears that the tahwildar occupies the key position in the structure. Suffice it to quote from the UNESCO Report of the Mission to Afghanistan: "all teaching aids are kept in padlocked cupboards. The keys are held by the tahwildars (official storekeepers) whose frequent absence from the premises stifles any inclination to make use of these aids." <sup>20</sup> The headmaster is the chief aide to the principal, who is chief school administrator. In one instance, Naimon Lycee in Charikar, the Provincial Director of Education also served as Principal of the Lycee. The normal prescribed teaching load is 24-26 hours per week. A regularly assigned teacher is not expected to teach more than 26 hours per week in his assigned job; hours worked over and above this number are subject to extra compensation.

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19 - The 1952 UNESCO Report uses the term 'secretaries;' it is presumed the intent was 'clerks', op cit, page 57.

20 - op cit, page 31

Teachers Salary Schedule

The scale of salaries for all government employees (includes teachers) holding "official rank" is listed below:

1st Rank	Afs	5700	per	month
2nd "		4800	"	"
3rd "		3900	"	"
4th "		2700	"	"
5th "		2400	"	"
6th "		2100	"	"
7th "		1800	"	"
8th "		1500	"	"
9th "		1350	"	"
10th "		1200	"	"
11th "		1050	"	"
12th "		960	"	"
13th "		900	"	"

For teachers holding official rank, the following additional monthly increments also apply:

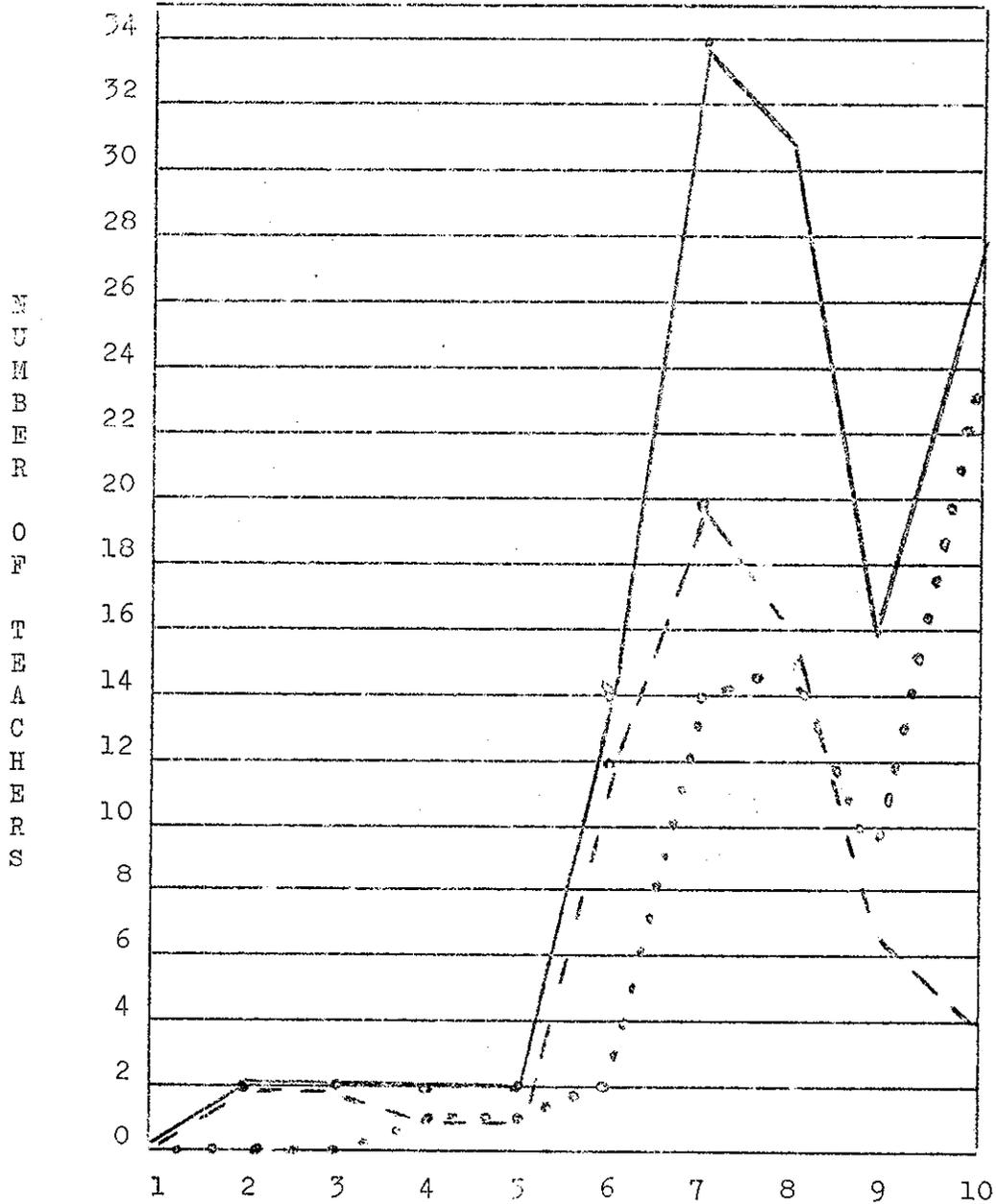
Doctor's Degree Holder	Afs	400
Master's " "		300
Bachelor's " "		200
12th Grade Graduate		100
9th Grade Graduate		50

For overtime work (over 26 hours) a special hourly rate is applied, currently 18 afs/hour for upper class teachers and 15 afs/hour for middle class teachers.

In the survey of the 141 lycee mathematics teachers (grades 7-12), 7 listed themselves as students teaching part time and 3 did not report; thus, 131 out of 141 held official rank. The distribution of the 131 official rank holders is shown in chart number 6.

In general, 9th grade graduates begin at the 11th rank, 12th grade graduates at the 10th, and faculty graduates at the 9th. Promotions are usually based on longevity. Examples:

DISTRIBUTION BY OFFICIAL RANK  
 OF LYCEE MATHEMATICS TEACHERS  
 (grades 7 ~ 12) December, 1964



Provinces... \* \* \* \* \* OFFICIAL RANK  
 Kabul..... - - - - -  
 Total..... = = = = =

CHART NUMBER 6

A 12th grade graduate starts teaching at rank 10; in two years he is ready for the 9th rank; in two more years, for the 8th rank; in three more years, for the 7th rank.

A faculty graduate starts teaching at rank 9; in one year he is advanced to the 8th rank; in two more years he gains the 7th rank.

Examination of Chart Number 6 shows that the median official rank of Afghanistan's lycee 7-12 grade mathematics teachers is rank 8, with a monthly salary of afs 1500. The salary range goes from afs 1200 to afs 4800 per month. This compares, on the surface, favorably with the statement in The Report of the Mission to Afghanistan, that in 1949 "many of the teachers in the provincial schools receive not more than 200 afghanis a month," and "teaching salaries vary between 150 and 712 afghanis per month, the higher figure being the salary of a university professor." The Report for 1949 also mentions:

Although staff salaries have tripled since 1938, they are, comparatively speaking, still very low.

A comparative study of prices in 1938 and 1949 shows that the cost of living in Kabul, for example, has risen by about 500 per cent.

It seems clear from our study that in 1938 a family of four could live reasonably well on 300 afghanis per month. At present (1949) the same family would need about 1,600 afghanis per month.<sup>21</sup>

Add the following: The official rate of exchange in August 1949 was \$1 = 28 afghanis.

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21 - op cit, pages 12, 67, 68

Assuming that the lycee middle and upper class mathematics teachers represent a valid sample of all lycee middle and upper class teachers, the financial plight of the middle and upper class lycee teachers is obvious and warrants no further comment.

As mentioned above, there exists a "Contractor (non-official) Rank", and a few teachers work on this basis. The salary schedule for this category is given below as a matter of information:

1st Class Contractor	Afs	4050	per month
2nd	"	3450	" "
3rd	"	2850	" "
4th	"	2550	" "
5th	"	1950	" "
6th	"	1650	" "
7th	"	1350	" "
8th	"	1050	" "
9th	"	870	" "
10th	"	780	" "
11th	"	690	" "
12th	"	660	" "
13th	"	630	" "
14th	"	600	" "
15th	"	570	" "
16th	"	540	" "
17th	"	510	" "

#### Physical Plant

The plant facilities for the lycees vary from a modern building (such as Habibia Lycee in Kabul) with library, laboratory, lavatory, and lighting, to a fairly primitive structure (such as Murad Ali Lycee in Khama) of mud walls, dirt floors, windowless, and with none of the aforementioned conveniences and facilities. But these two descriptions are not representative. The typical lycee building is of simple brick and mortar construction with no central heating,

and in fact no heating other than possibly a stove in some of the offices; no lighting; usually outdoor lavatories; with limited laboratory facilities lacking plumbing; and equipped with a telephone.

### Classrooms

Lycee classrooms vary in about the same ratio as do the lycees. The usual student accommodation consists of a table (desk) about 1 meter by  $\frac{1}{2}$  meter with a storage shelf under the desk top and an accompanying bench. This arrangement is designed for two students; it is not uncommon to find three students per desk. The benches and desks are of inferior construction (wood) and appear to be easily broken. Classroom visibility is often very poor, the floors are sometimes damp, and the rooms are usually drafty in cool weather and sultry in warm. Some schools are more fortunate, with modern classrooms and comfortable desk-seats constructed for maximum utility; a school such as Murad Ali is not so fortunate, with students being required to sit on straw on the ground. Other than the need for textbooks, especially in mathematics for grades nine through twelve, the next greatest need in the classroom is for adequate chalkboards. The usual chalkboard is about  $1\frac{1}{2}$  meters by 1 meter, and of roughly painted wood. Even such a new school (opened Spring 1964) as Habibia Lycee in Kabul was completed without installed, adequate blackboards. A few lycees (such as Ahmad Shah Baba in Kandahar, Nadiria in Kabul, and Sultan Ghias-ud-din Ghorri in Herat) have made chalkboards by improved concreting on sections of the walls and then painting black.

Some effort is being made, through the Institute of Education Audio-Visual Specialists, to manufacture locally a suitable blackboard for use in the schools.

The so-called Sleight Report of February 1962 earlier recognized the general need for adequate chalkboards with its statement: "Blackboards are quite inadequate in size and surface."<sup>22</sup>

Each class, or class section, is assigned a particular classroom and receives all instruction (except possibly in laboratory) in the designated room. Subject teachers report to the various classrooms for assigned periods of instruction.

#### Class Size

As one visits the classes in the lycees, he observes a tapering off in numbers of students from grades 7 to 12. In the middle class grades, it is not uncommon to find 50 to 60 students in a given classroom. In the upper class sections the usual class size for Kabul lycees was 40 to 50, with slightly fewer in the 12th class sections. In the provinces size varied from about 15 to 45 in the upper class sections. The girls lycees usually had very much smaller classes and fewer class sections in the upper grades. Continued enrollment hikes in the primary and middle schools will, as has been mentioned, put greater pressure on the upper classes.

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<sup>22</sup> Sleight, G.F., et al: A Survey of Education Within the Framework of Social and Economic Development in Afghanistan, UNESCO Educational Planning Mission, February 1962, page 33.

According to the Survey of Progress, 1962-64, while the number of teachers (in all schools) rose from 6,011 in 1341 (1962) to 6,643 in 1342 (1963), the average number of students per teacher rose from 44 to 46.<sup>23</sup> This statistic for all schools is reasonably representative of the lycee middle class grades; somewhat high at the present time for the provincial lycee upper class grades. As indicated above, the Kabul lycee upper class sections are more densely populated than those in the provinces.

### Libraries

Some schools have rooms designated as libraries. In a very few, notably Malalai Lycee in Kabul, the library seemed to be well-organized and even occasionally used; at least it has been open on the occasions of several visits to that school. However, where there do exist libraries, the main stock consists of old periodicals (such as Time, Life); even these show little or no use, as might be expected since most of the publications are in English. In general, the role of the school library in gaining a liberal education appears not to be understood or appreciated. No mathematics references were available in the many libraries visited.

### Science Laboratories

Specifically at the request of the Science Specialists and Members

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23 - op cit, pages 150-151.

of the Institute of Education, science laboratories were checked in most lycees. In some instances<sup>24</sup> there simply were no rooms designated as laboratories. In most schools, however, there was a room set aside as a laboratory or possibly several rooms were serving as laboratories for the several school sciences. One of the most distressing aspects of the lycee visits was the revelation that - where there were laboratory facilities and equipment, by admission of the administrators and science teachers, the laboratories were not being used. This observation is not consistent with the statement in the Ministry publication Education in Afghanistan: "Laboratories attached to these schools serve for experiments carried out in connection with lessons in chemistry, biology, and physics. Two periods per week have been set aside for laboratory work."<sup>25</sup>

In too many cases, expensive science equipment was rusting and becoming of no future use. In some schools, costly science laboratory equipment and supplies were still in the packing crates, having been there for one to two years; in at least one instance the crates were still outdoors, with no protection from the elements, at the gateway to the school.

Under the assumptions

- (1) that the Kingdom of Afghanistan cannot afford to waste either its revenues or that of other helping nations, and
- (2) that a course in the physical or biological sciences involves, a priori, the method of the laboratory;

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24 - Such as Khost, Mir Wais, and Murad Ali.

25 - op cit, page 21

it is suggested that a close look should be taken at such equipment and its lack of use with a view to determining steps necessary to get it into use, if possible. Further, it may well be that some of the more recently ordered equipment (Phywe) is not appropriate to the work of the lycee. Lastly, it is urged that full encouragement and cooperation be lent by the Ministry to such efforts as are being made by the Science Specialists and Members of the Institute of Education to further the use of the science labs and equipment and to train teachers in the application of laboratory techniques in teaching the school sciences in the lycees.

There were one or two instances of a real attempt to offer sound laboratory facilities and training. Especial tribute seems worthy of the efforts of the French and Afghan science teachers at Istiqlal Lycee in Kabul; there, through student work, the physics laboratory was being rebuilt, and equipment installed; furthermore, the facility showed use.

## THE CURRICULUM

### Boys Lycees

The curriculum for Persian-speaking regions of the middle and upper class grades of the boys lycees is set forth in chart number 7.<sup>26</sup> The only difference in the program for Pashto-speaking

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26 - Ministry of Education, Royal Afghan Dept. of Secondary Education: Syllabuses, Secondary Schools (Boys and Girls), 1956.

regions is that the class hours for Persian and Pashto are interchanged.

Noteworthy observations on the curriculum are:

1. Mathematics offerings are listed under "Arithmetic and Geometry," though the course content descriptions include algebra; for grades 7-9, 5 hours mathematics per week are prescribed; for grades 10-12, 7 hours.
2. The studies in biology, chemistry, and physics are spread throughout grades 7-12, except where "geology" replaces "biology" in grade 10.
3. Foreign languages are required in all middle and upper class grades.
4. Logic is not offered until grade 12.
5. There are no specific hours provided in the syllabus for laboratory work.

In the Foreword to the Syllabuses<sup>27</sup> the following statement appears:

...in scientific subjects such as mathematics, physics, and chemistry, 6 periods per week in the afternoons have been set aside for the senior classes of the Lycees, for practical and experimental work.

As has been mentioned, this prescription, whether for the senior or lower classes, is not being followed.

In the case of foreign languages, English is the language taught except at several of the foreign supported lycees in Kabul; in these schools the language of the supporting European country is required.

A thorough examination of the Syllabuses<sup>28</sup>, units of the Program

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27 - op cit

28 - op cit, pp. 17-19

for Mathematics, Twelfth Class, turned up the suggestion that, at the senior level at least, there exist three sections identified as "Math," "experimental sciences," and "Literay" (Literary). Two sections (mathematics and philosophy) appeared in evidence in the Istiqlal Lycee; however, at the time of this study, course requirements in the other lycees were the same for all students without any sectioning whatsoever.

### Girls Lycees

Chart number 8 reflects the scheduled teaching hours for the Malalai Girls' Lycee, "full lycee section," for grades 7-12, as extracted from the Education Ministry's Syllabuses.<sup>29</sup> This pattern of course offerings is followed in all seven girls lycees. Comparing the program for girls with that for boys, it is noted that:

- (1) Offerings in Persian, Pashtu, Arabic, Foreign Languages, Theology, History, and Geography are very similar.
- (2) "Mathematics" and "Geometry" are the listings for girls, with 5 hours offered in grades 7-9 which is the same as for the boys, but only 5 hours per week in grades 10-12, as compared to 7 hours in "Arithmetic and Geometry" for boys.
- (3) In the sciences, one less hour of Physics and 2 more hours of Biology (replacing Geology), along with an equivalent Chemistry block, is the offering.
- (4) The girls have no courses in Religion, Logic, General Knowledge-Economics, or Sports.
- (5) Drawing is more heavily emphasized in the girls' program; during the school visits considerable success in drawing was noted amongst the girls.

- (6) Sewing, which is required in all grades of the girls schools, seems to be presented most successfully, based on the results observed during the lycee visits.
- (7) The total weekly teaching hours are the same for boys except in grades 10 and 11, where there is one hour difference.

In the Foreword, as well as in the main body of the Syllabuses, mention is made of three sections within the girls lycee; the "House-keeping Section", "Full-Lycees Section", and the "Women Teacher's Training Section". The Syllabuses lists detailed program outlines for the other two sections.<sup>30</sup>

Charts numbers 9 and 10 set forth the offerings for the "House-keeping" and "Women Teacher's Training" Sections. In effect, however, the girls lycees function on a one-track program, i.e., that which is called the "Full-Lycees Section." As of January 1965, some explorations were being conducted, through the Office of Womens Education at the Ministry of Education, by specialists in the Institute of Education, toward preparing lycee girls to go into primary teaching.

In most girls lycees regularly assigned teachers of mathematics-science of the middle and upper class grades are few.<sup>31</sup> More often than not, teachers from nearby boys lycees are contracted to cover the girls lycee math-science classes. Unfortunately, many science-math classes in the girls lycees, when visited, had no instructor. Laboratory work was virtually non-existent. Special mention should

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30-- op cit, pp. 59-60

31 - See section of this report concerning mathematics teaching in the lycees.

EXTRACTION FROM MINISTRY OF EDUCATION  
SYLLABUSES (1956)

WEEKLY HOURS OF TEACHING IN LYCEES (Persian-speaking regions)  
(BOYS)

NO.	SUBJECTS	CLASSES					
		7	8	9	10	11	12
1	Theology & the Holy Koran	2	2	2	2	2	..
2	Persian	4	4	4	4	4	3
3	Pashto	3	3	3	3	3	3
4	Arithmetic and Geometry	5	5	5	7	7	7
5	History	2	2	2	2	2	2
6	Drawing and Handicrafts	1	1	1	..	..	..
7	Chemistry	2	2	2	3	3	3
8	Physics	2	2	2	3	3	3
9	Biology	2	2	2	..	3	3
10	Geology	..	..	..	3	..	..
11	Arabic	2	2	2	..	..	..
12	Foreign Languages	6	6	6	6	6	4
13	Gen. Knowledge-Economics	1	1	1	..	..	..
14	Religion	..	..	..	..	..	2
15	Logic	..	..	..	..	..	2
16	Geography	2	2	2	2	2	2
17	Sports	1	1	1	1	1	1
	Total .....	35	35	35	36	36	35

EXTRACTION FROM MINISTRY OF EDUCATION  
SYLLABUSES (1956)

FULL TEACHING HOURS FOR LYCEES

THE MALALAI (GIRL'S) LYCEE

"Full-Lycees section, from the 7th to the 12th grade

NO.	SUBJECTS	GRADES					
		7	8	9	10	11	12
1	Theology	2	2	2	2	2	2
2	Pashto	3	3	3	3	3	3
3	Persian	3	4	4	4	5	5
4	Foreign Languages	6	6	6	6	6	6
5	History	2	2	2	2	2	2
6	Geography	2	2	2	2	2	2
7	Mathematics	2	2	2	2	2	2
8	Geometry	3	3	3	3	3	3
9	Physics	2	2	2	3	2	2
10	Chemistry	2	2	2	3	3	3
11	Biology	2	2	2	3	2	3
12	Sewing	2	2	2	1	2	2
13	Drawing	2	1	1	1	1	...
14	Arabic	2	2	2	...	...	...
	TOTAL	35	35	35	35	35	35

EXTRACTION FROM MINISTRY OF EDUCATION  
SYLLABUSES (1956)

TEACHING HOURS FOR THE "HOUSE-KEEPING" SECTION

NO.	SUBJECTS	CLASSES	
		10th	11th
1	Theology	2	2
2	Persian	3	3
3	Pashto	3	3
4	Physics	2	2
5	Chemistry	2	2
6	Biology	2	2
7	Child-Care	2	2
8	Housekeeping	3	2
9	Painting and Handicrafts	3	3
10	Mathematics	2	2
11	Sewing	4	3
12	Cookery	3	3
13	Languages	4	4
14	Psychology	nil	2
	TOTAL.....	35	35

CHART NUMBER 9

EXTRACTION FROM MINISTRY OF EDUCATION  
SYLLABUSES (1956)

TEACHING PROGRAMME FOR WOMEN

TEACHERS' TRAINING SECTION

NO.	SUBJECTS	CLASSES	
		10th	11th
1	Holy Koran and Theology	2	2
2	Persian	5	4
3	Pashto	4	4
4	Physics	2	2
5	Chemistry	2	2
6	Biology	2	2
7	Mathematics	4	4
8	Psychology	1	1
9	Teaching Methods	...	1
10	Tailoring and Knitting	2	1
11	History	2	2
12	Geography	2	2
13	Drawing and Painting	1	1
14	Language (foreign)	6	6
	TOTAL.....	35	34

CHART NUMBER 10

## PART II

### THE MATHEMATICS TEACHERS

#### MATHEMATICS TEACHERS IN THE LYCEES

##### GRADES 7-12

###### General

A great benefit derived from the visits to Afghanistan's Lycees was the opportunity to meet and shake hands and speak with the teachers of mathematics. Also, there was the chance to briefly describe the work of the Education Ministry's Mathematics and Science Curriculum Committee.

As aforementioned, each mathematics teacher was asked to complete a questionnaire which is duplicated as exhibit number 1 on page 49 of this report. One person teaching mathematics did not wish to complete the entire questionnaire as he was planning to enter Kabul University in March 1965; another teacher reported that he had taught mathematics for twelve years but during the 1964-65 school year was teaching English and, ipso facto, was excluded. There were several foreigners teaching mathematics at the European-oriented lycees and one American Fulbright Teacher instructing in mathematics at Nadiria Lycee in Kabul. Foreign nationals teaching lycee mathematics were as follows:

<u>Lycee</u>	<u>Number</u>	<u>Nationality</u>
Nedjat	1	German
Istiqlal	1	French
Naderia	1	American

The efforts and accomplishments of these foreign teachers are recognized, both by this writer as well as by the Afghan school officials. However, they were not included in this survey, as its main subject of study was the Afghan Mathematics Teachers. Indeed, foreign teachers in foreign languages are much more common than foreign mathematics teachers; also there are several foreign science teachers in service as well as a few teachers in other areas.<sup>32</sup> Though the United States Peace Corps was beginning to make its presence felt in Afghanistan, there were no Peace Corps Lycee Mathematics Teachers in grades 7-12 at the time of the school visits.<sup>33</sup>

#### Lycee Distribution of Mathematics Teachers - Grades 7-12

Chart number 11 shows, by number, the location and native language of the Afghan lycee mathematics teachers for grades 7-12 at the time of the survey. Study of this data shows that there were 73 teaching in the Kabul and 68 in the provincial lycees.<sup>34</sup>

32 - As an example, Malalai (Girls) Lycee had 4 French women teaching French and one Austrian woman teaching physical education.

33 - Three Peace Corps Volunteers were teaching mathematics at the Cadastral Survey School in Kandahar.

34 - Including the one "student" who did not complete the entire questionnaire.

Thus, the average number of mathematics teachers in the 11 Kabul City lycees was 6 to 7, while the average in the provincial schools was 4. Eighty-two teachers claimed Darri (Farsi) as their native tongue, fifty-six reported Pashto and 2 Uzbeki as their native language, and one claimed both Darri and Pashto.

### Ages of Mathematics Teachers

The age distribution of the grade 7-12 lycee mathematics teachers is shown in chart number 12. All 68 provincial teachers responded to the age query; however, only 72 of the 73 Kabul teachers are included since one Kabul lycee woman mathematics teacher did not answer the age question.

The median teacher age was in the 27-30 age-interval with a mode in the 23-26 age-bracket. This statistic signifies a fairly young crop of lycee mathematics teachers, which is a reasonably favorable omen in the face of needed curriculum revision with a parallel in-service training program.

### Education

#### In the Provinces

Of the 68 provincial teachers reporting, the following data was obtained:

<u>EDUCATION</u>	<u>NUMBER</u>
4 years college or faculty	10
3 years college or faculty	1

Department of Science and Mathematics of the Institute of  
Education of Kabul University requests the  
Afghanistan Mathematics Teachers to kindly  
fill out and complete this form.

Name: \_\_\_\_\_ Age: \_\_\_\_\_ Birth Place: \_\_\_\_\_ Residence: \_\_\_\_\_  
(Family name)

Mother Tongue: \_\_\_\_\_ Place of Work: \_\_\_\_\_ Rank: \_\_\_\_\_

Graduate of which secondary school (Lycee, DMA, etc.): \_\_\_\_\_

How many years of college in Afghanistan, or abroad, did you complete? \_\_\_\_\_

What courses in Mathematics did you have in the University, and how many  
years of Mathematics did you have in the University \_\_\_\_\_

How many years have you taught Lycee (grade 7-12) Mathematics? \_\_\_\_\_

Do you wish to have higher education or training in mathematics? \_\_\_\_\_

In what grades do you now teach? \_\_\_\_\_

How many hours of Mathematics do you presently teach per week? \_\_\_\_\_

Besides Mathematics what other subjects, by grade, do you now teach? \_\_\_\_\_

How many hours per week do you teach these other subjects? \_\_\_\_\_

Total number of students in your present Mathematics classes? \_\_\_\_\_

Which of the following grades have Mathematics textbooks, and in which do  
you use notes without textbooks?

7th \_\_\_\_\_ 8th \_\_\_\_\_ 9th \_\_\_\_\_ 10th \_\_\_\_\_ 11th \_\_\_\_\_ 12th \_\_\_\_\_

Are you a regular teacher or a part-time teacher? \_\_\_\_\_

Do you have other duties besides regular teaching? \_\_\_\_\_

Do you have another job? \_\_\_\_\_ Number of hours per week you work in your  
other job? \_\_\_\_\_ What do you do in your other job? \_\_\_\_\_

Thank you! Department of Mathematics and Science, Institute of Education

EXHIBIT NUMBER 1

NUMBER OF MATHEMATICS TEACHERS AT EACH LYCEE

IN AFGHANISTAN, September-December, 1964

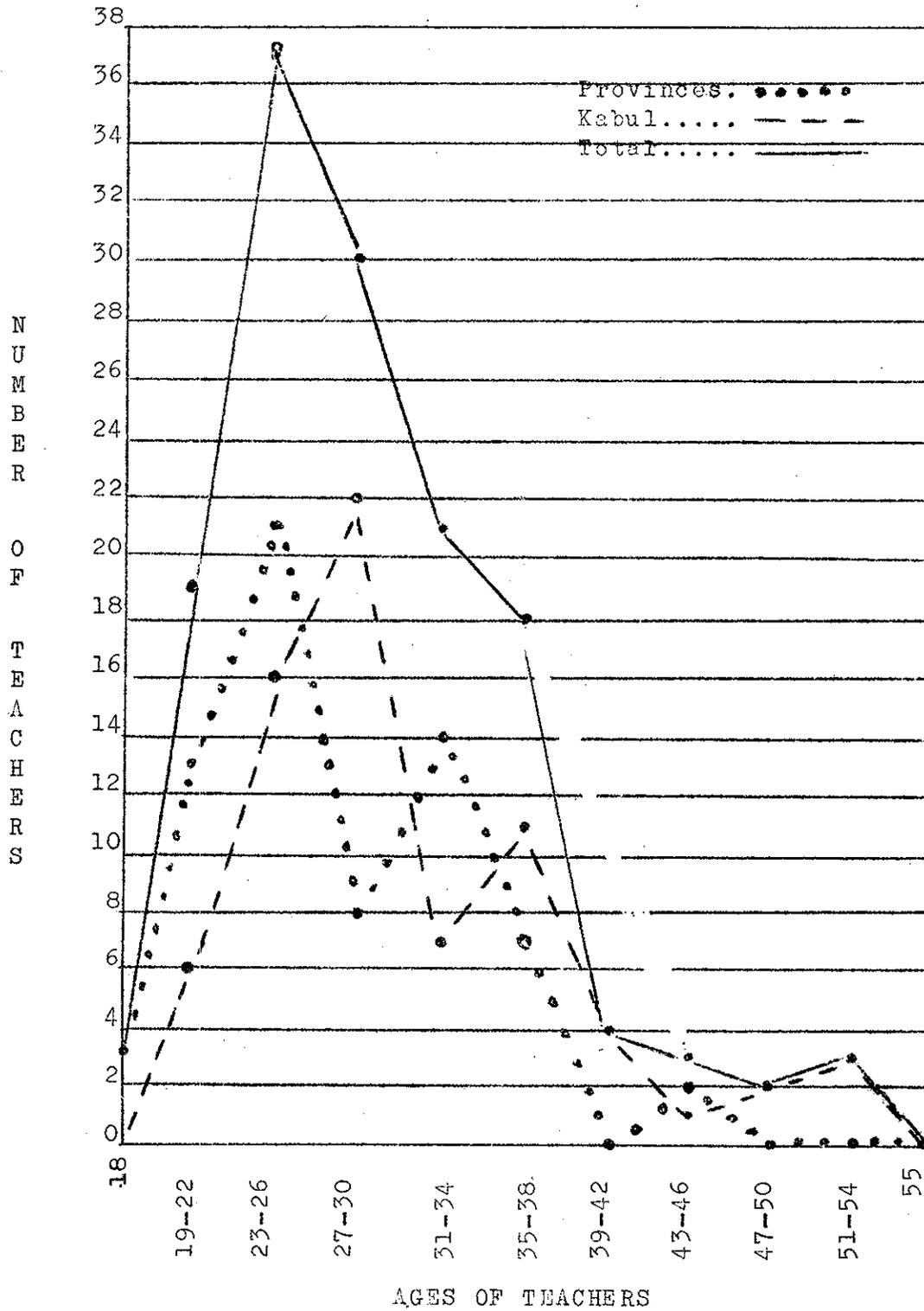
(Grades 7-12)

Location	Name of Lycee	Number of Teachers	Language		
			Darri	Pashto	Uzbeki
Bost	Lashkar Gah High School	6	4	2	.....
Charikar	Naimon	7	7	0	.....
Farah	Abu Naser Faraihi	2	1	1	.....
Ghazni	Sana'i	5	5	0	.....
Herat	Jami	2	2	0	.....
	Meri	4	4	0	.....
	Sultan Ghias-ud-din Ghor	5	5	0	.....
Jalalabad	Nangahar	7	1	6	.....
Kabul	Aiashah Durrani	4	2	2	.....
	Ghazi	9	7	2	.....
	Habibia	11*	7(1)	3(1)	.....
	Istiqlal	4	3	1	.....
	Khoshal Khan	7	0	7	.....
	Malalai	7	5	2	.....
	Nadiria	5	4	1	.....
	Nedjat	6	2	4	.....
	Rabia Balki	8	5	3	.....
	Rahman Baba	4	0	4	.....
Zarghona	8	6	2	.....	
Kandahar	Ahmad Shah Baba	5	1	4	.....
	Mir Wais Baba	4	1	3	.....
	Zarghona Ana	2	1	1	.....
Khama	Murad Ali-Khama	2	0	2	.....
Khanabad	Khanabad	3	2	1	.....
Khost	Khost	3	0	3	.....
Laghman	Roshan	2	0	2	.....
Maimana	Abu Obsid J'uz Jahni	4	2	0	2
Mazar-i-Sharif	Bakhtar	3	3	0	.....
	Sultana Rezhia	2	2	0	.....

\* One teacher claims 141 both Darri and Pashto as native languages. 82 56 2

CHART NUMBER 11

AGE DISTRIBUTION OF MATHEMATICS  
TEACHERS FOR GRADES 7 - 12 IN LYCEES OF AFGHANISTAN  
SEPTEMBER - DECEMBER, 1964



(No ages 0-17 or greater than 55 were reported)

CHART NUMBER 12

2 years college or faculty	1
1 year college or faculty	3
12th grade graduate	49
11th grade graduate	3
9th grade graduate	<u>1</u>
	68

Thus 10 out of 68, about 15%, of the provincial lycee mathematics teachers of grades 7-12 have what is generally considered to be the very minimum academic preparation for lycee teaching. Eight of the ten are alumni of the Kabul University Science Faculty, three of which have graduated within the past five years; one was trained at the American University at Beirut and one in the New York State College System.

#### In Kabul

The 73 Kabul lycee mathematics teachers reporting are at the following listed levels of education:

<u>EDUCATION</u>	<u>NUMBER</u>
Doctor of Philosophy in Physics <sup>35</sup>	1
4 years college or faculty	27
3 years college or faculty	5
2 years college or faculty	1
1 year college or faculty	6
12th grade graduate	<u>33</u>
	73

---

35 - The one PH. D. reporting teaches only 3 hours of math. and 3 hours of physics per week and is regularly assigned to the Faculty of Science of Kabul University.

In Kabul, then, 28 out of 73, or about 38% of the grade 7-12 lycee mathematics teachers, have at least 4 years academic preparation. Of the 28, 3 are Medical Faculty students with only one year of faculty mathematics and one is a Law Faculty graduate with no university mathematics training. Fourteen are Kabul University Faculty of Science graduates (men) and eight have gone through the Faculty of Science, Women's Section; of these twenty-two, fourteen are 29 years of age or younger.

Overall, 38 of 141 teachers reporting are faculty or 4-year college graduates. This is nearly 27% of the lycee mathematics teachers (grades 7-12). The educational level, by lycee, of the teachers is shown in chart number 13.

#### Teaching Experience

Chart number 14 gives the years of experience in teaching mathematics for lycee grades 7-12. The median years of teaching experience are:

Median interval for Kabul Lycees	- 4-5 years
Median interval for Provincial Lycees	- 2-3 years
Median interval for Total	- 3-4 years

Once again we see the Kabul schools' having the more experienced teachers. Those with more than 11 years experience number 16 out of 73 (c. 23%) in Kabul; there are 7 out of 68 (c. 11%) in the provinces. For the total population under study, 23 out of 141 (c. 17%) have more than 11 years lycee mathematics teaching

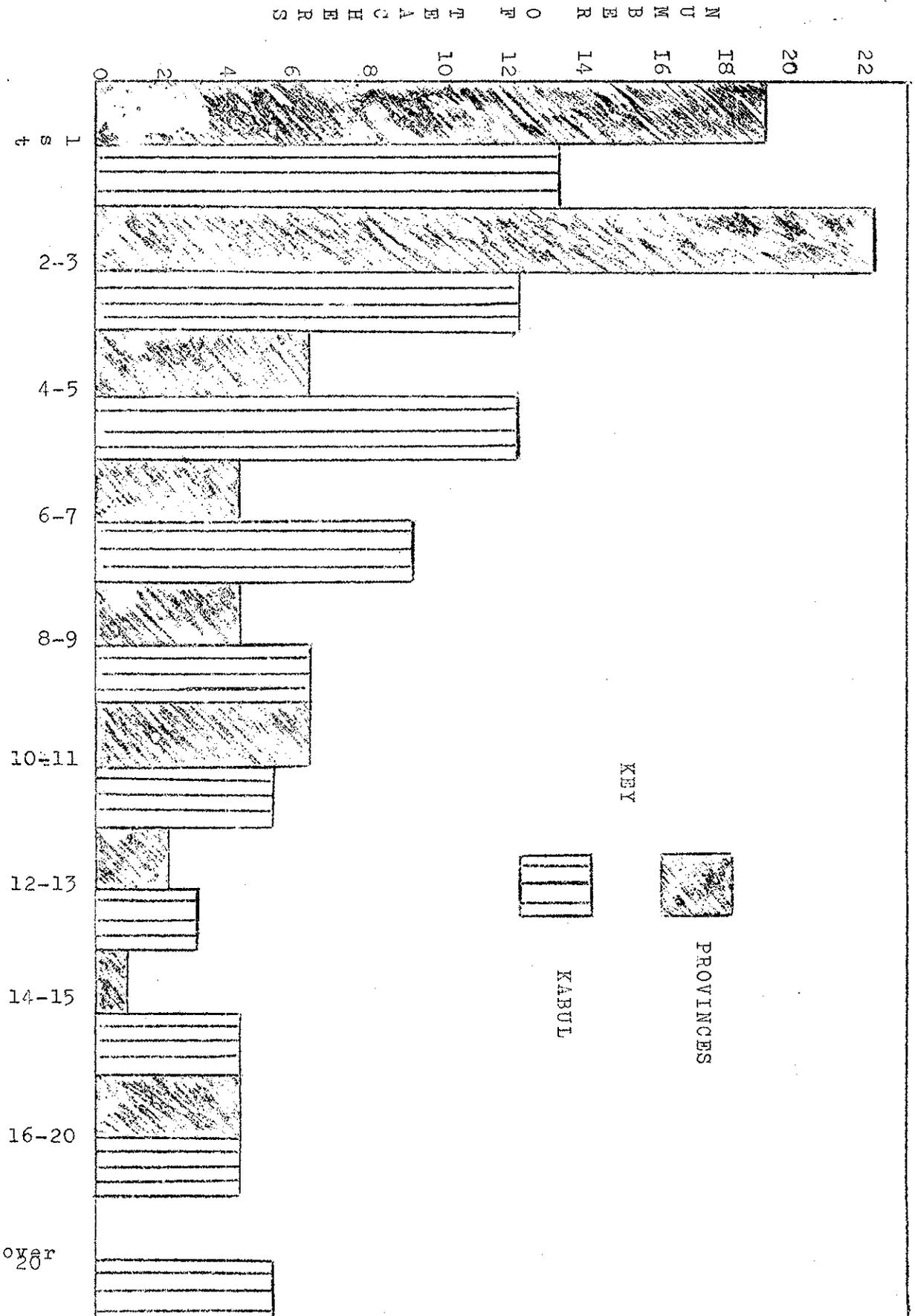
EDUCATION OF MATHEMATICS TEACHERS, Grades 7-12,  
AT EACH LYCEE IN AFGHANISTAN,  
September-December, 1964

Location	Name of Lycee	EDUCATION LEVEL							
		College Training					School Grade Completed		
		Ph.D.	Dipl.	3 yr.	2 yr.	1 yr.	12 gr.	11 gr. 9	
Bost	Lashkar Gah High School	..	2	..	..	..	3	1	
Charikar	Naimon	..	1	..	..	..	6	..	
Farah	Abu Naser Faraihi	..	..	..	..	..	2	..	
Ghazni	Sana'i	..	..	..	..	..	5	..	
Herat	Jami	..	..	..	1	..	1	..	
	Meri	..	1	..	..	..	3	..	
	Sultan Ghias-ud-din Ghorl	..	2	..	..	1	2	..	
Jalalabad	Nangahar	..	..	1	..	1	5	..	
Kabul	Aiashah Durrani	..	1	1	..	..	2	..	
	Ghazi	..	2	1	..	..	6	..	
	Habibia	..	6	..	..	2	3	..	
	Istiqlal	..	..	..	..	..	4	..	
	Khoshal Khan	..	1	..	..	3	3	..	
	Malalai	1	2	..	..	..	4	..	
	Nadiria	..	1	..	..	..	4	..	
	Nedjat	..	2	2	1	..	1	..	
	Rabia Balkhi	..	4	1	..	..	3	..	
	Rahman Baba	..	1	..	..	1	2	..	
Zarghona	..	7	..	..	..	1	..		
Kandahar	Ahmad Shah Baba	..	..	..	..	1	4	..	
	Mir Wais Baba	..	..	..	..	..	4	..	
	Zarghona Ana	..	..	..	..	..	1	..	
Khâma	Murad-Ali	..	1	..	..	..	1	..	
Khanabad	Khanabad	..	2	..	..	..	1	..	
Khost	Khost	..	..	..	..	..	3	..	
Laghman	Roshan	..	..	..	..	..	2	..	
Maimana	Abu Obaid J'uz Jahni	..	..	..	..	..	2	2	
Mazar-i-Sharif	Bakhtar	..	1	..	..	..	2	..	
	Sultana Rezhia	..	..	..	..	..	2	..	
<b>TOTALS</b>			1	37	6	2	9	82	3

CHART NUMBER 13

YEARS OF EXPERIENCE IN TEACHING MATHEMATICS FOR LYCEE

MATHEMATICS TEACHERS, Grades 7-12  
September - December 1964



YEARS EXPERIENCE  
CHART NUMBER 14

experience; 6 of these teachers hold faculty or college degrees (5 in Kabul and 1 in the provinces).

The rather low experience median for the mathematics teachers, it appears, is nothing more than a reflection of a rapidly expanding lycee system, which is concurrent with overall education expansion in the country.

### Salary Scale

In the earlier portion of this report, it was shown that the median official rank of the middle and upper grade lycee mathematics teachers was at rank 8, basic salary per month of afs 1500. The range of basic salaries is from afs 1200 to afs 4800 per month. Further discussion of salaries is found on page 29 preceding.

### Mathematics Teaching Load

Five-sixths of the 73 Kabul lycee 7-12 grade mathematics teachers instruct in mathematics at least 20 to 26 hours per week (26 hours being the normal work week) and 28 of the 73, which is about  $\frac{2}{5}$ , reported teaching mathematics in excess of 26 hours per week. In the provinces, two-fifths of the lycee 7-12 grade mathematics teachers instruct mathematics classes at least 20 to 26 hours per week, and 27 of the 68 reported overtime hours in mathematics teaching.

The differing patterns between the Kabul and provincial lycees are again worth noting. Here, the substantial percentage differ-

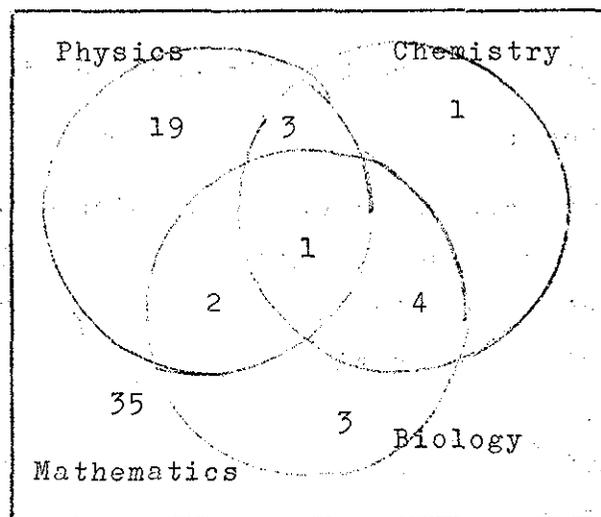
ences are attributed to the specialization in the Kabul lycees and lack of such specialization in the provinces.

The size of the classes is also an important feature in giving thought to the teaching load. As indicated on page 34 of this report, there was considerable variation in class size. A school such as Mir Wais Baba Lycee in Kandahar showed sections in mathematics (as well as other subjects) with 50 to 60 students enrolled; on the other hand Zarghona Ana Lycee, also in Kandahar, showed upper class sections with 15-20 girls enrolled.

#### Other Subjects Taught

##### Provincial Lycees

The following diagram shows the traditional physical and biological sciences which were also taught by the 68 provincial lycee teachers of mathematics grades 7-12:



This schema indicates that 35 out of the 68 teachers of mathematics taught none of the traditional science offerings at the time

of the survey. Worthy of note is the fact that 19 taught physics; of the 19, 7 taught at least as many hours in physics as in mathematics. The one person who taught all three named sciences as well as mathematics reported only four hours per week in mathematics, the balance in the sciences all at the middle class level. Nine of the mathematics teachers listed English and 11 listed Dari or Pashto as "other subjects taught." The following listed subjects were also taught by some provincial mathematics teachers:

drawing, agriculture, social studies,  
geology, general science, akhlaq  
(moral behavior), theology, and  
general knowledge.

Three teachers of mathematics were lycee principals, one was an assistant principal, one a headmaster, and one was the Provincial Director of Education.

Kabul Lycees

In the Kabul City Lycees the mathematics-science teaching affiliations were as follows:

Mathematics and Chemistry, Biology, and Physics	0
" Chemistry and Biology	0
" Physics and Biology	0
" Physics and Chemistry	0
" Biology	0
" Chemistry	1
" Physics	12
" General Science	1

Thus, 59 out of the 73 (c. 82%) Kabul teachers taught mathematics only.

In "other subjects taught," one teacher listed 'history' and one listed "general knowledge in the elementary sections."

Two lycee middle or upper class teachers of mathematics were lycee principals; one an assistant principal; one was a principal of another school as also was one teacher an assistant principal elsewhere; and four were headmasters.

Three of the 12 mathematics-physics teachers taught at least as many hours in physics as in mathematics.

It is clear that a Kabul mathematics teacher is much more of a specialist than is his provincial counterpart. The provincial teacher is often required to spread himself over a range of subjects; this is to be expected in the less populated schools of the provinces.

#### Other Jobs

A substantial number of mathematics teachers reported holding jobs involving work outside their regularly assigned schools. In Kabul, 13 were working on a contract basis teaching at other schools and 7 were working in other-than-teaching jobs. In the provinces, 15 were holding additional teaching positions with 3 reporting other-than-teaching work.

The number of hours worked, both on regularly assigned jobs and additional jobs, often ranged from 36 to 55 hours per week instructing. Assuming that, in general, teachers actually met all their classes, this is a very heavy working load and doesn't leave

much time for class preparation, etc. However, the demand for mathematics and any sort of teaching is clearly such that teachers may find it necessary to continue at such a pace, not to mention the economics which the teacher must face. And it may very well be that a higher percentage of mathematics teachers work extra jobs than actually reported doing so.

### Attitude Toward Teaching

In attempting to judge teachers' attitudes toward their work, it is realized that good evidence for making a judgement is hard to find. With this acknowledged limitation in mind, talks with teachers and administrators left the impression that teaching at the lycee level occupies a low position in the minds of teachers. The teachers seemed resigned to their fate and felt, in many places, that the Kabul authorities were unaware of their problems.

On the other hand, there was an awareness amongst some of the mathematics teachers of a great opportunity for serving their people.

### Additional Education Wants

In response to the question "Do you desire any further education in mathematics?", the report was:

in Kabul, 57 "yes"

in the Provinces, 66 "yes"

This appears to bode well for offerings of in-service education to all lycee mathematics teachers as well as for higher academic preparation in the instances of those who are especially qualified.

#### Composite of the Lycee Mathematics Teacher of Grades 7-12

##### In the Provinces

The typical Lycee Mathematics Teacher of Grades 7-12 is likely a man of 23 to 26 years of age, holder of the baccalaureate, with 2 to 3 years teaching experience and earning 1350 to 1500 afis per month (official rank of 8 or 9). He teaches from 16 to 24 hours of mathematics per week on his regularly assigned job and there is a reasonable chance that he puts in some overtime hours at his assigned school. His classes have about 45 students in the middle-class grades and about 25-30 in the upper-class grades. He teaches some lycee subjects in addition to mathematics; if he teaches a science, it is likely physics. He is probably bi-lingual, having command of both Darri and Pashto. And he may well feel like a forgotten man, especially if he is far from Kabul; at any rate he probably would elect to work in Kabul.

##### In Kabul

The typical Kabul teacher is about 27 to 30 years old, a baccalaureate holder with a reasonable chance of holding the bachelor's degree and with 4-5 years teaching experience. He teaches mathematics almost exclusive of other subjects, probably works some

overtime hours at his assigned school, and likely has another source of income through either a contract teaching job or non-teaching work. His middle class sections are of about the same size as those of his provincial brother, but the size of his upper class sections is somewhat larger, with 40-50 students not uncommon. His mother tongue is probably Pashto if he teaches in one of the two Kabul Pashto-teaching schools; otherwise it is likely to be Darri, with some Pashto proficiency. He prefers teaching in Kabul with little desire for a provincial assignment. His regular monthly salary is about afs 1800 since he holds the 7th official rank.

#### PREPARATION OF LYCEE MATHEMATICS TEACHERS

The Survey of Progress, 1961-62 shows that the number of students in middle schools and lycees, for the period 1955-56 to 1960-61, increased  $2\frac{1}{2}$  times, while the number of teachers for these schools increased twofold. Enrollments in the lycees went from 1,088 to 2,915 during that period.<sup>36</sup> At the time of this inquiry, lycee enrollments were as follows:<sup>37</sup>

	<u>Grades</u>		<u>Total</u>
	<u>7-9</u>	<u>10-12</u>	
Kabul	8,878	3,305	12,183
Provinces	<u>4,580</u>	<u>2,083</u>	<u>6,663</u>
Totals	13,458	5,388	18,846

36 - op cit, Table--Education (3).

37 - see Chart Number 2.

Such enrollment increases demand corresponding teacher increases.

As has been shown, some 27% of the grade 7-12 lycee mathematics teachers have received at least 4 years of college work. To teach mathematics at the middle and upper class level requires teachers who have had considerable faculty training in mathematics with some knowledge as to the teaching of mathematics.

The Planning Ministry's Survey of Progress, 1962-64, shows that in the year 1342 of the Muslim calendar the Science Faculty of Kabul University graduated 28 students as follows:<sup>38</sup>

<u>Specialty</u>	<u>Number</u>
Mathematics-Physics	9
Chemistry-Biology	8
Mines	4
Meteorology	7

Further, for the years 1335, 1340, 1341, and 1342 the University Science Faculty turned out 100 graduates as follows:<sup>39</sup>

<u>Year</u>	<u>Graduates</u>
1335	15
1340	25
1341	32
1342	28

Though there appears to be a tendency to increase its output, the average yearly graduates for the four years given is only 25.

The Survey of Progress, 1961-62 sums up the matter: "In the Lycee schools students increased much more rapidly than did the number of regular teachers."<sup>40</sup>

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38 - op cit, page 71

39 - op cit, page 149

40 - op cit, page 40

The Ministry's Education in Afghanistan lists 21 aims of the Ministry, one of which is

to strengthen the Faculties of Literature and Science at the Kabul University for the training of secondary school teachers. 41

The office of the Dean of the Faculty of Science of Kabul University furnished a copy of that Faculty's outline of courses for matriculants. As translated, the stated mathematics offerings for students specializing in mathematics-physics are:

1st year: Mathematics (algebra leading into analysis)

2nd year: Mathematics (calculus) and Vector Analysis

3rd year: Differential Equations

4th year: Modern Algebra

The mathematics program includes coverage of:

decimal numbers; polynomials; binomial theorem; imaginary numbers; functions; limits; continuity; circular functions; simple series; composite functions; derivatives; "successive" derivatives; Leibniz formula; definite and indefinite integrals; expansions by series of  $a^x$ ,  $\sin x$ ,  $\cos x$ , change of variable; Taylor's and Mac Laurin's series; division by zero; the differential.

No discussion in differential equations or modern algebra was shown.

The physics offerings, by contrast, are much more extensive and include:

2 years of electronics, 2 years of atomic physics, 2 years of general physics, thermodynamics, nuclear physics, optics, and electricity.

The mathematics offering falls far short of qualifying one for either teaching lycee mathematics or for anything resembling specialization in mathematics. The program is perhaps that for a physics major with some mathematics.

However it may be, this situation needs immediate attention. Analysis of survey data reveals that in the provinces 5 mathematics teachers of age 30 or less - - and in Kabul 16 mathematics teachers of age 30 or less - - are Faculty of Science Graduates (7 of the 21 were female and listed themselves as graduates of the Faculty of Science, "Women's Section"). Thus, in the past 5 to 7 years 21 mathematics teachers have been provided and were in the lycees as Faculty of Science graduates, which averages only 3 to 4 per year.

The following table of lycee middle and upper class mathematics teacher requirements is presented in order to arrive at a reasonable estimate of the number of qualified mathematics teachers which are likely to be required to staff the lycees in the next decade.

PRESENT NEEDS IN 1965

<u>School</u>	<u>7-9</u> <u>Enroll</u>	<u>10-12</u> <u>Enroll</u>	<u>7-9</u> <u>Student</u> <u>Class Hrs.</u> <u>per Week*</u>	<u>10-12</u> <u>Student</u> <u>Class Hrs.</u> <u>per Week*</u>	<u>Number Math.</u> <u>Teachers Presently</u> <u>Needed to</u> <u>Staff</u>
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PROVINCIAL LYCEES

Abu Naser Faraihi	135	54	675	378	2
Abu Obaid J'uz Jahni	285	32	1425	224	3



The following yardstick is used for determining "Number of Mathematics Teachers Presently Needed to Staff":

In Provinces: One teacher per 625 weekly student class hours-calculated on the basis of one teacher teaching mathematics 25 class-hours per week with an average of 25 students per class hour.

In Kabul: One teacher per 875 weekly student class hours-calculated on the basis of one teacher teaching mathematics 25 class-hours per week with an average of 35 students per class hour.

Thus, there would be required on the basis of 1964 enrollments and the yardstick used here some 68 provincial and 82 Kabul mathematics teachers now. As shown in the section of this report dealing with the educational level of the mathematics teachers, only 38 out of the present 141 teachers meet a faculty graduate requirement.

Thus, with an immediate needed minimum total of 150 qualified lycee mathematics teachers, and with 38 (at the most) now meeting such requirement, there is a current deficit of 112 faculty graduates. If we consider a 10% yearly attrition rate, and if the lycee middle and upper class enrollments continue at the present dynamic rate, as a minimum Afghanistan will need 200 additional lycee mathematics teachers in the next ten years. This estimate does not take into account the fact that many mathematics teachers spend a substantial number of hours teaching other subjects.

The Survey of Progress, 1961-1962, gave recognition to the dire need for adequate teacher preparation: "The number of students per

teacher has increased from 35 to 45, or by 28%, because of the rapid increase in the number of students and a disproportionate development of teacher-training facilities."<sup>42</sup>

And the Survey of Progress, 1962-64, reporting on the goals and accomplishments of the Second Five Year Plan called for "encouraging and popularizing advanced scientific, technical, and professional education," and "Training personnel required for implementation of development plans!"

Indeed, education is probably the hardest hit area in the way of modernizing. And it cannot be overlooked that substantial educational progress, at least quantitatively, has been made. Certainly the presence of qualified mathematics and science teachers in the lycees is vital to all aspects of the Royal Government's planning. These teachers must prepare, for instance, those who may go on and pursue training needed to satisfy the demands of the current and future Five Year Plans. Witness the statement in the Survey of Progress, 1962-64:

Employees reported again in September, 1963, as they have done over the last three years, that they had generally experienced difficulty in recruiting the following categories of workers: architects, engineers (all kinds), geologists, meteorologists, physicians, technicians, ..."<sup>43</sup>

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42 - op cit, page 36  
43 - op cit, page 26

PART III

THE MATHEMATICS CURRICULUM AND CLASSROOM TEACHING

MATHEMATICS CURRICULUM OFFERINGS

Grades 7-12

Boys Lycees

The general lycee curriculum offerings have been mentioned earlier and are set forth on pages 37-41 of this report.

Middle Class Grades

For boys lycees, grades 7-9 receive 5 periods (40-45 minutes each) mathematics instruction per week, 3 periods in "arithmetic" and 2 sessions in geometry. The syllabus lists the offering as 5 hours in "Arithmetic and Geometry." The grade 9 "arithmetic" is actually arithmetic about the first third of the year with the remaining  $\frac{2}{3}$  of the year devoted to algebra.

The arithmetic program for grades 7-9 includes the following:

7th Class: Arithmetic

Metric system; units of length, area, and volume; measurements by graduated ruler and weights of liquids; the rule of three; densities; decimals; simple fractions; calculations involving time and angles units of measure; English and Indian money; percentages; calculations of simple surfaces and volumes; "constant" practice in mental arithmetic.

## Geometry

"Simple" notions with reasoning and constructions; lines; segments of lines; addition and subtraction of line segments; angles; addition and subtraction of angles; bisectors and perpendiculars; triangles; "conditions for the identical equality of two triangles."

## 8th Class: Arithnotic

Review of Class Seven work; prime numbers; prime factors; proportional division; simple interest; discount; squares and cubes; square roots; calculations of areas, volumes, densities, weights; "use of letters" in simple algebra; linear equations in one variable; products with geometric representation; the forms:  $(a + b)(c + d)$ ;  $(a - b)^2$ ;  $(a + b)^2$ .

## Geometry

Parallels; angle sum in triangle; parallelogram; rhombuses, and squares; properties of triangles (medians, perpendicular bisectors of sides); circles; chords and areas of circles; central and inscribed angles of circles; circle and tangent constructions.

## 9th Class: Arithmetic

Review of work of Classes Seven and Eight; proportion, direct and inverse; coefficient of proportionality.

## Algebra

Positive and negative numbers with operations thereon; special products -  $(a + b)(a - b)$ ; monomials and polynomials; algebraic fractions; solutions of linear equations in one variable with simple applications; graphs of  $y = ax$  and  $y = ax + b$ .

## Geometry

Ratios of two segments; Thales' Theorem<sup>44</sup> with applications; properties of similar triangles;

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44 - If 3 or more parallel lines are cut by two transversals the segments of the two transversals between parallels are respectively proportional.

Pythagorean Theorem; regular polygons; calculations of sides of a square; equilateral triangles and regular hexagons; right-triangle trigonometry (sine, cosine, tangent ratios); areas of rectangles; parallelograms and trapeziums; stress on practical applications.

### Upper Class Grades

The syllabus reads: "In the lower classes pupils have become familiar with mathematics and so in the higher classes the work should have more rigour. Pupils should now solve problems for themselves and discover certain properties. The role of the pupil should be no longer the solution of numerical problems only." 45

#### 10th Class: Algebra

Polynomials (addition and multiplication); "noteworthy identities; parallels; vectors; rectangular coordinates; gradient of  $y = ax + b$ ; graphs and discussion of  $y = 1/x$  and  $y = x^2$ ; Charles' Relation<sup>46</sup>; first degree equations and inequalities in one variable; systems of linear equations in two variables with graphs and problems; solution of quadratic equations in one variable ("with numerical coefficients only") by completing the square.

#### Geometry

Review; symmetry and translation; harmonic division; sines, cosines, and tangents of angles  $0^\circ - 180^\circ$ ; sine and cosine laws<sup>47</sup>; area of triangle; regular polygons; circles - circumference and area; radian measure; review of area formulas; area of sector of a circle.

#### 11th Class: Geometry

Space geometry - planes, lines, orthogonality; dihedral angles; perpendicular planes; symmetry;

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45 - op cit, pages 15-16

46 - presumably the vector sum of collinear vectors or the algebraic sum of directed segments.

47 -  $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$  and  $a^2 = b^2 + c^2 - 2bc \cos A$ .

translation; projections of right angle and plane areas; prisms and pyramids - lateral area and volume; surfaces of cones and cylinders; tangents; volume of a sphere; numerical exercises.

### "Algebraic Quadratic Equations"

Existence and signs of roots; inequalities; "finding two numbers<sup>48</sup> given their sum and product", applications of graphs to quadratic functions.

### Trigonometry

Periodicity; graphs of circular functions; functions of related angles; vectors - sums and projections; sum and product formulas; half-angle formulas.

## 12th Class: (Mathematics Section)

### Vector Geometry

Projections; scalars; radical axis and planes; harmonic division; polar symmetry; translation and rotation; homothety; similitude; inversion; conic sections.

### Descriptive Geometry

Intersections; parallelism; representation of prisms and pyramids; plane sections; change of plane; rotation of planes; applications to distance and angle problems.

### Algebra Review

Polynomials; division of radicals; irrationals; linear and quadratic equations and inequalities; graphs; variation; derivatives; tangents to curves; applications of derivatives to linear and quadratic functions in one variable; quotients of binomials and trinomials; integration of polynomials with area applications.

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48 - probably finding the "roots" given their sum and product and then determining the quadratic equation.

### Trigonometry

Sum and product formulas; solution of simple trigonometric equations; triangle solutions; use of tables.

### Mechanics

Kinematics; rectilinear motion; velocity and acceleration; curvilinear motion; velocity and acceleration vectors with applications to uniform circular motion; simple harmonic motion.

### Statics

Equilibrium in a plane, line, circle and sphere; reaction; friction.

## 12th Class: (Experimental Sciences)

### Algebra

First degree equations and inequalities; 49 systems of first degree equations; derivatives; tangents and curves with applications; integrals with area applications; definition of  $\log x$  as  $\int \frac{1}{x} dx$  as well as the exponential function as the inverse of the log function.

### Trigonometry

Circular functions; sum and product formulas; triangle solutions.

### Mechanics

Rectilinear motion - velocity and acceleration diagrams and vectors; curvilinear motion; uniform circular motion; simple harmonic motion.

The Syllabuses also lists mathematics for the "Twelfth Class (Literary)". The content is:

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49 - presumably in one variable

Exercises on the syllabus in algebra for 10th and 11th classes; circular functions and periodicity; derivative of  $x^n$  and of a quotient; tangents to curves; simple applications of the derivative.

In the upper class grades, mathematics is allotted seven periods per week, four in "algebra" and three in "geometry." Algebra studies are spread through all upper class grades, as are also various notions of geometry - plane, solid, descriptive, vector and projective. There is such a smattering of mention of so many geometric studies that there is no real geometry offered. A dash of "numerical trigonometry" is found in grade 10 with circular functions being studied in grades 11 and 12. Some calculus notions are introduced under the name of algebra in the 12th class. We also find some "mechanics" and "Statics" listed in grade 12 under mathematics offerings.

An examination of the following-listed textbooks leads to the suggestion that a large portion of the program of study in mathematics was patterned after them:

- Lebosse', C. and Hemery, C.: Arithmétique, Algèbre, et Géométrie, Classe de Cinquième des Lycées et Collèges, Sixième Édition, Librairie Fernand Nathan, Paris, 1946.
- : Géométrie dans L'Espace, Classe de Première des Lycées et Collèges, Librairie Fernand Nathan, Programme 1947, Paris, 1950.
- : Géométrie Plane, Classe de Seconde des Lycées et Collèges, Librairie Fernand Nathan, Programme 1947, Cinquième Édition, Paris, 1950.

Bracket, F. et Dumarqué, J.: Algèbre et Cosmographie, Librairie Delagrave, Paris, 1931.

It may be that the mathematics courses set forth in the Ministry Syllabuses were appropriate at the time of the preparation of the program of studies. And it reflects considerable effort to make for a classical program, which is proper in the context of the lycee as it appears to this writer. However, the program appears to be fragmented with little continuity and mathematical structure. The beauty of Euclid, despite his errors, was in organization, structure, and logic. As mentioned earlier, logic is not offered until the 12th grade, whereas the principles of deductive logic are integral to any mathematics studies.

The structure of the complex number system is completely lost; nowhere is the notion of numbers of the form  $a + bi$ , where  $a, b$  are any reals and  $i^2 = -1$ , mentioned. Indeed, in conversing with lycee mathematics teachers, it was learned that some were of the opinion that, if the discriminant of the quadratic formula were negative then the second degree polynomial equation in one variable had no solution.

There is perhaps too much effort to get in too many topics (mechanics, descriptive geometry, statics, "calculus"); consequently there is not enough "mathematics." Indeed, calculus is not a branch of algebra; the limit is essential to the study of the differential and integral calculus, yet it is not mentioned in the Syllabuses. Descriptive geometry, designed primarily for technical school work (such as the Afghan Institute of Technology or the proposed Polytech-

nique), does not have a place, at the expense of the overall classical lycee program, in a general liberal curriculum. Mechanics and statics might be more aptly and ably treated in physics studies.

Finally, within the past decade, modern foundations (set theory) have filtered down to the secondary schools and are serving to unify mathematical thought. This is probably the time to bring these ideas into the lycee program.

Though there are three 12th grade mathematics tracks listed in the Syllabuses, except for Istiqlal Lycee<sup>50</sup> in Kabul, in effect there is the one mathematics offering for all students.

#### Girls Lycees

The program in mathematics, grades 7-12, in the girls lycees calls for 3 hours "Geometry" and 2 hours "Mathematics" per week over the six-years; this is the offering in the "full-lycee" sections.

The Syllabuses does not give any descriptions of mathematics course content for the "full-lycee section" girls; inquiry and observation reveals that the mathematics taught in the girls schools is a cramped version of the boys seven hours. The Syllabuses does include, interestingly enough, a "Programme of Mathematics for the House-Keeping Section," which terminates at the end of grade 11.

That program is sketched below:

#### IN CLASS X

Divisibility by 2, 3, 4, 5, 6, 9, 10, and 11; Prime Numbers, Decomposition of numbers into their prime factors. Least Common Multiple.

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50 - Istiqlal had two sections: Mathematics and Philosophy.

"Operation" of the Four Simple "Rules" over common fractions; simplification of fractions.

ALGEBRA:

Repetition of Algebraic calculations, especially application of monomials. Repetition of equations of the first degree with one unknown and two unknowns. Graphs of  $y = ax$  and  $y = ax + b$ . Solution by graph of two equations of the first degree with two unknowns. Written questions of a functional nature.

GEOMETRY:

Definitions of lines and geometrical shapes. Parallel lines; circumferences and measurements (without proof). Calculation of angles along with their relative units (Degree, Grade, Radian) and changing one into the other. Perpendiculars, triangles, etc. Conditions for the identical "qualities" of two triangles. Definitions. Triangular lines and angles between 0 - 30 - 45 - 60 and 90 degrees.

IN CLASS XI

ARITHMETIC:

Decimal fractions; operation of the Four simple rules. Conversion of decimal fractions into common fractions and vice-versa. Finding the square roots. Units of length, area and volume, capacity, Money. The Metric System. Preparation of a table showing native units of measurements and their foreign equivalents and a table showing conversion of English measures "of" the Metric System and native measures and vice-versa.

ALGEBRA:

Equations of the second degree with one unknown. Discussion of roots and their graphic representations. Definition of "triangle lines" and their use. Solution of right-angled triangle.

GEOMETRY:

Formulae regarding surface and volume of a prism, "a pyramid." Implementation of these formulae through numerous questions.

PART IV

THE DARUL MO' ALLAMEINS

GENERAL

Beginnings<sup>51</sup>

The first DMA was established in 1912 near the Madrased Shahi (Royal College) in Kabul. The main function of the original school was to train the Mullahs and Da-Mullahs as teachers. This early primary teacher training school had three sections with an enrollment of 120, and included grades 7-9. The students attended classes from noon to 4 p.m. as their mornings were spent in teaching at the mosques or in private homes. They received no salary until the reign of Amanullah, at which time their pay was 40 afghanis per month.

In 1920 the DMA was moved to the area of the Babai-Khodi Shrine in Kabul where the Taragi Primary School was annexed to it. The enrollment at that time was 500. Subjects taught were:

Persian; Arithmetic; Handwriting; Theology;  
History; Education; Drawing; Arabic and Sports.

Arabic and Sports were taught by Zaidan Badri, an Egyptian, the first known foreign DMA teacher.

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51 - Most of this section is based on conversations with Mr. Ghulam Mujuddidi, Dean of Kabul University's Faculty of Letters, as well as a brief history (in Persian) of the DMA's by Mr. Mujuddidi.

The early DMA graduates were not required to enter the teaching ranks. However, in 1923, Wasfi Beg, the Turkish advisor to the Minister of Education, proposed that future graduates be required to enter the teaching profession to meet the demands of that decade. The same year witnessed the inclusion of the Quzat Maktab (School of Judges) in the DMA.

In 1924 the enrollment was only 40, of whom 9 were failed by year's end. Twenty enrollees were boarding students, the first such in the DMA; three years later 164 of the 295 students were boarders. Also, in 1924 there were two foreigners, an Indian and an Egyptian, teaching in the school (Abdul Wahid and Mah'mud Nadim).

As in the case of the other schools of the nation, the DMA was closed for about two years during the "Time of Troubles", 1929-1930.

In 1935 only 13 students graduated; further, there were no boarding students at that time.

The first emergency teachers training program (Mustahjala) was organized in 1939, offering one year's training only at the 7th grade level. Of 378 students enrolled in this special program, 362 were graduated.

At the suggestion of its Turkish Director, Ramzee Ingol, the DMA was re-organized in 1939 and was re-located at Paghman, about 25 km. southwest of Kabul. There, boarding facilities were provided at the Behar Hotel. The school was organized into two sections, primary and secondary, and grade 10 was added. The primary section received two years training (grades 7-8) and

the secondary four years training (grades 7-10). At that time the total DMA enrollment was 110.

A year later the secondary section was moved to Kabul and in 1942 both sections located at the present Kabul DMA site in the Kart-i-Char section of the city. Also, semester examinations, which had been part of the overall program from its inception, were eliminated. At the same time the secondary section was divided into two divisions, science and sociology (social studies).

In 1942 the offerings were:

Science Section:

Arithmetic; Physics; Chemistry; Sociology;  
Agriculture; Pashto; English; Psychology;  
and Methods of Teaching.

Social Studies Section:

History; Geography; Psychology; Pedagogy;  
Methods of Teaching; Logic; Philosophy;  
Sociology; Pashto; and English.

In 1941 the eleventh grade was added followed by the twelfth grade in 1942. During this time the Principal was Dr. Anwar who had been trained in the United States of America. The staff included 8 Indian teachers and 28 Afghan teachers. There were three sections: science, social studies, and vocational.

Present DMA's

The Darul Mo'Allameins are four in number and are located in Kabul, Kandahar, Jalalabad, and Herat. Their main function remains

that of preparing primary school teachers (grades 1-6); as such, they are under the direction of the President of Vocational Education. Several other middle and primary school teacher training institutions exist<sup>52</sup> but are not covered in this study. The DMA's include grades 7-12 except the one in Kabul which has grades 10-12 only.<sup>53</sup> A contiguous middle school (Ibn Sina) provides the 7-9 class training for the students of the Kabul DMA.<sup>54</sup>

Enrollments in the DMA's, with teaching language, during September-December 1964 were reported as follows:

	Grades		Teaching Language
	7-9	10-12	
Herat	385	88	Darri
Jalalabad	501	189	Pashto
Kabul	-	480	Darri
Kandahar	428	94	Pashto

Only male students matriculate at the DMA's.

The Jalalabad and Kandahar schools have a 3-months vacation during the summer; Kabul and Herat vacation from December to March.

All schools have boarding facilities and the student bodies are drawn from rural areas of the country. The living quarters for

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52 - The Academy of Teacher Training (for primary school teachers) and the Higher Teachers' College (for middle school teachers).  
 53 - All DMA's have included the twelfth grade since 1942.  
 54 - Ibn Sina also acts as a feeder school for the Afghan Institute of Technology and the Kabul Vocational Agriculture School.

students are very crowded at the DMA's and the general cleanliness of the facilities and the students compare unfavorably with the better sanitary and hygienic conditions which were observed in the German-supported technicums and industrial school in Kabul, Kandahar and Khost.

All DMA's have superimposed an ENTEP center which tends to further over-crowd. The DMA in Jalalabad operates under the same administration as does the Nangahar Lycee in Jalalabad.

Attendance, examinations, grading and dismissal are carried on in about the same manner as in the lycees. Likewise, the salary schedule and complement of personnel are similar along with physical facilities and classrooms. Better chalkboards are in use in the DMA's than in most lycees; these are usually painted, smooth concrete.

In the matter of libraries and laboratories there exist, in general, considerably better facilities than in most lycees. In the Kabul and Kandahar DMA's, well-kept and regularly-used physical and biological laboratories exist with close supervision provided by science specialists of the Institute of Education. The Kandahar DMA library was the best school library seen during this study.

#### THE CURRICULUM

In general, the grade 7-9 curriculum offering is the same as for the 7-9 classes in the lycees. The affiliate of the Kabul DMA,

Ibn Sina, has been the scene of some extensive curriculum work and experimentation in middle grade science which program differs from the prescribed 7-9 grade program for the lycees. Curriculum offerings which were in effect in the Kabul DMA for classes 10-12 are listed below. This program is followed in the other DMA's with some local modifications:

<u>SUBJECT</u>	<u>CLASS HOURS PER WEEK</u>
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10th Class

(All sections)

Biology	6	(plus 2 lab.)
Algebra	4	
Geometry	3	
Persian	3	
Pashto	3	
English	4	9plus 2 lab.)
Art	2	
Handwriting	1	
Health	2	
Practical Arts and Agriculture	6	
Theology	2	
History and Geography	6	
Introduction to Education	3	

11th Class

(All sections)

Chemistry	6	(plus 2 lab.)
Geometry	3	
Algebra	4	
Persian	3	
Social Studies	6	
Pashto	3	
English	4	(plus 2 lab.)
Art	2	
Handwriting	1	
Health	2	
Agriculture	6	(plus 2 lab.)
Theology	2	
Foundations of Education	3	

12th Class

(Faculty Section)

Physics	6 (plus 2 lab.)
Earth Science	4
Trigonometry	3
Algebra	3
Geometry and Calculus	3
World History	3
Afghan History and Geography	3
Persian	3
Pashto	3
English	9 (plus 2 lab.)*
Logic	3
Theology	2

\* Hours to be changed March 1965

(Primary Teacher Section)

Physics	4 (plus 2 lab.)
Earth Science	3
Mathematics Review	2
Modern Afghan History and Geog.	3
Persian	3
Pashto	3
English	3 (plus 1 lab.)
Methods and Material Preparation	5
Community Education	2
Supervised Student Teaching	15
Seminar	2

Noteworthy is the science offerings of biology, chemistry, and physics by grade, namely the 10th, 11th, and 12th, respectively, as well as specific provision for laboratory work. Further, as indicated by the program outline, at the end of grade eleven, the students are sectioned into either a "Faculty" or "Primary Teacher" section. The Faculty Section graduates are then prepared for admission to the university or to the Higher Teachers College, which is presently a 2-year school for preparation of middle class teachers. The Primary Teacher section, as indicated by the professional

educational courses, is prepared to go directly into primary teaching upon twelfth grade graduation.

The 10-12 DMA program contains no provision for physical education, which surprises a bit; it is no wonder however in view of such a heavy-class-hour load for students. The numerous subjects and class-hours are designed to accommodate the "no-homework" policy which is general throughout all schools.

The mathematics offering is substantial, paralleling that for the lycee except in the case of the Primary Teacher Section of the 12th class.

#### MATHEMATICS TEACHING

There were seventeen DMA teachers of mathematics at the time of the visits; seven were native Pashto speakers and ten Darri. Their median age was 28 with the following educational background:

Master of Arts .....	1
(Attained at Teachers College, Columbia University)	
4 years faculty .....	5
(Faculty of Science Graduates-3 in 5th year of Faculty of Medicine -1 Faculty of Agriculture -1)	
3 years faculty .....	1
(in 16th year of Faculty of Education)	
2 years faculty .....	2
(in 3rd year of Faculty of Science -2)	

12th grade graduate .....5  
 (13th year of winter Institute,  
 Faculty of Education - 1)

11th grade graduate .....1

Enrolled in Faculty of Education .....1  
 (year unspecified)

Enrolled in Faculty of Medicine ....1.....1  
 (year unspecified)

Thus, only four of the seventeen have attained the minimum mathematics training which is deemed necessary for lycee or DMA mathematics teachers.

Eight of the teachers reported 16 or more mathematics class hours taught per week; the range of class periods in mathematics for the DMA teachers was from 6 to 36 hours. As suggested by the educational breakdown, 4 were students with no official rank. The 13 holding official rank were distributed as follows:

Official Rank	Number
6	2
7	4
8	4
9	1
10	2

With a median official rank of 8, the median basic monthly salary was afs 1500.

The four "student" part-time teachers (all at the Kabul DMA) were teaching mathematics for the first time. The 13 regular teachers had lycee/DMA/middle school mathematics teaching experience as follows:

Years Experience	Number
12	1
10	1
8	2
7	2
6	1
4	1
3	2
2	1
Beginning	2

Other subjects taught included: physics (4); psychology (1); agriculture (1); biology (1); methods of teaching (1); Darri (2); Pashto (3); lettering or drawing (4); English (1); and social studies (1). Two of the mathematics teachers are DMA principals.

The attitudes of the regular mathematics teachers at both Kandahar and Kabul seemed quite positive. This was reflected especially in the classroom teaching at Kandahar, where the teachers observed seemed to invite class participation and appeared to be better prepared for their class presentation than in the average lycee.

The mathematics textbook situation is the same as in the lycees - some limited texts for grades 7-8; none for grades 9-12. The result, of course, is dependence upon transcribing data from the teacher's notebook to the student's notebook.



## PART V

### RECOMMENDATIONS

'Tis hard; but with a will there is a way. Catullus

#### MATHEMATICS CURRICULUM REVISION Grades 7-12

A detailed outline of the recommended lycee mathematics curriculum for grades 7-12 is shown in appendix number 2 of this report. A brief summary of the outline follows.

For all grades several notions are present throughout-- unity of mathematics through modern set foundations; interplay of geometric and algebraic notions; emphasis on mathematical structure and axiomatic proof; student inquiry, through both inductive and deductive approaches; and appropriate applications of the concepts and relations which are introduced.

In particular, the grade seven content stresses the development of the set of real numbers (natural numbers to integers to rationals to irrationals to reals) with work in the concepts of measure and intuitive plane Euclidean geometry as treated in a point set context. Linear equations in one variable are introduced through the work in number sets. Dependent upon the developing curriculum for grades 1-6, the introductory set notions of grade seven may be modified to account for their introduction

in the lower grades.

In grade eight, the emphasis is on introductory algebraic notions with applications, the fundamentals of logic and mathematical proof (algebraic), polynomials, and graphical solutions of linear equations in two variables.

For the ninth class, the recommendation calls for emphasis on algebraic notions: systems of equations; fractions; ratio, proportion, and variation; radicals; quadratic equations; and inequalities. Geometric relations and graphing techniques are employed throughout. Algebra is presented as a deductive system.

Emphasis for the tenth class is on formal modern plane Euclidean geometry but with some solid and coordinate geometry included along with continued paralleling algebraic notions. In the tradition of the liberal arts, the deductive structure in mathematics is stressed.

In the eleventh class, the main topics are in matrix algebra and relations and functions—polynomial, exponential, logarithmic, and circular (trigonometric), with attention given to proof by the Axiom of Finite Mathematical Induction, the Binomial Theorem and an algebraic treatment of arithmetic and geometric series.

Concern in the twelfth class program recommendation is for analytic geometry; treatment of the complex numbers as ordered pairs with their geometric and trigonometric representations; fundamental work in theory of equations; the algebra of functions; and an introduction to analysis with considerable work in limits.

Such a program would more than adequately prepare a student for scientific, mathematical or engineering studies, and at the same time offers a liberal view of mathematics in the tradition of the lycee. Mastery of the program will prepare the student to enter the most difficult of first year calculus courses at the university level.

This curriculum recommendation was prepared in the light of developments in secondary and undergraduate curricula as proposed in other parts of the world, especially in the community of nations associated in the OEEC, which stretches from the North Sea to the Near East. The program was planned for a 30-32 week school year with 5-7 class meetings per week middle and upper classes, resp.

Mastery and understanding of such a program requires, ipso facto, regular home assignments, properly trained and enthusiastic teachers, and well-prepared texts.

It is further recommended that such a new curriculum be tried on an experimental basis, commencing in September 1965, and then implemented one year at a time in all lycees beginning in September 1966. In the event that a multi-track program is considered which might specify varying mathematics offerings perhaps with differing numbers of class hours or with fewer years in mathematics, appropriate modifications of this program seem feasible. For instance, if there existed something in the way of "literary" and "mathematics-science" tracks then the student in the "literary program" might take mathematics through grade eleven; this proposed program, if followed through grade eleven only, would still promote a liberal view of

mathematical structure and elegance.

No attempt is made to include "calculus" in the program of studies. Indeed, the present Ministry syllabus calls for "calculus" as a part of the algebra studies in grade twelve; but this is a very superficial touching upon several simple notions in derivatives and integrals with no provision for an understanding of the limit. On two counts, calculus topics are omitted in the proposed outline: (1) it is not essential to a liberal lycee/DMA preparation; and (2) the present and immediate future educational standards of the country indicate a practical need for considerably more attention to studies in arithmetic, algebra, and geometry before students are prepared to move into the area of analysis at the secondary school level.

#### LYCEE MATHEMATICS TEACHER PREPARATION

As cited earlier, there is an urgent need for a clearly defined program of teacher preparation. No less authority than the UNESCO Educational Planning Mission (the so-called Sleight Report) asserts:

Teachers in the upper grades of lycee classes should... be university graduates or or at least should have completed satisfactorily three years of post-secondary school study in the subject they are engaged to teach.

It is thereby recommended that the Royal Ministry of Education

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- Sleight, G.F., et al: A Survey of Education Within The Framework of Social and Economic Development in Afghanistan, UNESCO Educ. Plan. Mission, February 1962, page 73.

and the authorities of Kabul University hasten to define responsibility, goals, and curriculum for such a teacher preparation program leading to the bachelor's degree. Such a program of studies for teachers of lycee mathematics, it is suggested, should include:

- fundamentals of logic and set theory;
- differential and integral calculus through infinite series, Taylor's Formula with integral remainder, approximations, and improper and multiple integrals;
- abstract algebra;
- modern geometry;
- mathematical probability and statistics through the vehicle of the calculus;
- differential equations, including techniques of solution by the Laplace transform;
- methods of teaching mathematics; and
- practice teaching.

Other courses which might be offered and which are of particular value in teaching mathematics are:

- theory of equations;
- number theory; and
- history and foundations of mathematics.

Such a program might well be offered with a mathematics-physics specialization and should be geared toward graduating a minimum of 20-30 candidates per year for the ten-year period 1969-1979.

#### IN-SERVICE EDUCATION

In order to upgrade the competence of the present lycee mathe-

matics teachers, as well as to prepare them to teach the developing curriculum, it is recommended that the Ministry of Education bend every effort to support the in-service programs and teacher institutes that have been proposed through the Institute of Education, namely, the yearly workshops and proposed summer and winter 9-week mathematics-science institutes. The Sleight Report cited as one of its recommendations "more directly urged by the teachers themselves" -

The more effective training of teachers and an accelerated program of in-service training.<sup>51</sup>

#### TEXTBOOK PREPARATION

Not only is there a pressing need for some texts in grades 9-12, but there appears to be a need for better texts in grades 7 and 8. Notwithstanding, it is recommended that textbooks, drawn up in accordance with the afore-mentioned curriculum recommendation, be prepared at the rate of one class per year, to implement the evolving program of studies. Such implementation could begin at either the 7th or 9th class level, preferably at the seventh grade level to accommodate the newer approach; but at the 9th class level if it is judged expedient textbook-wise.<sup>52</sup>

All textbook preparation, present and future, should be carefully coordinated through responsible Ministry officials to obviate waste of effort and sub-standard publications. Further, just as in

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51.- Sleight, G.F., et al: *ibid*, page 32.

52 - The Ministry Mathematics Curriculum Sub-Committee, in November 1964, recommended new curriculum and texts be implemented beginning with the 7th class (and at the 1st grade level in the elementary schools).

the case of curriculum planning, close coordination must be maintained with the responsible authorities in primary curriculum development as well as with the program at the University.

#### REVISION OF THE SYLLABUSES

It is recommended that considered attention be given to the overall lycee program with a general view toward cutting down on the number of subjects studied and a particular view to eliminating "logic" and including it in the mathematics offering at the 8th class level. Further, that the mathematics courses be listed simply as "mathematics", and that the "full-lycee sections" of the girls schools be allowed the same number of hours (7) in mathematics as is presently granted the boys in the upper classes.

If the various "sections", such as "Housekeeping", "Women's Teacher Training", etc., do not exist, then these entries should be either removed from the Syllabuses or such sections created. In the case of the "Women's Teacher Training Section" listed for Girls Lycees, it is recommended that such sections be activated with vigour; if this be done, it is further suggested that the mathematics requirement be the same for this section as for the "full lycee" section.

#### COORDINATION

Curriculum revision and textbook preparation, especially for

the upper classes of the lycee and DMA, should be coordinated with parallel curriculum work and textbook writing in the school sciences. It is particularly necessary to have a close working liaison between the mathematics and physics specialists of the Ministry and bilateral and multilateral agencies serving the Ministry.

## ROAD CHART - page 1

<u>FROM</u>	<u>TO</u>	<u>DISTANCE</u>	<u>TIME</u>	<u>GAS</u>	<u>LODGING</u>	<u>ROAD CONDITIONS</u>
KABUL	Charikar	43 mi.	45 min.	X		paved - good.
	Salang Tunnel	37 mi.	1 hr. 10 min.			paved - mountainous; good.
	Doshi	43 mi.	1 hr. 30 min.	X		paved road ends at Doshi.
	Pul-i-Khumri	30 mi.	1 hr. 10 min.	X	fair	improved rock and gravel.
	Baghlan	24 mi.	40 min.	X		half paved; half rock and gravel.
	Aliabad	31 mi.	45 min.			mostly paved.
	Khanabad	17 mi.	40 min.	X		***
	Tal-o-qan	32 mi.	1 hr.	X		***
	Mashad (Kishim)	44 mi.	2 hr.			very poor
	Sabzi-Bahar	41 mi.	2 hr. 10 min.			***
Faizabad	33 mi.	1 hr. 30 min.	X	poor	***; levels off 10-12 mi. outside of Faizabad; along Kok-cha River; scenic.	
KHANABAD	Kunduz	16 mi.	40 min.	X	fair	flat, improved rock and gravel.
	Qasil Qalah	42 mi.	50 min.	X		paved - good.
KUNDUZ	Tashkurgan	80 mi.	5 hr.	X		ferry outside of Kunduz;
	Mazar-i-Sharif	39 mi.	1 hr. 10 min.	X	fair	desert; no roadway; poor.
	Balkh	14 mi.	25 min.			improved rock and gravel. improved rock and gravel.

\*\*\* Mountainous or hilly; unimproved, rock; single-lane.

APPENDIX NUMBER 1

## ROAD CHART - page 2

<u>FROM</u>	<u>TO</u>	<u>DISTANCE</u>	<u>TIME</u>	<u>GAS</u>	<u>LODGING</u>	<u>ROAD CONDITIONS</u>
KUNDUZ	Aq Chah	12 mi.	20 min.	X		improved rock and gravel.
(cont'd)	Shibargan	34 mi.	1 hr. 20 min.	X	fair	" " " "
	Andkhui	46 mi.	2 hr. 30 min.	X		desert; unimproved; sandy; ruts; very poor.
	Daulatabad (Maimana)	50 mi.	3 hr.			" " "
	Maimana	41 mi.	1 hr. 30 min.	X	fair	improved rock and gravel.
TASHKURGAN	Hazrat Sultan	24 mi.	1 hr.			" " " "
	Haibak (Samangan)	18 mi.	40 min.			" " " "
	Pul-i-Khunri	55 mi.	2 hr. 10 min.	X		" " " "
KABUL	Sarobi	52 mi.	1 hr. 5 min.	X		paved-mountainous; good.
	Jalalabad	63 mi.	1 hr. 15 min.	X	fair	paved - good.
JALALABAD	Khama	25 mi.	40 mi.			new bridge shortens distance to only a few miles; old road hilly; rocky surface; cross river on ferry near Khama.
JALALABAD	Laghman	19 mi.	40 mi.			very poor; unimproved; rocky.

## ROAD CHART - page 3

<u>FROM</u>	<u>TO</u>	<u>DISTANCE</u>	<u>TIME</u>	<u>GAS</u>	<u>LODGING</u>	<u>ROAD CONDITION</u>
JALALABAD	Ghazni	94 mi.	2 hr. 15 min.	X		paved, 40 mi.; improved gravel, 50 miles.
	Gardez	51 mi.	3 hr. 10 min.	X	fair	poor; unimproved; rocky and hilly.
	Khost	76 mi.	3 hr. 15 min.	X		poor; unimproved mountain road; single lane in many places.
GARDEZ	Kabul	87 mi.	3 hr. 10 min.	X	good	improved rock and gravel.
KANDAHAR	Girishk	74 mi.	1 hr. 40 min.	X		paved - good; occasional detours..
	Dilaram	76 mi.	1 hr. 35 min.	X		" " "
	Farah	84 mi.	2 hr. 40 min.	X	poor	desert; unimproved roads and trails.

PROPOSED LYCEE MATHEMATICS CURRICULUM

Grades 7-12

7th Class (30-32 weeks)

- I. Introduction to sets with operations; sets of numbers; geometric point sets. (3 weeks)
- II. Development of the set of natural numbers - historical systems of numeration relating present Afghan base ten numerals to Western; axioms; operations; interpolation; square and cube roots; solution of simple linear equations; graphs; word problems. (4 weeks)
- III. Development of the set of integers - motivated through equations and perceptive examples such as temperature, indebtedness; same approach as in developing the set of natural numbers. (4 weeks)
- IV. Development of the set of rational numbers - same approach as in developing the set of integers. (4 weeks)
- V. Geometric points related to the rationals - on the line; density of rationals; geometric constructions; perpendicular bisectors; the square; diagonal of a square; rectangle; triangle, given 3 sides; pictorial drawing of cubic unit of measure. (2 weeks)
- VI. Development of the set of irrational numbers and the real numbers - historical (Pythagorean's discovery of  $\sqrt{2}$ ); completeness of number line; properties of the equality relation; axioms for

APPENDIX NUMBER 2

addition and multiplication properties of the real numbers; operations; applications to graphs and solutions of linear equations in one variable. (4 weeks)

VII. Decimals - rationals; irrationals; arithmetic of repeating decimals; applications to percentage, bar graphs, circle graphs, profit and loss, interest. (4 weeks)

VIII. Measurement - concept of linear measure developed through student experimentation leading to the metric system; time; areas of rectangle, square, parallelogram, triangle, trapezium; money; volume of cube, rectangular parallelepiped, right circular cylinder, right circular cone; degree of error and computations with approximate and exact numbers; applications with emphasis on problems in the sciences and the metric system. (4 weeks)

IX. Intuitive plane geometry - point set approach to properties of parallel lines in the plane; plane triangle angle sum, by student experimentation; properties of the parallelogram, rectangle, square, trapezium, rhombus; properties of the right triangle; the circle - diameter, radius, circumference, arc; intersection of line with circle and circle with circle, treated as point sets. (3 weeks)

#### 8th Class (30-32 weeks)

I. Review of 7th class concepts. (3 weeks)

II. Algebraic terms and conventions - variable, constant, replacement set, solution set; symbols for operations; coefficient, exponent,

- base, power; order of operations convention; grouping symbols; factoring; substitution; formulae; with applications in plane and solid geometry, simple interest, distance, force, speed, and safety. (2 weeks)
- III. Logic - basic notions of symbolic logic; "or", "and", "not", "implies"; direct statement, converse, inverse, and converse of the inverse; logical equivalence through truth tables; quantifiers: none, some, all; negations; applications to statements and statement forms; role of logic in the study of mathematics. (4 weeks)
- IV. Mathematical proof - characterization of a mathematical system: undefined elements, definitions, axioms, logic, theorems; proofs of:  $(b + c) a = ba + ca$ ;  $a + b + c = (b + c) + a$ ; origins of term "algebra" - Muhammad ibn Musa al-Khowarizmi's work; indirect type proofs; simple number theory problems; irrationality of  $\sqrt{2}$  and  $1 + \sqrt{2}$ ; miscellaneous type proofs of some algebraic properties of the set of real numbers. (7 weeks)
- V. Review of solution of linear equations in one variable with word problems - number, profit and loss, distance/time/rate, age; equivalent equations. (3 weeks)
- VI. Polynomials - definition; operations; exponents; using grouping symbols; products in equations; closure or nonclosure under the fundamental operations; evolution of signs and symbols; special products and factors. (8 weeks)

VII. Graphing linear equations in 2 variables - coordinate systems; relation and function defined as sets; slope of line; form  $y = mx + b$ ; general forms and standard forms; graphs of some simple non-linear relations and functions. (5 weeks)

9th Class (30-32 weeks)

- I. Review of 8th class concepts. (4 weeks)
- II. Systems of linear equations - geometric possibilities; graphing and finding the solution set by graphing; algebraic techniques of solution; forming a linear equation - given a point and the slope or given two distinct points; applications. (4 weeks)
- III. Fractions - fractions and rational numbers; equivalent fractions; operations; simplification; fractions of the form  $\frac{ax + \frac{c}{by}}{dx + \frac{f}{ey}}$ ;  $a.1 = a$  and its application to simplifying and operating on real number fractions. (4 weeks)
- IV. Equations with real number fractions - lowest common denominator and lowest common multiple; solutions; applications to number, interest, motion, work, and mixture problems with emphasis on  
 1) specifying the replacement set; 2) estimating the result;  
 3) verifying the result. (4 weeks)
- V. Ratio, proportion, and variation, geometric and algebraic - definitions of ratio and proportion; dividing a segment into proportional segments by geometric construction; solving proportions by algebraic techniques (rule of three); proportional

division; direct and inverse proportion; variation - direct, inverse, as square; finding constant of proportionality; application with emphasis on the sciences. (3 weeks)

VI. Radicals - properties of rational exponents; finding squares and square roots by table; graph of  $y = x^3$ ; student construction of tables of cubes and cube roots to 2-place accuracy; definitions and theorems for operations on radicals. (5 weeks)

VII. Quadratic equations - general form; solution of special types; graphs; student proof of theorem:  $ab = 0 \Rightarrow a = 0 \vee b = 0$ ; solution by factoring and completing the square; derivation of the quadratic formula stressing the generality of the formula and the meaning of "exactly two roots"; extension of the real number system to the complex number system through the definition  $i^2 = -1$ ; nature of roots through examination of  $(b^2 - 4ac)$ ; forming a quadratic equation, given the roots; applications to area; distance/time/rate, triangle, and number problems; historical sketch of the development of quadratics. (4 weeks)

VIII. Inequalities - definition; axioms of order for the set of real numbers; order property theorems; graphs of inequalities and systems of inequalities; absolute value; applications to economics and the sciences. (4 weeks)

10th Class (30-32 weeks)

1. Logical thinking in geometric studies; review of characteristics of a mathematical structure through 9th class algebraic notions;

- forming hypotheses; the syllogism and deductive inference;  
analysis and proof. (4 weeks)
- II. Parallel lines - deductive study as point sets; definitions;  
formal properties; angles associated with parallel lines;  
parallel lines in space; sum of angles of triangle proof;  
exterior and interior angles. (3 weeks)
- III. Algebraic review of equations and exponents. (1 week)
- IV. Indirect methods of proof - reductio ad absurdum; by elimination;  
converse of the inverse. (3 weeks)
- V. Algebraic review of radicals. (1 week)
- VI. Formal geometric properties of quadrilaterals as point sets;  
formal properties of 3 or more parallel lines in the plane;  
geometric construction and proof for division of a segment and  
for a parallelogram. (4 weeks)
- VII. Inductive geometric reasoning - the  $30^\circ - 60^\circ$  and  $45^\circ - 90^\circ$   
triangles; angles formed by intersections of circles with secants  
and tangents; faulty inductive reasoning; areas and volumes of 3 -  
dimensional point sets and irregular geometric point sets;  
inductive and deductive thought compared. (4 weeks)
- VIII. Review of graphing in 2 - 3 dimensions and formula solving.  
(1 week)
- IX. Loci: necessary and sufficient conditions - locus in 2 and 3  
dimensions; intersection of conics; graphic representation of  
conics; methods of proving a locus. (3 weeks)

- X. Geometric ratio and proportion - triangles; similar triangles; similar polygons; line segments; construction of a mean proportional; construction on the number line of  $\sqrt{3}$ ,  $-\sqrt{5}$ ,  $\sqrt{2+1}$ ,  $\sqrt[4]{2}$ ; formal proof of the Pythagorean Theorem and its converse; congruence treated as a special case of similarity with  $k = 1$ .  
(3 weeks)
- XI. Algebraic review of proportion and review of radicals. (1 week)
- XII. Circle measure - regular polygons; inscribing and circumscribing regular polygons; division of a line segment into extreme and mean ratios; regular polygons and circle area; numerical computation of pi. (2 weeks)
- XIII. Trigonometry of the right triangle - review of similar triangle and right triangle properties; sine, cosine and tangent ratios; use of tables with interpolation; applications of ratios to problems of navigation, indirect measure, forces - components, and velocity. (2 weeks)

11th Class (30 - 32 weeks)

- I. Review of the real number system and its properties; treatment of functions as ordered pairs; graphs of relations and functions; distance between two points in the Cartesian plane; graphs and solution sets for inequality relations and absolute value functions. (3 weeks)
- II. Systems of equations and matrices - graphs of sets of ordered pairs; equivalent systems; solutions of systems of linear equations

in 2, 3 variables and their graphs; matrix definition; vector definition in terms of a matrix; vectors - notation, sum, product of a scalar and a vector; definition of  $i, j, k$ ; inner (dot) product of 2 vectors and length of a vector; etc.; determinants as special matrices; applications to systems of equations with use of Cramer's Rule; outer product of 2 vectors; applications of matrix algebra to word problems with emphasis on problems in the physical sciences.

(8 weeks)

- III. Algebraic relations and functions - rational and algebraic operations defined; algebraic, polynomial, and rational functions with domain and range; properties of polynomials and polynomial functions; statement of the Fundamental Theorem of Algebra and the corollary (number of roots theorem); review of quadratic equations and graphs; intuitive discussion of the parabola. (4 weeks)
- IV. Axiom of Finite Mathematical Induction, Binomial Theorem, and Geometric and Arithmetic Series - Axiom of Finite Mathematical Induction and applications; Binomial Theorem for positive integral exponents, and the general term; general Binomial Theorem -- proof of theorem for positive integral exponents through induction; arithmetic and geometric series with applications. (3 weeks)
- V. Exponents and logarithms - definitions and properties; using induction, prove:  $a^m \cdot a^n = a^{m+n}$ ,  $(a^m)^n = a^{mn}$ ,  $(ab)^n = a^n b^n$ , for  $m$  and  $n$  positive integers; scientific notation; applications to physical sciences; rational exponents with properties and theorems; special

- properties for  $i^2 = -1$ ; rationalizing denominators; logarithms - concept and definition as an exponent; computations; other bases for logarithms; logarithmic functions with graphs; logarithmic equations; power functions. (4 weeks)
- VI. Trigonometric functions - discussion of the six functions as ordered pairs in the four quadrants; special angles; tables; logs; solution of triangles; sine and cosine laws; trigonometric analysis - circular functions and relation to trigonometric functions; radian measure; periodicity and graphs; inverse functions; identities; trigonometric equations; difference, sum, half-angle, and double angle formulas. (8 weeks)
- VII. Systems of quadratic equations in two variables - algebraic and graphic solutions. (2 weeks)

12th Class (30-32 weeks)

- I. Analytic Geometry - Descartes' "La Geometrie"; locus; mid-point; slope of a straight line; direction cosines; angle between directed lines; the straight line; conic sections as point sets; polar coordinates with applications and graphing; parametric equations. (7 weeks)
- II. Complex Number System - treated as ordered pairs with axiomatic properties; a number field; alternate notation -  $a + bi$ ; geometric representation of complex numbers and vectors; polar coordinates and trigonometric form of complex numbers with  $x$  and  $\frac{y}{x}$ ; proof,

by mathematical induction, of DeMoivre's Theorem; roots of complex numbers. (5 weeks)

III. Theory of Equations - review polynomial definition; division algorithm; remainder theorem; factor theorem; applications of theorems; synthetic division; real roots of a polynomial with upper and lower bounds and number of roots; complex roots as conjugate pairs; rational roots theorem and corollary; irrational roots by linear interpolation; discussion of polynomial equations of degree greater than two noting formulas for cubic and quartic. (6 weeks)

IV. Introduction to analysis -- functional notation; formal definition of the limit with applications to simple polynomial and absolute value functions; limit theorems with applications; "domination" axiom; special trigonometric limits; application of limit theorems to polynomial, rational, algebraic, and circular functions and to areas under graphs of polynomial functions. (6 weeks)

V. Algebra of functions - sum; difference; product; quotient; domain; composites; graphs - domain, range, intercepts, asymptotes, symmetry, extent (through limits); inverse functions; functions derived from equations. (8 weeks)